

Prepared for:
United States Fish and Wildlife Service
Alamosa, Colorado



Draft Environmental Assessment of Planned Gas and Oil Exploration, Baca National Wildlife Refuge, Saguache County, Colorado

January 2008



U.S. Fish and Wildlife Service



San Luis Valley National Wildlife Refuge Complex
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January 18, 2008

Dear Interested Party:

Enclosed for your review is the *Environmental Assessment of Proposed Gas and Oil Exploration, Baca National Wildlife Refuge, Saguache County, Colorado*. This document was prepared by the U.S. Fish and Wildlife Service (Service) in compliance with the National Environmental Policy Act (NEPA).

This draft Environmental Assessment (EA) analyzes the adoption of standards and measures by the Service to ensure that initial exploration of the mineral estate under the Baca National Wildlife Refuge (Refuge) by Lexam Explorations (U.S.A.) Inc. (Lexam) constitutes a reasonable use of the Refuge's surface estate. The scope of this EA does not address production of natural gas and oil from any of the wells described above. If necessary, the Service regulation of production and associated transportation would be the subject of a separate analysis pursuant to the NEPA.

The U.S. owns the surface estate of the Refuge, and it is administered by the Service as a National Wildlife Refuge pursuant to the Great Sand Dunes National Park and Preserve Act of 2000, the NWR System Administration Act, and other applicable laws and regulations. As the surface owner, the Service has a responsibility to protect the surface estate of the Refuge and its associated resources. Pursuant to Colorado law and the Surface Use Agreement that was entered into between the Service's and Lexam's predecessors-in-interest, the Service has discretion to ensure that Lexam's use of the surface estate is reasonable and does not cause undue surface disturbance. Thus, the Service has both the responsibility and the authority to formulate standards and measures for ensuring that the surface estate of the Refuge and its associated resources are not unreasonably impacted by Lexam's planned activities.

In response to public requests to delay the release of the draft EA and/or extend the public comment period, we are releasing the draft EA as soon as possible and extending the public comment period to 45 days from the release date to enable public opportunity to review and comment on this draft EA. The public comment period will end on **March 2, 2008**.

This document is also available for viewing or downloading on the Service's website at:
<http://www.fws.gov/alamosa>

In preparing the final decision document the Service will carefully consider all comments received during the 45 day comment period. There will not be an additional public comment period prior to or after a final determination by the Service.

Written comments or questions you may have concerning this proposal are welcome. Comments should be directed to: U.S. Fish and Wildlife Service, ATTN: Michael Blenden, 9383 El Rancho Lane, Alamosa, CO 81101, or by email at Baca_EA@fws.gov.

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San Luis Valley NWR Complex
Region 6, National Wildlife Refuge System

Prepared for:
United States Fish and Wildlife Service
Alamosa, Colorado

Draft Environmental Assessment of Planned Gas and Oil Exploration, Baca National Wildlife Refuge, Saguache County, Colorado

January 2008

Acronyms and Abbreviations

| | |
|-----------------|--|
| °F | degrees Fahrenheit |
| 3D | three dimensional |
| AIRFA | American Indian Religious Freedom Act |
| APCD | Air Pollution Control Division |
| APD | applications for permit to drill |
| APE | area of potential effect |
| APEN | Air Pollutant Emission Notice |
| ARPA | Archaeological Resource Protection Act |
| BMP | best management practices |
| BOP | blowout preventer |
| CCP | comprehensive conservation plan |
| CDA | Colorado Department of Agriculture |
| CDOW | Colorado Division of Wildlife |
| CDPHE | Colorado Department of Public Health and Environment |
| CDWR | Colorado Department of Water Resources |
| CFR | Code of Federal Regulations |
| CNHP | Colorado Natural Heritage Program |
| COGCC | Colorado Oil and Gas Conservation Commission |
| CR | County Road |
| CRS | Colorado Revised Statute |
| dBA | decibels on the “A” weighted scale |
| DOLA | Colorado Department of Local Affairs |
| DOT | Department of Transportation |
| EA | Environmental Assessment |
| EO | Executive Order |
| ESA | Endangered Species Act |
| L _{dn} | sound level day/night |

| | |
|---------------------|---|
| L _{eq(24)} | 24-hour equivalent sound level |
| Lexam | Lexam Explorations (U.S.A.) Inc. |
| MBTA | Migratory Bird Treaty Act |
| MD | measured depth |
| mg/L | milligrams per liter |
| NAGPRA | Native American Graves Protection and Repatriation Act |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| NMPM | New Mexico Prime Meridian |
| NPS | National Park Service |
| NRCS | Natural Resources Conservation Service |
| NRDC | Natural Resources Defense Council |
| NRHP | National Register of Historic Places |
| NWI | National Wetland Inventory |
| NWR | National Wildlife Refuge |
| OSHA | Occupational Safety and Health Administration |
| RFFA | Reasonably Foreseeable Future Actions |
| Refuge | Baca National Wildlife Refuge |
| SH | State Highway |
| SHPO | State Historic Preservation Office |
| SLV RETAC | San Luis Valley Regional Emergency Medical Services/Trauma Advisory Council |
| SPCC Plan | Spill Prevention, Control, and Countermeasure Plan |
| SWMP | Storm Water Management Plan |
| SVOC | Semi-volatile organic compound |
| SWSP | substitute water supply plan |
| TCP | traditional cultural property |
| TDS | total dissolved solids |
| TNC | The Nature Conservancy |

| | |
|-------|---|
| TVD | total vertical depth |
| U.S. | United States |
| USC | United States Code |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |
| VOC | volatile organic compound |

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1.0 Purpose and Need

The purpose of this Environmental Assessment (EA) is to ensure that initial exploration of the mineral estate under the Baca National Wildlife Refuge (Refuge) by Lexam Explorations (U.S.A.) Inc. (Lexam) is conducted in a reasonable manner. By establishing stipulations and recommendations to protect the surface estate and other resources of the Refuge from unreasonable damage during all phases of currently planned oil and gas exploration being conducted by Lexam, including the intended drilling of two exploratory gas wells on the Refuge, the USFWS seeks to protect Refuge resources while at the same time honoring Lexam's vested rights to access and explore the mineral estate.

1.1 Introduction

Authorized in 2000, the Baca National Wildlife Refuge is one of the largest and most recent additions to the National Wildlife Refuge System (NWR System) administered by the USFWS, Department of the Interior. The approved Refuge acquisition boundary consists of over 92,500 acres located in Saguache and Alamosa counties in the San Luis Valley of south-central Colorado (**Figure 1-1**) and includes some lands which were part of the "Luis Maria Baca Grant No. 4" - commonly referred to as the "Baca Ranch." Congress approved this refuge boundary and authorized acquisition of lands within it with passage of Public Law 106-530, also known as the "Great Sand Dunes National Park and Preserve Act of 2000." This legislation focused not only on protecting the region's hydrology, which the unique sand dunes ecosystem depends upon, but also protecting the ecological, cultural, and wildlife resources of the area.

The proposed purpose of the Refuge is "to restore, enhance and maintain wetland, upland, riparian and other habitats for wildlife, plants and fish species that are native to the San Luis Valley, Colorado. Management of the refuge will emphasize migratory bird conservation and will consider the refuge's role in broader landscape conservation efforts" (USFWS 2005).

Situated in the San Luis Valley, a high mountain desert surrounded by two 14,000-foot mountain ranges, the Refuge contains a diverse suite of habitats including desert shrublands, grasslands, wet meadows, playa wetlands, and riparian areas. Fed primarily by melting mountain snow, numerous streams flow across the Refuge providing an abundance of life in an otherwise arid landscape. The Refuge is home to a large number of wildlife and plant species.

The Refuge abuts lands owned or controlled by other conservation entities including The Nature Conservancy (TNC), the National Park Service (NPS), and the Colorado State Land Board. This complex of lands, totaling more than 500,000 acres, contains one of the largest and most diverse assemblages of wetland habitats remaining in Colorado.

In addition to the plant and animal resources contained on the refuge, the area also is rich in historic and cultural resource sites, some of which date over 12,000 years ago. Many of these are eligible to be placed on the National Register of Historic Places. On federally managed lands, such as the Refuge, eligible sites share the same management status as already listed sites.

Lexam owns the mineral interest, including the right to explore for and develop oil and gas, beneath land now included within the Refuge. Lexam acquired its mineral interest prior to acquisition of the surface interest in the Baca Ranch by the USFWS and inclusion of the surface in the NWR System.

With respect to State of Colorado law on subsurface mineral rights in Colorado, the subsurface mineral property owner has rights to pursue recovery of its minerals.

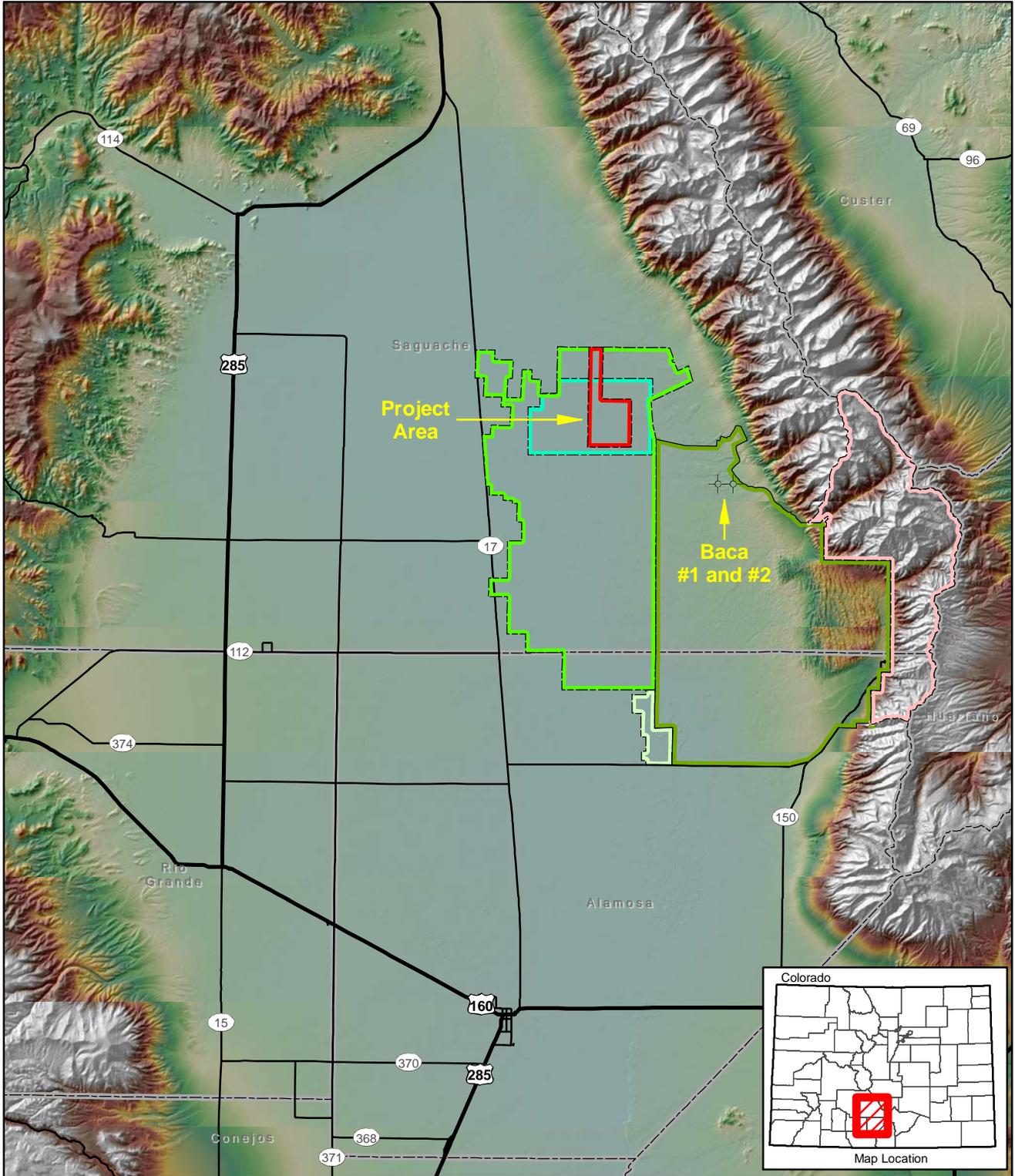


U.S. Fish & Wildlife Service

Baca National Wildlife Refuge

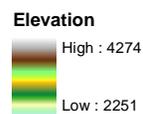
Saguache and Alamosa Counties, Colorado

Figure 1-1 -- Project Location



Legend

- Project Area
- Baca NWR Acquisition Boundary
- 3D Seismic Survey Area
- Great Sand Dunes National Preserve
- Great Sand Dunes NP Acquisition Boundary
- San Luis State Park and Wildlife Area



Lexam has provided satisfactory evidence to USFWS showing that it is legal owner of the above mentioned separated mineral rights below portions of the Refuge, and therefore is legally entitled to make use of the surface for exploration. The USFWS would deny surface access without such evidence. As established legal owner of portions of the Baca Refuge subsurface mineral estate, Lexam has contacted the USFWS regarding its intention to explore the subsurface mineral estate.

1.2 Background

1.2.1 Mineral Ownership

Lexam's mineral interest underlies a large tract of land including portions of the Refuge that were originally granted to the Baca family by the United States (U.S.) government as replacement for land lost in the Mexican American War. There are 100,000 acres of land in the Baca Grant, which is located in Townships 41 to 43 North (T41N to T43N) and Ranges 10 to 12 East (R10E to R12E), New Mexico Prime Meridian (NMPM) in Saguache County. On the Baca Grant, Lexam presently owns a 100 percent interest in the non-oil and gas mineral rights and a 75 percent interest in the oil and gas rights. Fifty percent of the non-oil and gas minerals were acquired from Baca Minerals, Inc. in 1987. Later, the other 50 percent interest in the non-oil and gas minerals and 50 percent of the oil and gas rights were purchased from Newhall Land and Farming Company. Lexam acquired an additional 25 percent of the oil and gas rights in 1998. The remaining 25 percent of the oil and gas rights is owned by ConocoPhillips.

Surface access and use was and is provided by Lexam's ownership of the mineral estate and is further provided for by a Surface Use Agreement that was signed in 1992 by the previous owner and Lexam's predecessors in-interest. The Surface Use Agreement is a 20-year agreement (of two 10-year terms) that describes Lexam's rights to use the surface of the Baca Grant. The agreement may be extended beyond the current lease term should production be achieved from the property. Lexam also pays taxes to Saguache County based upon its mineral interest. In 2006, this payment amounted to approximately \$15,000.

1.2.2 Previous Exploration

Lexam conducted mineral exploration drilling in the early 1990s. Twenty-seven mineral exploration boreholes drilled in 1992 and 1993 encountered strong shows of live oil, but the shows were not indicative of commercially producible hydrocarbons (Watkins et al. 1995; Cappa and Wallace 2007). The oil shows are evidence of a large, concealed seep located more than 4 miles along the east margin of the San Luis Valley. Analyses indicated that the oil is Cretaceous in origin. Cretaceous sedimentary rocks are a major source of oil and gas produced in the Rocky Mountain region.

Data available in the public domain and proprietary data obtained by Lexam were combined with data from the mineral exploration drill holes to map and interpret the geology beneath the Baca Grant. This mapping led to the drilling of two exploration wells - the Baca #1 and Baca #2 wells (**Figure 1-1**). These wells were permitted with the Colorado Oil and Gas Conservation Commission (COGCC) and were drilled in 1995. The Baca #1 was drilled to a depth of 4,322 feet and the Baca #2 was drilled to a depth of 6,932 feet. The wells were plugged and abandoned in 1996 in accordance with COGCC rules and plugging orders (COGCC approved surface reclamation January 2007 [COGCC 2007]). Data obtained from the Baca #1 and Baca #2 wells along with two dimensional seismic data acquired in 1996, 1998, 1999, and 2002 and data from other exploration techniques indicated that a thicker Cretaceous section is present on deeper blocks under parts of the Baca Grant. This information led to Lexam's proposal to locate two exploration wells in a prospective area in the north-central portion of the Baca Grant generally located in the southern portions of T43N, R11E NMPM. These proposed wells, both of which are within the boundaries of the Refuge, were permitted with the COGCC as Baca #5 and Baca #6). Baca wells #3 and #4 were permitted but never drilled, but also were located in the southern part of T43N, R11E.

1.2.3 Current Planned Exploration Program

In order to define the exploration target, Lexam performed a three dimensional (3D) seismic exploration program on these lands, after receiving a permit from the COGCC to conduct the program. The 3D seismic survey area is shown on **Figure 1-1**. Also prior to conducting the 3D seismic program, Lexam and the USFWS mutually agreed upon measures to mitigate impacts of the program including the decontamination of vehicles (power washing, and cleaning) prior to entering the Refuge and archaeological surveys of project areas (**Appendix A**). In late summer/early fall of 2006, Lexam conducted an archaeological inventory of the Baca #5 and Baca #6 drill sites and access roads, and the entire length of the lines to be used in conducting the 3D seismic program. The seismic program was conducted in early 2007 in accordance with the agreed upon protection measures. New information resulting from the 3D seismic program led to defining better targets for the planned drilling program and changes to the proposed drill locations. These new targets are identified as Baca amended #6 (forthwith referred to as Baca #6) and Baca #7 drill locations (**Figure 1-2**). The amended Baca #6 was close enough to the original and did not require a new permit. Drilling will occur on Baca #5 and on either Baca #6 or Baca #7 locations; a total of two wells will be drilled. Drilling is scheduled to occur during 2008. Seismic and exploration drilling activities require the posting of bonds according to COGCC regulations. Statewide financial assurance bonds of \$25,000 are required for drilling or seismic operations (COGCC 700 Series Rules). Separate bonds were posted for seismic and drilling activities. Seismic activities require a notice of intent be filed with the COGCC before seismic activities can commence.

1.3 Purpose and Need for the Proposed Action

The purpose of this EA is to ensure that initial exploration of the mineral estate is conducted in a reasonable manner. By establishing stipulations and recommendations to protect the surface estate and other resources of the Refuge from unreasonable damage during all phases of currently planned oil and gas exploration being conducted by Lexam, including the intended drilling of two exploratory gas wells on the Refuge, the USFWS seeks to protect Refuge resources while at the same time recognizing Lexam's vested rights to access and explore the mineral estate.

The scope of this EA does not address production of natural gas and oil from any of the wells described above. If necessary, the USFWS regulation of production and associated transportation would be the subject of a separate analysis pursuant to the National Environmental Policy Act (NEPA).

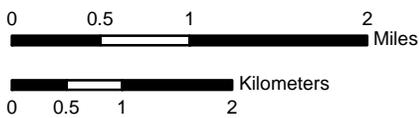
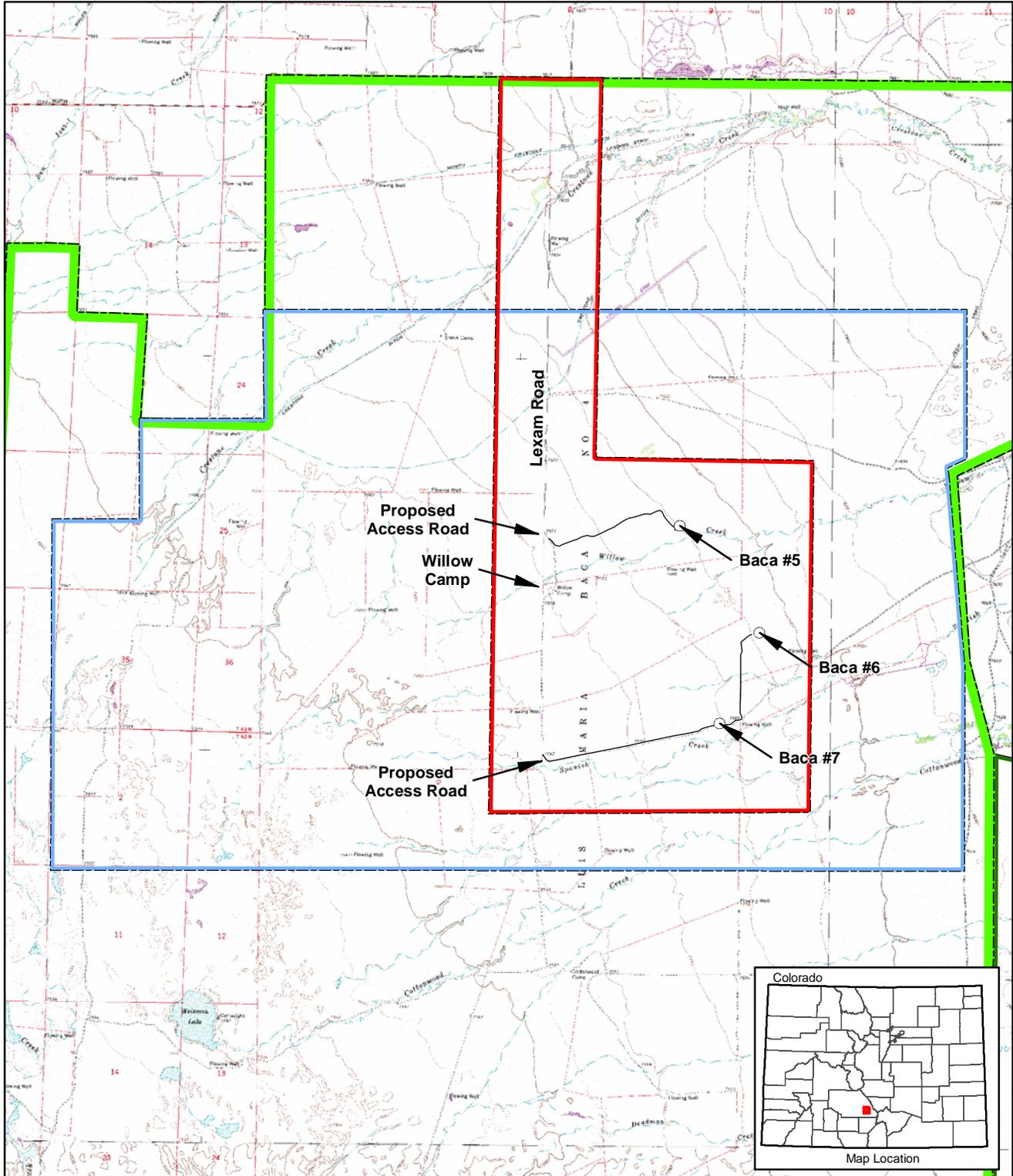
The U.S. owns the surface estate of the Refuge, and it is administered by the USFWS as a National Wildlife Refuge pursuant to the Great Sand Dunes National Park and Preserve Act of 2000, the NWR System Administration Act, and other applicable laws and regulations. As the surface owner, the USFWS has a responsibility to protect the surface estate of the Refuge and its associated resources. Pursuant to Colorado law and the Surface Use Agreement that was entered into between the previous landowner and Lexam's predecessors-in-interest, the USFWS has discretion to ensure that Lexam's use of the surface estate is reasonable and does not cause undue surface disturbance. Thus, the USFWS has both the responsibility and the authority to formulate standards and measures for ensuring that the surface estate of the Refuge and its associated resources are not unreasonably impacted by Lexam's planned activities.

1.4 Conformance with USFWS Management Plans

The Refuge conceptual management plan (2005) provides a broad overview of the USFWS's proposed management approach to wildlife and their relative habitats, public uses, facilities, interagency coordination, and other operational needs of the Refuge until such a time that a full comprehensive conservation plan can be created. The comprehensive conservation plan (CCP) planning process for the Refuge is scheduled to start with baseline data collection in 2008, but development of the CCP will take several years. The CCP will



Figure 1-2 -- Proposed Lexam Gas Exploration Wells



Legend

- Proposed Well Location
- Proposed Access Road
- Project Area
- 3D Seismic Survey Area
- Baca NWR Boundary

provide a thorough, in-depth analysis of all facets of current and future refuge management activities. Given the limited scope of Lexam's current proposal, the USFWS has determined that it can commence prior to preparation of the CCP as long as protective measures are in place to protect the surface and other resources of the Refuge and insure that the exploration activities do not interfere with regular Refuge management.

1.5 Relation to Statutes, Regulations, and Other Plans

Oil and gas management is not new to the USFWS as the agency has managed oil and gas operations on approximately one quarter of the over 575 National Wildlife Refuges in the NWR System. Under the National Wildlife Refuge Administration Act of 1966, as amended, the USFWS is responsible for managing all activities on refuges including oil and gas operations on non-federally owned (private) mineral rights on refuges. It is the policy of the USFWS "to protect USFWS resources to the maximum extent possible without infringing on the rights of sub-surface owners". The following sections describe the legal framework under which the USFWS regulates oil and gas exploration that takes place on Refuge lands where the USFWS does not own the subsurface rights. In addition to USFWS' regulations concerning oil and gas activities, other statutes and regulations are cited.

1.5.1 USFWS Regulations

1.5.1.1 Excepted Mineral Rights

USFWS Manual, Land Use Series, 612 FW 2, Oil and Gas (Manual) (USFWS 2007) provides standard policy guidance and background information on management of oil and gas activities on NWR System lands (**Appendix B**). In this Manual, the USFWS provides for the exercise of non-federally owned mineral rights while protecting USFWS resources to the maximum extent possible. The provisions of the Manual applicable to Lexam's mineral interests that are discussed below recognize and incorporate these concepts.

On a large portion of the Refuge, Lexam holds "excepted rights" that also are referred to as "outstanding rights" (USFWS 2007). Excepted rights occur when oil and gas rights are owned by third parties at the time the USFWS acquires title to the lands. The "owner of excepted (outstanding) oil and gas rights has the right to sell, lease, explore for, and remove those minerals subject to the terms of the instrument by which that interest was acquired or reserved and to the State laws governing protection of the surface and the rights of the surface owner." Section 2.9.B of the Manual provides the procedural requirements for permitting oil and gas activities on USFWS lands (2007).

In addition to the Manual (USFWS 2007), reserved and excepted rights are addressed in the NWR System Administration Act of 1966 and addressed by the regulation in Title 50 Code of Federal Regulations (CFR) 29.32 (Mineral Rights Reserved and Excepted). This regulation provides general rules governing the exercise of reserved and excepted mineral rights on NWR System lands. 50 CFR 29.32 states the following:

Persons holding mineral rights in wildlife refuge lands by reservation in the conveyance to the United States and persons holding mineral rights in such lands which rights vested prior to the acquisition of the lands by the United States shall, to the greatest extent practicable, conduct all exploration, development, and production operations in such a manner as to prevent damage, erosion, pollution, or contamination to the lands, waters, facilities and vegetation of the area. So far as is practicable, such operations also must be conducted without interference with the operation of the refuge or disturbance to the wildlife thereon. Physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations. Persons conducting mineral operations on refuge areas must comply with all applicable federal and state laws and regulations for the protection of wildlife and the administration of the area. Oil field brine, slag, and all other waste and contaminating substances must be kept in the smallest practicable area, must be confined so as to prevent escape as a result of rains and high water or otherwise, and must be removed from the area as quickly as practicable in such a manner as to prevent contamination, pollution, damage, or

injury to the lands, waters, facilities, or vegetation of the refuge or to wildlife. Structures and equipment must be removed from the area when the need for them has ended. Upon the cessation of operations the area shall be restored as nearly as possible to its condition prior to the commencement of operations. Nothing in this section shall be applied so as to contravene or nullify rights vested in holders of mineral interests on refuge lands.

The USFWS Manual, 612 FW2 Section 2.9.B (7) states:

The key factors in successfully balancing the development of private mineral interests and the protection of wildlife and other resources on Service lands are early and frequent communication and cooperation between the Service and the mineral rights owner, and a commitment to reasonableness on the part of both parties.

The USFWS and Lexam have engaged in the “early and frequent communication and cooperation” described in the Manual, much of which is documented in the conditions that were agreed to between Lexam and the USFWS regarding the seismic survey that was conducted in the winter of 2007.

1.5.1.2 Compatible Uses Policy

The NWR System Administration Act of 1966, Policy 603 FW 2 Compatible Uses Policy and the National Wildlife Refuge System Improvement Act, set forth general rules and provides guidelines for determining compatibility of proposed and existing uses of Refuge. However, provisions of 630 FW 2, as they relate to the compatibility standard of the NWR System Administration Act to the exercise of reserved and excepted mineral rights on NWR System lands, state the following:

The Service must recognize and allow owners’ property rights that are not vested in the federal government, such as reserved or excepted rights, to explore and develop minerals or oil and gas beneath a refuge, regardless of whether the use is compatible. In these situations, a compatibility determination is not required and should not be completed.

Therefore, the compatibility standard of the NWR System Administration Act does not apply to Lexam’s exploration program on the Refuge.

1.5.1.3 Appropriate Refuge Use Policy

The NWR System Administration Act of 1966, Policy 603 FW 1 Appropriate Refuge Uses Policy, sets forth general rules and provides guidelines for determining appropriate uses of national wildlife refuges. The Appropriate Refuge Use Policy of the NWR System Administration Act, does not apply to Lexam’s exploration program on the Refuge for the reasons described above in section 1.5.1.2 and because exercise of the subsurface mineral holders’(Lexam’s) rights is not at the USFWS’s discretion and jurisdiction.

1.5.2 Other Laws Relating to Oil and Gas Activity on NWR System Lands

1.5.2.1 National Environmental Policy Act

NEPA (42 United States Code [USC] 4321 -4370f) requires federal agencies to examine the environmental impact of their actions, incorporate environmental information, and utilize public participation, as appropriate, in the planning and implementation of their actions. NEPA compliance is required only whenever a federal agency takes an action. A federal action typically takes the form of a permit or other explicit land use authorization without which the activity cannot proceed. As discussed above, although USFWS regulations and the Manual (USFWS 2007) explicitly recognize that the USFWS has the right and is obligated to prevent unreasonable degradation of the surface resources of the Refuge, USFWS does not have the authority to completely deny Lexam’s activities on the Refuge. However USFWS, in an effort to assist in agency planning and decision making, has decided to apply the NEPA process to the utilization of its discretionary authority to prevent unreasonable degradation of the surface resources of the Refuge.

1.5.2.2 National Historic Preservation Act (NHPA) of 1966, as amended

Section 106 of the NHPA requires federal agencies to assess the effects of an undertaking on historical and archaeological sites. This is accomplished by inventorying proposed disturbance areas or area of potential effect (APE), evaluating site importance and eligibility to the National Register of Historic Places (NRHP), assessing the effect of the undertaking on NRHP-eligible sites, and consulting with appropriate historic preservation agencies. The proposed action is not considered an undertaking as defined by NHPA, and therefore is not subject to review. Nevertheless, the USFWS is conducting a review of effects on historical and archaeological sites in order to ensure that the proposed measures protect cultural resources to the maximum extent practicable.

1.5.2.3 Archaeological Resources Protection Act of 1979

The Archaeological Resources Protection Act of 1979 (16 USC 470aa-470mm) and amendments provide for the protection of archaeological resources on public and Native American lands and provide for exchange of information between governmental entities and academic or private archaeological researchers. An archaeological resource under the Act is defined as material remains of past human life or activities that are of archaeological interest and includes utensils, art work, weapons, and fossilized human remains.

1.5.2.4 Migratory Bird Treaty Act and Migratory Bird Conservation Act

The Migratory Bird Treaty Act (MBTA) (16 USC 703-712) is an Act of Congress that implements various treaties between the United States and other nations of the MBTA and provides for the protection of migratory birds and specifies penalties for harming or unlawfully killing migratory birds. Section 715e of the Migratory Bird Conservation Act provides statutory authority for regulation of reserved mineral rights on refuge lands (it subordinates oil and gas interests to such rules and regulations as may be prescribed by the Secretary from time to time).

1.5.2.5 Endangered Species Act

The Endangered Species Act (ESA) (16 USC 1531-1544) provides for the protection of endangered and threatened species and the habitats upon which they depend. Section 7 of the act requires federal agencies, to consult with the Secretary of the Interior or the Secretary of Commerce in cases where the agencies' action may affect a listed species, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species.

1.5.3 Other Federal Regulations

The planned Lexam exploration activities also are governed by a number of other federal regulatory programs. The list below is not intended to be exhaustive:

- Clean Water Act
- Clean Air Act
- American Indian Religious Freedom Act (AIRFA)
- Native American Grave Protection and Repatriation Act (NAGPRA)
- Resource Conservation Recovery Act
- Occupational Health and Safety Administration (OSHA) regulations
- Department of Transportation (DOT) regulations

1.5.4 State Regulations and Rules

The major regulatory agencies and programs under which the planned natural gas and oil exploration drilling activities are regulated are discussed below.

1.5.4.1 Colorado Oil and Gas Conservation Commission

The Colorado Oil and Gas Conservation Commission (COGCC) regulates oil and gas drilling on state and private mineral lands in Colorado. COGCC oil and gas rules cover all phases of oil and gas drilling operations, address pollution prevention, and provide for penalties and fines for non-compliance with the rules. The oil and gas rules give the Commission staff latitude when developing conditions of approval for applications for permit to drill (APDs) depending on specific site concerns or conditions. In the case of the Baca #5, and Baca #6, APDs, 18 conditions of approval were applied to the permits (**Appendix C**). The Baca #7 permit is pending, but it is expected that the same 18 conditions will apply. Issuance of drilling permits by the COGCC in no way diminishes the authority of the USFWS to regulate activities to prevent unreasonable impacts to surface resources.

1.5.4.2 Colorado Department of Public Health and Environment

Major regulatory programs of the Colorado Department of Public Health and Environment (CDPHE) that apply to the exploration activities include the regulation of storm water discharges during construction activities, storage and disposal of solid waste, and air emissions sources.

1.6 Description of Lexam's Planned Exploration Program

The following provides a description of Lexam's planned gas and oil exploration program, including a description of the protection measures that have been incorporated into the COGCC permits to drill at the request of USFWS (**Appendix C**).

Lexam's planned activities will incorporate Best Management Practices (BMPs) where appropriate to lessen impacts. BMPs are "techniques, procedures, measures, or practices which are regularly used in the industry and are site specific, economically feasible, and are used to guide, or may be applied to, management actions to aid in achieving desired outcomes. Measures or procedures that can be utilized within a BMP may include, but are not limited to, structural and nonstructural controls, operational procedures, and maintenance procedures" (ALL Consulting 2002).

1.6.1 Road and Drill Pad Construction

Before drilling can occur, access roads and well pads will be constructed. The following describes the general procedure for construction. No construction would occur during the months of May, June or July. **Table 1-1** summarizes the approximate total acres of disturbance for access roads and pads. Construction will be conducted in accordance with COGCC 1000 Series rules and a Storm Water Management Plan (SWMP) for construction disturbances greater than 1.0 acre in accordance with CDPHE storm water rules (CDPHE 2007a).

Table 1-1 Total Surface Disturbance

| Road/Well | Approximate Acres of Disturbance |
|--|----------------------------------|
| Total Surface Disturbance Baca #5 and Baca #6 Drill Sites | |
| Baca #5 Location | 2.1 |
| Baca #5 Access Road | 3.3 |

Table 1-1 Total Surface Disturbance

| Road/Well | Approximate Acres of Disturbance |
|--|---|
| Baca #6 Location | 2.1 |
| Baca #6 Access Road | 7.0 |
| Total Acres | 14.5 |
| Total Surface Disturbance Baca #5 and Baca #7 Drill Sites | |
| Baca #5 Location | 2.1 |
| Baca #5 Access Road | 3.3 |
| Baca #7 Location | 2.1 |
| Baca #7 Access Road | 4.2 |
| Total Acres | 11.7 |

The following summarizes the requirements of the COGCC regarding surface disturbance and site reclamation for non-crop land sites (COGCC 2007). The following procedures apply to site preparation, drilling, and reclamation:

- “The operator shall separate and store the A soil horizon or the top six (6) inches, whichever is deeper, and mark or document stockpile locations to facilitate subsequent reclamation. When separating the A soil horizon, the operator shall segregate the horizon based upon noted changes in physical characteristics such as color, texture, density or consistency.”
- “When the soil horizons are too rocky or too thin for the operator to practicably segregate, then the topsoil shall be segregated to the extent possible and stored. Too rocky shall mean that the soil horizon consists of greater than thirty five percent (35%) by volume rock fragments larger than ten (10) inches in diameter. Too thin shall mean soil horizons that are less than six (6) inches in thickness. The operator shall segregate remaining soils on crop land to the extent practicable to a depth of three (3) feet below the ground surface or bedrock, whichever is shallower, based upon noted changes in physical characteristics such as color, texture, density or consistency and such soils shall be stockpiled to avoid loss and mixing with other soils.”
- “All stockpiled soils shall be protected from degradation due to contamination, compaction and, to the extent practicable, from wind and water erosion during drilling and production operations. Best management practices (BMPs) to minimize erosion and offsite sedimentation by controlling storm water runoff shall be implemented.” The best management practices can include, depending on site conditions, silt fences, plant buffers, rock filter dikes, slope roughening, and mulch.”
- “The drilling location shall be designed and constructed to provide a safe working area while reasonably minimizing the total surface area disturbed. Consistent with applicable spacing orders and well location orders and regulations, in locating drill pads, steep slopes shall be avoided when reasonably possible. The drill pad site shall be located on the most level location obtainable that will accommodate the intended use. Deep vertical cuts and steep long fill slopes shall be constructed to the least percent slope practical. BMPs minimize erosion and offsite sedimentation by controlling storm water runoff shall be implemented.”

- “In order to reasonably minimize land disturbances and facilitate future reclamation, well sites...and access roads shall be located, constructed and maintained so as to reasonably control dust, minimize erosion, alteration of natural features and removal of surface materials. BMPs to minimize erosion and offsite sedimentation by controlling storm water runoff shall be implemented.”
- “Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the land area devoted to oil and gas operations. BMPs to minimize erosion and offsite sedimentation by controlling storm water runoff shall be implemented. Where feasible and practicable, operators are encouraged to share access roads in developing a field. Where feasible and practicable, roads shall be routed to complement other land usage. To the greatest extent practicable, all vehicles used by the operator, contractors, and other parties associated with the well shall not travel outside of the original access road boundary.”
- “During drilling, production, and reclamation operations, all disturbed areas shall be kept reasonably free of noxious weeds and undesirable species as practicable.”
- “Upon the plugging and abandonment of a well, all ... mouse and rat holes and cellars shall be backfilled. All debris, abandoned gathering line risers and flow line risers, and surface equipment shall be removed within three (3) months of plugging a well. All access roads to plugged and abandoned wells and associated production facilities shall be closed, graded and recontoured. Culverts and any other obstructions that were part of the access road(s) shall be removed. Well locations, access roads and associated facilities shall be reclaimed. As applicable, compaction alleviation, restoration, and revegetation of well sites, associated production facilities, and access roads shall be performed to the same standards as established for interim reclamation under Rule 1003.” Additionally, “All such reclamation work shall be completed within three (3) months on crop land and twelve (12) months on non-crop land after plugging a well or final closure of associated production facilities. The Director may grant an extension where unusual circumstances are encountered, but every reasonable effort shall be made to complete reclamation before the next local growing season.”

Successful reclamation of the well site and access road will be considered completed when:

- “On non-crop land, reclamation has been performed as per Rules 1003. and 1004., and the total cover of live perennial vegetation, excluding noxious weeds, provides sufficient soils erosion control as determined by the Director through a visual appraisal. The Director shall consider the total cover of live perennial vegetation of adjacent or nearby undisturbed land, not including overstory or tree canopy cover, having similar soils, slope and aspect of the reclaimed area.”
- “A Sundry Notice, Form 4, has been submitted by the operator which describes the final reclamation procedures and any mitigation measures associated with final reclamation performed by the operator.”
- “A final reclamation inspection has been completed by the Director, there are no outstanding compliance issues relating to Commission rules, regulations, orders, permit conditions or the act, and the Director has notified the operator that final reclamation has been approved.”

In addition to the COGCC 1000 Series rules concerning erosion control and reclamation, the CDPHE has a permit system under the Clean Water Act to provide control over storm water discharges and minimize soil erosion and degradation of water resources. The storm water permit system specifies reclamation goals and requires that operators have an SWMP. The SWMP defines what erosion controls will be used during ground disturbing activities, explains how hazardous materials (such as oils and fuels) will be managed to prevent soil and water contamination, and specifies how reclamation and monitoring will occur. The major features of a Stormwater Management Plan (SWMP) include:

- Identification of site specific measures that will be used to control erosion and BMPs including silt fences, plant buffers, rock filter dikes, slope roughening, and mulch. The SWMP includes descriptions and drawings of the specific erosion control structures to be used.

- The SWMP should identify materials that will be stored and used on-site and procedures for preventing and managing spills. Spill prevention and management can be addressed separately in a Spill Prevention, Control, and Countermeasure (SPCC) Plan. SPCC plans must be site specific, comply with applicable rules, and be certified by a professional engineer. The SWMP and SPCC plans must be kept on-site.
- The SWMP must describe the methods used for site stabilization of the site. Stabilization methods can include standards for dealing with compaction, seed mixtures, and seeding method (drill seeding, hydromulching, etc).
- Procedures for inspection and maintenance are described in the SWMP. Periodic inspections of erosion control devices and re-vegetation progress are required and the SWMP must describe how inspection and maintenance is to take place and how it is to be documented. In addition to periodic inspections, inspections are required after strong precipitation events as defined by the permit.

Final stabilization of a site under the CDPHE storm water rules, “means that all ground surface disturbing activities at the site have been completed, and all disturbed areas have been either built on, paved, or a uniform vegetative cover has been established with an individual plant density of at least 70 percent of pre-disturbance levels, or equivalent permanent, physical erosion reduction methods have been employed. Re-seeding alone does not qualify.” For oil and gas operations, if a site reverts to cropland after oil and gas activities, then permit coverage is no longer required.

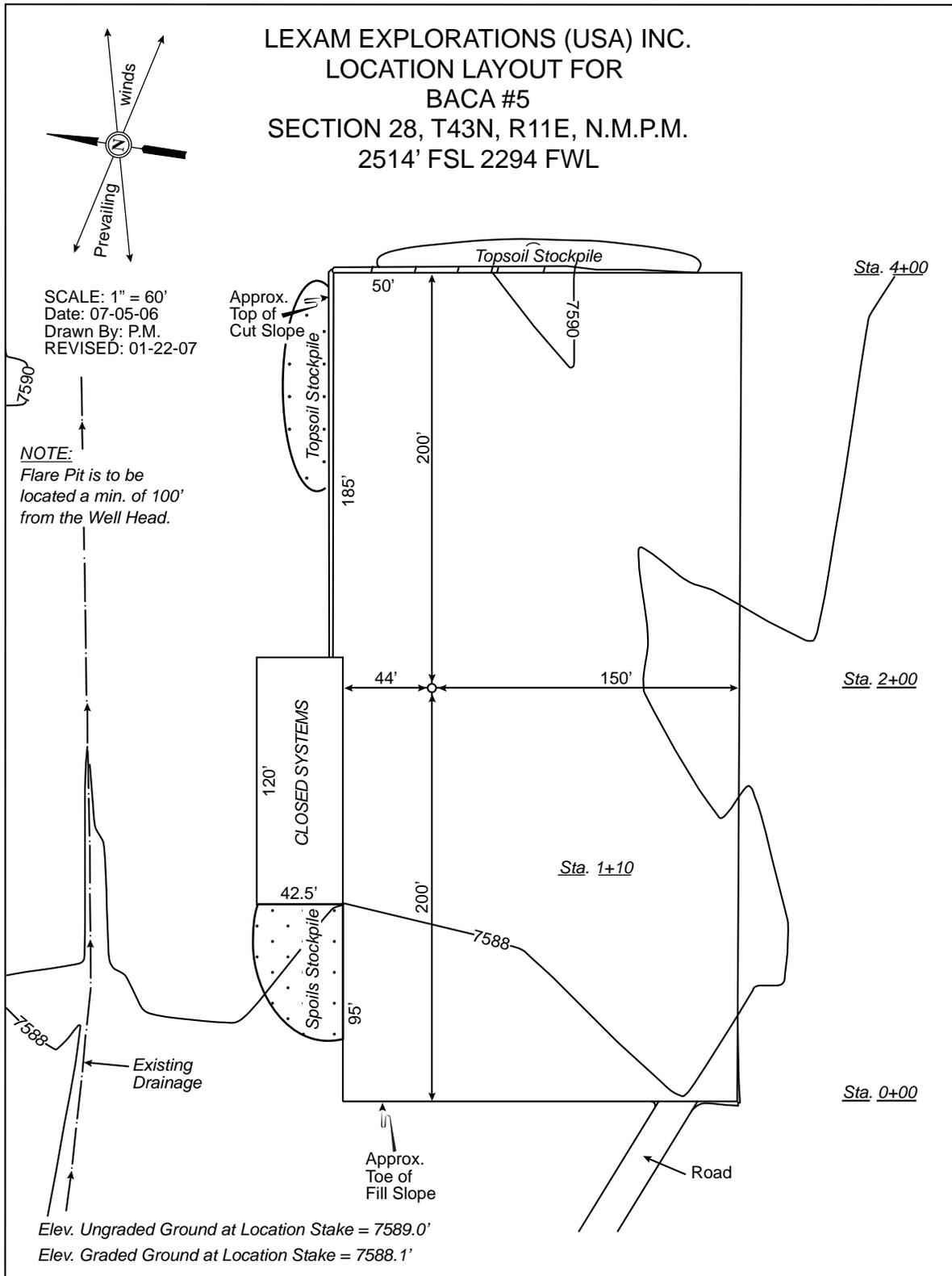
1.6.1.1 Road Construction

The routes for the planned access roads have been designed to minimize the amount of road construction and impacts to habitat, soils, and sensitive plants. BMPs as described above will be used to minimize runoff and erosion and facilitate reclamation. Access roads to the locations will branch off of the Lexam Road, a main north-south road through the Refuge (**Figure 1-2**). The Lexam Road is gravel and will not need to be upgraded to handle the equipment and traffic. An access road to the Baca #5 location will have to be built. The road will be approximately 1.1 miles long with a running surface of approximately 15 feet. Total width of disturbance will be approximately 25 feet. For access to locations Baca #6 and #7, there already exists a two-track unimproved road that goes to those locations. To access the Baca #6 location, an additional road will have to be built with the same running width and overall width of disturbance as the Baca #5 access road. The existing two-track road will be upgraded to accommodate the equipment needed to transport the drilling rig and service the operation. The distance of the access road to the Baca #7 location that will be upgraded will be approximately 1.4 miles. The additional distance of road that will be constructed to the Baca #6 location will be approximately 0.9 mile for a total of approximately 2.3 miles.

Road construction may take from 1 week to 1 month to complete depending upon the terrain and soil conditions. The equipment will consist of haul trucks for transporting earth moving equipment and gravel, and earth moving equipment. Water trucks will be required to wet down the location for dust control.

1.6.1.2 Well Pad Construction

Disturbance for each well pad is expected to be approximately 2.1 acres, allowing for a nominal 90,000 square foot well pad and soil stockpile areas (**Figure 1-3**). BMPs as described above will be used in pad construction as required by COGCC rules to control runoff and erosion. Bulldozers (two to three D7-sized Caterpillars) will be used to construct and level the drilling locations. Top soil and growth medium will be stockpiled for later reclamation. The pads and access roads will be graveled as necessary to support the rig and the ongoing operations. Road and well pad construction will take place during daylight hours.



1.6.2 Drilling Operations

1.6.2.1 Location Preparation

When the pad is completed, several operations will take place before the drilling rig moves on location. A small rig will move in, and drill and set approximately 80 to 150 feet of 20-inch conductor pipe. The conductor pipe will provide stability for the hole in the unconsolidated materials in the uppermost part of the subsurface. The conductor pipe will be cemented in place from a depth of approximately 80 to 150 feet to the surface as required by the COGCC permit (**Figure 1-4**). The small rig also will drill the “rathole” and “mousehole,” which are used to manipulate and store pipe and equipment used in the drilling process. The rathole and mousehole would nominally be 13 to 24 feet deep, cased with 8.63-inch pipe, and be sealed from contact with groundwater. Drill location preparation will take approximately 3 days. Equipment typically used consists of a water well-type rig, several vehicles and trailers. The work will take place during daylight hours.

After location preparation, the drilling rig and associated equipment will be moved to the location and erected. Moving a drilling rig may require 30 to 60 truck loads of equipment. After the pieces are assembled, the derrick will be raised to a height of approximately 135 feet. Derrick heights vary depending on the depth of the drill hole and weight capacity of the rig.

1.6.2.2 Drilling

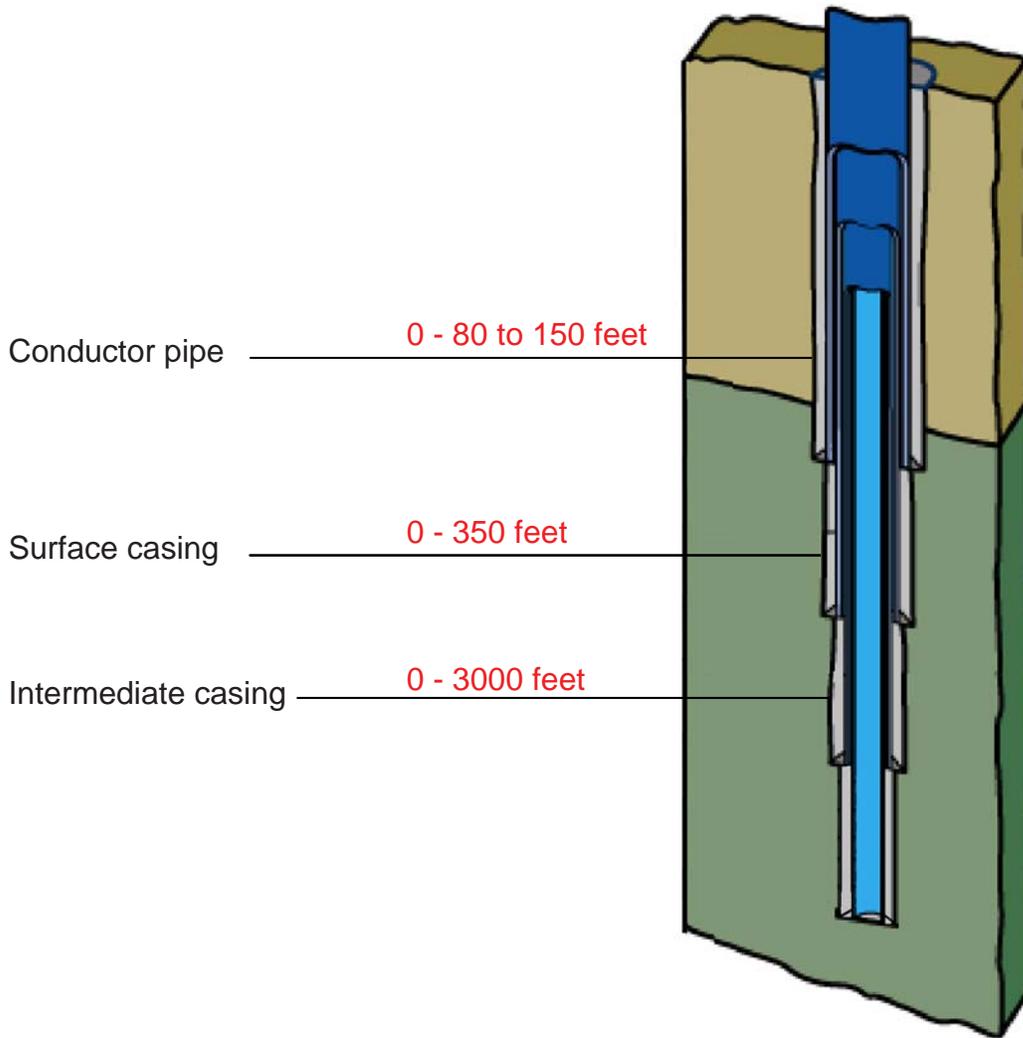
Once the rig is ready, a 17.5-inch-diameter hole will be drilled to approximately 350 feet, at which point a string of 13.38-inch-diameter surface casing will be set and cemented from total depth to the surface (**Figure 1-4**). After the surface casing is set, a blowout preventer (BOP) will be attached to the top of the surface casing. A blowout is an uncontrolled release of subsurface fluids (oil, gas, and water) to the surface, which if ignited could cause a dangerous or hazardous fire. Through a system of hydraulically activated valves and manifolds, the BOP is designed to shut the well in and also allow fluid to be pumped into the hole and stop the uncontrolled release of fluids (i.e., to “kill” the well). BOPs are required by COGCC rule, and conditions of the drilling permit approval specify the pressure rating of the BOP, which depends on potential subsurface conditions. COGCC rules also require testing of the BOP before drilling out from the surface casing.

Drilling fluid or mud will be circulated through the drill pipe to the bottom of the hole, through the bit, up the bore of the well, and finally to the surface. When the mud emerges from the hole, it will pass through a series of equipment used to screen and remove drill cuttings (rock chips) and sand-size solids. When the solids have been removed, the mud will be placed into holding tanks, and from the tank, pumped back into the well. The mud would be maintained at a specific weight and viscosity to cool the bit, seal off any porous zones (thereby protecting aquifers or preventing damage to producing zone productivity), control subsurface pressure, lubricate the drill string, clean the bottom of the hole, and bring the drill cuttings to the surface (Moore 1974). There are three common types of drilling fluids: water-based, oil-based, and synthetics. Water-based muds are the most common and are largely made up of water and bentonite, a naturally occurring clay that has special properties used to maintain proper viscosity and other properties over a wide range of drilling conditions. Lexam’s drilling operations will use fresh water-based drilling fluids, unless unforeseen downhole conditions require the use of different types of drilling fluids.

Upon drilling out of the surface casing, the well will be deepened to a depth of approximately 3,000 feet. At that point, a 9.63-inch intermediate casing string (**Figure 1-4**) will be placed in the hole and cemented in from total depth to the surface in accordance with COGCC rules. The intermediate casing will be used to protect the deep aquifer and ensure stability of the hole as the well is deepened to its target depth. To provide additional protection for the aquifer, the 3,000-foot depth for the intermediate string is a permit condition irrespective of surface management issues. The COGCC has authority under Rule 317 to set casing and cementing requirements to protect aquifers. The 3,000-foot depth of intermediate aquifer protection casing was added as a condition of the drilling permits by the COGCC at the specific request of the USFWS.



Figure: 1-4 -- Well Casing Program



Source: Schlumberger (2007), COGCC (2007)

After the intermediate casing is set, the well will be deepened, and prospective zones will be evaluated if encountered while drilling. Rock cores may be obtained depending on data derived during drilling. The expected total depth is approximately 14,000 feet, and once the total depth is reached, geophysical wireline well logs will be run. If warranted, formation productivity tests (drill stem tests or wireline formation tests) will be conducted on prospective zones. Data from logging and testing will support a determination as to the commercial potential of the zone(s) of interest. If the zones are deemed not to be commercially productive, the well will be plugged and abandoned according to COGCC regulations. If tests indicate commercial productivity, 5.5-inch production casing (**Figure 1-4**) will be run and set according to COGCC rules. The drilling rig will be rigged down and moved off to the next well or removed from the area. Rig down and move off should take an estimated 5 days subject to weather conditions and truck availability. The USFWS will perform another NEPA environmental review prior to any proposed oil and gas development in the Refuge.

1.6.2.3 Well Abandonment and Reclamation

Under COGCC reclamation rules, after a well is plugged, the drill site and access roads must be reclaimed. For final reclamation of well sites, the rules include the following requirements:

- Upon the plugging and abandonment of a well, all mouse and rat holes, and cellars shall be backfilled.
- All access roads to plugged and abandoned wells shall be closed, graded, and recontoured. Culverts and any other obstructions that were part of the access road(s) shall be removed.
- Well locations, access roads, and associated facilities shall be reclaimed according to rules and including, as applicable, compaction alleviation, restoration, and revegetation of well sites and access roads.

COGCC rules allow the surface owner to waive reclamation requirements. If, for instance, the surface owner wants to retain roads, the operator and surface owner can make agreement to do so. However, it is intent of the Refuge management that roads and pads be completely removed and the areas reclaimed to prior use in accordance with COGCC rules regarding reclamation, the operator must comply with the provisions of the SWMP requirements concerning final site stabilization.

In addition, USFWS regulations 50 CFR 29.32, Mineral Rights Reserved and Excerpted, requires oil and gas companies to restore their sites as closely as possible to the conditions that existed before the project. Lexam's restoration efforts will be under the direct supervision of the USFWS, using only endemic plants and seed mixtures approved by the USFWS. The USFWS will monitor restoration efforts from that point on to ensure that restoration efforts have been successful.

1.6.2.4 Water Requirements

Ideally to reduce impacts and disturbance to Refuge resources, water would be piped to the well locations using temporary plastic pipe laid out on the surface from the supply well to the drilling locations. Water requirements for the project are estimated to be a maximum of 15 acre-feet. Water would be obtained from a nearby monitoring well (SW-5) that is owned by the USFWS. The well is cased to approximately 181 feet below the ground surface and is considered to be tributary to the stream system. The well would be temporarily permitted as an industrial well for the duration of the project and a substitute water supply plan (SWSP) would be required from the Colorado Division of Water Resources to replace water pumped from SW-5. Lexam has investigated nearby agriculture water rights and transferring the consumptive use portion of those water rights to Well SW-5 to offset depletions arising from the drilling program. Lexam will file for a SWSP pursuant to Colorado Revised Statutes (CRS) 37-92-308(5), which applies when the depletions will not exceed 5 years. The plan would be approved for 1 year and can be renewed annually, but not to exceed 5 years.

However, in the event that well water would not be available, water will have to be purchased from an off-site source and trucked to the drilling locations. Depending on daily water needs of the rig and the capacity of the tanker truck, as many as 250 truckloads per well could be required to supply water to the drilling operations.

1.6.2.5 Solid Waste and Hazardous Materials

Trash containers and portable toilets will be located on well sites during well pad construction, drilling operations, and site restoration. Toilet holding tanks will be pumped bi-weekly or as needed and their contents disposed of at a municipal sewage treatment facility in accordance with applicable rules and regulations regarding sewage treatment and disposal. Garbage, trash, and other non-hazardous waste material will be collected in a portable, self-contained, fully enclosed trash cage during operations. Trash will not be burned on location. The collected material will be hauled to an approved landfill.

According to the U.S. Environmental Protection Agency (USEPA) rule, certain wastes intrinsic to the drilling and production of oil and gas are exempt from regulation as hazardous wastes (USEPA 1988). Although exempted from regulation as hazardous wastes, it is still required that these wastes be disposed of according to applicable rules and in an environmentally acceptable manner. Drilling mud and drill cuttings are included in the exempt waste category.

Drilling mud will constitute the largest volume of solid waste generated by the drilling operation. At the request of the USFWS, a condition of the COGCC permit requires use of a mud system that does not use an excavated reserve pit. The drilling system will be a closed-loop type of system in which all fluids and drill cuttings are contained in tanks. Also at the request of the USFWS, the COGCC permit requires Lexam to transport all drilling mud and drill cuttings to an off-site third-party commercial disposal facility permitted by CDPHE to handle such wastes.

Lexam will maintain a file, according to 29 CFR 1910.1200 (g), containing Material Safety Data Sheets for all chemicals, compounds, and/or substances that will be used during drilling and completion operations. A variety of chemicals and materials, including petroleum fuels, lubricants, paints, and additives, are used to drill and complete a well. Some of these chemicals and materials may be considered hazardous or contain constituents that are hazardous. The transportation, use, storage, and handling of hazardous materials will follow procedures specified by federal and state regulations. Transportation of the materials to the well locations will be regulated by the DOT under 49 CFR, Parts 171–180. DOT regulations pertain to packaging, container handling, labeling, placards on vehicles, and other safety aspects.

A SPCC Plan will be developed for the drill sites. A SPCC Plan is site-specific, describes how certain hazardous materials will be managed (oils and fuels), and provides information and procedures in case of a spill or release of those materials occurs. SPCC plans will be developed when a drilling contractor is chosen, since the SPCC Plan has to be specific to the equipment and storage that will be on-site. A SPCC Plan must be reviewed and certified by a professional engineer. Lexam will be responsible for providing the certification of the SPCC Plan.

1.6.2.6 Workforce and Time Requirements

Construction of the access road and drill pad will be completed by local contractors and only during daylight hours. When drilling commences, the operation will become a continuous 24-hour operation until the well is drilled to total projected depth. Following road and pad construction, the following personnel will be on-site for any given shift (tour): six rig hands including the driller, one tool pusher (drilling contractor's supervisor), one company representative, one geologist, two mud loggers, one mud engineer, one water truck/equipment operator, and one gatekeeper. A rig crew will work one 12-hour tour per 24-hour day. Supervisory personnel, the geologist, mud loggers, mud engineer, water truck/equipment operator, and gatekeeper will be on-site 24 hours per day. Other personnel will be on-site on a regular basis, but they are not considered part of the drilling personnel: drilling contractor health and safety supervisor, delivery drivers, suppliers, and government inspectors. Service company personnel (for cementing, BOP testing, wireline, drill stem testing, and casing)

will be present for the time needed to conduct given services (6- to 24-hour events). Therefore, at any given time there may be from 14 to 30 people on-site during drilling operations. It is estimated that each well would take approximately 60 to 90 days to drill and complete perhaps longer if unforeseen circumstances arise.

1.6.2.7 Health and Safety

Health and safety for drilling operations are governed by regulations of the COGCC, OSHA, and CDPHE.

Conditions of the COGCC permit include the following health and safety measures:

- Prior to commencing operations, an inventory of all chemicals and products that will be used or stored on site must be provided to the COGCC, the surface owner, and local emergency response personnel prior to bringing those substances on to the Refuge. If additional chemicals or products are required, then information about these substances must be provided to the COGCC, the surface owner, and local emergency response personnel prior to bringing them on to the Refuge.
- Prior to commencing operations, an emergency response plan will be completed by Lexam and approved by the USFWS and discussed with local governments responsible for emergency services. A meeting with the local emergency response personnel will be held to establish an adequate safety and response plan for drilling and completion activities.

A copy of the emergency response plan and emergency contact numbers will be provided to Refuge staff, local governments responsible for emergency services, and monitors before operations begin.

1.7 Identification of Issues

A number of resource protection issues were identified by the USFWS and Lexam prior to the 3D seismic survey and COGCC consideration of the Lexam's Notice of Intent to conduct the seismic survey. Additional concerns were identified during the COGCC APD review process. These issues and concerns were incorporated into protection measures as agreed to by USFWS and Lexam or were incorporated into the seismic and drilling permits issued by the COGCC. Subsequently, concerns were identified through public scoping that is part of this EA process. These issues are summarized below.

Concerns and potential impacts identified by the USFWS and Lexam are:

- Introduction of noxious weeds to the Refuge;
- Disturbance of cultural resources;
- Disturbance impacts to migratory birds and other wildlife (especially during summer breeding) and their habitat;
- Impacts to surface and groundwater resources;
- Contamination of soil;
- Impacts to sensitive habitat, wildlife, plants or other sensitive natural and cultural resource features while conducting operations;
- Soil and vegetation impacts from moving equipment and construction activities;
- Drill cuttings and drilling fluid disposal;
- Conflicts with Refuge management activities;
- Disturbance and potential damage to sensitive Rio Grande suckers (Colorado endangered) and Rio Grande Chub (Colorado species of concern) and their habitats in Crestone Creek; and

- Ability of the USFWS to adequately monitor whether exploration operations are being conducted in a manner that minimizes surface impacts.

Major issues and concerns that were identified during the COGCC's APD review process were:

- Introduction of non-native species and noxious weeds;
- Groundwater quality; and
- Disposal of drill cuttings.

Major issues and concerns identified through the NEPA process include:

- Degradation of air quality;
- Degradation of surface water and groundwater quality;
- Potential impacts to vegetation, habitats, and wildlife;
- Increased noise;
- Degradation of visual quality;
- Management of hazardous materials and solid wastes;
- Degradation of visual environment;
- Impacts to human quality of life and livelihoods; and
- Impacts to cultural resources.

2.0 Description of Proposed Project and Alternatives

2.1 Introduction

The following section describes the Proposed Action Alternative, and two other alternatives - the No Federal Involvement Alternative (No Action Alternative); and the No Mineral Exploration Alternative - that will be considered in this EA. The intent of this EA is to analyze the standards and measures to be adopted by the USFWS to minimize the impact of the surface disturbing activities associated with the planned oil and gas exploration program on Lexam-owned mineral rights that underlie the Refuge.

2.2 Proposed Action Alternative

The USFWS is proposing standards for ensuring that the planned exploration of the mineral estate underlying the Refuge by Lexam does not unreasonably degrade or impact the Refuge's surface estate and associated resources. In response to the potential impact issues and concerns as listed in Section 1.7, the USFWS also is proposing specific environmental protection measures to implement these standards. Certain of these measures have already been implemented with respect to seismic surveying that has been conducted by Lexam; other measures have been adopted by the COGCC and incorporated into conditions of approval of drilling permits issued for the planned drilling; and still other measures may be adopted by Lexam through agreement with the USFWS. Under the No Federal Involvement Alternative, the USFWS would have accepted Lexam's planned activities without imposition of any surface protection standards or measures (see Section 2.4). Taken together, these standards and measures are designed to ensure that the manner, location, and timing of Lexam's activities constitute a reasonable use of the Refuge's surface estate. Many of these protection measures were implemented when seismic operations were conducted in the winter of 2006-2007 (listed in **Appendix A**). Additional protection measures were developed during the COGCC drilling permit application review and the development of this EA.

To minimize the potential impacts identified in Section 1.7, Lexam and the USFWS have agreed to implement the following measures:

- 1) All vehicles and equipment from outside the Refuge will be decontaminated per USFWS procedures to prevent the introduction of noxious weeds to the Refuge.
- 2) All ground-disturbing activities associated with drilling operations and setup will require on-site archaeological monitoring. In addition, once timing of road and pad construction activities is determined, biologists will survey affected areas to document current wildlife activity and sensitivities to be addressed and/or avoided.
- 3) Trained environmental monitors will continue to serve as liaisons between the Refuge Manager, construction contractor, and drill rig personnel and ensure that all operations are conducted in a manner that minimizes surface impacts.
- 4) Impacts to sensitive habitat, wildlife, plants or other sensitive natural, cultural or historical resource features will be avoided to the extent possible while constructing the access road and well pads.
- 5) All construction of roads and pads will occur in a way that best facilitates their subsequent complete removal and reclamation once Lexam activities have ceased at these sites. This includes separating and stockpiling topsoil layers on-site to be replaced during reclamation. All disturbed areas will be reclaimed per the COGCC requirements and with USFWS input.
- 6) A baseline water quality study of the near-surface unconfined aquifer, deeper aquifers, and surface water in proximity to the planned well locations will be conducted prior to drilling. Baseline sampling has been conducted in the project area and the results are presented in Section 3.4. In addition, at least three monitoring wells will be installed near each well pad to monitor potential spills or releases.

- 7) Casings will be set with COGCC-approved cement to 3,000 feet below the surface which will fully protect the aquifers from contamination through communication in the borehole (**Figure 1-4**).
- 8) A closed loop mud and drill cuttings system will be used to minimize impacts to surrounding habitats. In addition, drill cuttings will be isolated in an above-ground tank during drilling. Cuttings will be removed from the Refuge and disposed of off-site in accordance with state regulations.
- 9) Drilling operations will be modified, as necessary, to reduce conflicts with regular Refuge management activities.
- 10) A gate guard will be provided by Lexam, and approved by the USFWS, to document traffic entering and exiting the Refuge and to eliminate potential illegal entry onto the Refuge.
- 11) Arrangements for additional USFWS law enforcement personnel will be made in the event it is deemed necessary to effectively enforce state, federal, refuge, and wildlife laws during drilling activities.
- 12) Construction and drilling activities will be conducted from August 1 through April 30 in order to avoid conflicts with wildlife and limit ground disturbance activities to periods of low precipitation to minimize impacts to soil.
- 13) Well sites will be located as far from sensitive wet meadow wetlands as practicable.
- 14) Drill pads will be fenced if necessary to prevent large ungulates from gaining access to the sites.
- 15) To protect special status species such as the Rio Grande Sucker and Rio Grande Chub, USFWS and Lexam will:
 - Establish a 0.25-mile buffer zone of no activity around potential and identified habitat.
 - Limit vehicle crossings to existing or pre-approved crossings.
 - Sample waterways for particulate matter, creating a baseline and regular monitoring during period of activity.
 - Assess stability and suitability of road water crossings prior to road construction and drilling activities. Perform upgrade, if needed. Conduct periodic monitoring of crossings during activities and documentation of any deficiencies that may occur that may be indicative of potential structural failure.
 - Provide dust suppression in the vicinity of waterway crossings.
- 16) Pre- and post-drilling aerial photographs will be taken of the proposed drilling and road construction area. The photographs will be color and will provide complete coverage of the drilling and road construction area. The pre-survey documentation shall be submitted within 10 days of initiation of the drilling, the post-survey documentation shall be submitted within 110 days of completion along with a digitized version of the pre-survey photographs. These photographs will become the property of the Refuge.
- 17) The Operator shall provide detailed maps or plats to the Refuge Manager or his authorized representative of the proposed project layout, showing routes, staging areas, construction areas, and work locations.
- 18) All materials brought into the Refuge to build up the location pad will be authorized by the Refuge Manager or his authorized representative. To minimize the spread of invasive species, no top soils will be brought in from off refuge.
- 19) Summaries of all the results generated from the water quality sampling, archaeological survey work and any other sampling or monitoring, including the results of Lexam's exploratory drilling, will be provided to the Refuge Manager upon completion and summation.

- 20) The Operator's drilling activities will be restricted to the period of August 1 through April 30. Any field operations conducted during the refuge's migratory bird closure period (May 1 through July 31) must be coordinated and authorized by the Refuge Manager or his authorized representative. FWS will consider allowing Lexam to continue work in early May if allowing access is necessary to complete activities and such activities would not impact the Refuge and resources greater than what is anticipated in the EA. Rigging and down operations can only be conducted during daylight hours. Drilling operations will be conducted 24 hours per day when drilling past the casing.
- 21) The Operator shall designate an onsite representative for field operations who shall be present during all phases of the Operator's operation and be the sole representative of the Operator and subcontractors regarding all communications and decisions of the Refuge Manager or his authorized representative. The Operator shall keep the Refuge Manager or his authorized representative informed if there is any change of designated representative for field operations.
- 22) Refuge officials will conduct an on site meeting before rig-up with representatives of the Operator, drilling contractor, subcontractors, suppliers and service companies. The purpose of the meeting is to go over regulations and such conditions that apply to work crew conduct on the refuge.
- 23) Prior to rig-up, an Emergency Preparedness Plan covering exploratory drilling, well control, materials hauling, spill response, and fire evacuation, will be provided to the Refuge Manager and discussed in a pre-operation meeting to be held with local governments. The plan shall contain a telephone list naming key contacts for emergency operations and activation.
- 24) The Operator will upgrade and maintain all access routes, roads and bridges designated for its use across the Refuge in accordance with acceptable specifications and standards. The Operator shall have road maintenance equipment and operator(s) readily available to perform road repairs and maintenance as needed, or as directed by the Refuge Manager or his authorized representative.
- 25) Dust levels on regularly traveled access routes must be kept to a minimum. The Operator shall have a water truck and operator(s) readily available to perform dust abatement as needed, or as directed by the Refuge Manager or his authorized representative. Only water will be allowed for dust suppression efforts. Dust control measures shall be implemented throughout the traveled areas of the project area in addition to the dust abatement requirement in measure #15.
- 26) The drill site and immediate access roads shall be constructed of refuge approved material for all drilling locations. Drill pads may not exceed 90,000 square feet in area. All existing drainage patterns within roads to be constructed shall be maintained uninterrupted by the use of culverts, bridges or other applicable techniques as specified and authorized by the Refuge Manager or his authorized representative.
- 27) The soils at the location site will be tested using approved standards to determine levels of heavy metals, chemical pollutant, and other contaminants, prior to rig-up operations. Duplicate tests will be conducted before completion or at abandonment. If the exit test reveals levels above the background established by pre-drilling test, cleanup will be required. The most practical method of clean up is soil removal. Any quantity of soil removed will be replaced to the original contours.
- 28) Upon completion of drilling operations, the Refuge Manager or his authorized representative must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged according to state law, all above ground structures removed and the site and road restored as directed by the Refuge Manager or his authorized representative. Any damage to existing surface vegetation, water channels, or other physical features shall be restored to original site conditions. All costs shall be born by the Operator.
- 29) Pits, ponds and/or open tanks are prohibited. Portable enclosed tanks must be used in circulating operations for the temporary storage of all drilling fluids, cuttings, mud, and contaminants. All drilling fluids, cuttings, mud, contaminants, portable tanks, and other equipment must be transported off

Refuge to an state approved facility upon cessation of drilling activity. It is highly recommended that an auger tank be used for transferring drill cuttings and sand to a vehicle for off Refuge transport.

- 30) All toxic construction and equipment supplies and refuse (oil, grease, gasoline, diesel, paint, and other petrochemical derivatives) shall be centrally stored. Wastes shall be disposed off refuge immediately following completion of drilling operations. In the event of an accidental spill or discharge of oil, brine, or any other petrochemical substance, the Operator shall immediately notify the Refuge Manager or his authorized representative. The Operator shall remove contaminated soils for proper disposal off Refuge, and replace such soils with the same type soils or of a type specified and approved by the Refuge Manager or his authorized representative. A site reclamation plan may be required by the Refuge Manager or his authorized representative.
- 31) Catch pans or other liner systems approved by the Refuge Manager are required for equipment and locations such as mud pumps, bulk mud additive tanks, fuel tanks, mixing shed, generators, accumulator and lines, and under the entire rig floor. The catch pans will cover the entire surface area under the equipment. The rig floor catch pan will be tied to allow for wash down and mud drainage from drill pipe. The catch pans will be kept free and clean from accumulated debris and spill materials.
- 32) The Operator will be responsible for providing all water needed for drilling operations. No waste water will be discharged onto Refuge lands, ditches, or water bodies. The Operator will provide a containerized or temporary septic system for domestic sewage disposal during drilling operations, which shall be removed upon completion of drilling. Use of portable toilets at drill site or the installation of a septic system, or similar treatment system or tanks will be required for any trailer or quarters on site. No surface discharge of septic system or portable toilet water is permitted. Septic tanks must be inspected weekly during operations and pumped as necessary. Upon completion of operations, the septic tanks must be pumped out and all material hauled away.
- 33) All disposable type materials and trash brought onto the Refuge or generated at the drill site shall be removed from the Refuge on a biweekly basis and upon completion of the drilling activities. The drill site and operational area shall be kept free of debris and trash at all times. Trash shall be contained securely at the drill site in such a manner (fully enclosed trash cages) as to prevent trash from being spread by wind or wildlife. No trash may be disposed of or buried on the Refuge.
- 34) General Refuge access conditions :
 - Access is to allow Lexam and/or its contractors access to portions of the Refuge for the purpose of carrying out drilling of oil and gas exploration wells Baca #5 and Baca #6 or Baca #5 and Baca #7 (either #6 or #7 would be drilled, but not both).
 - The Refuge Manager is the coordinating official having immediate jurisdiction and administrative responsibility for oil and gas operations on the Baca National Wildlife Refuge (Refuge) lands and property, all entry upon the Refuge must be coordinated with the Refuge Manager or his authorized representative The Refuge Manager must be advised at least 48 hours in advance of initial activity.
 - The failure of the U.S. to require strict performance of the terms, conditions, covenants, agreements, or stipulations of this permit for access to conduct exploration activities on national wildlife refuge lands, shall not constitute a waiver or relinquishment of the right of the United States to strictly enforce thereafter such terms, conditions, covenants, agreements, or stipulations which shall, at all times, continue in full force and effect.
 - Lexam and/or its contractors (Operator) shall save, hold harmless, defend, and indemnify the United States of America, its agents and employees for loss, damages, or judgments and expenses on account of bodily injury, death or property damage, or claims for bodily injury, death. or property damage of any nature whatsoever, and by whomever made, arising out of the Operator, his employees, subcontractors or agents with respect to the exploration of any and all mineral rights within the lands administered by the Refuge.

- All applicable federal and state regulations apply and will be in force. Operator shall be responsible for the actions of all exploration and support personnel. Violations of applicable laws or regulations will subject the operator and/or his employees to prosecution under state and/or federal laws. Individuals utilizing the Refuge under the Operator's authorization are subject to inspections of vehicles and their contents by federal and state law enforcement officers.
- Proof of general liability insurance in the amount of \$1,000,000 must be furnished to repair/mitigate any damages. This does not limit the liability for damages to this amount.
- Operators will act in a manner that is respectful of Refuge habitats, wildlife, and property. Gates are to be locked or unlocked as they are found.
- All vehicle access will be restricted to developed roads and two-tracks. All terrain vehicle use and deviations to vehicle use must be pre-approved by the Refuge Manager in writing prior to any action taken.
- Vehicle speed limits will be set at the discretion of Refuge Manager and limits will be strictly adhered to.
- No pets will be allowed on the Refuge.
- Possession of firearms is strictly prohibited on the Refuge.
- Fires are strictly prohibited in any areas of the Refuge.
- Operators are not to be considered agents of the USFWS and are not to represent the USFWS in any matters.
- Operators will perform all work in accordance with the highest standards of the industry and to the satisfaction of the USFWS.
- Operators will perform all work in accordance with all applicable laws and regulations and will obtain all necessary permits or licenses when required to do so.
- All personnel and activities shall be restricted to the immediate drilling area and the direct access road to the drill site.
- Feeding wildlife species is prohibited. Molesting or destroying the home or dens of wildlife is prohibited. If dens are found during the normal course of operations, distinctive flagging will be used to alert all personnel of the den location. Adverse impacts on fish, wildlife and the environment shall be kept to an absolute minimum. All road kills will be reported to the Refuge Manager or his authorized representative.
- Littering is prohibited. All cans, bottles, lunch papers, and operations trash must be removed. Cigarette butts are considered litter. All vehicles will be equipped with a container to carry out trash.
- All necessary permits, contacts and clearances must be completed or obtained by and at the Operator's expense. Copies of all permits and clearances must be documented prior to the start of the activity.
- No overnight quarters will be permitted on the refuge unless authorized by Refuge Manager.

In addition to the protective measures and access conditions described above, Lexam and Saguache County have entered into an agreement to provide protective measures for county resources. The agreement and measures are provided in **Appendix D**. Provisions include reimbursement to the county for road repair and signage and testing of drilling fluid and drill cuttings to be disposed in Saguache County.

2.3 No Federal Involvement Alternative (No Action Alternative)

For the purposes of this EA, it is assumed that under the No Federal Involvement Alternative, the USFWS would accept Lexam's planned activities without negotiating any surface protection standards or measures for Lexam's exploration activities. Oil and gas exploration activities would be conducted subject only to standard rules and conditions of approval imposed by the COGCC and other applicable rules and regulations of various federal and state agencies. For instance, the road agreement between Lexam and Saguache County would be in force in this alternative, but the planned access roads would not be sited to avoid sensitive species and instead would proceed directly to the drill sites.

Under the No Federal Involvement Alternative, there would be many fewer specific conditions that Lexam would be obligated to follow. However, Lexam would have to comply with all applicable federal, state, and local regulations. Of the COGCC permit conditions; it should be noted that Conditions 4, 6, 7, 8, 9, 14, 15, 16, and 17 were instituted at the request of the USFWS. It is not certain which of those requested conditions would have been applied to the permit in the absence of USFWS input, given the right of surface owners to negotiate surface reclamation and other access provisions or the COGCC's authority to impose permit conditions to prevent environmental degradation as determined by the permit review process.

The COGCC permit conditions included at the request of the USFWS are summarized below (the full permits are presented in **Appendix C**):

Condition 4 - Surface casing depth will be set at a depth of 3,000 feet.

Condition 6 - Prior to commencing operations, an inventory of all chemicals and products that will be used or stored on site must be provided to the COGCC, the surface owner, and local emergency response personnel prior to bringing those substances on to the Refuge. If additional chemicals or products are required, then information about these substances must be provided to the COGCC, the surface owner, and the local emergency response personnel prior to bringing them on to the Refuge.

Condition 7- Prior to commencing operations, a meeting with the local emergency response personnel will be held to establish an adequate safety and response plan for drilling, completion, and production activities.

Condition 8 - A closed loop mud and cutting system will be used and cuttings will be placed in an above ground and lined enclosure, unless landowner approval to use an alternative mud and cutting system is obtained in writing.

Condition 9 - The drill cuttings will not be left at or buried on the drill site or elsewhere on the Baca National Wildlife Refuge, unless landowner approval is obtained in writing. Cuttings will be disposed in accordance with COGCC Rule 907.

Condition 14 - A guard, provided by Lexam, shall be stationed at the property gate on County Road T during all drilling and completion activities. The guard will limit access to the property to Lexam employees, Lexam contractors, and other authorized personnel.

Condition 15 - Baseline water quality data will be acquired from both near surface (unconfined aquifer) and deeper aquifers in proximity to proposed wells prior to the spud of the wells and again within six months after the wells are completed and/or plugged. Sampling and analysis procedures must be approved by the COGCC staff prior to conducting this work. Data will be provided to the COGCC and the surface owner. Data will be used to assess any possible long-term affects on ground water quality.

Condition 16 - A minimum of one up-gradient and two down-gradient monitoring wells will be installed around each drill pad. The wells will be completed in the shallow unconfined aquifer. The locations and elevations of the wells will be surveyed and depth to water will be measured. Water samples will be collected for chemical

analysis before the wells are spud and at predetermined intervals thereafter, which will be agreed to by the United States Fish and Wildlife Service (USFWS) and Lexam. If spills or releases of drilling related chemicals at sites occur, then the sampling frequency may be increased to a frequency agreed to by the USFWS, Baca Grande Water and Sanitation District, and Lexam.

Condition 17 - Equipment and vehicles brought onto the Baca National Wildlife Refuge from outside the San Luis Valley must be cleaned and decontaminated to minimize introduction of non-native species and noxious weeds.

In addition to the permit conditions included at the behest of the USFWS, some important actions have occurred because of the conditions imposed by the USFWS including Baca #5 access road re-route to avoid sensitive plant species and moving Baca #5 out of a wet meadow (**Figure 2-1**). These actions would not have occurred were it not for the protection measures and conditions imposed by the USFWS. In addition to actions described, protective measures that would not have been instituted include timing restrictions on activities to protect wildlife; vegetation, and soil resources; requirement for an emergency response plan, and any other provisions not listed as conditions in the COGCC permits, but are listed in Section 2.2; Proposed Action.

2.4 No Mineral Exploration Alternative

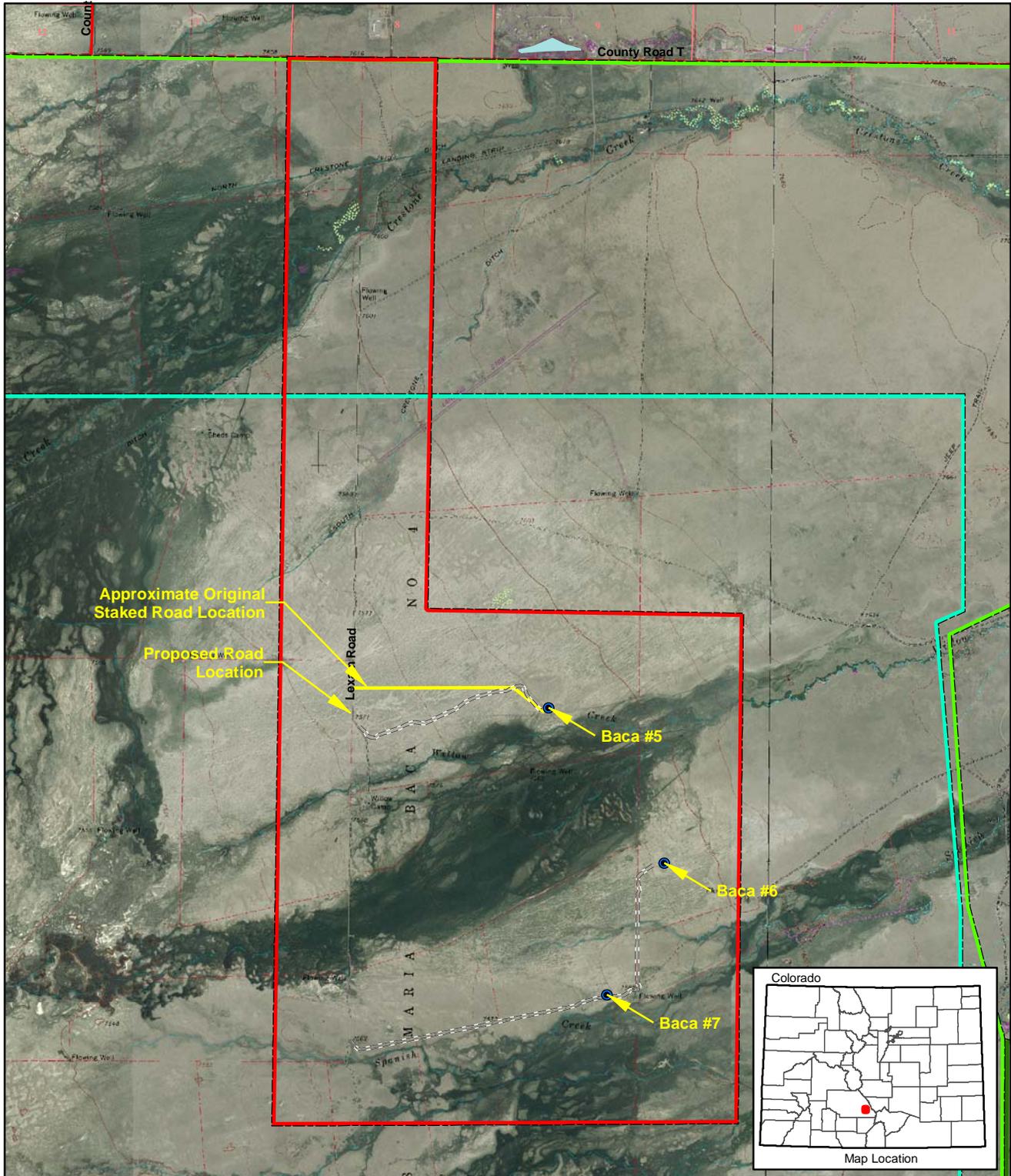
Under this alternative, several scenarios could occur including potential purchase of the mineral estate by the federal government, Lexam's donation of the mineral estate to the federal government, or any other reason that Lexam might choose not to go forward with exploration. Another possible scenario, would be that the United States would acquire the Refuge's severed mineral estate from Lexam and ConocoPhillips by purchase or exchange pursuant to the authorization contained in Section 8(a)(1) of the Great Sand Dunes National Park and Preserve Act of 2000, 16 USC 410hhh-6(a)(1). Federal acquisition of the outstanding mineral rights would preclude Lexam from proceeding with its planned exploration program, and the effects of that program would not occur. USFWS has not, to date, pursued this alternative because no funds have been identified or appropriated for the acquisition of the severed mineral estates, and Lexam and ConocoPhillips have not consented to such acquisition as required by 16 USC 410hhh-6(a)(1). Also, Lexam has stated that it fully intends to proceed with its planned exploration program (McEwen 2007). Consequently, it is uncertain whether this alternative is currently practicable. However, this alternative has been selected for analysis because, unlike the other alternatives analyzed in this EA, it describes a future without mineral resource exploration and its associated impacts and establishes an environmental baseline from which to measure the potential impacts of other alternatives.

Under this alternative, it is assumed that no oil or gas exploration would occur on the Refuge; however regular Refuge management activities such as surveys and other baseline data collection activities for the Comprehensive Conservation Plan would take place beginning in 2008.

2.5 Alternatives Considered but Eliminated from Further Analysis

2.5.1 Suspend Drilling Until Completion of a Comprehensive Conservation Plan

Suspension of the planned drilling pending development of a Comprehensive Conservation Plan (CCP) was eliminated from consideration because it is considered an unreasonable constraint on Lexam's rights to develop its mineral estate. The purpose of this EA is to analyze the USFWS adoption of standards and measures to mitigate impacts of the drilling of only these two planned oil and gas exploration wells on the federal surface estate. Second, as noted above, the roads and drill pads affect approximately 14 acres of land on the Refuge. The CCP will apply to the entire refuge, which is approximately 92,500 acres. Therefore, USFWS believes that impact of this planned drilling program on surface resources of the Refuge can be thoroughly assessed and evaluated prior to the completion of the CCP. Finally, information obtained through Lexam's proposed exploratory drilling will be beneficial to USFWS' planning efforts by further defining the economic viability of the underlying mineral estate and predicting potential development scenarios which would be incorporated into the CCP.



Legend

- Proposed Well Site
- Project Area
- Proposed Access Road
- Baca NWR Acquisition Boundary
- 3D Seismic Survey Area



UTM ZONE 13
NAD 27

2.5.2 Directionally Drill the Wells from Outside of the Refuge

Generally, exploratory wells are vertically drilled because subsurface conditions cannot be predicted with certainty in unexplored areas, especially at greater depths and with a potential for over-pressurized zones. Directional drilling would increase the technical difficulties in drilling and create greater risk of losing the hole or creating potentially hazardous conditions. The Council on Environmental Quality further clarifies elimination of this alternative in its "Questions and Answers About the NEPA Regulations" (1981) when it states that "reasonable alternatives include those that are *practical or feasible* from the technical and economic standpoint." Directional drilling of a 14,000-foot deep exploratory well was judged to be neither technically nor economically practical or feasible as described in the following discussion.

Directional drilling is generally defined as "drilling a nonvertical hole through the earth" (Short 1993). There are a number of different designs of directional drilling including a simple slant hole, single bend, double bend, and extended reach (**Figure 2-2**). Directional drilling is conducted for a variety of reasons and includes multiple wells from one location, inaccessible surface locations, access productive zones from existing vertical bores, and enhance productivity.

Lexam's plans for testing the oil and gas potential of the Refuge by drilling the proposed wells are driven primarily by the interpretation of the available 2D and 3D seismic data. The importance of the seismic data is magnified by the very limited control available from previous drilling. Within the entire area of the Refuge and adjacent Great Sand Dunes National Park, well control is only available from Lexam's Baca #1 and #2 wells. As defined by the results of oil and gas exploration conducted from 1995 to the present, no wells have been drilled in areas currently judged to be prospective for oil and gas. Because of lateral variations in geologic formations within the area, the Baca #1 and #2 wells do not provide suitable well control for interpreting seismic data in the area of the proposed wells.

Seismic data are recorded in the time domain. Reflections from geological strata are recorded and imaged by the amount of time it takes for waves to return to the surface after the seismic energy source has initiated a sound wave. The depth of any particular horizon is dependent upon the velocity at which the sound waves travel down through various rock types and back to the surface. Lacking data from previous drilling, significant uncertainty exists in estimating seismic velocities. As a result, the interpreted depth and geometry of targeted geologic formations are only approximate.

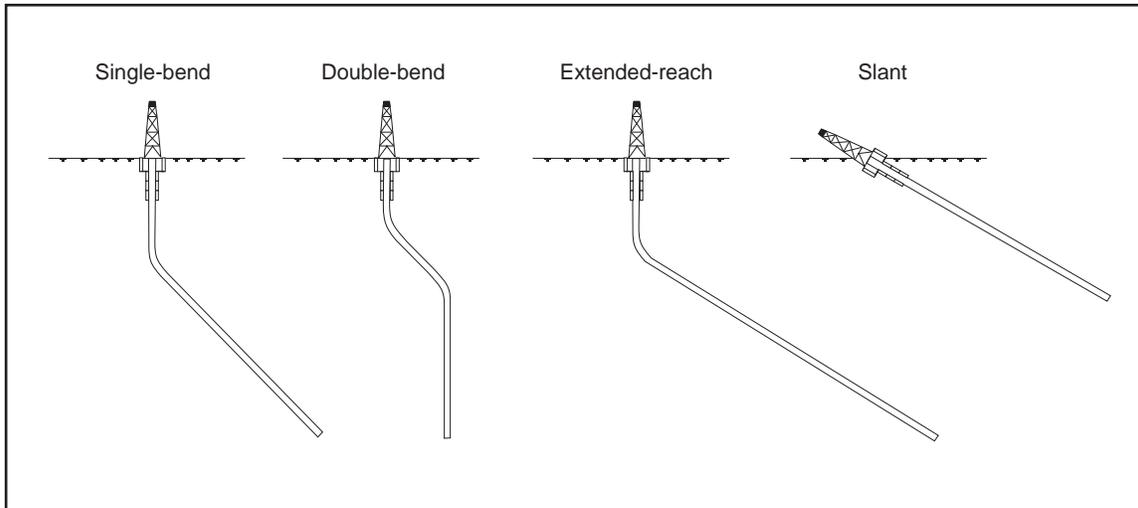
While Lexam has endeavored to minimize the uncertainty by completing a 25 square mile 3D seismic survey in early 2007, the interpretation of 3D seismic data is still subject to significant uncertainties due to lateral and vertical changes in rock characteristics that affect seismic velocities. The interpretation of 3D seismic data is often an iterative process that includes initial interpretation, drilling and subsequent re-interpretation using velocity measurements obtained from geophysical logs of the well or wells that have been drilled.

Vertical wells minimize exploration risks associated with the uncertainty in estimating depth in an area with little or no well control and to minimize the number of wells needed to definitively test the target during the early stages of exploration. A vertical well bore will intersect the target geologic formation at its true depth below the surface, even though that may be significantly different than the original interpreted depth. Wells drilled at a deviated angle add the risk of not encountering the target at the preferred location, potentially increasing the exploration time because of the need to drill additional wells.

More importantly, the velocity control gained from vertical wells is superior to data gained from drilling deviated wells in that a vertical well will provide a discrete velocity function from the surface directly through the total depth of the well. Drilling vertical wells at both of the proposed locations will provide unique velocity functions at two points which can be used to define lateral variations in seismic velocities directly over the target.



Directional Drilling Patterns



Source: Short (1993)

Observed lateral variations in seismic velocities can then be projected beyond the area of the two initial wells for the purpose of re-interpreting seismic data and generating new well plans. Inferior velocity control obtained during the early stages of exploration will continue to add uncertainty to subsequent drilling prognoses and well plans.

Other concerns regarding directional drilling involve the simple fact that a deviated well will have a longer measured depth (MD) than the true vertical depth (TVD) of the target zone. In the case of the planned drilling, the nearest locations from which to drill outside the Refuge would be east of the proposed locations. The nearest surface location outside of the Refuge to the Baca #5 downhole location would be approximately 11,000 feet away. Assuming the case of simple slant hole configuration, an additional 3,000 feet would have to be drilled. The actual borehole configuration would be more complex and result in additional drilling distances of more than 4,000 feet and MDs in excess of 18,000 feet. The consequences of the increased distance include, but would not be limited to, a larger rig, a larger drill pad (greater disturbance), more time needed to drill the well, more drill cuttings, and higher potential for hole problems (sticking drill pipe and drilling tools, inadequate ability to test potential zones, losing the hole). All of the preceding have direct cost consequences for the operator and have greater potential for environmental damage. Based on the foregoing, USFWS had determined directional drilling is not a technically or economically feasible alternative and has no identifiable environmental benefits in this case.

2.5.3 Permit Only One Well

Exploration for oil and gas in the San Luis valley has been very limited to date. No exploration wells have been drilled in the entire 25-square-mile area of the 3D seismic program acquired on the Refuge. Therefore, Lexam has made a number of interpretative assumptions to locate prospective oil and/or gas targets. Lexam believes drilling of the initial well will provide hard data regarding a number of the elements required for entrapment of oil or gas. It is highly likely that there will be significant changes in the interpretative model of the geology as a result of drilling the initial well. Therefore Lexam believes a second well will be required to test additional potential based upon the new information acquired from the initial well.

2.5.4 Deny Lexam Access

The USFWS does not have the authority to deny Lexam, as legal owner of the separated mineral rights and party to a binding surface uses agreement, access to the Refuge to pursue recovery of its minerals. As mentioned above, Colorado property law allows the subsurface mineral owner to make reasonable and necessary use of the surface to explore for, develop, and produce its mineral interest. Any action by the USFWS to totally deny Lexam the reasonable opportunity to explore for minerals would likely be considered by Lexam an unconstitutional "taking" of their private property (mineral estate) without just compensation (U.S. Constitution, Amendment V). Therefore this alternative was considered and eliminated from detailed analysis.

3.0 Affected Environment

3.1 Introduction

This EA analyzes USFWS's adoption of standards and measures to ensure that Lexam's planned exploration of the mineral estate underlying the Refuge does not unreasonably degrade or impact the USFWS surface estate and associated resources. As such, the sites of the exploration wells and existing and planned access roads constitute the project area (**Figure 1-2**). The larger approximately 16,246-acre area of the earlier seismic exploration by Lexam serves to provide the regional context for most of the "on the ground" resources (e.g., vegetation, wildlife, cultural resources, geology, etc.). The 16,000-acre seismic survey area is referred to as the project vicinity. Larger regional contexts are used as appropriate for resources such as air, groundwater, and visual resources.

3.1.1 Baca Refuge

The approved Refuge comprises 92,500 acres in Saguache and Alamosa counties in the San Luis Valley of south-central Colorado (**Figure 1-1**) (USFWS 2005). Situated in the San Luis Valley, a high mountain desert surrounded by two 14,000-foot mountain ranges, the Refuge contains a highly diverse suite of habitats including desert shrublands, grasslands, wet meadows, playa wetlands, and riparian areas. Fed largely by melting mountain snow, numerous streams crisscross the Refuge providing an abundance of life in an otherwise arid landscape. The Refuge is home to a multitude of wildlife and plant species.

Congress authorized acquisition of land within the Refuge with passage of Public Law 106-530, also known as the "Great Sand Dunes National Park and Preserve Act of 2000." This legislation, which received widespread support, focused not only on protecting the region's hydrology, which the unique sand dunes ecosystem depends upon, but also on protecting the ecological, cultural, and wildlife resources of the area.

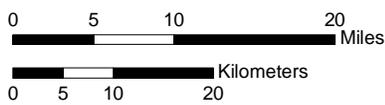
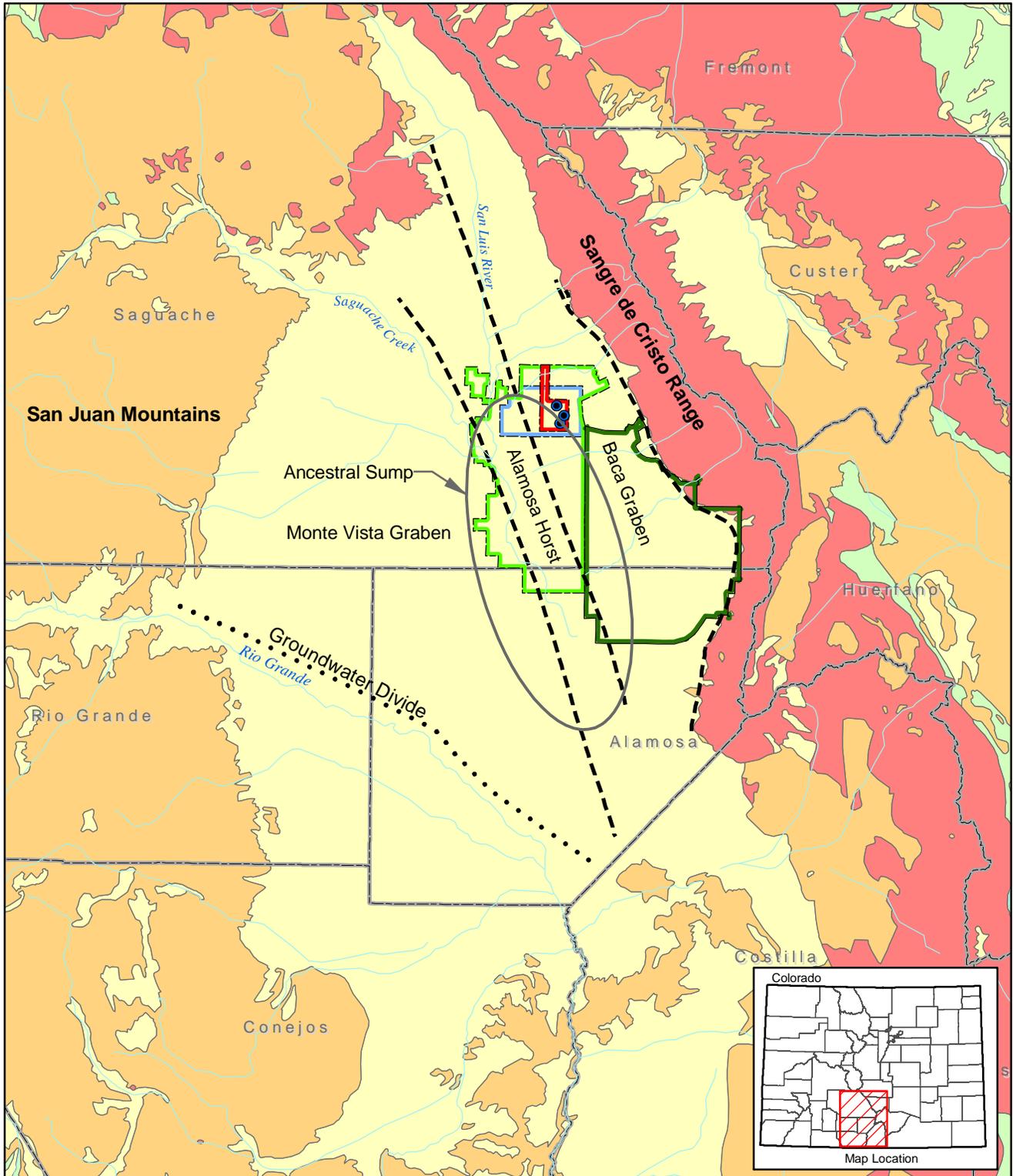
3.1.2 Project Area

The planned access roads and two exploration wells will be located in the north central portion of the Baca Grant, generally in the southern portions of T43N, R11E NMPM (**Figure 1-2**). Lexam's planned drilling is at an approximate elevation of 7,600 feet and is on a slight west-facing slope covered with shrubs. The project area is about 5,200 acres in size, compared to the seismic survey area of 16,246 acres and the Refuge, which contains 92,500 acres. The project area provides a 0.50-mile buffer around key elements of Lexam's planned drilling program.

3.2 Geology, Minerals, and Soils

3.2.1 Geology

The San Luis Valley is part of the much larger Rio Grande Rift Zone, which extends from southern New Mexico northward through the San Luis and Upper Arkansas Valleys to its northern termination near Leadville, Colorado (McCalpin 1996). The San Luis Valley is bordered on the east by the linear Sangre de Cristo Mountains, which resulted from extensive block faulting during the Laramide Orogeny (**Figure 3-1**). The west side of the valley is flanked by the San Juan Mountains, the result of extensive Tertiary-aged volcanism. In sharp contrast with the steeply faulted eastern side of the valley floor, the Oligocene volcanic rocks of the San Juan Mountains gently dip eastward into the valley floor where they are interbedded with valley-fill deposits. Valley-fill deposits consist of sedimentary rocks that inter-finger with volcanic deposits (McCalpin 1996). Quaternary deposits include pediments along the mountain fronts, alluvium, and sand dunes.



Legend

- Proposed Well Site
- Project Area
- 3D Seismic Survey Area
- Baca NWR Acquisition Boundary
- Great Sand Dunes NP Acquisition Area
- Fault
- Quaternary Deposits
- Tertiary Sandstone and Volcanics
- Cretaceous Sandstone
- Paleozoic Sediment/Precambrian Crystalline



The project area is immediately underlain by Quaternary alluvium (Cappa and Wallace 2007). Below the alluvium are over 10,000 feet of sedimentary deposits of the Alamosa and Santa Fe Formations (Mayo et al. 2006). These sediments consist of stream and lake deposits composed of sand, clay, and gravel.

3.2.2 Minerals

The most recent modern-day mining activities to have occurred in the general vicinity of Crestone, Colorado have been operations conducted by Battle Mountain Gold Company at its San Luis Mine, located some 50-plus miles southeast of Crestone and in Costilla County, which ceased operations in late 1996; and, the former Summitville Mine which is located some 60-plus miles southwest of Crestone and in Rio Grande County. The Summitville Mine was operated by Galactic Resources, Inc. and ceased operations in late 1992. In the immediate vicinity of Crestone, the last recorded mining took place in the late 1800s (Sangres.com 2007). Prospecting for gold and silver occurred throughout the immediate area in the Sangre de Cristo's, and Crestone itself was founded at one of the locations where there was a small producing ore body. Production was sufficient to support the construction of a stamp mill at the location; however the mine soon played out.

The major mineral commodities that are mined in the San Luis Valley vicinity are sand and gravel (Guilinger and Keller 2000). The nearest sand and gravel pits are located a couple of miles north of the Refuge in T44N, R11E. Other sand and gravel operations are scattered around the San Luis valley, and concentrated around the towns of Alamosa and Del Norte. Other minerals that are mined in the area include gold, silver, peat, and limestone. In 2006, there were no active mine permits issued or pending mine permits in Saguache County (Colorado Geological Survey 2007). Only 46 mining claims were recorded in the county compared with 5,693 for the entire state. At present, no minerals are produced from the Refuge or project area.

3.2.3 Soils

The following provides a description of the soils present at the planned project components.

3.2.3.1 Baca #5 and #6 Well Locations and Baca #5 Access Road

The Baca #5 and Baca #6 wells and Baca #5 access road will be constructed on Laney loam (Soil Map Unit #42) (U.S. Department of Agriculture-Natural Resources Conservation Service [USDA-NRCS] 2007) (**Figure 3-2**). The Laney loam has 0 to 3 percent slopes and consists of very friable A horizons and stratified very strongly alkaline C horizons. Depth of the calcareous material ranges from 9 to 10 inches below ground surface. Laney soils reside on gently sloping flood plains and alluvial fans with slopes of 0 to 3 percent. They are well-drained with slow-to-medium runoff and moderate permeability. The Laney soil is considered erodible by wind (USDA-NRCS 1984).

3.2.3.2 Baca #7 Well Location

The Baca #7 location will be constructed on Mosca loamy sand, (Soil Map Unit #50) (USDA-NRCS 2007). The Mosca series has 0 to 3 percent slopes and consists of very deep, well drained soils that formed in mixed alluvium. They have low runoff and moderate permeability; Mosca loamy sand is highly erodible (USDA-NRCS 1984).

3.2.3.3 Baca #6 and #7 Access Road

The access road to the Baca #6 and #7 locations crosses the Mosca loamy sand from the Lexam Road to approximately 1,000 feet north of the Baca #7 location (USDA-NRCS 2007). From there the road crosses the Laney loam (USDA-NRCS 2007) approximately 1,200 feet north of the Baca #7 location. The road then crosses onto the Laney loam for approximately 1,600 feet before it turns to the northeast and crosses onto Kerber loamy sand for a few hundred feet (Soil Map Unit #41). The Kerber loamy sand is highly erodible.

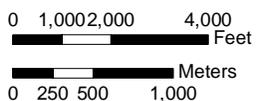
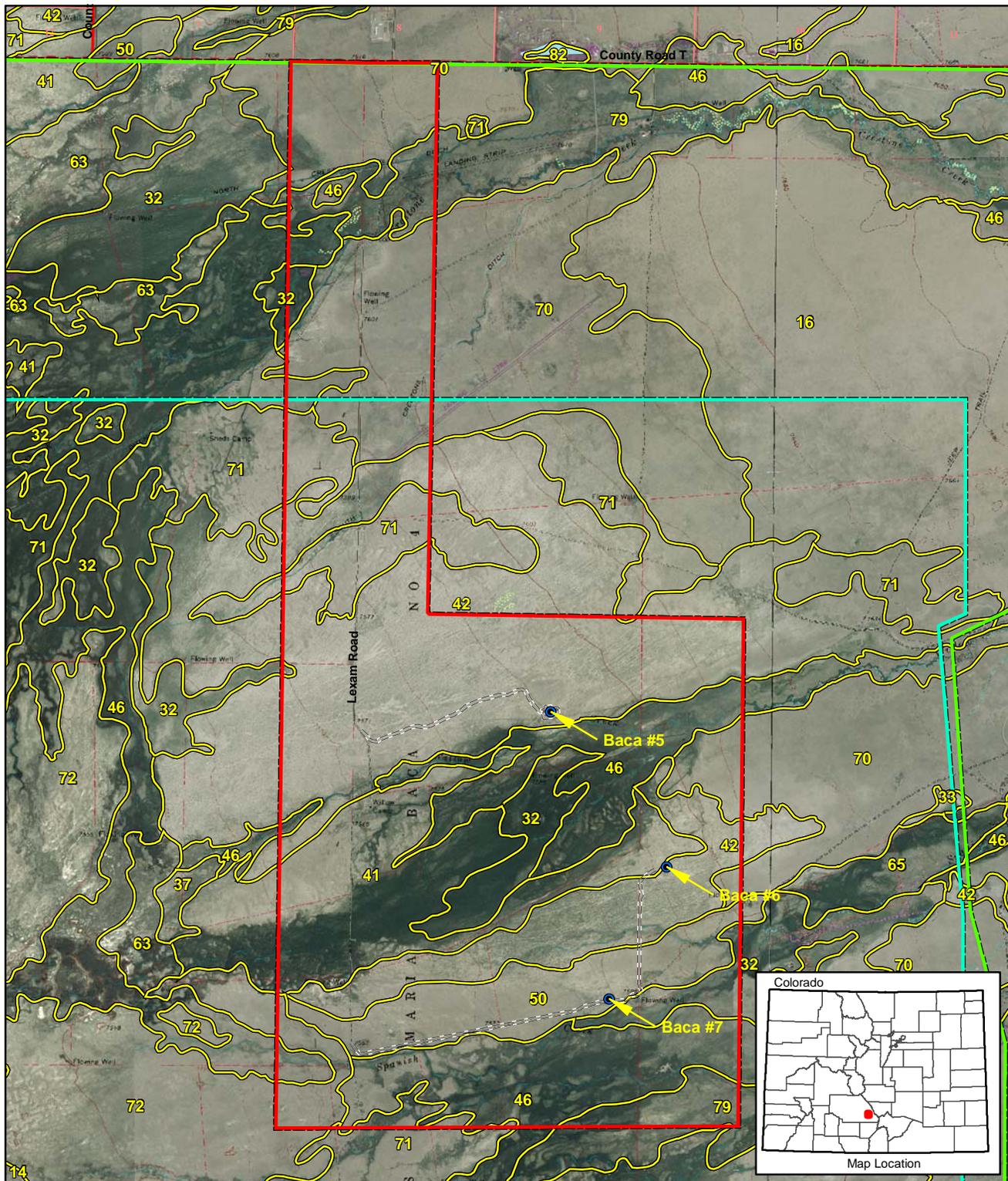


U.S. Fish & Wildlife Service

Baca National Wildlife Refuge

Saguache and Alamosa Counties, Colorado

Figure 3-2 -- Project Area Soil Map Units



Legend

- Proposed Well Site
- Project Area
- Proposed Access Road
- Baca NWR Acquisition Boundary
- Soil Survey (SSURGO)
- 3D Seismic Survey Area



UTM ZONE 13
NAD 27

3.3 Air Resources

3.3.1 Climate

In the immediate area of the Refuge, summers are warm or hot on the valley floor and much cooler in the mountains. Winters are cold in the mountains, and valleys are colder than the lower slopes of adjacent mountains because of cold air drainage. Precipitation occurs in the mountains throughout the year, and a deep snowpack usually accumulates during the winter. Snowmelt usually supplies much more water than can be used for agriculture in the area. Precipitation in the valley in summer falls as showers, and some thunderstorms occur. In winter, the ground is covered with snow much of the time. Chinook winds, which blow downslope and are warm and dry, often melt and evaporate the snow (USDA-NRCS 1984).

In winter the average temperature is 22 degrees Fahrenheit (°F), and the average daily minimum temperature is 7°F. The lowest temperature on record, which occurred in Saguache on January 7, 1971, is -34°F. In summer, the average temperature is 62°F, and the average maximum daily temperature is 80°F. The highest recorded temperature, which occurred on June 23, 1954, is 93°F. The total annual precipitation is 8.64 inches. Of this, 6 inches, or 70 percent, usually falls in April through September. In 2 years out of 10, the rainfall in April through September is less than 5 inches. The heaviest 1-day rainfall during the 1954-1978 period of record was 1.50 inches at Saguache on June 17, 1969. Thunderstorms occur on approximately 60 days each year, and most occur in summer (USDA-NRCS 1984).

The average seasonal snowfall is 29 inches. The greatest snow depth at any one time during the period of record was 14 inches. On an average of 21 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year-to-year.

The average relative humidity in mid-afternoon is approximately 40 percent. Humidity is higher at night, and the average at dawn is approximately 60 percent. The sun shines 80 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the southwest. The highest average wind speed (approximately 11 miles per hour), occurs in the spring (USDA-NRCS 1984).

3.3.2 Air Quality

Saguache County is predominantly agricultural and non-industrial. Major air emission sources include agriculture, biogenic, fires, vehicles (combustion and dust), and wood burning (CDPHE 2007) (**Table 3-1**). Air quality in the County could generally be described as good most times of the year. Other than vehicle and combustion sources for heating, there are no emission sources in the project area, except during periods when hay mowing occurs.

Table 3-1 2005 Saguache County Emission Inventory (Tons per Year)

| Category | CO | NO _x | PM ₁₀ | SO ₂ | VOC | Benzene |
|----------------------------|-------|-----------------|------------------|-----------------|--------|---------|
| Agriculture | 0 | 0 | 1,048 | 0 | 0 | 0 |
| Biogenic | 2,659 | 331 | 0 | 0 | 16,270 | 0 |
| Commercial Cooking | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 151 | 0 | 0 | 0 |
| Forest and Prescribed Fire | 1,011 | 32 | 146 | 9 | 71 | 5 |
| Fuel Combustion | 3 | 8 | 0 | 1 | 0 | 0 |
| Highway Vehicles | 1,994 | 192 | 6 | 6 | 121 | 5 |
| Non-Road | 848 | 166 | 21 | 20 | 175 | 3 |

Table 3-1 2005 Saguache County Emission Inventory (Tons per Year)

| Category | CO | NO _x | PM ₁₀ | SO ₂ | VOC | Benzene |
|---------------------|--------------|-----------------|------------------|-----------------|---------------|-----------|
| Road Dust | 0 | 0 | 1,143 | 0 | 0 | 0 |
| Solvent Utilization | 0 | 0 | 0 | 0 | 32 | 5 |
| Stationary Sources | 0 | 0 | 30 | 0 | 9 | 0 |
| Structure Fires | 0 | 0 | 0 | 0 | 0 | 0 |
| Surface Coating | 0 | 0 | 0 | 0 | 4 | 0 |
| Woodburning | 455 | 5 | 63 | 1 | 122 | 3 |
| Total | 6,971 | 734 | 2,609 | 37 | 16,804 | 20 |

CO – carbon monoxide

NO_x – nitrogen oxides

SO₂ – sulfur dioxide

Source: CDPHE 2007b.

3.4 Water Resources (Quantity and Quality)

3.4.1 Surface Water

The Refuge lies within a topographic basin referred to as the “Closed Basin” (Mayo et al. 2006). The lowest portion of the Closed Basin is known locally as the “Sump,” which occurs on part of the Refuge, but does not include the project area or project vicinity. The Closed Basin or Sump may have occurred in middle Pleistocene when the lake that filled the valley began to dry up, resulting in an environment of swamps and organic-rich sediments. Mayo et al. (2006) refer to the Closed Basin of Pleistocene time as the “ancestral sump.” Presently, the Closed Basin covers approximately 2,940 square miles in the northern part of the valley and is separated from the rest of the valley by a low alluvial fan. Water enters the Closed Basin through precipitation and snowmelt and exits primarily through evapotranspiration. The Closed Basin is composed of the San Luis and Saguache drainage basins (USEPA 2007a). The surface water in the basins generally flow into San Luis Creek, which flows generally to the south, and since there is no outlet, water is impounded in San Luis Lake and associated lakes in an area south of the Refuge. Although the project area is in the San Luis Creek drainage, the surface water flows into ephemeral playa lakes on the western border of the Refuge (Anderson 2007).

USEPA water quality assessment data indicate that the surface water quality in the project area is fully supportive of the State Designated Use categories (agriculture, aquatic life warm water class 2, and recreation primary contact (USEPA 2007b). The analytical results for the baseline sampling of surface water can be found in **Appendix E**.

3.4.2 Groundwater

The project area is in the San Luis Valley portion of the Rio Grande Aquifer System. The San Luis Valley is the northernmost portion of the aquifer system that stretches from Saguache County, Colorado, to West Texas (Robson and Banta 1995). The project area is underlain by two relatively distinct aquifers, the unconfined or shallow aquifer and the confined or deep aquifer. The unconfined aquifer extends to a depth of 30 to 60 feet below the surface (Mayo et al. 2006). The upper unconfined aquifer is separated from the confined aquifer by a clay layer that is widespread across the subsurface of the San Luis Valley (Davey 2003). The confined aquifer ranges from 60 to over 4,500 feet below the surface (Mayo et al. 2006). Depth to the confined aquifer in the project area is expected to be between 100 and 200 feet below the surface. Mayo et al. (2006) have

subdivided the confined aquifer in the San Luis Valley into three zones based on water chemistry. Where the unconfined aquifer comes to the surface, natural seeps, wet meadows, and inter-dune wetlands typically result (USFWS 2005). Below the unconfined aquifer are a number of clay-based layers that serve to separate, although not disconnect entirely, the unconfined aquifer from the deeper layers of sands and gravels containing water in the confined aquifer. The clay layers reduce upward movement of water from the confined aquifer creating water pressure. The unconfined aquifer is recharged by infiltration of irrigation waters, canal leakage, seepage from mountain streams that flow across permeable alluvial fans, and infiltration from precipitation. The confined aquifer is recharged from precipitation in the mountains and enters the aquifer at higher elevations in the mountains. Flow of groundwater in the upper unconfined aquifer is from northeast to southwest (Rupert and Plummer 2004).

Groundwater quality in the San Luis Valley can be variable ranging from less than 500 milligrams per liter (mg/L) total dissolved solids (TDS) along the fringes to over 3,000 mg/L in the center of the basin (Robson and Banta 1994). However, reported TDS values in the unconfined aquifer in the northern valley have been reported as high as 35,000 mg/L according to Mayo et al. (2006), who concluded that “the elevated TDS of northern valley unconfined and upper active confined systems result from mineral dissolution, ion exchange and methanogenesis of organic and evaporate lake sediments deposited in an ancient lake.” The highest values of TDS in the unconfined aquifer are found in the San Luis Lakes area at the lowest portion of the Closed Basin, approximately 20 miles south of the planned project area.

Groundwater quality impairment issues in the San Luis Valley include the presence of bacteria, toxic metals, and nitrate that have been detected in private domestic drinking water wells (USEPA 2007c). In response, the San Luis Valley Drinking Water Well Project was initiated in April 2007 and includes free testing of water from private wells and provides information on various water treatment techniques.

TDS values in the planned project area are generally less than 500 mg/L based on groundwater baseline sampling analytical results (**Figure 3-3**) (**Appendix E**). However, TDS in the deeper wells in the area may exceed 500 mg/L. Groundwater in the San Luis Valley is characterized as calcium bicarbonate or magnesium bicarbonate (Robson and Banta 1995). A number of metals were analyzed in the samples, but no unusual concentrations of metals were detected (**Appendix E**). Concentrations of analyzed metals that are on the Colorado groundwater standards list did not exceed the standards (CDPHE 2007c).

Organic parameters also were measured in the samples obtained for baseline analysis and included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and hydrocarbon compounds (gasoline, diesel, methane, and ethane). No VOCs were detected in the baseline samples. However, a SVOC, bis(2-Ethylhexyl)phthalate, was found in several samples, but no other SVOCs were detected. The origin of bis(2-Ethylhexyl)phthalate in the samples is likely from sample contamination from plastic containers used for sample collection (Telesto 2007). Bis(2-Ethylhexyl)phthalate is commonly associated with plastics, but it is not very persistent in an aquatic environment (Howard 1989).

The baseline sample analysis did not detect gasoline and diesel fuel; however, the lighter hydrocarbon gases methane and ethane were present. Methane was detected in 17 out of 20 wells that were sampled, and ethane was detected in 10 wells (**Appendix E**). Moreover, methane was detected in five of seven surface water samples. No ethane was detected in the surface water samples. The hydrocarbon gases likely originated from the decomposition of organic matter that accumulated in the “ancient sump” (Mayo et al. 2006).

3.5 Vegetation and Habitats

3.5.1 Vegetation Communities

The Refuge is characterized by a diverse range of habitats including desert shrublands, grasslands, wet meadows, playa wetlands, and riparian areas (USFWS 2005). Specific vegetation communities (**Figure 3-4**)

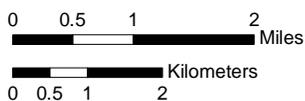
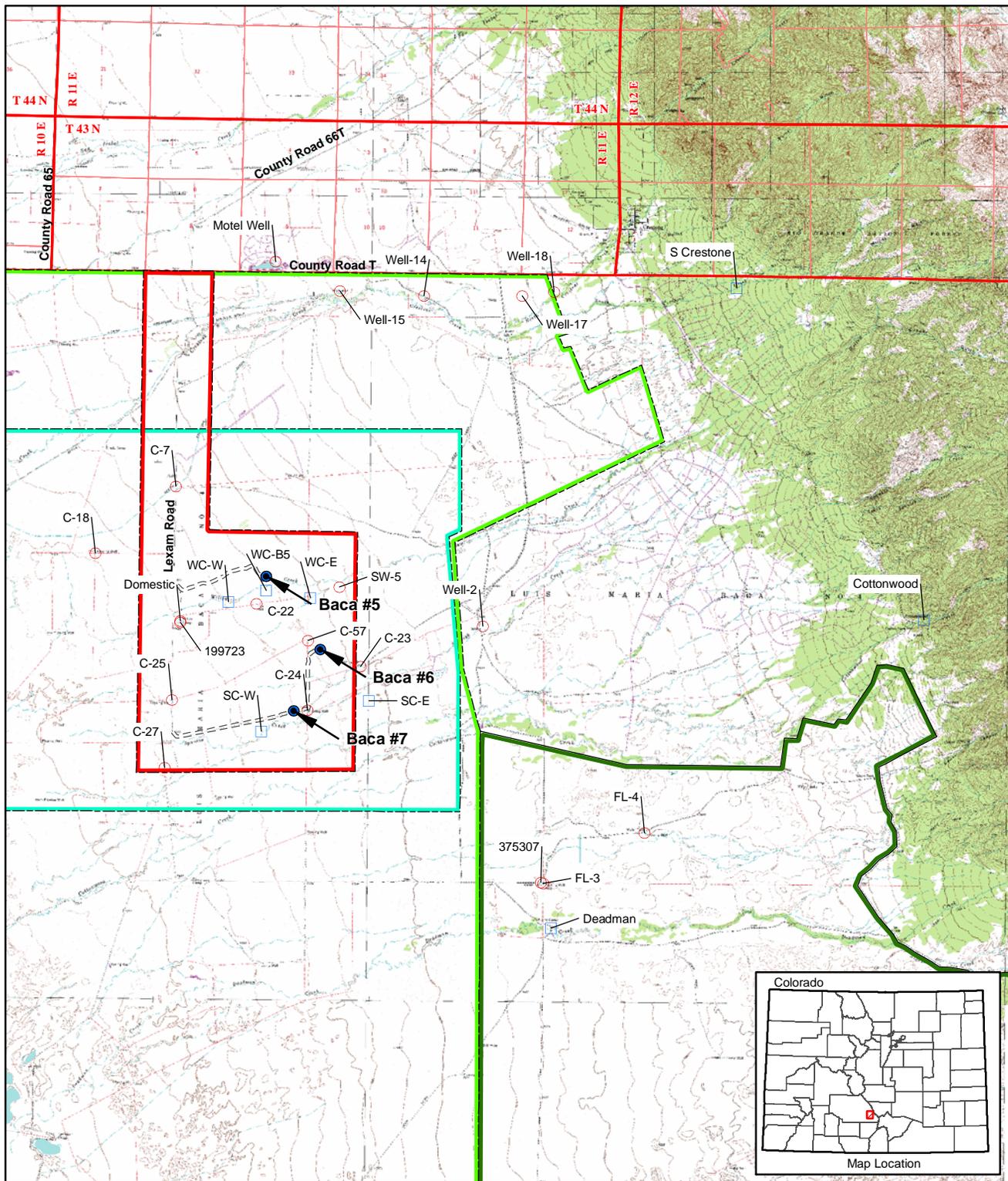


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Baca National Wildlife Refuge

Saguache and Alamosa Counties, Colorado

Figure: 3-3 -- Baseline Water Sampling Locations



Legend

- Water Well Sampling Location (Ground Water)
- Surface Water Sampling Location
- Proposed Well Site
- == Proposed Access Road
- Project Area
- Baca NWR Acquisition Boundary
- 3D Seismic Survey Area
- Great Sand Dunes NP Acquisition Boundary

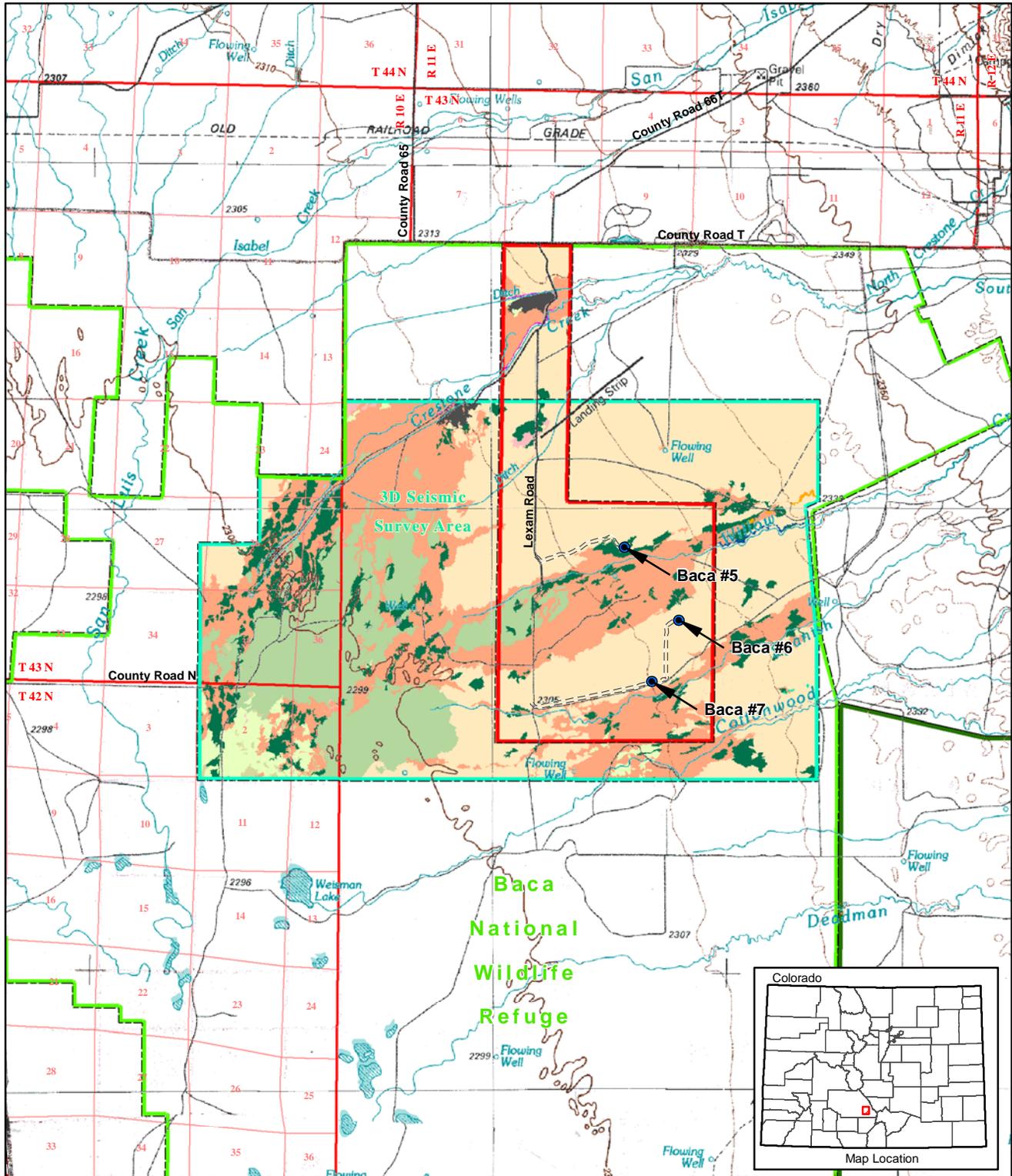




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Figure: 3-4 -- Vegetation Classification for the
3D Seismic Region Survey Area



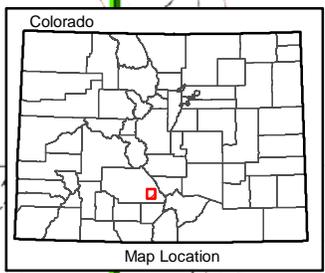
Legend

- Proposed Well Site
- == Proposed Access Road
- Project Area
- 3D Seismic Survey Area
- Baca NWR Acquisition Boundary
- Great Sand Dunes NP Acquisition Area

NVCS Alliance Vegetation Classification

- Redtop Intermittently Flooded Herbaceous Alliance
- Saltgrass Intermittently Flooded Herbaceous Alliance
- Rabbitbrush Shrubland Alliance
- Baltic Rush Seasonally Flooded Herbaceous Alliance
- Narrow-leaf Cottonwood Intermittently Flooded Herbaceous Alliance
- Willow Temporarily Flooded Herbaceous Alliance
- Greasewood Intermittently Flooded Sparsely Vegetated Alliance

- Greasewood Shrubland Alliance
- Alkali Sacaton Herbaceous Alliance
- Bare ground / sparse vegetation
- Intermittently flooded mud flats (i.e. playas, lakes)
- Non-agriculture disturbed areas
- Sand flats
- Water



UTM ZONE 13
NAD 27

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers



within these habitats were classified based on the International Vegetation Classification (Grossman et al. 1998). Vegetation types were delineated based on review of aerial photography and ground-truthing surveys conducted by USFWS. Within the project vicinity, there are five general vegetation types: grasslands, shrubland, wet meadows/non-woody riparian areas, woody riparian areas, and playas. **Table 3-2** summarizes the number of acres of each vegetation type present in this area.

Table 3-2 Vegetation Types Present in the Project Area¹

| Vegetation Classes | Acres |
|--------------------------------------|--------------|
| Grasslands | 292 |
| Shrubland | 3,254 |
| Wet meadows/non-woody riparian areas | 1,585 |
| Woody riparian areas | 9 |
| Playas | 19 |
| Total² | 5,159 |

¹Source: Grossman et al. 1998.

²Does not include open water, barren areas, sand flats, and developed areas that do not display vegetation characteristics.

The most common vegetation types within the project area are shrublands and wet meadows/non-woody riparian areas. The wet meadows are wet during active runoff periods when native grasses and rushes are irrigated and grown primarily for water bird production. Open water, barren areas, sand flats, and developed areas accounts for less than 1 percent of the project area and do not display vegetation characteristics; consequently they are not discussed in this section of the EA.

Table 3-3 provides a description of the vegetation types, sub-communities, and species commonly associated with these vegetation communities within the project vicinity.

Table 3-3 Vegetation Types and Sub-communities that Occur in the Project Vicinity

| Vegetation Type | Sub-community ¹ | Common Species |
|-----------------|---|--|
| Grasslands | <ul style="list-style-type: none"> Alkali Sacaton Herbaceous Alliance | Alkali sacaton, western wheatgrass, buffalograss, tansyaster, fourwing saltbush, scarlet globemallow, prairie coneflower, James' galleta, bush muhly, little barley, Indian ricegrass, blue grama, seepweed, cholla cactus, and pricklypear cactus |
| Shrubland | <ul style="list-style-type: none"> Rabbitbrush Shrubland Alliance Greasewood Shrubland Alliance | Rubber rabbitbrush, greasewood, four-wing saltbush, shadscale, winterfat, Indian ricegrass, Alkali sacaton, western wheat grass, blue grama, silver sagebrush, big sagebrush, broom snakeweed, yucca, pricklypear cactus, bluebunch wheatgrass, James' galleta, spike dropseed, fewflower buckwheat, and clasping pepperweed |

Table 3-3 Vegetation Types and Sub-communities that Occur in the Project Vicinity

| Vegetation Type | Sub-community¹ | Common Species |
|--------------------------------------|---|--|
| Wet Meadows/Non-woody riparian areas | <ul style="list-style-type: none"> • Baltic Rush Seasonally Flooded Herbaceous Alliance • Saltgrass Intermittently Flooded Herbaceous Alliance • Redtop Intermittently Flooded Herbaceous Alliance | Baltic rush, redtop, foxtail barley, greasewood, alkali sacaton, Nuttall's alkaligrass, sedges, tufted hairgrass, fleabane, bluebell, lupine, goldenrod, Junegrass, shrubby cinquefoil, and western wheatgrass |
| Woody Riparian Areas | <ul style="list-style-type: none"> • Willow Temporarily Flooded Shrubland Alliance | Narrowleaf cottonwood, willows, red-osier dogwood, and greasewood |
| Playas | <ul style="list-style-type: none"> • Greasewood Intermittently Flooded Sparsely Vegetated Alliance | Greasewood, four-wing saltbush, saltgrass, alkali sacaton, spike-rush, and foxtail barley |

¹Source: Grossman et al. 1998; vegetation mapping was conducted by USFWS personnel.

3.5.1.1 Wetland, Riparian, and Aquatic Habitats

The Refuge contains a diversity of wetland types. According to the National Wetland Inventory (NWI) map produced by the USFWS, approximately 32 percent (1,309 acres) of the project area is classified as wetlands (see **Table 3-4**). Four types of wetlands and waters of the U.S. potentially occur: palustrine emergent, unconsolidated shore, aquatic bed, and lacustrine. These wetland and waters of the U.S. types are concentrated along the streams and playa areas located within the project area. The palustrine emergent and unconsolidated shore temporary and seasonal wetlands are referred to locally as wet meadows and non-woody riparian areas.

Table 3-4 Wetland Types Present in the Project Area¹

| Wetland Type | Acres | % |
|--------------------------|--------------|------------|
| PEM, Temporary | 956 | 73.0 |
| PEM/PUS, Seasonal | 352 | 26.8 |
| PEM, Semi-permanent | 1 | <1 |
| PAB, L2USC, Lake | <1 | <1 |
| Total² | 1,309 | 100 |

¹Source: USFWS 1990.

²Based on USFWS consultation and USFWS field surveys, the PSS NWI classification has been reclassified as shrubland habitat for this analysis.

Wet Meadows/Non-woody Riparian Areas

Wet meadows and non-woody riparian areas comprise the largest wetland type in the project area. Where the water table just reaches the soil surface during the early part of the growing season or inundates the surface for short periods is usually where this vegetation type is found.

The majority of this vegetation type is found in the north, central, and western portions of the project area along Crestone, Spanish, and Willow creeks. Historically, the Refuge was managed as a working ranch under which creation and maintenance of this habitat type was perfected for utilization as high quality cattle forage. Current management of the wet meadows by the USFWS involves similar management and maintenance for use as migratory bird nesting, foraging and cover by actively flooding the meadows and haying in the fall in an attempt to promote the native plant communities.

The dominant sub-community in this vegetation type is the Baltic Rush (*Juncus balticus*) Seasonally Flooded Herbaceous Alliance. The Baltic Rush Seasonally Flooded Herbaceous Alliance occupies seasonally flooded swales and wet, low- to mid-elevation sites, where habitats are often alkaline. The graminoid layer is dense with up to 98 percent cover, and dominated by Baltic rush. It is found throughout the project area.

The two other communities that compose the wet meadows/non-woody riparian areas are the Saltgrass Intermittently Flooded Herbaceous Alliance and the Redtop (*Agrostis gigantea*) Intermittently Flooded Herbaceous Alliance. In the project area, the Saltgrass Intermittently Flooded Herbaceous Alliance occurs south of North Crestone Creek, while the Redtop (*Agrostis gigantea*) Intermittently Flooded Herbaceous Alliance sub-community is found along Willow Creek on the eastern edge.

Woody Riparian Areas

The project area has less than 1 percent of woody riparian habitat; this habitat is located along North Crestone Creek (USFWS 2005). There are no woody riparian vegetation communities near the planned well sites.

This habitat type is composed of one sub-community, Willow (*Salix* spp.) Temporarily Flooded Shrubland Alliance is found north of North Crestone Creek. This community is usually found in the floodplains of the creeks, located on islands, sand or cobble bars, and immediate streambanks. It is tree-dominated with a diverse shrub component and is dependent on the natural hydrological regime, especially annual to episodic flooding. Narrowleaf cottonwood is the dominant tree species with understory vegetation of willows (*Salix* spp.), red-osier dogwood (*Cornus stolonifera*), and greasewood (USFWS 2005).

Playas

Playas can experience weeks, months, or even years between periods of inundation. This vegetation type is found in small patches in the south- and north-central portions of the project area. This vegetation type is characterized by sparsely vegetated areas (<10 percent canopy cover), with typical species including greasewood and four-wing saltbrush (*Atriplex canescens*). Surrounding the playas is usually greasewood and rubber rabbitbrush (*Ericameria nauseosa*) with an understory of saltgrass and western wheat grass (*Pascopyrum smithii*). Barren salt flats also are a component of playa wetland systems. The only sub-community in this vegetation type is Greasewood Intermittently Flooded Sparsely Vegetated Alliance. It often occurs along flat to gently sloping stream terraces, where soils are alkaline and may be moderately saline.

3.5.1.2 Upland Habitats

Grasslands

Grasslands occur throughout the project area. This vegetation type is typically found in lowland and upland areas on swales, playas, mesa tops, plateau parks, alluvial flats, and plains. The only sub-community in this vegetation type is Alkali Sacaton (*Sporobolus airoides*) Herbaceous Alliance, which is widespread on the valley floor. A sparse to moderately dense graminoid layer of medium-tall bunch grasses with smaller densities

of short grasses and forbs characterize this sub-community, with alkali sacaton being the dominant grass. The access road to the Baca #5 location, and the location itself, are located within this vegetation type.

Shrublands

Shrubland is the most dominant vegetation type in the project area, and is widespread on the valley floor. Many of the plants within this type are drought resistant and tolerant to a range of soil salinity, conditions common to the valley floor. The most dominant sub-community is the Rubber Rabbitbrush (*Ericameria nauseosa*) Shrubland Alliance, usually characterized by open to moderately dense, short-shrub layer dominated by rubber rabbitbrush, big sagebrush, broom snakeweed (*Gutierrezia sarothrae*), sand sagebrush (*Artemisia filifolia*), pricklypear cactus (*Opuntia* spp.), yucca (*Yucca* spp.), Indian ricegrass, and blue grama. It is typically found on alluvial fans and flats with moderate to deep soils. This sub-community is dominant throughout the project area. The two access roads and Baca #6 and Baca #7 well sites are located within this vegetation sub-community.

The Greasewood Shrubland Alliance is found mostly on the west side of the project area, with the dominant species being greasewood, four-wing saltbush, alkali sacaton, saltgrass, and spike-rush (*Eleocharis palustris*). This sub-community typically has saline soils, a shallow water table, and floods intermittently, but remains dry for most of the growing season. In both sub-communities, exotic species also are common including cheat grass (*Bromus tectorum*) and crested wheatgrass (*Agropyron cristatum*).

3.5.2 Special Status Plant Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species that are protected under the Endangered Species Act or are considered as candidates for such listing by the USFWS, and those species that are state-listed as threatened or endangered.

Within the project area, the globally rare Slender spiderflower (*Cleome multicaulis*) is the only rare plant species found. Slender spiderflower is an annual that inhabits saline or alkaline soils at the edge of wetlands or moist meadows, especially where the water table nears the surface. A member of the caper family, population size fluctuates considerably from year-to-year. The species was once found in suitable habitats in south-central Colorado, and from southeastern Arizona to western Texas and to northern New Mexico, and one disjunct population was found in central Wyoming (Colorado Natural Heritage Program [CNHP] 2005). Drainage of wetlands throughout its range is thought to have decreased the amount of habitat available. This species now occurs almost exclusively in the San Luis Valley, commonly found in the transition area between the Baltic Rush Seasonally Flooded Herbaceous Alliance and the Rabbitbrush Shrubland Alliance, where it thrives in moist, slightly saline conditions (USFWS 2005). Sizeable populations of this rare plant are known to occur in the planned project area.

3.5.3 Invasive and Noxious Weeds

Subsequent to disturbance, vegetation communities may be susceptible to infestations of noxious species. These species are most prevalent in areas of prior surface disturbance, such as agricultural areas, roadsides, existing utility rights-of-way, and wildlife concentration areas. The prevention of the introduction or spread of noxious and invasive weeds is a high priority to federal, state and county agencies. Under Executive Order (EO) 13112 of February 3, 1999 - Invasive Species, federal agencies shall not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the U.S. or elsewhere unless it has been determined that the benefits of such actions outweigh the potential harm caused by invasive species and that all feasible and prudent measures to minimize the risk of harm will be taken in conjunction with the actions.

The terms “noxious weed” and “invasive weed” are often used interchangeably to describe any plant that is unwanted and grows or spreads aggressively. The term “noxious weed” is legally defined under both federal

and state laws. Under the Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974 [7 USC SS 2801-2814]), a noxious weed is defined as “any plant or plant product that can directly or indirectly injure or cause damage to crops, livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment” (Animal and Plant Health Inspection Service 2000; Institute of Public Law 1994). The Federal Plant Protection Act contains a list of 137 federally restricted and regulated federal noxious weeds, as per CFR Title 7, Chapter III, Part 360, including 19 aquatic and wetland weeds, 62 parasitic weeds, and 56 terrestrial weeds. Each state is federally mandated to uphold the rules and regulations set forth by this Act and manage their lands accordingly.

In addition to federal noxious weed lists, Colorado regulates noxious and invasive species through the Colorado Noxious Weed Act, which classifies noxious weeds into three lists, A, B, and C (§ 35 5.5-101 through 119, CRS [2003]). Each list has specific control requirements, with the most stringent requirements for those species found on List A. Only List A species are required by law to be controlled (Colorado Department of Agriculture [CDA] 2006). The Alamosa County weed control board monitors local weed infestations and provides guidance on weed control. The species that are managed and regulated by the state and county agencies are included in **Table 3-5**.

Plants of primary concern in the project area include Canada thistle (*Cirsium arvense*), perennial pepperweed (*Lepidium latifolium*), Russian knapweed (*Acroptilon repens*) and salt cedar (*Tamarisk* spp.), especially in the wetland and riparian habitats. Salt cedar is found primarily along the west side of the playa wetlands in disturbed areas, such as roads, in the project vicinity. Russian knapweed is primarily found in the northwest portion of the project area, while perennial pepperweed is found farther south and is often found in conjunction with Baltic rush communities. Yellow toadflax (*Linaria vulgaris*) has been reported in the Refuge.

3.6 Wildlife and Fisheries

3.6.1 Recreationally and Economically Important Species and Nongame Wildlife

As discussed in Section 3.5, Vegetation and Habitats, wildlife habitat within the project vicinity consists primarily of semi-desert shrubland, semi-desert grassland, wet meadows, and non-woody riparian habitats. Semi-desert shrubland and semi-desert grassland are the most common wildlife habitats within the project area. The project vicinity is characterized by flat to low rolling terrain with intermittent streams, wet meadows, and wetlands. Baseline descriptions of both resident and migratory wildlife include species that have either been documented or that may occur in the project area based on habitat associations. Wildlife species are typical of the high mountain semi-desert shrublands of the San Luis Valley. Riparian/wetland habitats found along the drainages and ponds within the project vicinity support a greater diversity and population density of wildlife species than habitat types occurring in the project area.

Information regarding wildlife species and habitat within the project area was obtained from a review of existing published sources, USFWS and Colorado Division of Wildlife (CDOW) file information, CNHP database information, and a site-specific biological assessment on the Baca Grande property 2 miles east of the planned project area (CNHP 2006). The biological assessment is relevant due to its close proximity to the project area and information on special status wildlife species in the San Luis Valley. The survey was conducted by the CNHP in the summer of 2005 and examined the existing use of the Baca Grande by terrestrial and aquatic vertebrates and special status species.

3.6.1.1 Big Game

Elk, mule deer, and pronghorn are the primary big game species within the project area (CDOW 2007g). The project area occurs in game management unit 82. In 2006, a total of 393 elk, 81 mule deer, and 120 pronghorn were harvested in unit 82 (CDOW 2007d). Details on each big game species are presented below.

Table 3-5 Noxious Weeds Potentially Occurring within the Project Area

| Common Name | Scientific Name | Federal List¹ | Colorado Noxious Weed List² | Alamosa County Noxious Weed List³ | Primary Concern for the Refuge |
|--------------------|-----------------------------------|---------------------------------|---|---|---------------------------------------|
| Velvetleaf | <i>Abutilon theophrasti</i> | | C | | |
| Russian knapweed | <i>Acroptilon repens</i> | | B | X | X |
| Jointed goatgrass | <i>Aegilops cylindrica</i> | | C | | |
| Camelthorn | <i>Alhagi pseudalhagi</i> | | A | | |
| Spurred anoda | <i>Anoda cristata</i> | | B | | |
| Corn chamomile | <i>Anthemis arvensis</i> | | B | | |
| Mayweed chamomile | <i>Anthemis cotula</i> | | B | | |
| Common burdock | <i>Arctium minus</i> | | C | | |
| Absinth wormwood | <i>Artemisia absinthium</i> | | B | | |
| Downy brome | <i>Bromus tectorum</i> | | C | | |
| Hoary cress | <i>Cardaria draba</i> | | B | X | X |
| Plumeless thistle | <i>Carduus acanthoides</i> | | B | | |
| Musk thistle | <i>Carduus nutans</i> | | B | | |
| Wild caraway | <i>Carum carvi</i> | | B | | |
| Diffuse knapweed | <i>Centaurea diffusa</i> | | B | | |
| Spotted knapweed | <i>Centaurea maculosa</i> | | B | | |
| Meadow knapweed | <i>Centaurea pratensis</i> | | A | | |
| Yellow starthistle | <i>Centaurea solstitialis</i> | | A | | |
| Squarrose knapweed | <i>Centaurea virgata</i> | | A | | |
| Rush skeletonweed | <i>Chondrilla juncea</i> | | A | | |
| Oxeye daisy | <i>Chrysanthemum leucanthemum</i> | | B | | |
| Chicory | <i>Cichorium intybus</i> | | C | | |
| Canada thistle | <i>Cirsium Arvense</i> | | B | X | X |
| Bull thistle | <i>Cirsium vulgare</i> | | B | | |
| Chinese clematis | <i>Clematis orientalis</i> | | B | | |
| Poison hemlock | <i>Conium maculatum</i> | | C | | |
| Field bindweed | <i>Convolvulus arvensis</i> | | C | X | |
| Common crupina | <i>Crupina vulgaris</i> | X | A | | |
| Houndstongue | <i>Cynoglossum officinale</i> | | B | | |
| Yellow nutsedge | <i>Cyperus esculentus</i> | | B | | |

Table 3-5 Noxious Weeds Potentially Occurring within the Project Area

| Common Name | Scientific Name | Federal List ¹ | Colorado Noxious Weed List ² | Alamosa County Noxious Weed List ³ | Primary Concern for the Refuge |
|-----------------------------------|-------------------------------|---------------------------|---|---|--------------------------------|
| Common teasel | <i>Dipsacus fullonum</i> | | B | | |
| Cutleaf teasel | <i>Dipsacus laciniatus</i> | | B | | |
| Russian-olive | <i>Elaeagnus angustifolia</i> | | B | | |
| Quackgrass | <i>Elytrigia repens</i> | | B | | |
| Redstem filaree | <i>Erodium cicutarium</i> | | B | | |
| Cypress spurge | <i>Euphorbia cyparissias</i> | | A | | |
| Leafy spurge | <i>Euphorbia esula</i> | | B | | |
| Myrtle spurge | <i>Euphorbia myrsinites</i> | | A | | |
| Halogeton | <i>Halogeton glomeratus</i> | | C | | |
| Dame's rocket | <i>Hesperis matronalis</i> | | B | | |
| Venice mallow | <i>Hibiscus trionum</i> | | B | | |
| Orange hawkweed | <i>Hieracium aurantiacum</i> | | A | | |
| Hydrilla | <i>Hydrilla verticillata</i> | X | A | | |
| Black henbane | <i>Hyoscyamus niger</i> | | B | | |
| Common St. Johnswort | <i>Hypericum perforatum</i> | | C | | |
| Dyer's woad | <i>Isatis tinctoria</i> | | A | | |
| Perennial pepperweed | <i>Lepidium latifolium</i> | | B | X | X |
| Sericea lespedeza | <i>Lespedeza cuneata</i> | | A | | |
| Dalmatian toadflax, broad-leaved | <i>Linaria dalmatica</i> | | B | | |
| Dalmatian toadflax, narrow-leaved | <i>Linaria genistifolia</i> | | B | | |
| Yellow toadflax | <i>Linaria vulgaris</i> | | B | | |
| Purple loosestrife | <i>Lythrum salicaria</i> | | A | | |
| Scentless chamomile | <i>Matricaria perforata</i> | | B | | |
| Eurasian watermilfoil | <i>Myriophyllum spicatum</i> | | B | | |
| Scotch thistle | <i>Onopordum acanthium</i> | | B | | |
| Scotch thistle | <i>Onopordum tauricum</i> | | B | | |
| Wild proso millet | <i>Panicum miliaceum</i> | | C | | |
| African rue | <i>Peganum harmala</i> | | A | | |
| Sulfur cinquefoil | <i>Potentilla recta</i> | | B | | |

Table 3-5 Noxious Weeds Potentially Occurring within the Project Area

| Common Name | Scientific Name | Federal List ¹ | Colorado Noxious Weed List ² | Alamosa County Noxious Weed List ³ | Primary Concern for the Refuge |
|----------------------|-----------------------------------|---------------------------|---|---|--------------------------------|
| Mediterranean sage | <i>Salvia aethiopsis</i> | | A | | |
| Giant salvinia | <i>Salvinia molesta</i> | X | A | | |
| Bouncingbet | <i>Saponaria officinalis</i> | | B | | |
| Tansy ragwort | <i>Senecio jacobaea</i> | | A | | |
| Perennial sowthistle | <i>Sonchus arvensis</i> | | C | | |
| Johnsongrass | <i>Sorghum halepense</i> | | C | | |
| Medusahead | <i>Taeniatherum caput-medusae</i> | | A | | |
| Salt Cedar | <i>Tamarisk</i> spp. | | B | X | X |
| Common tansy | <i>Tanacetum vulgare</i> | | B | | |
| Puncturevine | <i>Tribulus terrestris</i> | | C | | |
| Moth mullein | <i>Verbascum blattaria</i> | | B | | |
| Common mullein | <i>Verbascum thapsus</i> | | C | | |

¹Each state is federally mandated to uphold the rules and regulations set forth by the Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974 [7 USC SS 2801-2814]).

²In the Colorado Noxious Weed Act (§ 35 5.5-101 through 119, CRS [2003]), noxious weeds are classified into three lists, A, B, and C. Each list has specific control requirements, with the most stringent requirements for those species found on List A. List A includes noxious weeds targeted for eradication and for which management plans have been developed for their control. Control of these species is required by law. If these species were found within the project area, Lexam will be required to follow the prescribed management techniques stipulated by Colorado's Noxious Weed Act. These techniques must be applied for the duration of the seed longevity for the particular species. List B species are recommended for control, but management plans have not yet been developed for these species and control is not required by law. List C species are generally considered too widespread to effectively control, and control of List C species is not required (CDA 2006).

³A county noxious weed list is not available for Saguache county.

Sources: CDA 2006.

A large herd of resident elk occurs within the vicinity of the project area. Elk use a variety of habitat types within the project area but primarily occur in wet meadows and shrub-dominated habitats (USFWS 2005). Elk populations within the project area usually peak during winter months (November-March), with populations highest during severe winters (USFWS 2005). The entire project area is considered summer range, while the eastern portion of the project area is considered severe winter range (CDOW 2007g). Two small areas located in the eastern portion of the project area are considered winter concentration areas by CDOW. These areas occur along Crestone, Cottonwood, Spanish, and Willow creeks (CDOW 2007g). **Figure 3-5** presents the designated elk winter range located within the project area.

Mule deer are typically found in riparian areas and abandoned agricultural fields (USFWS 2005). The eastern portion of the project area is considered winter range (CDOW 2007g). **Figure 3-6** presents the designated mule deer winter range located within the project area.

Pronghorn occur throughout the project area year-round. Use of the project area by pronghorn is highly dependent on water and forage availability. The entire project area is considered pronghorn winter range (CDOW 2007g). A small area located in the northern portion of the project area is considered a winter concentration area by CDOW (CDOW 2007g). **Figure 3-7** presents the designated pronghorn winter range located within the project area.

Big game population numbers fluctuate slightly from year-to-year based on weather and habitat conditions. Water availability and the amount of quality winter habitat are the limiting factors within the project area. Water availability, forage quality, cover, and weather patterns typically determine the level of use and movement of big game species through the project area.

Mountain lion and black bear also are classified as big game species in Colorado (CDOW 2007d). Both of these species are fairly common in south-central Colorado and occupy the higher elevations of the Sangre de Cristo mountain range east of the project area (Fitzgerald et al. 1994). Due to the lack of preferred habitat (i.e., canyons, mesas, brushy hillsides), occurrence within the project area by these species would be limited to dispersing individuals.

3.6.1.2 Small Game and Furbearers

Small game species that occur within the project area are mourning dove, cottontail, and white-tailed jackrabbit (USFWS 2005). Currently, there are no upland game birds other than mourning dove found within the project area due to the absence of suitable habitat. Mourning doves are found in a wide range of habitats in close proximity to water and are most likely to occur within the project area during spring, summer, and early fall. Furbearers that may occur within the project area include the coyote, badger, red fox, bobcat, beaver, muskrat, skunk, and raccoon (Fitzgerald et al. 1994).

The project area contains important nesting habitat for waterfowl as well as important staging habitats that are utilized during migration (USFWS 2005). Common species found within the project area include Canada goose, mallard, Northern pintail, gadwall, American wigeon, cinnamon, green-winged and blue-winged teal (USFWS 2005). Waterfowl are found throughout the project vicinity in appropriate habitats such as wetlands, ponds, wet meadows, and riparian areas.

3.6.1.3 Nongame Species

A diversity of nongame species (e.g., small mammals, passerines, raptors, and reptiles) occupy a wide range of trophic levels and habitat types within the project area. Habitats (e.g., semi-desert shrublands, wet meadows) support a variety of resident and seasonal nongame species. Nongame mammals include such species as deer mouse, silky pocket mouse, meadow vole, Ord's kangaroo rat, thirteen-lined ground squirrel, Gunnison's prairie dog, and northern pocket gopher (USFWS 2005). The Gunnison's prairie dog is uncommon and is only found in small colonies in the San Luis Valley and south-central Colorado (Fitzgerald et al. 1994).

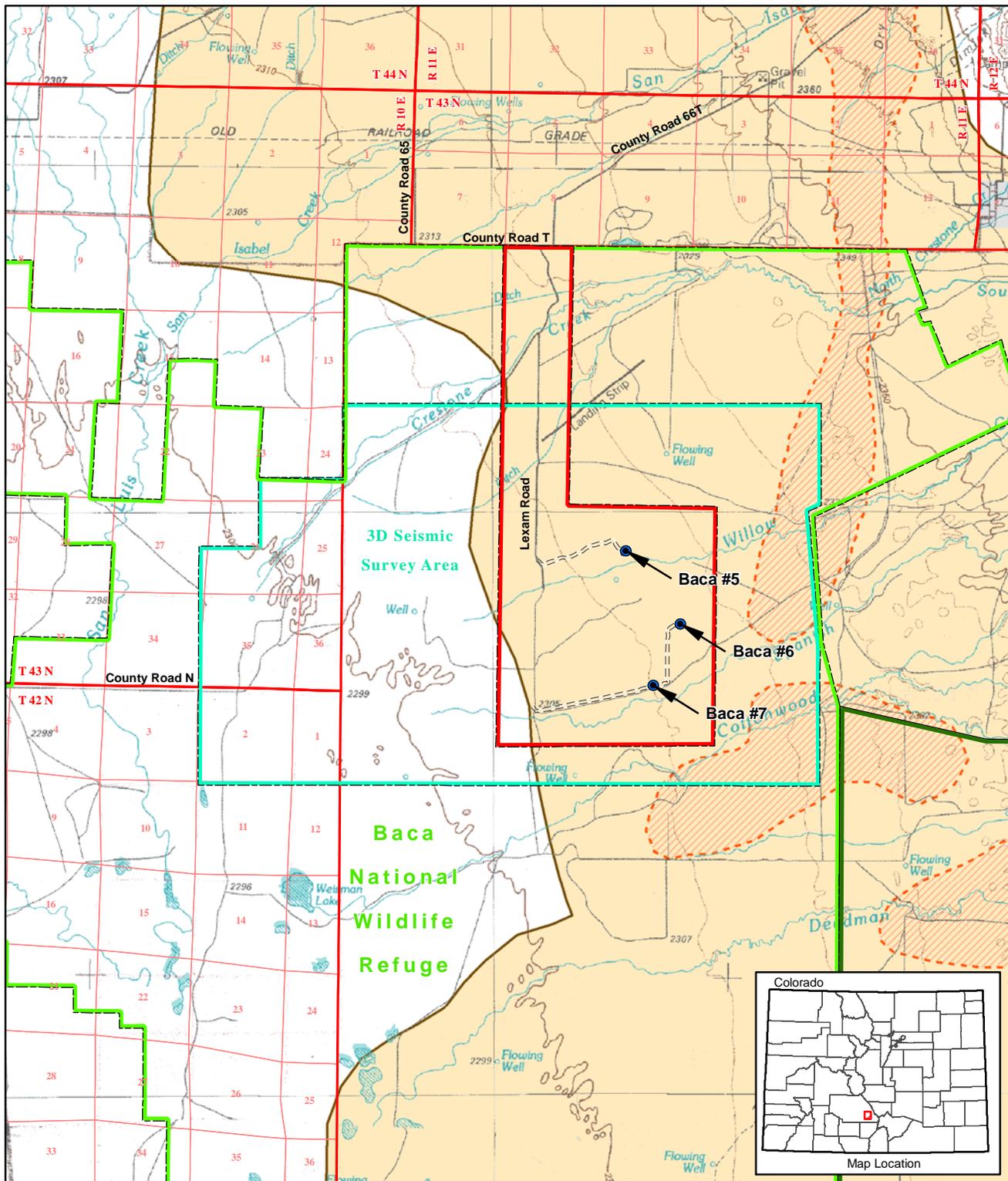


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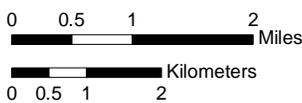
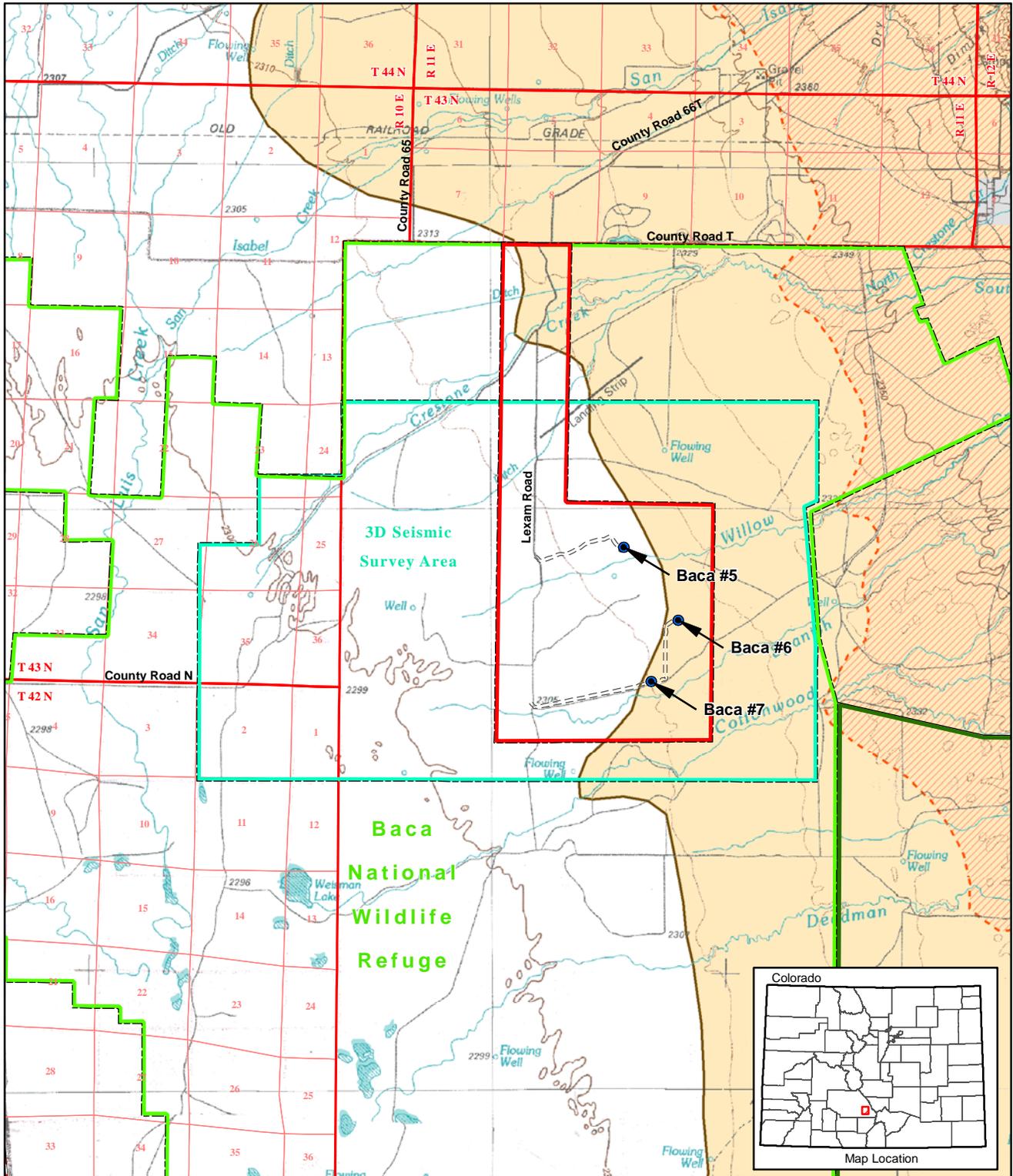
Figure: 3-5 -- Designated Elk Winter Range



Legend

- Proposed Well Site
- Proposed Access Road
- Elk Winter Concentration Area
- Elk Severe Winter Range
- Project Area
- 3D Seismic Survey Area
- Baca NWR Acquisition Boundary
- Great Sand Dunes NP Acquisition Boundary

UTM ZONE 13
NAD 27



Legend

- Proposed Well Site
- Proposed Access Road
- Mule Deer Severe Winter Range
- Mule Deer Winter Range
- Project Area
- 3D Seismic Survey Area
- Baca NWR Acquisition Boundary
- Great Sand Dunes NP Acquisition Boundary

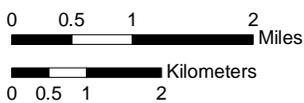
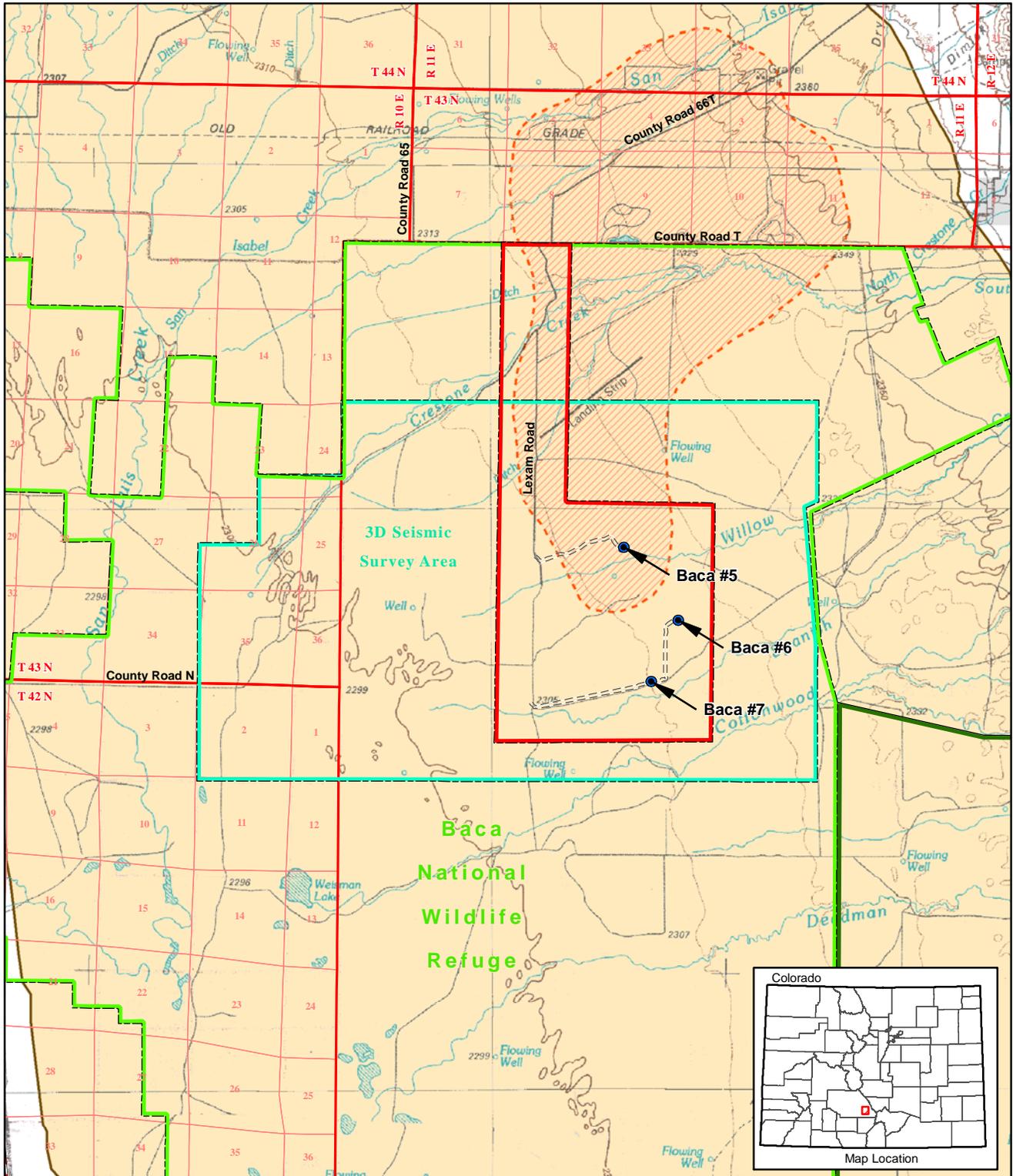


U.S. Fish & Wildlife Service

Baca National Wildlife Refuge

Saguache and Alamosa Counties, Colorado

Figure: 3-7 -- Designated Pronghorn Winter Range



Legend

- Proposed Well Site
- Proposed Access Road
- Pronghorn Winter Concentration Area
- Pronghorn Winter Range
- Project Area
- 3D Seismic Survey Area
- Baca NWR Acquisition Boundary
- Great Sand Dunes NP Acquisition Boundary



UTM ZONE 13
NAD 27

The USFWS is currently preparing a 12-month finding on a petition to list the Gunnison's prairie dog as threatened or endangered under the Endangered Species Act of 1973 (USFWS 2007a) The northern pocket gopher is a Colorado species of concern and is discussed in detail in Section 3.6.2, Special Status Wildlife Species. Small mammals provide a substantial prey base for the areas predators including mammals (e.g., coyote, badger, skunk), raptors (eagles, hawks, falcons, owls), and reptile species. Representative birds that occur within the project area are discussed below in Section 3.6.4, Migratory Birds.

Several bat species may occur within the project area including Brazilian free-tailed bat, western small-footed myotis, long-eared myotis, long-legged myotis, hoary bat, and Townsend's big-eared bat (Fitzgerald et al. 1994). The Townsend's big-eared bat is a Colorado species of concern and is discussed in detail in Section 3.6.2, Special Status Wildlife Species.

The project area contains important nesting habitat for shorebirds and waterbirds as well as important staging habitats that are utilized during migration (USFWS 2005). Common species found within the project area include greater sandhill crane, greater and lesser yellowlegs, American avocet, white-faced ibis, Wilson's phalarope, snipe, sora, and Virginia rail. Shorebirds and waterbirds are found throughout the project area in appropriate habitats such as wetlands, ponds, wet meadows, and riparian areas.

Other important nongame species that are found within the project area include several species of reptiles and amphibians. These species include the short-horned lizard, bull snake, western garter snake, tiger salamander, chorus frog, Great Plains toad, woodhouse's toad, Plains spadefoot toad, and northern leopard frog (CDOW 2007b; CNHP 2006; USFWS and Lexam Explorations 2007; USFWS 2005). The northern leopard frog is a Colorado species of concern and is discussed in Section 3.6.2, Special Status Wildlife Species.

3.6.1.4 Migratory Birds

Nongame birds within the project region include a wide range of migratory bird species including neotropical migrants - birds that breed in North America and winter in the neotropical region of South America. These birds are considered integral to natural communities and act as environmental indicators based on their sensitivity to environmental changes caused by human activities. Representative bird species breeding in the project region include yellow warbler, song sparrow, western wood pewee, black-billed magpie, American crow, western meadowlark, and a number of raptor species (see below) [Garcia 2007; USFWS and Lexam Explorations 2007; USFWS 2005]. Migratory birds are protected under the MBTA (16 USC 703 711) and EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (66 Federal Register 3853).

The San Luis Valley hosts an array of hawks, falcons, owls, and eagles throughout the year. Abundant food sources (e.g., rodents, waterfowl) are found throughout the numerous wetlands, wet meadows, ponds, lakes, and streams that occur in the San Luis Valley (USFWS and Lexam Explorations 2007). Details on raptor species found within the project vicinity are presented below.

Prairie falcons are common year-round residents within the project area and use various habitats extensively for feeding and resting. Red-tailed hawks, Swainson's hawks, and American kestrels nest in the vicinity of the project area, primarily in trees and snags scattered along creeks and water delivery canals (Garcia 2007; USFWS and Lexam Explorations 2007).

Northern harriers and short-eared owls likely nest in dense vegetation found in wet meadows and marshes (Garcia 2007; USFWS and Lexam Explorations 2007). Great horned and long-eared owls likely nest in the project vicinity in deciduous trees found along riparian areas and are likely to occur in the banks of incised creeks and water delivery ditches (USFWS and Lexam Explorations 2007).

Species such as ferruginous hawk, rough-legged hawk, northern harrier, short-eared owl, and golden and bald eagles are common winter residents within the project area (USFWS and Lexam Explorations 2007). The hawks, owls, and golden eagles forage for rodents, small mammals, and other prey in riparian areas, uplands,

and short-emergent wetlands where cover is abundant. Details on the bald eagle, peregrine falcon, and ferruginous hawk are discussed in Section 3.6.2, Special Status Wildlife Species.

Passerine or songbird species occupy the entire range of habitats found within the project area. However, due to the higher level of plant diversity and structure, more abundant potential nest sites, and greater food base, the riparian areas and wetlands support the highest diversity of bird species within the seismic survey area. Details on sensitive species such as southwestern willow flycatcher, western yellow-billed cuckoo, mountain plover, and long-billed curlew will be discussed further in Section 3.6.2, Special Status Species.

3.6.1.5 Fisheries

Crestone Creek is inhabited by four native fish species: Rio Grande sucker (*Catostomus plebeius*), Rio Grande chub (*Gila pandora*), fathead minnow (*Pimephales promelas*), and longnose dace (*Rhinichthys cataractae*) [USFWS and Lexam Explorations 2007]. The Rio Grande sucker and Rio Grande chub are discussed in detail in Section 3.6.2, Special Status Wildlife Species

3.6.2 Special Status Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed species that are protected under the ESA, species designated as state endangered or threatened by CDOW, and state species of concern identified by CDOW.

In July 2007, the USFWS issued a letter of Concurrence with the Determination of No Effect for all federally listed species including southwestern willow flycatcher and Canada lynx for the project area. The following discussion summarizes known data for the sensitive wildlife species identified for the project area by the applicable agencies.

A total of 27 special status species (20 terrestrial and 7 aquatic) were identified as potentially occurring within the project area (CDOW 2007e; CNHP 2007; USFWS 2007c). These species, their associated habitats, and their potential for occurrence within the project area are summarized in **Table 3-6**. Occurrence potential within the project area and cumulative effects area was evaluated for each species based on their habitat requirements and/or known distribution. Based on these evaluations, 10 special status species have been eliminated from detailed analyses based on their habitat requirements and/or known distributions (**Table 3-6**). These species include wolverine, lynx, Gunnison's sage grouse, Mexican spotted owl, boreal toad, Uncompahgre fritillary butterfly, bonytail, razorback sucker, humpback chub, and Colorado pikeminnow. The 17 special status species identified as potentially occurring within the project area are described below.

3.6.2.1 Mammals

Townsend's big-eared Bat (SC). The Townsend's big-eared bat (*Plecotus townsendii*) occurs throughout Colorado but is largely absent for the eastern plains (Fitzgerald et al. 1994). This species is most commonly found in desert shrublands, pinyon-juniper woodlands, and open montane forests (Fitzgerald et al. 1994). This species is highly associated with caves and mines. The Townsend's big-eared bat is very susceptible to disturbance at roost sites (Fitzgerald et al. 1994). This species periodically moves to alternate roosts and actively forages and drinks throughout the winter. Common foraging associations include edge habitats along streams, adjacent to and within a variety of wooded habitats (Fitzgerald et al. 1994). Although this species has not been documented within the project area (Garcia 2007), suitable foraging habitat occurs within the project area. The potential for this species to occur within the project area is considered moderate.

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam's Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status ¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|---|---------------------|---|--|---|
| MAMMALS | | | | |
| Townsend's big-eared bat <i>Corynorhinus townsendii</i> | SC | Range: Occurs throughout the western U.S. Habitat: Highly associated with caves and mines. Very susceptible to disturbance at roost sites. Periodically moves to alternate roosts and actively forages and drinks throughout the winter. Foraging associations include edge habitats along streams, adjacent to and within a variety of wooded habitats. | Moderate. Suitable foraging habitat exists within the project area. | No. |
| Northern pocket gopher <i>Thomomys talpoides agrestis</i> | SC | Range: This subspecies occurs in the San Luis Valley north and east of the Rio Grande River. Habitat: A wide variety of vegetation communities including semidesert shrublands, grasslands, forests, and alpine tundra. | High. This species has been documented approximately 2 miles east of the project area on the Baca Grande. | No. |
| Black-footed ferret <i>Mustela nigripes</i> | FE, SE | Range: Isolated locations in South Dakota, Wyoming, Utah, and Colorado. Habitat: Prairie dog colonies. Uses the burrows as living quarters and nurseries. | Low. Suitable habitat occurs within Gunnison's prairie dog colonies within the project area. However, the nearest known population is located in northwest Colorado. | Yes |
| Wolverine <i>Gulo gulo</i> | SE | Range: Throughout boreal forest and tundra regions of North America. Several historical records exist for Colorado, although their status is currently unknown. Habitat: Boreal forests, bogs, lowlands, and tundra. Dens are typically in log jams, under rocks and boulders, or under tree roots. | None. | Yes. Lack of suitable habitat occurs within the project area. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam's Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|---|---------------------------|--|--|---|
| Lynx <i>Lynx canadensis</i> | FT, SE | <p>Range: Found throughout Canada and Alaska as well as the high elevation forests of Colorado, Utah, Wyoming, Montana, and Idaho.</p> <p>Habitat: Coniferous forests such as spruce-fir with well-developed understories. Uneven aged stands of spruce-fir with rock outcrops and large boulders is the preferred habitat. Dens are typically under ledges, trees, deadfalls, or occasionally in caves.</p> | None. | Yes. Lack of suitable habitat occurs within the project area. |
| BIRDS | | | | |
| Bald eagle <i>Haliaeetus leucocephalus</i> | ST | <p>Range: Throughout Colorado, however most breeding occurs along the front range and western portion of the state.</p> <p>Habitat: Generally nests and roosts in close proximity to large water bodies including rivers, lakes, and reservoirs. Nests in large trees such as cottonwood and ponderosa pine. Breeding season is February 15-July 15.</p> | Moderate. Occurrence is limited to migrating and wintering individuals. Most of the bald eagle use is along Crestone Creek northeast of the project area. | No. |
| Ferruginous hawk <i>Buteo regalis</i> | SC | <p>Range: Throughout the Great Plains and grassland/shrub-steppe areas of western North America.</p> <p>Habitat: Open grassland and shrub-steppe habitats. Nests on the ground, usually on a hill or rock outcrop. Forages over open country. Breeding season is March 15-July 15.</p> | High. This species has been documented nesting in the vicinity of the project area. | No. |
| American Peregrine Falcon <i>Falco peregrinus anatum</i> | SC | <p>Range: Primarily found in western Colorado but breeding pairs also are found along the front range.</p> <p>Habitat: Foothill and mountain cliffs surrounded by pinyon-juniper or ponderosa pine woodlands. Nest sites consist of a small depression on a cliff ledge. Breeding season is March 15-July 15.</p> | High. This species has been documented foraging around wetlands and marshes within the project area. However, no known nesting habitat occurs within the vicinity of the project area. | No. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam's Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|--|---------------------------|---|---|--|
| Gunnison sage-grouse <i>Centrocercus minimus</i> | SC | <p>Range: In Colorado, this species is found primarily in Gunnison county with small scattered populations in Montrose, San Miguel, Mesa and Saguache counties.</p> <p>Habitat: Sagebrush grasslands. Leks are located in open areas in close proximity to escape cover. Nests are located in sagebrush habitat, typically within 2 miles of the lek. Broods are raised in wet, grassy areas near sagebrush. Winter habitat consists of south and east facing slopes with minimal snow cover. Breeding season is March 15-July 1.</p> | None. | Yes. The nearest population is a small introduced population restricted to an area approximately 25 miles northwest of the project area. |
| Greater sandhill crane <i>Grus canadensis tabida</i> | SC | <p>Range: In Colorado, this species breeds in the northwest portion of the state and migrates through the San Luis Valley in the fall and spring.</p> <p>Habitat: Flooded fields, wetlands, marshes, meadows, and agricultural fields. Breeding season is April 1-July 15.</p> | High. A large number of greater sandhill cranes, part of the Rocky Mountain population, migrate through the San Luis Valley in the fall and spring. | No. |
| Western snowy plover <i>Charadrius alexandrinus</i> | SC | <p>Range: Found along manmade reservoirs in southeast Colorado and alkali-covered playas in the San Luis Valley.</p> <p>Habitat: Sandy beaches, dry salt flats, river bars, and alkali covered playas. Breeding season is April 1-July 15.</p> | High. This species has been documented approximately 15 miles south of the project area near San Luis Lake. | No. |
| Mountain plover <i>Charadrius montanus</i> | SC | <p>Range: Western North America with the largest breeding populations found in Colorado and eastern Montana.</p> <p>Habitat: Native short-grass prairie, stunted shrublands, agricultural fields, and overgrazed pastures. Breeding season is April 1-July 15.</p> | High. Very few records exist for the San Luis Valley although this species was observed east of the project area on the Baca Grande in 2005. Suitable habitat occurs within the project area. | No. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam's Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|--|---------------------------|--|--|---|
| Long-billed curlew <i>Numenius americanus</i> | SC | Range: Found primarily in southeastern Colorado with isolated populations in the northeast and northwest Colorado. Habitat: Short-grass prairie with scattered playas. Feeds along lake and reservoir edges during migration. Breeding season is April 1-July 15. | Moderate. This species has been documented migrating through the project area. Suitable nesting habitat occurs within the project area. | No. |
| Western yellow-billed cuckoo <i>Coccyzus americanus</i> | FC; SC | Range: In Colorado, this species is primarily found west of the continental divide along riparian areas. Habitat: Old growth riparian woodlands with dense understories. Nests are typically located high in trees with closed canopies. Breeding season is April 15-July 15. | Low. This species has been documented in dense, old-growth cottonwood forests on McIntire Springs approximately 35 miles south of the project area. Suitable habitat occurs in the vicinity of the project area. | No. |
| Mexican spotted owl <i>Strix occidentalis lucida</i> | FT, ST | Range: In Colorado, this species is found in the south-central and southwest portions of the state. Habitat: In south-central Colorado, this species prefers deep rocky canyons with tall old growth conifers such as white pine and Douglas fir. In southwest Colorado, this species is found in narrow slick-rock canyons that cut through pinyon-juniper woodlands. Breeding season is March 15-July 15. | None. | Yes. Lack of suitable habitat (i.e., deep rocky canyons with tall conifers) occurs within the project area. |
| Burrowing owl <i>Athene cunicularia</i> | ST | Range: Found primarily in eastern Colorado as a summer resident although small populations occur in the western Colorado and the San Luis Valley. Habitat: Open country from desert scrub to grasslands. Often found in or around prairie dog colonies. Nests in burrows. Breeding season is March 15-August 15. | High. This species has been documented nesting at several locations in the vicinity of the project area. | No. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam's Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status ¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|---|---------------------|---|---|---|
| Southwestern willow flycatcher <i>Empidonax traillii extimus</i> | FE, SE | Range: Southwestern U.S. and Mexico. In Colorado, this species has been found in the southwest corner of the state and the San Luis Valley. Habitat: Riparian areas with a well developed willow component. Breeding season is April 15-July 15. | Low. This species has been documented at Rio Grande and Higel State Wildlife Areas approximately 25 miles southwest of the project area. Suitable habitat occurs in the vicinity of the project area. | No. |
| Amphibians | | | | |
| Boreal toad <i>Bufo boreas boreas</i> | SE | Range: In Colorado, this species is restricted to the Rocky Mountains and is found at elevations between 7,000 and 12,000 feet. Habitat: Restricted to areas with suitable breeding habitat in spruce-fir forests and alpine meadows. Breeding habitat includes lakes, marshes, ponds, and bogs with sunny exposures and quiet, shallow water. Breeding season is April 15-August 15. | None. | Yes. Lack of suitable habitat (e.g., high elevation spruce-fir forests, alpine meadows) occurs within the project area. |
| Northern leopard frog <i>Rana pipiens</i> | SC | Range: Once the most widespread frog species in North America, this species has been drastically declining in the last 50 years. In Colorado, this species is found statewide except for the southeast and east-central portion of the state. Habitat: Typical habitats include wet meadows and the banks and shallows of marshes, ponds, glacial kettle ponds, beaver ponds, lakes, reservoirs, streams, and irrigation ditches. Breeding season is April 15-August 15. | High. Suitable habitat exists within the project area. | No. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam's Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status ¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|---|---------------------|--|--|--|
| Invertebrates | | | | |
| Uncompahgre fritillary butterfly <i>Boloria acrocneuma</i> | FE | <p>Range: This butterfly is endemic to the high alpine meadows of the San Juan Mountains in southwestern Colorado.</p> <p>Habitat: This species of butterfly lives in patches of snow willow (<i>Salix</i> spp.) at high elevations as well as moist tundra with dwarf willows above 13,000 feet.</p> | None. | Yes. Project area is outside of species range and a lack of suitable habitat occurs within the project area. |
| Fish | | | | |
| Bonytail <i>Gila elegans</i> | FE, SE | <p>Range: Historically, bonytails were present in the Colorado River system, which includes the Yampa, Green, Colorado and Gunnison rivers. Today, there are no known populations in Colorado. They can be found in the Green River drainage in Utah and Mohave Reservoir on the Arizona-Nevada border.</p> <p>Habitat: This fish typically lives in large, fast-flowing waterways of the Colorado River system.</p> | None. | Yes. The project area does not occur within the known range of this species. |
| Razorback sucker <i>Xyrauchen texanus</i> | FE, SE | <p>Range: Originally widespread in the Colorado River system, wild populations were reduced to a small number of individuals in the Yampa, Colorado and Gunnison rivers in Colorado. Reproducing populations remain only in the middle Green River in Utah and in an off-channel pond in the Colorado River near Grand Junction.</p> <p>Habitat: This species is found in deep, clear to turbid waters of large rivers and some reservoirs over mud, sand or gravel.</p> | None. | Yes. The project area does not occur within the known range of this species. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam’s Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status ¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|--|---------------------|---|---|--|
| Humpback chub <i>Gila cypha</i> | FE, ST | <p>Range: The historic range of the humpback is similar to the pikeminnow, occurring in great numbers throughout the Colorado River system from Green River in Wyoming to the Gulf of California in Mexico. Today, they can be found in deep, canyon-bound portions of the Colorado River system such as Black Rocks and Westwater canyons on the Colorado River and Yampa Canyon inside Dinosaur National Monument.</p> <p>Habitat: This species prefers deep, fast-moving, turbid waters often associated with large boulders and steep cliffs.</p> | None. | Yes. The project area does not occur within the known range of this species. |
| Colorado pikeminnow <i>Ptychocheilus lucius</i> | FE, ST | <p>Range: Historically, the pikeminnow occurred in great numbers throughout the Colorado River system from Green River in Wyoming to the Gulf of California in Mexico. In Colorado, they are currently found in the Green, Yampa, White, Colorado, Gunnison, San Juan and Dolores rivers.</p> <p>Habitat: This species thrives in swift flowing muddy rivers with quiet, warm backwaters.</p> | None. | Yes. The project area does not occur within the known range of this species. |
| Rio Grande sucker <i>Catostomus plebeius</i> | SE | <p>Range: Historically, this species was found throughout the Rio Grande river system. In Colorado, this species is now limited to several small tributaries of the Rio Grande River.</p> <p>Habitat: This species prefers small streams with clear water, pools, and riffles.</p> | High. This species was documented near the project area in Crestone Creek by CDOW in 2005. | No. |
| Rio Grande chub <i>Gila pandora</i> | SC | <p>Range: In Colorado, this species range is restricted to the Rio Grande Basin.</p> <p>Habitat: This species prefers pools of small to moderate streams near areas of current.</p> | High. This species was documented near the project area in Crestone Creek by CDOW in 2005. It also has been documented 1.5 miles north of Weisman Lake. | No. |

Table 3-6 Special Status Species Identified for the Environmental Assessment of Lexam’s Planned Oil and Gas Exploration

| Common Name/ Scientific Name | Status¹ | Range Habitat Requirements | Potential for Occurrence on or Near the Project Area | Eliminated from Detailed Analysis |
|---|---------------------------|--|--|---|
| Rio Grande cutthroat trout <i>Oncorhynchus clarki virginalis</i> | SC | Range: In Colorado, this species range is confined to the headwaters of the Rio Grande surrounding the San Luis Valley. Habitat: This species like other cutthroat trout species prefers clear, cold streams and lakes. | Moderate. This species is known to occur in the Saguache Creek drainage west of the project area and in the San Luis Creek drainage northwest of the project area. | No. This species occurs in perennial streams, but has never been documented in Crestone Creek, the only perennial stream in the project area. |

¹Status:

FE-Federally Endangered

FT-Federally Threatened

FC-Federal Candidate

SE-State Endangered

ST-State Threatened

SC-State Species of Concern

Source: Butterfly Conservation Initiative 2007; Black-footed Ferret Recovery Program 2007; CDOW 2007a,b,c,e,f,g; CDOW 2003, 2002; CNHP 2007, 2006; Ellison et al. 2003; Fitzgerald et al. 1994; Garcia 2007; Gray 1998; Gunnison’s Sage-grouse Rangewide Steering Committee 2005; Johnsgard 1990; Kingery 1998; USFWS Mountain-Prairie Region 2007; USFWS and Lexam Explorations 2007; USFWS 2007a,b,c; USFWS 2005; Woodling 1985).

Northern Pocket Gopher (SC). The northern pocket gopher (*Thomomys talpoides agrestis*) occurs in the San Luis Valley north and east of the Rio Grande River (Fitzgerald et al. 1994). This species inhabits a wide variety of habitats including desert shrublands, grasslands, forests, and alpine tundra. This species was documented in 2005 by CNHP on the Baca Grande 1 mile east of the project area (CNHP 2006). The potential for this species to occur within the project area is considered high.

Black-footed Ferret (FE, SE). The black-footed ferret (*Mustela nigripes*) is known only from a reintroduced population in northwestern Colorado (CDOW 2007a). Black-footed ferrets are considered obligate associates to prairie dogs, which constitute their primary food source and provide burrows for shelter (Black-footed Ferret Recovery Program 2007; CDOW 2007a; Fitzgerald et al. 1994). Although the Refuge occurs within the historic range of the black-footed ferret, this species is presently restricted to reintroduced populations in Arizona, northwestern Colorado, Montana, South Dakota, north-central Utah, and Wyoming; however, remnant ferret populations may exist in portions of its former range (Black-footed Ferret Recovery Program 2007). Potentially suitable habitat within Gunnison's prairie dog colonies occurs within the project area. No designated critical habitat has been established for the ferret. Based on the current distribution of this species, the potential for this species to occur within the project area is considered low.

3.6.2.2 Birds

Bald Eagle (ST). The bald eagle (*Haliaeetus leucocephalus*) is primarily a winter migrant throughout Colorado, although bald eagle nests have been documented throughout Colorado, primarily along river, lakes and reservoirs. Primary wintering areas for this species in Colorado include the South Platte, Arkansas, White, Colorado, and Yampa rivers (Gray 1998). Bald eagles typically select very large, open canopy trees such as cottonwood and ponderosa pine for nesting (Johnsgard 1990; Kingery 1998). Within the project area, bald eagles primarily feed on waterfowl and carrion. Most of the bald eagle use near the project area occurs along Crestone Creek (USFWS and Lexam Explorations 2007). CDOW considers the entire project area winter range and a small area northeast of the project area along Crestone Creek as roosting habitat. No known nest sites occur within the vicinity of the project area (CDOW 2007g). The potential for this species to occur within the project area is considered moderate.

Ferruginous Hawk (SC). Ferruginous hawks (*Buteo regalis*) are found throughout the Great Plains and shrub-steppe areas of western North America (Johnsgard 1990; Kingery 1998). In Colorado, this species is typically found in arid to semiarid regions, as well as grasslands and agricultural areas. Most breeding records occur on the eastern plains, northwest Colorado, and San Luis Valley (Kingery 1998). This species forages over open country and typically nests on cliff faces, rock outcrops, and grassy knolls but may also nest in pinyon-juniper woodlands (Johnsgard 1990; Kingery 1998). In Colorado, nesting can begin as early as mid-March and last through July (Kingery 1998). This species has been documented nesting in the vicinity of the project area (Garcia 2007; USFWS and Lexam Explorations 2007). The potential for this species to occur within the project area is considered high.

American Peregrine Falcon (SC). The peregrine falcon (*Falco peregrinus*) is found throughout western Colorado in areas of suitable habitat. This species prefers areas with suitable nesting habitat (i.e., ledges on tall cliffs) with pinyon-juniper or ponderosa pine woodlands nearby (Johnsgard 1990; Kingery 1998). In Colorado, peregrine falcons arrive at their nesting areas in March and typically begin nesting by April (Kingery 1998). This species hunts for shorebirds and other small water birds in the wetlands and short-emergent vegetation wetlands within the project area during spring and fall migration (USFWS and Lexam Explorations 2007). There are no known nesting areas in the immediate vicinity of the project area (CDOW 2007g). Suitable foraging habitat occurs within the project area. The potential of this species to occur within the project area is considered moderate.

Greater Sandhill Crane (SC). In Colorado, the greater sandhill crane (*Grus canadensis*) breeds in northwest Colorado and migrates through the San Luis Valley in the spring and fall in route to wintering grounds in New Mexico (Kingery 1998). This species inhabits a wide variety of habitats including wetlands, flooded fields, beaver ponds, marshes, wet meadows. Greater sandhill cranes arrive in the San Luis Valley in late February

and begin courtship in March (Kingery 1998). This species has been documented using flooded meadows and wetlands within the project area (USFWS 2005). The potential for this species to occur within the project area is considered high.

Western Snowy Plover (SC). The western snowy plover (*Charadrius alexandrinus*) is considered a rare migrant and rare breeder in Colorado. This species utilizes broad, alkali beaches of manmade reservoirs and typically nests within a shallow depression (Kingery 1998). This species has successfully adapted to nesting on the shores of irrigation storage reservoirs. Western snowy plovers arrive in Colorado in early April and typically nests in late April and May. Nests have been documented at several southeastern Colorado reservoirs along the Arkansas River and in the San Luis Valley (Kingery 1998). This species has been documented nesting at San Luis Lake approximately 15 miles south of the project area (Kingery 1998). The potential for this species to occur within the project area is considered low as habitat for this species is not present in project area.

Mountain Plover (SC). In Colorado, mountain plovers (*Charadrius montanus*) are found on the eastern plains and intermountain parks and valleys including North Park, South Park, and the San Luis Valley (Kingery 1998). Breeding habitat for the mountain plover in the San Luis Valley is characterized as semi-desert shrublands (Kingery 1998). In the San Luis Valley, mountain plovers use flat, sparsely vegetated areas with stunted shrubs and widely spaced dwarf rabbitbrush (Kingery 1998). This species generally arrive on their breeding grounds from mid-March through mid April. Nests are typically built in a slight depression on bare or open ground (Kingery 1998). Eggs are typically laid in May, averaging three per clutch. Mountain plovers typically migrate from their breeding grounds in early August to late September to wintering grounds located from Texas to southern California (Kingery 1998). This species was documented in 2005 by CNHP on the Baca Grande east of the project area (CNHP 2006). The potential for this species to occur within the project area is considered high.

Long-billed Curlew (SC). The long-billed curlew (*Numenius americanus*) is found mainly in southeastern Colorado with additional small populations found in northeastern and northwestern Colorado (Kingery 1998). This species prefers open, sparsely vegetated habitats such as short-grass prairie with scattered wetlands and playas. Adults typically arrive on breeding grounds in April and lay eggs by May. Very few breeding records exist for the San Luis Valley, although suitable nesting habitat occurs within the project area (USFWS 2005). This species has been documented migrating through the project area (Garcia 2007). The potential for this species to occur within the project area is considered to be high in the project area.

Western Yellow-billed Cuckoo (FC, SC). The western yellow-billed cuckoo (*Coccyzus americanus*) is limited to west of the Continental Divide in Colorado although small scattered populations occur in the San Luis Valley (USFWS 2005). Typical habitat of the western yellow-billed cuckoo consists of old growth riparian woodlands with dense understories (Kingery 1998). Nests are typically located high in trees with closed canopies. Nesting peaks later (mid-June through August) than in most co-occurring bird species, and may be triggered by an abundance of the cicadas, katydids, caterpillars, or other large prey that form the bulk of their diet. The species is inconspicuous on its breeding range, except when calling to attract or to contact mates (Kingery 1998). This species has been documented in the San Luis Valley in dense, old-growth cottonwoods on McIntire Springs approximately 35 miles south of the project area (USFWS 2005). Suitable habitat occurs in the vicinity of the project area for this species along riparian areas (USFWS 2005). The potential for this species to occur within the project area is considered low.

Burrowing Owl (SC). The burrowing owl (*Athene cunicularia*) is typically associated with prairie dog colonies and heavily grazed tracts of mixed-grass prairie. In Colorado, this species is found on the eastern plains, intermountain parks and valleys, and western portions of the state including areas around Cortez and Grand Junction (Kingery 1998). Habitat typically consists of desert-shrublands and grasslands with sparse vegetation and abundant burrows (Kingery 1998). This species arrives in Colorado in late March or early April and begins nesting by late April (Kingery 1998). The breeding season is typically March 15-August 15. Burrowing owls nest in rodent burrows in areas with sparse vegetation and several nesting records have been recorded in the

San Luis Valley (Kingery 1998). This species has been documented nesting in the vicinity of the project area (Garcia 2007; USFWS and Lexam Explorations 2007). The potential for this species to occur within the project area is considered high.

Southwestern Willow Flycatcher (FE, SE). The USFWS (1995) listed the southwestern willow flycatcher (*Empidonax trailli extimus*) as an endangered species on February 27, 1995. The breeding range of the southwestern willow flycatcher includes southern California, Arizona, New Mexico, extreme southern portions of Nevada and Utah, far western Texas, southwestern Colorado, and extreme northwestern Mexico (USFWS 2007b). The southwestern willow flycatcher historically nested primarily in willows, buttonbush, and coyote brush, with a scattered overstory of cottonwood (USFWS 2007b). This species nests in dense riparian habitats from sea level to approximately 8,500 feet in Arizona and southwestern Colorado. This species still nests in native vegetation where available, but has been known to nest in thickets dominated by *Tamarisk* spp. (USFWS 2007b). The southwestern willow flycatcher typically builds a nest near surface water or the damp soil of intermittent streams that support the riparian vegetation. Nests are cup-shaped made constructed of plant material usually 3 to 15 feet aboveground in a fork or on a horizontal branch of a medium-sized bush or small tree with dense vegetation above and around the nest (USFWS 2007b). The southwestern willow flycatcher arrives on breeding grounds in late April and May, nesting typically begins in May and June and young usually fledge from late June into mid-August (USFWS 2007b). Surveys to document the presence of southwestern willow flycatcher within the project area have not been conducted to date. Suitable habitat occurs in the vicinity of the project area for this species along riparian areas (USFWS 2005). This species has been documented by CDOW at Rio Grande and Higel State Wildlife Areas approximately 25 miles southwest of the project area and Alamosa NWR approximately 30 miles south of the project area (CDOW 2003, 2002). The potential for this species to occur within the project area is considered low.

3.6.2.3 Amphibians

Northern Leopard Frog (SC). The northern leopard frog (*Rana pipiens*) was once considered the most widespread frog species in North America. In Colorado, this species is found throughout the state except for the southeast and east-central portions of the state (CDOW 2007b). This species prefers wet meadows and the banks and shallows of marshes, ponds, glacial kettle ponds, lakes, reservoirs, streams, and irrigation ditches (CDOW 2007b). The breeding season for this species is April 15-August 15. The potential for this species to occur within the project area is considered high.

3.6.2.4 Fish

Rio Grande Sucker (SE). The Rio Grande sucker (*Catostomus plebeius*) occurs exclusively in the Rio Grande basin from Colorado to Mexico (CDOW 2007c; Woodling 1985). In Colorado, this species is limited to small creeks and springs within the San Luis Valley such as Hot Creek and McIntyre Springs (CDOW 2007c; Woodling 1985). This species prefers backwaters and pools near rapidly flowing water (Woodling 1985). The Rio Grande sucker typically spawns from February to April and may spawn a second time in late summer (Woodling 1985). This species was documented near the project area in 2005 by CDOW in Crestone Creek and laterals in the project area (CNHP 2006). The potential for this species to occur within the project area is considered high.

Rio Grande Chub (SC). The Rio Grande chub (*Gila pandora*) occurs in a single area in Texas, and north through the Rio Grande and Pecos River drainages of New Mexico into southern Colorado (Woodling 1985). In Colorado, this species is found exclusively in the Rio Grande basin in pools of small streams and creeks. The Rio Grande chub prefers streams with undercut banks, overhanging bank vegetation, and aquatic vegetation (CDOW 2007c; Woodling 1985). The spawning period for this species is largely unknown although it most likely mimics that of the Rio Grande sucker. This species was documented near the project area in 2005 by CDOW in a ditch associated with Crestone Creek and at a spring 1.5 miles north of Weisman Lake (CNHP 2007, 2006). The potential for this species to occur within the project area is considered high.

Rio Grande Cutthroat Trout (SC). The Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) occurs in the headwaters of the Rio Grande River surrounding the San Luis Valley. This species prefers clear, cold streams and lakes, and shallow riffles and runs for spawning (CDOW 2007c). The spawning period for this species is roughly March-July depending on water temperature (CDOW 2007c). The Rio Grande cutthroat trout is known to occur in the Saguache Creek drainage west of the project area and in the San Luis Creek drainage northwest of the project area (CDOW 2007c). The potential for this species to occur within the project area is considered moderate.

3.7 Cultural Resources

3.7.1 Regulatory Framework

Cultural resources on all federal lands are regulated by a series of federal laws enacted to protect these resources from damage or loss due to federally funded activities or private undertakings on federally managed lands. The public's recognition that these non-renewable resources are important and should be protected began very early in the 20th century and continues to the present. Three of the most important laws are the National Historic Preservation Act (NHPA) of 1966, as amended; the American Indian Religious Freedom Act (AIRFA) of 1978; and the Archaeological Resource Protection Act (ARPA) of 1979. EO 11593 also provides necessary guidance on protection and enhancement of cultural resources. New legislation and emphases that have come to the forefront over the past 20 years include the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, EO 13007, the consideration of historic and traditional landscapes, and the increased awareness of and consultation for traditional cultural properties.

Section 106 of the NHPA requires federal agencies to assess the effects of an undertaking on historical and archaeological sites. The proposed action is not considered an undertaking as defined by NHPA, and therefore is not subject to review. Nevertheless, the USFWS is conducting a review of effects on historical and archaeological sites in order to ensure that the proposed measures protect cultural resources to the maximum extent practicable. This was accomplished by inventorying planned disturbance areas or area of potential effect (APE), evaluating site importance and eligibility to the National Register of Historic Places (NRHP), assessing the effect of the proposed action on NRHP-eligible sites, and consulting with appropriate historic preservation agencies. The APE for the Lexam project includes the planned well pads, plus a 100-foot buffer, and the planned access roads, plus a 50-foot buffer on either side of each road. .

3.7.2 Cultural Resources Investigations

In the fall of 2006, TRC Mariah Associates Inc. (TRC Mariah) conducted cultural resource investigations on portions of the Refuge on behalf of the USFWS, Region 6, and Lexam (TRC Mariah 2006). These investigations included Class I and Class III inventories. Class I inventories are a review of reports containing the results of previously conducted surveys in the planned project area, as well as library and archival sources for regional prehistory and history. Class III inventories are intensive field surveys of areas in which potential impacts are anticipated or are likely to occur.

On September 20, 2006, TRC Mariah conducted a Class I file search using the Compass on-line cultural resources database of the Colorado Historical Society. The file search indicated that no cultural resource inventories were previously conducted, and no sites have been previously documented within the APE.

From September 29 through October 1, 2006, TRC Mariah conducted a Class III cultural resource inventory of the planned Baca #5 and Baca #6 well pads and access roads within the Refuge. The survey boundary consisted of a 10-acre block centered on the planned well pad location and a 100-foot-wide corridor centered on the access road centerline. A total of 37.6 acres was inventoried on federal land administered by the USFWS.

As a result of the Class III inventory, a total of two sites (5SH3146 and 5SH3147.1) and four isolates (5SH3148, 5SH3149, 5SH3150, and 5SH3151) were recorded. The sites included a prehistoric lithic scatter and historic canal. All of the isolates are prehistoric.

Site 5SH3146 consists of a sparse disperse lithic scatter that included one basalt and four obsidian flakes. No features, diagnostic artifacts, or other unique artifacts were located during the inventory. Intensive inspection of the sand sheet in and around the site boundary did not reveal any evidence of buried cultural deposits or soils. Two shovel tests were dug within the site boundary to a depth of approximately 20 inches. Neither shovel test encountered any buried cultural deposits or soils. As a result of the inventory and shovel testing, the site was recommended by the USFWS as not eligible for the NRHP, and in a letter dated December 7, 2006, the Colorado State Historic Preservation Office (SHPO) concurred with the eligibility determination (Contiguglia 2006).

Site 5SH3147.1 is a canal that measures approximately 3 to 4 feet wide and 1 foot deep and will be crossed by a planned access road. The canal is a named, adjudicated canal listed in the 1901 Decree Book, Water District No. 25, Saguache County, Colorado, and is part of the irrigation system associated with the post-Spanish period settlement and homesteading of the San Luis Valley. The canal was recommended by the USFWS as eligible for the NRHP, and the SHPO concurred with the eligibility determination (Contiguglia 2006).

Four isolates were located during the Class III inventory. Isolate 5SH3148 consists of a single piece of limestone heat-altered rock. Isolate 5SH3149 consists of a basalt projectile point base. The remaining two isolates, 5SH3150 and 5SH3151, consist of a white chert projectile point and a brown chert modified flake, respectively. All four of the isolates are not eligible for the NRHP (Contiguglia 2006).

Subsequent to the Class III inventory conducted for the planned Baca #5 and Baca #6 well pads and access roads, TRC Mariah conducted a Class III inventory for Lexam's Baca 3D Seismic Project, which encompasses the currently planned well pads and access roads (TRC Mariah 2007). A total of 325.9 miles (2,607 acres) of planned seismic lines, access roads, and fence lines were inventoried within the Refuge. The inventory was conducted from mid-October to mid-November 2006.

A total of 61 sites and 96 isolated finds were recorded during the Baca 3D Seismic Project Class III inventory. A total of 39 of the sites are prehistoric open camps, 5 are historic sites (cow camp, bridge, and artifact scatters), 3 sites are multi-component sites containing both prehistoric and historic components, and 14 are segments of historic canal systems. The isolated finds primarily are prehistoric lithic, groundstone, or heat-tered rock remains, and a few are historic trash.

All of the canals segments were recommended by the USFWS as eligible for the NRHP. A total of 37 of the remaining 47 sites were unevaluated prehistoric sites and 1 was an unevaluated historic site. Additional data were recommended for these 38 sites in order to determine their NRHP eligibility. A total of 9 sites and the 96 isolated finds were recommended as not eligible for the NRHP. In a letter dated January 29, 2007, the Colorado SHPO concurred with the NRHP eligibility determination for the 9 sites and 96 isolated finds and that additional data were necessary to determine the eligibility of the 38 sites (Contiguglia 2007).

The 38 sites that were either eligible for the NRHP or needed additional data were avoided during seismic activities by rerouting those activities around the sites. To avoid impact to the NRHP-eligible canals by seismic vehicles, the vehicles were driven over the canals when the ground was frozen. This protection measure was reviewed by the USFWS and submitted to the SHPO for review and concurrence prior to initiation of seismic activities. In a letter dated January 29, 2007, the Colorado SHPO concurred that no adverse effects will occur to the canals since vehicular traffic would take place when the ground was frozen (Contiguglia 2007).

3.8 Native American Traditional Values

Federal law and agency guidance require federal agencies to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by actions on federal lands. This consultation includes the identification of places (i.e., physical locations) of traditional cultural importance to Native American tribes. Places that may be of traditional cultural importance to Native American people include, but are not limited to, locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules or practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes, may be taken. Additionally, some of these locations may be considered sacred to particular Native American individuals or tribes.

In 1992, the NHPA was amended to explicitly allow that “properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined to be eligible for inclusion on the NRHP.” If a resource has been identified as having importance in traditional cultural practices and the continuing cultural identity of a community, it may be considered a traditional cultural property (TCP). The term “traditional cultural property” first came into use within the federal legal framework for historic preservation and cultural resource management in an attempt to categorize historic properties containing traditional cultural significance. National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker and King 1989) defines a TCP as “one that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community.” To qualify for nomination to the NRHP, a TCP must be more than 50 years old, must be a place with definable boundaries, must retain integrity, and must meet certain criteria as outlined for cultural resources in the NHPA.

In addition to the NRHP eligibility, some places of cultural and religious importance also must be evaluated to determine if they should be considered under other federal laws, regulations, directives, or policies which include, but are not limited to, EO 13007 of 1996, the AIRFA of 1978, and the NAGPRA of 1990.

Although not required to comply with NHPA in order to ensure that cultural resources are protected to the maximum extent practicable, the USFWS initiated government-to-government consultation for Lexam’s planned project by sending letters on September 20, 2007, to the following Native American tribal groups: Southern Ute, Ute Mountain Ute, Jicarilla Apache, Hopi, Uintah & Ouray/Northern Ute, Navajo Nation, Pueblo of Santa Ana, Pueblo of Santo Domingo, San Ildefonso Pueblo, Pueblo of Nambe, San Juan Pueblo, Santa Clara Pueblo, Pueblo of Jemez, Pueblo of Picuris, Pueblo of Taos, and Pueblo of Zuni. The letters were sent to inform the various tribal groups of the proposed action and to solicit any comments the tribes may have concerning TCPs or places of cultural and religious importance to the tribes in the project area. **Table 3-7** lists the Native American groups that have been contacted and summarizes the current status of consultation and the concerns they have identified regarding the proposed action.

Table 3-7 Summary of Native American Consultation

| Name of Tribe | Date of Letter | Follow-up Calls | Status |
|---------------------------|----------------|---------------------|--|
| Southern Ute Indian Tribe | 9/20/07 | 10/9/07 10/17/07 | No response to date. |
| Ute Mountain Ute Tribe | 9/20/07 | 10/9/07 10/11/07 | Tribe requested a second copy of the 9/20/07 letter. |

Table 3-7 Summary of Native American Consultation

| Name of Tribe | Date of Letter | Follow-up Calls | Status |
|-----------------------------------|-----------------------|------------------------|--|
| Jicarilla Apache Tribe | 9/20/07 | 10/10/07 10/17/07 | No response to date. |
| The Hopi Tribe | 9/20/07 | 10/18/07 | Tribe requested and was provided copies of the survey reports. Also requested an EIS be prepared for the project, additional consultation if NRHP-eligible prehistoric sites would be adversely affected, and copies of any mitigation plans, if needed. |
| Uintah & Ouray/Northern Ute Tribe | 9/20/07 | 10/10/07 10/16/07 | Tribe requested a second copy of the 9/20/07 letter. |
| Navajo Nation | 9/20/07 | 10/10/07 10/11/07 | Tribe stated that no Navajo TCPs or historic properties would be impacted by the project, but requested to be contacted in the event of unanticipated discoveries. |
| Pueblo of Santa Ana | 9/20/07 | 10/11/07 | Tribe has no comment at this time. |
| Pueblo of Santo Domingo | 9/20/07 | 10/11/07 10/17/07 | No response to date. |
| San Ildefonso Pueblo | 9/20/07 | 10/11/07 10/17/07 | Tribe has no concerns, but requested an update on the project. |
| Pueblo of Nambe | 9/20/07 | 10/11/07 10/17/07 | No response to date. |
| San Juan Pueblo | 9/20/07 | 10/11/07 10/17/07 | No response to date. |
| Santa Clara Pueblo | 9/20/07 | 10/11/07 | Tribe requested copies of the survey reports. |
| Pueblo of Jemez | 9/20/07 | 10/11/07 10/17/07 | Tribe has no concerns at this time, but stated that other Pueblos may be interested in the project. |
| Pueblo of Picuris | 9/20/07 | 10/11/07 10/17/07 | No response to date. |
| Pueblo of Taos | 9/20/07 | 10/11/07 10/17/07 | No response to date. |
| Pueblo of Zuni | 9/20/07 | 10/11/07 10/17/07 | Tribe requested and was provided copies of the survey reports. |

Source: Van Ness 2007.

3.9 Recreation

The Refuge is presently closed to the public, and as such, there are no recreational opportunities at the Refuge or in the project area.

3.10 Socioeconomic Resources

Because the Refuge is federal land currently closed to the public, there are no direct economic or social considerations associated with the project area. Therefore, the influence area for economic and social considerations associated with the planned Lexam Project is viewed within a regional context and includes a portion of southern Saguache County in south-central Colorado and the City of Alamosa in Alamosa County. Alamosa was included in the region of influence as it is the most likely location for the drill rig crews and other project personnel to be stationed during the project. The region is predominately rural with several small communities (i.e., Crestone, Moffat, Hooper, and Center) nearby.

3.10.1 Population

Saguache County had a population of 5,917 residents in 2000. The U.S. Census Bureau estimated an 18.4 percent increase in population between April 1, 2000 and July 1, 2006 for a total estimated population of 7,006 residents in 2006 (U.S. Census Bureau 2007). The majority of Saguache County residents (3,676 est.) lived in unincorporated areas, including the Baca Grande subdivision. Center and Saguache are the county's two largest communities, with 2,500 and 620 residents, respectively, in 2004. Other communities in the region include Bonanza City, Crestone, and Moffat (U.S. Census Bureau 2005).

Population growth in Saguache County has occurred primarily from lifestyle migration into the Baca Grande and Crestone communities, and the settlement in Center of agricultural households employed across the San Luis Valley.

The City of Alamosa has a current estimated population of 8,679, up from 7,960 recorded in the 2000 census.

3.10.2 Economic Overview

Total full- and part-time employment in Saguache County increased to 2,750 jobs in 2003 from 2,131 jobs in 1990, a gain of 619 jobs or 29 percent. Employers in Saguache County include the federal government (National Park Service [NPS], USFWS, USFS, U.S. Postal Service, NRCS [agriculture], and others), farmers and ranchers, recreational and tourism outlets and sites, and the service industry.

In 2002, agricultural operations in Saguache County involved approximately 24 percent of the county's total acreage, and sales of local crops and livestock generated more than \$176 million in the two-county region. Potatoes, barley and wheat grains, and forage for livestock feed were the predominant crops in terms of acres harvested.

Recreation and tourism also have a substantial role in the regional economy, and attractions in the San Luis Valley include: the Great Sand Dunes National Park; portions of the Rio Grande National Forest; the Cumbres and Toltec Scenic Railway (a steam-powered excursion railroad); Monte Vista, and Alamosa refuges; San Luis Lakes State Park and multiple state wildlife management areas; Los Caminos Antiguos Scenic Byway; Fort Garland Historic Fort and Museum; multiple spiritual, new age, and retreat centers in Crestone and the Baca Grande subdivision; Shrine of the Stations of the Cross in San Luis; numerous local museums and historical sites; and the annual sandhill crane migration and festival. Visitors and travelers support numerous jobs in the region's retail trade, accommodations and dining, and entertainment and other affiliated industries.

The City of Alamosa bills itself as the lodging hub of the San Luis Valley and offers many lodging and dining establishments that cater to the tourists who visit San Luis Valley attractions.

3.10.3 Income, Poverty, and Unemployment

Total personal income in Saguache County was \$120.4 million in 2003. Despite recent gains, per capita income in the area lags behind other areas in Colorado. Per capita income of \$18,063 in Saguache (2003),

ranked the county 62nd in the state. Over time, local unemployment rates have been persistently above the statewide averages. The seasonality of many jobs in agriculture, tourism, and trade, contribute to that pattern, as well as to the lower than average per capita incomes. There are no disadvantaged populations in the influence area.

3.10.4 Demographic Characteristics

In 2000, 37 percent of the population of Saguache County was over 45 years of age. More than 31 percent of Saguache County residents had moved there since 1995. The county has a relatively large minority population. More than one of four residents in Saguache County are nonwhite (primarily Hispanic or Latino), compared to about one of six statewide. Apaches, Navajos, and Utes were the most commonly reported Native American tribal affiliations. No established American Indian reservations are located in Saguache County.

3.10.5 Housing

At the time of the 2000 census, more than 25 percent of all units were reported vacant in Saguache County. However, 46 percent of the vacant units (361 units) were reported as being for seasonal, recreational, or occasional use. The latter includes about 75 units located in Crestone, the Baca Grande subdivision, and nearby areas. Recent population growth and migration are reflected in levels of new residential construction. An estimated 454 new homes were reported in Saguache County (nearly a 15 percent increase in 5 years). Many of these units are located in the Baca Grande subdivision, a planned community consisting of 15,000 acres divided into approximately 4,200 lots. The community includes parks, a recreational vehicle park, tennis courts, ballfields, and greenbelts. Baca Grande is accessed via County Road T.

3.10.6 Traffic

The primary highway access through the region to the project area is via State Highway (SH) 17, a key north-south regional highway in the San Luis Valley, to Saguache County Road (CR) T to Lexam Road on the Refuge.

Saguache CR T is a paved road that extends east from SH 17 and terminates at two destinations — Crestone and the Baca Grande subdivision; therefore, traffic on CR T is related primarily to these destinations. The Crestone destination includes the Town of Crestone (population 73 in 2000) and three USFS trailheads. The Baca Grande destination includes a small Colorado College satellite facility, a restaurant and several other small businesses, over 600 residences, and more than a dozen spiritual retreat centers.

The City of Alamosa is reached by Highways 285 and 160 and by SH 17. Commuters from Alamosa to the project site would take SH 17 to CR T, a commute of over 50 miles each way.

3.10.7 Emergency Services

In Saguache County, the County Sheriff responds to accidents and incidents on CRs. Troop 5B of the Colorado State Patrol, headquartered in Alamosa, handles incidents on SHs 150 and 17.

The San Luis Valley Regional Emergency Medical Services/Trauma Advisory Council (SLV RETAC) encompasses six counties located in the south-central portion of Colorado; these counties include Alamosa, Conejos, Costilla, Rio Grande, Mineral, and Saguache. There are 10 Emergency Medical Service transport services in the San Luis Valley. The SLV RETAC includes a fully trained Hazmat team that has dealt with incidents that have involved explosives, fuel spills, unknown white powders, methamphetamine labs, school chemicals, and numerous other incidents.

Emergency medical service for Saguache County and Alamosa, including ambulance transport, is dispatched from the San Luis Valley Regional Medical Center. The San Luis Valley Regional Medical Center is the major

trauma center in the San Luis Valley and includes a Level III trauma center, a six-bed intensive care unit, 24-hour lab and imaging services, and an in- and out-patient surgery unit. Other area hospitals include the Conejos County Hospital in La Jara and the Rio Grande Hospital in Del Norte, both Level IV trauma centers.

The Crestone and Baca Grande Volunteer Fire Departments (6 and 30 volunteers, respectively) provide primary structural fire protection for their communities. The Kundalini Fire Management (a 20-member department) also serves the Baca Grande subdivision and surrounding area.

In 2007, the town of Crestone applied for and received \$638,210 in Energy and Mineral Impact Assistance program money from the Colorado Department of Local Affairs (DOLA), specifically mentioning Lexam's planned exploration in the application. The money (of which \$500,000 is an outright grant and the remaining \$138,210 is a loan) is intended to provide for a water system to deliver potable drinking water and for fire fighting. The program, founded by the state legislature in 1977, was designed provide assistance to local communities that are impacted by boom and bust cycles in the energy and mineral extraction industries (DOLA 2007). A water system in nearby Crestone would increase the preparedness to deal with fire emergencies.

3.10.8 Land Use and Ownership

The land use and ownership in the project area is a NWR, administered by the USFWS. Regional land uses include agriculture, forested areas, and areas supporting wildlife, rural residential, residential, commercial, and industrial land uses. The Baca Grande subdivision and Crestone are included in the rural residential development category. The majority of Saguache County has been zoned as agricultural, with residential uses allowed "by right." Other uses on private lands in unincorporated areas require approvals from the respective zoning administrators and commissions. Federal lands account for approximately 69 percent of the lands in Saguache County. Another 4 percent of the land in the county is managed by the state, and 27 percent is privately owned. The latter includes a small amount of land managed by local public entities such as municipalities or school districts.

3.10.9 Environmental Justice

On February 11, 1994, President Clinton issued EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." This EO is designed to focus the attention of federal agencies on the human health and environmental conditions in minority communities and low-income communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations. In an accompanying Presidential memorandum, the President emphasized existing laws, including the National Environmental Policy Act (NEPA), should provide opportunities for federal agencies to address environmental hazards in minority and low-income communities.

The Crestone/Baca Grande subdivision area does not comprise a minority or low-income community.

3.11 Aesthetics

3.11.1 Visual Resources

3.11.1.1 Regional Physical Setting

The planned Lexam Project is situated in the Refuge, in Saguache County, in the northern San Luis Valley, approximately 15 miles northwest of Great Sand Dunes National Park, approximately 19 miles east of U.S. Highway 285, approximately 6 miles southwest of Crestone, approximately 8 miles southeast of Moffat, and approximately 32 miles north of Alamosa, Colorado. The San Luis Valley is located within the Southern Rocky Mountain Physiographic Province, which is characterized by long, north-south-trending mountain ranges separated by broad valleys.

3.11.1.2 Project Area Physical Setting

The planned project area is located along Spanish and Willow Creeks approximately 1 to 3 miles west of Camino del Rey on the Baca Grande subdivision. The site contains scenic resources comparable to other areas of the region with similar habitats and features, and its overall level of scenic quality is considered moderate to high.

The planned project is situated at an elevation of approximately 7,600 feet above mean sea level. The immediate area is dominated by a single large cottonwood tree (*Populus deltoides*), and a variety of vegetation communities including desert shrublands, grasslands, wet meadows, and playa wetlands. Please see Section 3.5, Vegetation and Habitats, for detailed descriptions of communities.

The project area has distant views to and from trails and recreation areas of the San Isabel National Forest in the Sangre de Cristo mountain range (approximately 8.0 miles to the east), Kit Carson peak (approximately 10.5 miles to the east), and trails and recreation areas of the Rio Grande National Forest (approximately 30.0 miles to the west).

The greatest potential for public views of the planned project is from the gate at Lexam Road and CR T which is to the north of the planned project and from Camino del Rey Road on the Baca Grande subdivision to the east. Other viewing opportunities are from residences, religious sites, recreation areas, and roads in the San Luis Valley and higher elevations to the east, north, and west of the well sites and at substantial distances (3 to 30 miles away).

The nearest residences with views to the project site are located approximately 3 miles to the east, along Camino del Rey Road. Residences in the Baca Grande subdivision along the base of the Sangre de Cristo Mountains would have views at a distance of 4.5 or more miles.

3.11.2 Noise

3.11.2.1 Ambient Soundscape Setting

At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day. Variation is caused both by changes in the noise source, and by changes in weather conditions. The magnitude of a change in sound level is measured in decibels. A three-decibel change is a 100 percent increase or decrease in the sound level, and a ten-decibel change is a 1,000 percent increase or decrease in the sound level. Sound levels in decibels are measured in dBA, which means sound levels on the "A" scale of a standard sound level meter.

Two measures of the time-varying quality of environmental noise are the 24-hour equivalent sound level ($L_{eq(24)}$), and the sound level day/night (L_{dn}) (USEPA 1974). The $L_{eq(24)}$ is the level of steady sound with the equivalent energy as the time-varying sound of concern, averaged over a 24-hour period. The L_{dn} accounts for people's greater sensitivity to nighttime noise by adding 10 decibels of the dBA to the $L_{eq(24)}$. The L_{dn} is applied between the hours of 10 p.m. and 7 a.m.

The planned project will occur in a rural agricultural area. Noise sources in rural areas are predominantly natural and include insects, birds, wind, weather, and livestock. Other noises associated with rural areas include vehicles, farm machinery, and semi-tractor trailer trucks. Accordingly, existing ambient noise levels near project work locations are low. Background noise levels in rural areas typically range between 35 and 45 dBA (L_{dn}) (USEPA 1974). The primary sources of noise in rural residential and agricultural areas are roadway traffic and farm machinery on a seasonal basis. Background noise levels are approximately 40 dBA in rural residential areas and 45 dBA in agricultural cropland with equipment operating.

Typical noise-sensitive areas include residences, schools and day care facilities, hospitals, long-term care facilities, places of worship, libraries, and parks and recreational areas specifically known for their solitude and

tranquility such as wilderness areas. Noise sensitive receptors near the proposed project include rural residences, low-density residential clusters, schools, places of worship, libraries, and areas specifically valued for solitude and tranquility.

Existing human-caused noise sources that occur in and around the planned project area include, but are not limited to residents, visitors, vehicles, motorized and mechanical equipment, overhead aircraft, and surrounding residential and agricultural noise influences (NPS 2007). A NPS noise study conducted at the then Great Sand Dunes National Monument during July 1993 and October 1994 found background ambient noise levels averaged less than 45 dBA for 99 percent of the study, less than 40 dBA for 90 percent of the duration, and less than 35 dBA for 50 percent of the study. These findings are compatible with the USEPA data described above for rural residential and agricultural areas (USEPA 1974).

3.11.2.2 Regulatory Framework

Federal Regulations

The Noise Control Act of 1972 required the USEPA to establish noise emission criteria and testing methods that applied mainly to transportation effects of noise. In 1974, the USEPA issued guidance levels for the protection of public health and welfare in residential land use areas. The guidance levels specified an outdoor L_{dn} of 55 dBA and an indoor L_{dn} of 45 dBA. These guidance levels are not considered as standards or regulations and were developed without consideration of technical or economic feasibility.

OSHA regulations are designed to protect workers from occupational noise exposure. OSHA's regulations provide for permissible noise level exposures as a function of the amount of time during which the worker is exposed.

State Regulations

Colorado Statute 25-12-103, provides for maximum permissible noise levels for applicable activities that will be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. The statute provides limits for sound levels of noise radiating from a property line (Refuge boundary) at a distance of 25 feet or more for certain time periods. Those limits are provided below in **Table 3-8**.

Table 3-8 Maximum Permissible Noise Levels

| Zone | 7:00 a.m. to next 7:00 p.m. | 7:00 p.m. to next 7:00 a.m. |
|------------------|------------------------------------|------------------------------------|
| Residential | 55 dBA | 50 dBA |
| Commercial | 60 dBA | 55 dBA |
| Light industrial | 70 dBA | 65 dBA |
| Industrial | 80 dBA | 75 dBA |

4.0 Environmental Consequences

4.1 Introduction

The following sections describe the potential impacts of the Proposed Action Alternative, the No Federal Involvement Alternative and the No Mineral Exploration Alternative. The Proposed Action Alternative is the adoption of standards and environmental protective measures by USFWS to protect the surface estate and other resources of the Refuge from unreasonable damage during all phases of the currently planned exploration program by Lexam; some of these measures have already been adopted by the COGCC as conditions of approval for the seismic survey and well permit applications. Under the No Federal Involvement Alternative, Lexam's planned exploration program will proceed without adoption of the USFWS's proposed standards and measures, unless such standards and measures have already been adopted by the COGCC as special conditions in Lexam's survey and drilling permits. Under the No Mineral Exploration Alternative, the United States would acquire the Refuge's severed mineral estate or Lexam would choose not to go forward and Lexam's planned exploration program would not proceed.

Oil and gas exploration and production is an iterative process. The result of the currently planned two-well exploration program may be that no further exploration is warranted, additional exploration wells are necessary or that commercially developable quantities of oil and natural gas exist. It is not possible to determine in advance of the exploration program whether any further exploration or development is warranted or the layout and configuration of any additional wells and associated facilities including roads.

If commercially developable quantities of oil are discovered, any additional wells could include a pumping system and adjacent storage tank from which crude oil would be hauled off the Refuge in tanker trucks to an oil refinery. If natural gas is discovered in commercial quantities, a subsurface transportation system would be required to an adjacent roadway at which point the gas would be further transported in a pipeline system located in road rights-of-way to the point of distribution. In a production scenario, techniques to minimize the impact of oil and gas development in the surface estate, such as directional drilling and drilling multiple wells from a single drill pad, are possible, although no determination can be made at this time regarding the feasibility of any of these alternatives on the Refuge. Lexam understands and agrees that additional NEPA analysis will be required if results of the planned exploration require additional activities as described above.

Since the USFWS has not developed specific management plans for the planned project area, no reasonably foreseeable future actions have been identified. However, the USFWS could implement ground disturbing activities in the future in support of regular Refuge management activities. Such ground disturbing activities will be subject to applicable rules and regulations and such protection measures that the USFWS will impose on itself to minimize impacts.

The cumulative impact study area for resources discussed in this EA includes the project area, the northern portion of the Refuge from the project area to CR T, the town of Crestone, the Baca Grande Subdivision, and areas immediately adjacent to the Refuge north of CR T, unless stated otherwise for a particular resource. No reasonably foreseeable projects were determined for this area (mines, oil and gas drilling, major construction projects).

In 2008 USFWS will be attempting to describe habitat characteristics and bird use of wet meadows during late spring through early fall. In doing this USFWS will have developed predictive models to help managers anticipate vegetation and bird response to the traditional practices of spring flooding followed by hay harvest and/or grazing in late summer or spring flooding without being followed by hay harvest and/or grazing in late summer.

4.2 Geology, Mineral Resources, and Soils

4.2.1 Effects of Lexam's Planned Exploration Program

Lexam's planned exploration program is not expected to effect geological conditions or mineral resources. Construction of roads and drill pads is expected to cause minimal long term impacts to soils; the maximum amount of disturbance for Lexam's planned exploration program is 14.5 acres of soils that would be disturbed or covered with Lexam's access roads and drill pads. Potential impacts to soils from planned exploration activities include the removal of vegetation, soil compaction, increased susceptibility of the soils to wind and water erosion, loss of topsoil productivity, and contamination of soils with hazardous materials. Disturbance is expected to be short term since reclamation would commence as soon as drilling activities are concluded. Roads and drill locations would be contoured back to original contours and disturbed areas would be re-seeded and temporary or permanent erosion control structures installed as needed. As discussed in Chapter 1.0, the COGCC Series 1000 Rules and the CDPHE storm water permit rules provide for specific soils handling and reclamation procedures. The stormwater permit requires revegetation goals that must be followed in order to terminate coverage under the permit. Because of the erosive nature of the soils and the semi-arid climate, complete revegetation and reclamation to the goal in the storm water rules (70 percent of original vegetation) may be a long term undertaking.

In addition to the impact of road and drill pad construction, soils could be impacted by any spills of hazardous materials (petroleum fuels, lubricants, paints, and additives). The SPCC requires immediate containment of spills or releases. Because of the temporary nature of the operations, the quantity of materials (oils and fuels) on-site would be relatively small. Impacts from spills would be short term and limited to the immediate vicinity of the spill and impacted soil would have to be removed and disposed offsite in accordance with applicable rules.

4.2.2 Proposed Action Alternative

Under the Proposed Action Alternative, the USFWS would adopt protective standards and measures to ensure that Lexam's planned exploratory drilling project does not unreasonably degrade or impact environmental resources. The impacts would be lowered with the implementation of protective measures proposed by the USFWS in addition to COGCC and CDPHE rules. USFWS Protective Measure #5 (construction to facilitate revegetation in accordance with COGCC rules with input from USFWS) reinforces COGCC's site reclamation requirements and would grant USFWS an enhanced role in such reclamation. The provision for Environmental Monitors pursuant to USFWS Protective Measure #3 (trained environmental monitors) would help ensure that protective measures required by USFWS, COGCC, and CDPHE are adhered to and that operations are conducted in a manner that reduces impacts. Spills of hazardous materials would be contained and remediated according to applicable rules and regulations of the COGCC and CDPHE; Environmental Monitors required by USFWS Protective Measure #3 would further ensure that hazardous material spills are adequately contained and remediated.

In summary, adoption of the Proposed Action Alternative will further reduce the minimal impacts to Refuge soils resulting from Lexam's planned exploration program.

4.2.2.1 Applicant Committed Protective Measures

USFWS Protective Measures #3, #5, and #34:

- Trained environmental monitors (#3);
- Construction to facilitate revegetation in accordance with COGCC rules with input from USFWS (#5); and
- Vehicles restricted to existing and proposed access roads and location (#34).

4.2.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, Lexam's planned exploration program would be conducted under applicable COGCC and CDPHE rules and regulations, as well as the specific conditions that have already been incorporated into Lexam's survey and drilling permits. A maximum of 14.5 acres of Refuge lands would be impacted by access road and drill pad construction as described in subsection 4.2.1 above. In addition, soils may be impacted by hazardous material spills. Because there would be no Environmental Monitors or enhanced input from USFWS into the site reclamation process and no restrictions on off-road vehicle use, there is a potential for greater impacts to the Refuge's soils under this Alternative than the Proposed Action Alternative.

4.2.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the impacts to soils that have been identified in subsection 4.2.1 would not occur. Existing roads and two-tracks would continue to be used for Refuge administration, maintenance and management.

4.2.5 Cumulative Impacts

4.2.5.1 Proposed Action

No cumulative impacts have been identified for geology, minerals, or soils. Under the Proposed Action, the planned project would add 14.5 acres of roads and pads to existing infrastructure that was present when the Refuge was a working ranch. In addition to the Lexam Road, there are various gravel and unpaved roads used to access Refuge offices, pastures, water wells, and irrigation equipment. These roads would continue to be used for Refuge administration, maintenance and management. The planned exploration wells would be the only oil and gas wells drilled on the Refuge to date. A total of 18 exploratory oil and gas wells have been drilled in all of Saguache County, only a few of which had hydrocarbon shows and there is no hydrocarbon production in the county (Cappa and Wallace 2007). There are no other reasonably foreseeable future activities (RFFA) regarding oil and gas in the cumulative effects study area as Lexam's planned activities are the only oil and gas permit applications of current record in the county (COGCC 2007). There are no RFFAs regarding road building or construction activities in the cumulative effects study area.

4.2.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts for the same reasons discussed above for the Proposed Action.

4.2.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.3 Air Quality

4.3.1 Effects of Lexam's Planned Exploration Program

Air quality impacts of the planned activities consist of emissions from vehicles and drilling and support equipment. Dust emissions also would result from traffic on unpaved roads and locations. With regard to emissions from the drilling operation (primarily diesel exhaust), a drilling rig is not considered a stationary source in Colorado unless it remains at the same location for longer than 12 months. If it is located at a site for less than 12 months, it is considered a mobile/temporary source. Mobile sources, including non-road engines, are not regulated in Colorado from an air permitting standpoint.

The drill rig engine specifications are not known at this time, but the draw-works rating could conceivably range from 1,200 to 1,500 horsepower to drill wells to the planned depth. The drill rig would be powered with diesel fuel.

The CDPHE Air Pollution Control Division (APCD) regulates sources of air pollutant emissions in Colorado. The method of registering air pollutant emission sources occurs through the filing of an Air Pollutant Emission Notice (APEN), and/or through a construction permit application. There are several exemptions from the requirement to file an APEN and a construction permit application. The exemptions from APEN requirements are outlined in Regulation No. 3, Part A, II.D. Sources are exempted because by themselves, or cumulatively as a category, they are deemed to have a negligible impact on air quality.

Reg. 3, Part A.II.D.1.III states, "Oil and gas exploration and production operations (well site and associated equipment) shall provide written notice to the Colorado Oil and Gas Conservation Commission of proposed drilling locations prior to commencement of such operations. Air Pollutant Emission Notices are not required until after exploration and/or production drilling, workovers, completions, and testing are finished."

The exemptions from construction permit requirements are outlined in Regulation No. 3, Part B, II.D. Reg. 3, Part B.II.D.1.a, which states that sources exempted from APEN filing requirements in Section II.D. of Part A of this regulation are exempt from having to obtain an air quality construction permit. Once the well is drilled and if production does not occur, the owner or operator shall submit written notice to the APCD indicating that the well was plugged, or that emissions are otherwise not reportable.

COGCC and CDPHE rules direct oil and gas operators to take appropriate actions to reduce dust emissions from their activities. Dust emissions may result from traffic on unpaved roads and locations. CDPHE rules specifically exempt reporting of dust emissions for developments that total less than 25 contiguous acres of disturbance and less than 6 months in duration. However, operators are required to implement a fugitive dust control plan, which can include but are not limited to watering roads, graveling roads, and controlling vehicle speeds.

Control measures to suppress dust emissions should minimize impacts. Emissions from drilling rig engines would occur, but since the activities would be short-term and would be conducted in compliance with applicable rules of the CDPHE and COGCC, the impacts of drill emission would be minimal. If water has to be hauled to the project area, there is increased likelihood of higher dust emissions from the additional road traffic. However, even under this scenario, the fugitive dust control plan would help limit these emissions to short-term, minimal impacts.

4.3.2 Proposed Action Alternative

The USFWS protection measures specifically address dust emissions, but do not address engine emissions. The USFWS is proposing that dust control measures be implemented near water bodies for the protection of sensitive aquatic life. Under the Proposed Action, air quality impacts would be minimized by compliance with COGCC, CDPE rules. The impacts would be short term for the duration of the activities. Impacts of airborne dust to surface water would be minimized through implementation of USFWS Protection Measures #15 and #25.

4.3.2.1 Applicant Committed Protective Measures

- USFWS protection measure #15 requires dust suppression for the protection of aquatic habitat.
- USFWS protection measure #25: Dust levels on regularly traveled access routes must be kept to a minimum. The Operator shall have a water truck and operator(s) readily available to perform dust abatement as needed, or as directed by the Refuge Manager or his authorized representative. Only water will be allowed for dust suppression efforts. Dust control measures shall be implemented

throughout the traveled areas of the project area in addition to the dust abatement requirement in measure #15.

4.3.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, Lexam's planned exploration program would be conducted under applicable COGCC and CDPHE rules and regulations, as well as the specific conditions that have already been incorporated into Lexam's survey and drilling permits. Since the planned project activities would be conducted in compliance with applicable COGCC and CDPHE rules as described above, the impacts would be slightly more than the Proposed Action Alternative, and will not include Protective Measures #15 and #25.

4.3.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the impacts to air quality that have been identified in subsection 4.3.1 would not occur. Impacts of dust emissions from routine vehicle use for Refuge administration and maintenance and management would continue.

4.3.5 Cumulative Impacts

4.3.5.1 Proposed Action Alternative

Past and current activities that contribute to air emissions in the cumulative impacts study area are emissions from vehicle traffic, equipment and seasonal emissions from residential heating. Lexam's planned activities under the Proposed Action would result in a temporary increase in emissions in the area, but there would be no cumulative impacts to air quality since there are no RFFAs in the area that would contribute to future emissions.

4.3.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.3.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.4 Water Resources

4.4.1 Effects of Lexam's Planned Exploration Program

There are two types of potential impacts to surface water resources that could occur as a result of Lexam's planned activities:

- Increased sedimentation and turbidity of surface water as a result of ground disturbance and increased erosion into surface waters via runoff; and
- Effects on water quality (i.e., potential contamination of surface water resources with drilling fluids, petroleum, or other chemicals used for natural gas drilling).

The potential for adverse impacts would be greatest in the short term after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts. The magnitude of these potential impacts to surface water resources depends on, slope aspect and gradient, soil type, the duration and timing of the activities, and the success or failure of reclamation and protection

measures. Since revegetation may be a long term activity, any potential impacts to surface water also would be long term, however minimal.

Potential impacts to ground water resources could include contamination of aquifers during drilling. Impacts to groundwater from drilling would be short term until protective casing is run and stops the fluid infiltration from the drilling mud.

4.4.2 Proposed Action Alternative

4.4.2.1 Surface Water Quality

Protection of water quality is an important concern. Potential impacts to surface water include sedimentation due to runoff and erosion and contamination of surface water from spills. Specific USFWS measures to minimize impacts are listed below in Section 4.4.3 and are intended to eliminate or minimize potential short and long term impacts to surface water. The COGCC and CDPHE rules concerning erosion control and sedimentation also would minimize impacts to surface water quality. Surface water would be protected from contamination by establishing protective measures such as buffers between surface water and surface activities. Proper handling of hazardous materials in accordance with applicable rules and regulations also would minimize potential impacts. The primary hazardous materials to be used are fuels (diesel and gasoline), drilling mud additives, and cement.

4.4.2.2 Groundwater Quality

In order to protect groundwater quality, several conditions and measures would be implemented. A closed-loop mud system would be used to eliminate the need for a drilling reserve pit, and drilling fluids and drill cuttings would be disposed of offsite. About 350 feet of surface casing would be run to protect the unconfined aquifer, and 3,000 feet of casing would be run to protect the confined aquifer. The casing strings will be fixed in place with cement pumped into in the annular space between casings or the borehole. The cement will fill the annular space from the depth where the casing is set to the surface. This will ensure that the aquifers are not only protected during drilling, but also are isolated from each other.

The use of drilling mud is designed to lessen the impact to porous and permeable formations. The use of drilling mud is an accepted practice for drilling all types of wells including water wells, environmental monitoring wells, and utility borings. Drilling mud is designed to seal the sides of the borehole and minimize the infiltration of the fluid component of the mud into porous and permeable layers. Impacts are expected to be limited to less than a few feet from the borehole. After drilling, the use of cement to case the borehole would seal porous zones from further infiltration of drilling fluids. If the well is plugged and abandoned, COGCC rules require that cement plugs be placed over porous and permeable zones to protect aquifers. Over a period of time the filtrate would disperse into the formation by movement of groundwater. The impact of the mud filtrate is expected to be negligible. Impacts to water quality would be less than significant because of the protection measures of the USFWS and compliance with permit conditions and rules of the COGCC.

4.4.2.3 Water Use

Lexam is negotiating to obtain approximately 15 acre-feet of water for use in the planned project. The water is being obtained through agreement with the USFWS, which owns the water well source. The Colorado Division of Water Resources has regulatory authority over the agreement and is not subject to USFWS protective measures. Acquisition of the 15 acre-feet of water from a well provided by the USFWS would result in no impact to water supply on the Refuge, since Lexam would be required to offset the depletion of water it uses, as described in Section 2.2.2.5. Because of the water replacement agreement, there would be no impact to water supply on the Refuge. If a substitute water supply plan is not approved, then water would have to be purchased from an off-site source and trucked to the drilling locations. If water is brought in from an outside source, there would be no impacts to groundwater use on the Refuge.

4.4.2.4 Applicant Committed Protective Measures

USFWS Protective Measures #6, #7, #13, #15, #27, #29, #30, #31, and #32, provide the following requirements:

- Baseline sampling and analysis of surface and groundwater (#6);
- Installation of monitoring wells at drill sites to monitor and quickly identify potential adverse conditions (#6);
- Installing at least 3,000 feet of intermediate casing for aquifer protection (#7);
- Locate activities as far as practicable from wetlands and water bodies (#13);
- Restrict activities in 0.25-mile-wide buffer zones from important water habitats (#15);
- Dust suppression near surface water bodies and throughout the project area (#15);
- Baseline soil testing (#27);
- Prohibition of pits, use of a closed-loop drilling fluid system to eliminate the need for a reserve pit and storage of drilling fluids and cuttings in tanks (#29);
- Off-site disposal of unused drilling fluid and drill cuttings (#29);
- Centralized storage of toxic materials and timely removal of waste materials when drilling operations have ceased (#30);
- Catch pans under equipment such as pumps, fuel tanks, and generators (#31); and
- No discharge of wastewater including sewage (#32).

4.4.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, Lexam's planned exploration program would be conducted under applicable COGCC and CDPHE rules and regulations, as well as the specific conditions that have already been incorporated into Lexam's survey and drilling permits. Potential impacts to groundwater and surface water under the No Action Alternative would be minimized through the implementation of COGCC Permit Conditions #8, #9, #12, #15, and #16 in and compliance with applicable CDPHE rules. Permit conditions regarding protection of water resources were included into the drilling permits at the request of the USFWS. Without the stringent protective measures implemented by the USFWS, impacts to water resources are potentially greater.

4.4.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the impacts to water resources that have been identified in subsection 4.4.1 would not occur. Surface water conditions would not be expected to be materially different from current conditions.

4.4.5 Cumulative Impacts

4.4.5.1 Proposed Action

No cumulative impacts to water resources have been identified and the USFWS. In addition, other than annual irrigation practices, no water projects have been identified in the cumulative effects study area which would create water-related cumulative impacts.

4.4.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.4.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.5 Vegetation and Habitats

4.5.1 Effects of Lexam's Planned Exploration Program

Direct effects would include reduction and removal of vegetation, soil compaction, and potential increased soil erosion. These effects would result from the creation of access roads and pad locations. In addition, the introduction and establishment of invasive and noxious species could occur due to vehicles entering the Refuge. Disturbed areas would be more vulnerable to invasions by noxious species. Effects to vegetation may be long term given the semi-arid climate and erosive nature of the soils.

To minimize the potential for direct effects to vegetation communities, construction and drilling activities would be conducted in accordance with all federal, state, and local laws and regulations and follow all of the COGCC permit conditions. All disturbed areas would be reclaimed according to the COGCC permit requirements and CDPHE regulations (as described in Section 1.6.1). To minimize the introduction of noxious and invasive plant species, the COGCC permit requirements and regulations would be implemented. According to COGCC permit condition #1, added at the request of USFWS, all equipment and vehicles brought onto the project area would be cleaned and decontaminated.

4.5.2 Proposed Action Alternative

4.5.2.1 Vegetation and Wetlands

In addition to the laws and regulations of other governmental agencies, impacts to vegetation communities would be minimized through the implementation of USFWS protective measures as described in Section 2.2. Protective measures imposed by the USFWS include the addition of environmental monitors, extra law enforcement personnel to enforce state, federal, refuge, and wildlife laws, additional requirements as requested by the USFWS, and the modification of drilling activities as necessary to avoid conflicts with other Refuge management activities. Reclamation activities would be conducted to ensure that the construction of roads and well pads would occur in a way that best facilitates the complete reclamation of the disturbed areas once Lexam activities have ceased.

Areas temporarily disturbed by construction and operation activities would be reclaimed as described above. In 3 to 5 years following successful reclamation, these areas would provide food, cover and nesting wildlife habitat. However, it may require up to 15 to 20 years for vegetation communities, especially shrub communities, to return to predisturbance levels. Those areas disturbed by construction and operation activities would be temporarily unavailable to wildlife use and as habitat. Therefore, impacts to vegetation and wetlands would be less than significant.

4.5.2.2 Noxious Weeds

Under the Proposed Action Alternative, the introduction and establishment of invasive and noxious species would be minimized by decontamination of vehicles based on USFWS protection measures, and any additional requirements required by the USFWS. Impacts due to invasive and noxious weeds are expected to be less than significant.

4.5.2.3 Sensitive Plant Species

Only one sensitive plant species has been identified in the project area, the slender spiderflower. Impacts to this sensitive plant species in the project area have been minimized by avoiding as much as possible areas that may contain sensitive plants. In laying out the location of roads, the avoidance of areas containing the

slender spider flower was conducted under the direction of the USFWS. Based on the avoidance of the flower as determined during the growing season, impacts are expected to be less than significant.

4.5.2.4 Applicant Committed Protective Measures

The following applicant committed protective measures will lessen impacts to vegetation.

- All vehicles and equipment from outside the Refuge will be decontaminated per USFWS procedures to prevent the introduction of noxious weeds to the Refuge (#1).
- Impacts to sensitive habitat, wildlife, plants or other sensitive natural or cultural resource features will be avoided to the extent possible while constructing the access road and well pads (#4).
- All construction of roads and pads will occur in a way that best facilitates their subsequent complete removal and reclamation once Lexam activities have ceased at these sites. This includes separating and stockpiling topsoil layers on-site to be replaced during reclamation. All disturbed areas will be reclaimed per the COGCC permit requirements and with USFWS input (#5).
- Well sites will be located as far from sensitive wet meadow wetlands as practicable (#13).
- All materials brought in to the Refuge to build up the location pad will be authorized by the Refuge Manager or his authorized representative. To minimize the spread of invasive species no top soils will be brought in from off Refuge (#18).
- Upon completion of drilling operations, the Refuge Manager or his authorized representative must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged according to state law, all above ground structures removed and the site and road restored as directed by the Refuge Manager or his authorized representative. Any damage to existing surface vegetation, water channels, or other physical features shall be restored to original site conditions. All costs shall be born by the Operator (#28).

4.5.3 No Federal Involvement Alternative

4.5.3.1 Vegetation and Wetlands

To minimize the potential for direct effects to vegetation communities, construction and drilling activities would be conducted in accordance with all federal, state, and local laws and regulations and follow all of the COGCC permit conditions. All disturbed areas would be reclaimed according to the COGCC permit requirements and CDPHE regulations as described in Section 1.6.1. Impacts would be greater than the Proposed Action Alternative since measures such as the USFWS requested re-route of the access road to Baca #5 to avoid dense populations of the slender spiderflower would not take place. Well sites and associated roads may have been located in sensitive wet meadow wetlands, thus impeding sheet water flows and potentially altering plant species composition and/or vigor.

4.5.3.2 Noxious Weeds

To minimize the introduction of noxious and invasive plant species, the COGCC permit requirements and regulations would be implemented. According to COGCC permit condition #1, added at the request of USFWS, all equipment and vehicles brought onto the project area would be cleaned and decontaminated. According to COGCC regulations, all disturbed areas shall be kept free of noxious weeds as practicable. However, impacts are potentially greater because there would be no on-site monitoring to ensure that vehicle contamination is done properly, no requirement allowing the Refuge manager to approve all construction material brought in and no requirement preventing the importation of topsoils onto the Refuge.

4.5.3.3 Sensitive Plant Species

Under the No Federal Involvement Alternative, there would be no procedure to re-route roads in order to avoid the sensitive spider flower. Impacts to the slender spider flower would be greater than the Proposed Action Alternative.

4.5.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the impacts to vegetation that have been identified in subsection 4.5.1 would not occur.

4.5.5 Cumulative Impacts

4.5.5.1 Proposed Alternative

No RFFAs that would result in cumulative impacts to vegetation and habitats have been identified in the cumulative effects study area. However, any future activities that may occur within the cumulative impact study area would be subject to federal, state, local, and Refuge laws and regulations that preserve native plant communities, protect sensitive plant species, and prevent the introduction of noxious and invasive plant species.

4.5.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.5.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.6 Wildlife and Fisheries

4.6.1 Effects of Lexam's Planned Exploration Program

Wildlife and fisheries species and related issues addressed by this analysis were determined through consultation with CDOW, CNHP, and USFWS. The primary issues related to wildlife and fisheries resources include the loss or alteration of native habitats, increased habitat fragmentation, animal displacement, direct loss of wildlife, and impacts associated with water crossings at Crestone and Willow creeks. However, the effects on wildlife species and their habitats would depend on factors such as the sensitivity of the species, seasonal use patterns, type and timing of project activity, and physical parameters (e.g., topography, cover, forage, and climate).

4.6.2 Proposed Action Alternative

Under the Proposed Action Alternative, the USFWS and Lexam have developed a number of protection measures in order to mitigate surface impacts to terrestrial wildlife, aquatic species, and special status species within the project area. However, there may be some unavoidable direct impacts to wildlife: a reduction or alteration of habitat, habitat fragmentation, and animal displacement. Additionally, there may be an increase in indirect impacts such as noise, human presence in sensitive habitats, and vehicle-related mortalities in areas with special status species. Impacts to wildlife and fisheries resources as a result of the planned project would be minimized by implementation of USFWS protective measures.

4.6.2.1 Big Game

Direct impacts to big game species (elk, mule deer, and pronghorn) would result from the incremental disturbance of habitat and increased habitat fragmentation. The loss of available vegetation would be

long-term (greater than 20 years), although herbaceous species may become established within 3 to 5 years, depending on reclamation success and future weather conditions. In most instances, suitable habitat adjacent to the disturbed areas would be available for these species until grasses and woody vegetation were reestablished within the disturbance areas.

Other impacts to big game species would include increased animal disturbance as a result of increased noise levels and human presence. As a result, big game animals likely would decrease their use within 0.5 mile of surface disturbance activities (Ward 1976).

Impacts to big game species are expected to be minimal because of USFWS protective measures and because of the temporary nature of the activities. Seasonal restrictions on activities would eliminate disturbance to birthing animals and animals caring for newborns. Fences would be used, if needed, to prevent animals from coming in direct contact with machinery and hazardous materials. Other measures would include restricting vehicle traffic to existing Refuge roads and reducing habitat fragmentation and habitat loss by limiting the construction of new roads. Preconstruction surveys for wildlife species including big game would occur in areas where the access roads and well pads would be built. Vehicle speed restrictions would reduce potential for road kill accidents. Impacts to mountain lions and black bears also would be expected to be minimal, based on the infrequent occurrence of these species within the project area.

Because of the above protective measures impacts to big game species would be less than significant.

4.6.2.2 Small Game

Impacts to small game would be greater than those to large game because they are limited in their ability to temporarily relocate during periods of disturbance because of their smaller size. Temporary disturbances and habitat losses could cause unnatural movements of these species away from the disturbance and altered habitats, which may result in an increased vulnerability to predators. USFWS protective measures would minimize impacts to small game species. Seasonal restrictions on activities would eliminate disturbance to birthing animals and animals caring for newborns. Vehicle traffic would be restricted to existing Refuge roads or new access roads, thereby reducing habitat fragmentation and habitat loss by limiting the construction of new roads. Vehicle speed restrictions would reduce potential for road kill accidents.

4.6.2.3 Non-game Species

Impacts to non-game species are expected to be minimal because of USFWS protective measures. Vehicle traffic would be restricted to existing Refuge or new access roads, thereby reducing habitat fragmentation and habitat loss. Seasonal timing restrictions would eliminate disturbance to birthing animals and animals caring for newborn. Preconstruction surveys for wildlife species, including non-game species, would occur in areas where the access roads and well pads would be built, and sensitive habitat (e.g., wet meadows and riparian areas) would be avoided whenever possible. Vehicle speed restrictions would reduce potential for road kill accidents.

4.6.2.4 Migratory Birds

Impacts to migratory birds (waterfowl, shorebirds, passerines and raptors) are expected to be minimal because of USFWS protective measures. Vehicle traffic would be restricted to existing Refuge or new access roads, thereby reducing habitat fragmentation and habitat loss. Seasonal timing restrictions would eliminate disturbance to nesting birds and those with unfledged young. Preconstruction surveys for wildlife species, including migratory birds, would occur in areas where the access roads and well pads would be built, and sensitive habitat (e.g., wet meadows and riparian areas) would be avoided whenever possible. Vehicle speed restrictions would reduce potential for road kill accidents.

4.6.2.5 Fisheries

Impact issues evaluated for aquatic communities (i.e., fish and amphibians) and sensitive fish species (i.e., Rio Grande sucker, Rio Grande chub) included potential effects of project activities on water quality and quantity and habitat in the Crestone Creek drainage. The occurrence of nongame fish is limited to Crestone Creek within the project area. The aquatic stages of amphibians could occur in Crestone, Willow, and Spanish creeks as well as in wet meadows during spring and fall months. Migrating amphibians in their terrestrial stages may still be occurring during the months of August over many wetter portions of the project area. Impacts to migrating amphibians in their terrestrial stages would be minimized by seasonal restrictions resulting in no activity being allowed on the Refuge during the peak migration times of June and July.

Impacts to fisheries would be minimized by implementation of USFWS protective measures. Construction activities would maintain a distance of at least 0.25 mile from sensitive water crossings such as Crestone Creek. Vehicle traffic would be restricted along water crossings with fish present. Water quality monitoring would be conducted in waterways near construction activities to determine the presence of impacts due to the planned project and to enable implementation of protective measures to mitigate potential problems.

4.6.2.6 Special Status Species

The USFWS protective measures also would minimize impacts to special status species. Vehicle traffic would be restricted to existing Refuge roads and the new access roads, thereby reducing habitat fragmentation and habitat loss by limiting the construction of new roads. Preconstruction surveys for wildlife species including special status species, would occur in areas where the access roads and well pads would be built, and sensitive habitat (e.g., wet meadows and riparian areas) would be avoided. Therefore, impacts to special status species would be minimal.

4.6.2.7 Applicant Committed Protective Measures

USFWS Protective Measures #3, #4, #6, #8, #9, #12, #13, #14, #15, and #35 would provide for the following requirements:

- Trained environmental monitors (#3);
- Impacts to sensitive habitat, wildlife, or other sensitive natural resource features will be avoided while constructing the access road and well pads (#4).
- Baseline water quality sampling and analysis of shallow groundwater and surface water in proximity to the planned well locations will be conducted prior to drilling (#6).
- Implementation of a closed loop mud and drill cuttings system will be used to minimize impacts to surrounding habitats (#8).
- Drilling operations will be modified, as necessary at the direction of USFWS, to reduce conflicts with other Refuge management activities (#9).
- Seasonal restrictions (May 1 through July 31) on construction and drilling activities would avoid conflicts with birthing and/or nesting and the fledging of young birds (#12).
- Well sites would be located as far from sensitive wet meadow wetlands as possible (#13).
- Fencing of drill pads if necessary to prevent large ungulates from gaining access to the sites (#14).
- Establish a 0.25-mile buffer zone of no activity around potential and identified sensitive species fisheries habitat (#15).
- Limit vehicle crossings to existing or pre-approved crossings (#15).
- All vehicle access will be restricted to developed roads and two-tracks (#34).
- Vehicle speed restrictions would reduce potential for road kill accidents (#34).

4.6.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, impacts on terrestrial wildlife, aquatic species, and special status species were assessed based on standard rules and conditions of approval imposed by the COGCC, and other applicable rules and regulations of various federal and state agencies (e.g., CDOW and USFWS). No additional protective measures would be required by the USFWS to reduce impacts on wildlife resources.

4.6.3.1 Big Game

Impacts to big game under this Alternative would be slightly greater than under the Proposed Action Alternative since the protection measures listed in Section 4.6.3 would not be implemented.

4.6.3.2 Small Game

Impacts to small game under this Alternative would be greater than the Proposed Action Alternative since the protection measures listed in Section 4.6.3 would not be implemented.

4.6.3.3 Nongame Species

Impacts to nongame species under this Alternative would be the same as small game.

4.6.3.4 Migratory Birds

Impacts to migratory birds under this Alternative could be greater than under the Proposed Action Alternative. No restrictions on timing of drilling activities would result in some breeding birds being more limited in their ability to temporarily relocate during periods of disturbance because of fidelity to nests and unfledged young. This could result in nest abandonment and failure.

4.6.3.5 Fisheries

Impacts to fisheries under this Alternative would be greater than under the Proposed Action Alternative. There would be no buffer zone around surface waters excluding construction activities and no monitoring of surface waters to monitor for potential impacts. Surface disturbance activities associated with construction of new roads could result in soil erosion within these floodplains (Garcia 2007). Construction activities could cause mortalities to amphibians during their occurrence in terrestrial habitats.

Compliance with COGCC and CDPHE regarding handling of hazardous materials and chemicals would result in minimal impacts to Crestone, Willow, and Spanish creeks. Any spills would be contained and remediated according to applicable rules and regulation. Storage and containment measures would be used at the well pads to minimize any chemicals entering these drainages.

4.6.3.6 Special Status Species

Potential impacts to special status species would be the same or slightly greater than under the Proposed Action Alternative. Because there would be no protective measures by USFWS, direct impacts to special status species would include the incremental disturbance of habitat and increased habitat fragmentation. Impacts also could include mortalities of less mobile species (e.g., small mammals and amphibians), nest abandonment, and loss of eggs or young as a result of crushing from vehicles and equipment. However, potential impacts would be minimal because of the limited project area and temporary nature of the planned project.

4.6.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the impacts to wildlife and fisheries that have been identified in subsection 4.6.1 would not occur.

4.6.5 Cumulative Impacts

4.6.5.1 Proposed Alternative

The cumulative impact study area for wildlife resources is the Refuge. In the absence of known RFFAs on the Refuge, there would be no cumulative impacts to wildlife resources.

4.6.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.6.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.7 Cultural Resources

The Class III inventory identified one prehistoric lithic scatter (5SH3146), one historic canal (5SH3147.1), and four isolated finds. Site 5SH3146 and all four of the isolates were recommended as not eligible for the NRHP; no further work is recommended at these sites. The historic canal was recommended as eligible for the NRHP.

4.7.1 Effects of Lexam's Planned Exploration Program

Direct effects to historic properties that could occur as a result of Lexam's planned exploration program include disturbance or destruction of archaeological sites as a result of road or well pad construction. Indirect effects include vandalism, illegal collecting, or inadvertent destruction due to increased numbers of people (i.e., construction personnel) in the project area and increased erosion due to soil disturbance associated with construction activities.

4.7.2 Proposed Action Alternative

Under the Proposed Action Alternative, the USFWS would adopt protective standards and measures to ensure that Lexam's exploratory drilling project does not unreasonably degrade or impact environmental resources. Lexam proposes to install a culvert to allow vehicular traffic to cross the NRHP-eligible canal (5SH3147.1) without affecting the historic character of the resource. Therefore, no direct adverse effects to the historic canal would occur as a result of the Proposed Action.

To minimize the potential for indirect effects to historic properties, project personnel would be requested to perform contract operations in a careful and conscientious manner and to perform all work in accordance with all laws and regulations (Section 2.2). Little or no indirect effects to historic properties from modifications to erosion/sedimentation rates during drilling activities are anticipated. In accordance with applicant-committed environmental protection measures, all construction of roads and pads would occur in a way which best facilitates their complete removal and reclamation once Lexam activities have ceased at these sites. All disturbed areas would be reclaimed per the COGCC permit requirements and with input from the USFWS.

Given the sand deposits throughout the area and specifically at the well pad and access road locations, monitoring of all proposed ground disturbance would be conducted by a qualified archaeologist (Section 2.2). If any previously unknown cultural resources are discovered during well pad and access road development, all construction activities would cease within the vicinity of the discovery and the USFWS Authorized Officer would be notified of the find. Steps would be taken to protect the site from vandalism or further damage until the USFWS Authorized Officer can evaluate the nature of the discovery as outlined in the Unanticipated Discoveries Plan, which is being prepared by Western Cultural Resource Management, Inc. Construction would not resume in the area of the discovery until the USFWS Authorized Officer has issued a notice to proceed.

If construction or other project personnel discover what may be human remains, funerary objects, or items of cultural patrimony, construction would cease within the vicinity of the discovery, and the USFWS Authorized Officer would be notified of the find. Any discovered Native American human remains, funerary objects, or items of cultural patrimony would be handled in accordance with NAGPRA. Non-Native American human remains would be handled in accordance with Colorado law. Construction would not resume in the area of the discovery until the USFWS Authorized Officer has issued a notice to proceed.

All known historic properties identified within the APE would be avoided by project construction. Archaeological monitors would be present during ground-disturbing activities in the event subsurface materials are discovered. Any previously unknown historic properties that may be discovered during ground-disturbing activities would be protected in accordance with the Unanticipated Discoveries Plan. Therefore, no additional protection measures or monitoring are recommended.

4.7.2.1 Applicant Committed Protective Measures

- All known archaeological resources identified within the APE would be avoided by project construction (#2).
- Archaeological monitors would be present during ground-disturbing activities in the event subsurface materials are discovered (#3).
- Impacts to sensitive habitat, wildlife, plants or other sensitive natural, cultural or historical resource features will be avoided to the extent possible while constructing the access road and well pads (#4).

4.7.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, Lexam's planned exploration program would be conducted under applicable COGCC rules and regulations as well as the specific conditions that have already been incorporated into Lexam's survey and drilling permits. No Archaeological monitors would be present during ground disturbing activities which would increase the chance of impacts to historic resources in the event of unanticipated discoveries during construction.

4.7.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the impacts to cultural resources that have been identified in subsection 4.7.1 would not occur. Archaeological discovery is often dependent upon ground-disturbing activities. If drilling activities do not occur, there is less potential of the discovery of archaeological resources.

4.7.5 Cumulative Impacts

4.7.5.1 Proposed Action

The cumulative impact study area for cultural resources encompasses the Refuge. Under the Proposed Action Alternative, no adverse effects to archaeological resources would occur; therefore, there would be no incremental impact to historic properties when added to past, present, and RFFAs within the cumulative impact study area.

4.7.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.7.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.8 Native American Traditional Values

The effects of federal undertakings on TCPs or places of religious and cultural significance to contemporary Native Americans are given consideration under the provisions of EO 13007, AIRFA, NAGPRA, and recent amendments to the NHPA. As amended, the NHPA now integrates Indian tribes into the Section 106 compliance process, and also strives to make the NHPA and NEPA procedurally compatible. Furthermore, under NAGPRA, culturally affiliated Indian tribes and federal agencies jointly may develop procedures to be taken when Native American human remains are discovered on federal lands.

4.8.1 Effects of Lexam's Planned Exploration Program

Potential direct and indirect impacts to Native American traditional values as a result of the Lexam's planned exploration program would be the same as those described for cultural resources in Section 4.7. Government-to-government consultation between the USFWS and tribal representatives was initiated on September 20, 2007, and currently is ongoing. To date, no TCPs or places of cultural and religious importance to the tribes have been identified either during the cultural resources inventory or through tribal consultation.

If a TCP or place of cultural and religious importance is identified by tribal representatives, no surface disturbance would occur within or immediately adjacent to the boundary of the property prior to completion of all consultation required by law. If data recovery or other form of mitigation is required at a TCP or place of cultural and religious importance, a data recovery or mitigation plan would be reviewed and approved by the USFWS and SHPO. Tribal representatives would be asked to participate in the development of any such data recovery or mitigation plan. Therefore, no adverse effects to Native American traditional values are anticipated as a result of Lexam's planned exploration program.

4.8.2 Proposed Action Alternative

Potential direct and indirect impacts to Native American traditional values as a result of the Proposed Action Alternative would be the same as those described for Lexam's planned exploration program in subsection 4.8.1.

No adverse effects to Native American traditional values are anticipated as a result of the Proposed Action Alternative.

4.8.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, Lexam's planned exploration program would be conducted under applicable COGCC rules and regulations, the provisions of EO 13007, AIRFA, NAGPRA, and recent amendments to the NHPA, as well as the specific conditions that have already been incorporated into Lexam's survey and drilling permits. Under this Alternative, potential effects to Native American traditional values would be the same as described for the Proposed Action Alternative (Section 4.8.2).

4.8.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and there would be no effects to Native American traditional values.

4.8.5 Cumulative Impacts

4.8.5.1 Proposed Action

The cumulative impact study area for Native American traditional values encompasses the Refuge. To date, no TCPs or places of cultural and religious importance have been identified by tribal representatives. If any properties of tribal importance are identified, the properties would be protected under the same laws and regulations that protect important cultural resources. Therefore, no adverse effects to Native American

traditional values are anticipated as a result of the Proposed Action Alternative and no incremental impacts to these values would occur when added to past, present, and reasonably foreseeable future actions within the cumulative impact study area.

Reasonably foreseeable future actions that may occur within the cumulative impact study area would be subject to federal and state laws that protect TCPs and places of cultural and religious importance to Native Americans. Class III inventories and government-to-government consultation would be completed for any future proposed development, and potential adverse effects to any Native American traditional values would be avoided or mitigated as appropriate.

4.8.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.8.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.9 Recreation

4.9.1 Effects of Lexam's Planned Exploration Program

Lexam's planned exploration program would have no impacts to recreation resources as the Refuge is not currently accessible to the public. The planned activities would not diminish recreational opportunities outside of the Refuge, such as at Great Sand Dunes National Park, the portions of which are within a mile from the project area.

4.9.2 Proposed Action Alternative

The Proposed Action Alternative would have no impacts to recreation resources because the Refuge is not accessible to the public.

4.9.3 No Federal Involvement Alternative

The No Federal Involvement Alternative would have no impacts to recreation resources because the Refuge is not accessible to the public.

4.9.4 No Mineral Exploration Alternative

Under the No Mineral exploration Alternative, Lexam's planned exploration program would not go forward and there would be no impacts to recreation.

4.9.5 Cumulative Impacts

4.9.5.1 Proposed Action

Since the Proposed Action Alternative would result in no impacts to recreation resources, there would be no cumulative impacts.

4.9.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.9.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.10 Socioeconomic Resources

4.10.1 Effects of Lexam's Planned Exploration Program

4.10.1.1 Economy

Lexam's planned exploration program is expected to employ approximately 20 personnel on-site for the duration of approximately 4 to 5 months. The exploration itself would be contained within the Baca Refuge; however, project personnel are likely to lodge in Alamosa for the duration of the project. The presence of project personnel in Alamosa would generate a small amount of additional income for local businesses; motels, dining establishments, gas stations, etc. Alamosa County generates about \$100,000 in lodging tax revenue (Colorado State Cooperative University Extension 2006), and the additional income would be a small fraction of that revenue. However, the additional room receipts and other personal expenditures would be a minor beneficial impact.

4.10.1.2 Traffic

Lexam's planned exploration program would generate additional traffic on local roads, notably CR T, and temporary traffic delays may occur when large equipment is moved to the planned drill sites. Movement of large equipment would be regulated by the Colorado DOT and may involve temporary lane closures or traffic detours to accommodate wide loads. Depending on the day of the week and time of day, such disruptions may cause a temporary negative impact on existing local traffic patterns.

In the event water is required to be trucked in to the drill sites, as many as 250 tanker truck loads per well may be required and will increase the impact on existing local traffic patterns.

4.10.1.3 Emergency Services

Local emergency services may potentially be called upon during Lexam's planned exploration program in the event that an emergency situation develops. The local emergency response team's capabilities and assets include Emergency Medical Service transport services, a fully trained Hazmat team, police and firefighters, and a Level III trauma center. In addition, three of the COGCC permit conditions are relevant to the local community emergency response:

- Prior to commencing operations, an inventory of all chemicals and products that will be used or stored on site must be provided to the COGCC, the surface owner, and local emergency response personnel prior to bringing those materials on to the Refuge. If additional chemicals or products are required, then information about these substances must be provided to the COGCC, the surface owner, and local emergency response personnel prior to bringing them on to the Refuge.
- Prior to commencing operations, a meeting with the local emergency response personnel will be held to establish an adequate safety and response plan for drilling activities.
- Prior to rig-up, Lexam, in concert with its selected drilling contractor, will prepare an Emergency Preparedness Plan covering exploratory drilling, well control, materials hauling, spill response, and fire evacuation. The plan will be provided to the Refuge Manager and local governments. The provisions of the plan will be discussed in a pre-operation meeting to be held with Refuge management and local governments. The plan shall contain a telephone list naming key contacts for emergency operations and activation. Deficiencies in local emergency services will be identified and measures to emergency response will be discussed and implemented.

4.10.1.4 Other Socioeconomic Resources

Lexam's planned exploration program would not have an impact on regional demographics, housing, or land use. There are no Environmental Justice issues relating to Lexam's planned exploration, as the Crestone and Baca Grande subdivision area does not comprise a low income or minority population.

4.10.2 Proposed Action Alternative

Under the Proposed Action Alternative, Lexam's planned exploratory drilling project would be conducted within the COGCC rules and permit conditions and additional measures adopted by the USFWS to ensure that the project does not unreasonably degrade or impact the surface estate. Socioeconomic impacts under the Proposed Action Alternative would be similar to those described above in subsection 4.10.1 as no additional measures or standards relating to socioeconomics have been adopted by the USFWS.

4.10.3 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, Lexam would conduct their exploratory project within standard COGCC rules and permit conditions. Socioeconomic impacts under the No Action Alternative would be the same as those described above in subsection 4.10.1.

4.10.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative exploratory drilling for gas and oil would not occur. The traffic impacts of heavy equipment on local roads would not occur. The economic benefits that would have occurred from drilling activities would be lost. Other activities might take place on the Refuge, including scientific studies and surveys and maintenance projects that might attract small numbers of people to the area.

4.10.5 Cumulative Impacts

4.10.5.1 Proposed Action

Because no RFFAs have been identified in the cumulative effects area and socioeconomic impacts are anticipated to be minimal and temporary, there would be no cumulative impacts.

4.10.5.2 No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

4.10.5.3 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

4.11 Aesthetics

There were numerous concerns about the effects of the planned project on the setting of the area surrounding the planned project. The visual aspects and quietness are highly prized values for area residents. The issues addressed under aesthetics, visual resources and noise, address the potential impacts to the values expressed by residents of the area.

4.11.1 Visual Resources

4.11.1.1 Effects of Lexam's Planned Exploration Program

This section discusses potential visual impacts associated with the project's drill rig, facility lighting, drill pads (2), upgraded access roads, and ancillary facilities. Project activities would be temporary, lasting

approximately 120 to 180 days. The dominant facility would be the drill rig, which would be approximately 135 feet in height. The project would create nighttime glare from the light of the drill rig and facilities that would be seen from viewers in the surrounding viewshed.

The drill rig, facility lighting, roads, and drill pads, which may be visible by viewers at a distance of 2.0 miles or greater, would create an adverse aesthetic impact. This visual impact is estimated as less than significant due to the middleground to background viewing distances. While nighttime glare from facility lighting would have an adverse affect on viewers, it is estimated that the impact would be less than significant. This glare would reduce the darkness of the night sky and degrades viewers' enjoyment of the nighttime sky from secluded residences, trails, and recreation areas. It is possible that lighting may also have an affect on wildlife. The glare is incompatible with the mostly dark nighttime sky of the undeveloped areas near the project area. However, the lights are needed to allow for the safe operation of the facility at night and to comply with OSHA regulations. Although shielded lighting could potentially reduce the nighttime glare, even the most rigorously mitigated lighting plan would not completely eliminate nighttime glare from a facility that must comply with OSHA's lighting requirements.

The drilling rig would be visible during clear days, but differing vantage points would affect visibility. The tallest object in the project area is a tall cottonwood tree that is an estimated 53 feet tall and is visible for long distances. The rig being over 2 times taller than this tree also would be visible over distances of several miles. It would be especially visible from north of the project area along CR T. Looking down from the higher elevations to the east, the rig may not stand out above the horizon at a distance of more than a few miles. Atmospheric conditions such as wind-blown dust and haze also would affect view of the rig. On cloudy, windy, or snowy days, the rig would be less visible or not visible.

Diminishment of the viewshed is a concern with regard to visitors to the Great Sand Dunes National Park located adjacent to the Refuge. The closest proposed location (Baca #7) is 2 miles from the extreme northern boundary of the park (**Figure 1-1**), but is about 18 miles northwest of the park visitor center. The vast majority of visitors to the park will be at the visitor center and immediate environs. Although the rig would not be viewable at a distance of 18 miles, the elevation of the dunes immediately to the north and northwest would preclude viewing from the visitor center. The nearest that potential visitors traveling to the park would be to the project area is if they were traveling on State Highway 17. From the nearest point on Highway 17, travelers would be at least 6 miles due west of the project area. At that distance, the rig would be hard to discern by the casual viewer. At night, lights from the project area would not likely be distinguishable from the lights of Crestone and the Baca Grande Subdivision that are directly in the line of sight to the east and northeast of the project area. It is possible that a few park visitors could view the rig from the northern extent of the park, but as stated above, the park boundary is at least 2 miles from the closest proposed location and it is not likely that many visitors would be present in that part of the park.

Fugitive dust emissions from vehicle traffic also would present visual effects.

The presence of the drill rig, facility lighting, roads, and drill pads, by viewers from the perimeter of the Refuge, would create an adverse aesthetic impact; however, viewing at distances of 2.0 miles or more would diminish the impact. The impacts would be temporary in nature. Therefore, visual impacts would be less than significant.

4.11.1.2 Proposed Action Alternative

No special protection measures are recommended specifically for visual resources; however Lexam will ensure to the extent possible for safety that lights on the drilling rig and location are directed to work areas. The air quality protective measure of wetting down roads would reduce the visual effects of dust emissions.

4.11.1.3 No Federal Involvement Alternative

Impacts associated with the No Federal Involvement Action Alternative would be similar as those described for the Proposed Action Alternative because of dust abatement requirement as required by the CDPHE (Section 4.3.1).

4.11.1.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the visual effects that have been identified in subsection 4.11.1.1 would not occur.

4.11.2 Noise

This section analyzes the potential noise effects of the planned exploration program, which would emanate from the access roads and drilling locations.

4.11.2.1 Effects of Lexam's Planned Exploration Program

Road construction, vehicle operation, and drilling equipment operation would be the sources of noise above ambient levels. The planned exploration program is located in a setting that can be characterized as rural, where ambient noise levels range from 35 to 45 dBA. Noise is attenuated as the distance from the source to the receptor increases.

Noise monitoring results of natural gas drilling rigs at the Pinedale Anticline in Wyoming recorded the highest average noise levels of 66.8 dBA at 130 feet from the drilling rig in various directions around the rig (ENSR 2007). The drilling activity that is most likely to produce the highest noise levels is drill pipe moving in or out of the hole (tripping). Based on the average 66.8 dBA reading 130 feet from the derrick, noise attenuation calculations (Engineering Page 2007) indicate that at a distance of 2,000 feet from the rig, noise levels would attenuate to 43.1 dBA, within the ambient noise range for the setting of the proposed project and well below the Colorado statutory maximum permissible noise level in a nighttime residential setting (50 dBA). Because noise effects would be at ambient levels at 2,000 feet or less from the rig, and the activities would be temporary in nature, the effects of noise from the project are expected to be minimal. Noise may have an impact on wildlife, but beyond 2,000 feet from the source, those impacts are expected to be minimal.

It is expected that Lexam will use a drilling rig (if available) equipped with a diesel-electric conversion type power system. A diesel electric power system uses diesel engines to power electric motors, which are the prime movers for the system. The use of the system allows for fewer spikes in noise when the rig is pulling heavy loads, as for instance, when tripping drill pipe out of the hole. It is not possible to remove all sources of noise, but Lexam will strive to obtain muffling equipment on all engines that will reduce sound levels to reasonable minimums.

4.11.2.2 Proposed Action Alternative

Impacts associated with the Proposed Action Alternative would be the same as those outlined above in subsection 4.11.2.1 as the USFWS has not adopted special protection measures specifically for noise effects. Lexam, however, has committed to the use of mufflers on drilling rig engines that are designed to further attenuate noise emissions and will a diesel-electric powered rig (if available) to further reduce noise.

4.11.2.3 No Federal Involvement Alternative

Impacts caused by potential noise effects would be the same for the No Federal Involvement Alternative as those outlined above in subsection 4.11.2.1. Lexam, as stated above has committed to the use of mufflers on drilling rig engines that are designed to further attenuate noise emissions and use a diesel-electric powered rig (if available) to further reduce noise.

4.11.2.4 No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, Lexam's planned exploration program would not go forward and the potential noise effects that have been identified in subsection 4.11.2.1 would not occur.

4.11.2.5 Cumulative Impacts

Proposed Action

Because minimal visual and noise effects are anticipated from the Proposed Action Alternative and no RFFAS in the cumulative impacts study area have been identified, there would be no cumulative impacts.

No Federal Involvement Alternative

Under the No Federal Involvement Alternative, there would be no cumulative impacts as discussed above for the Proposed Action.

No Mineral Exploration Alternative

Under the No Mineral Exploration Alternative, there would be no cumulative impacts because no mineral exploration activities would occur.

5.0 Consultation and Coordination

5.1 Introduction

The USFWS is the lead agency for this EA. There are no cooperating agencies.

5.2 Preparers and Reviewers

Table 5-1 lists the preparers and reviewers who participated in preparing the Baca Refuge Gas Exploration Project Environmental Assessment.

Table 5-1 List of Preparers and Reviewers

| Name | Education/Experience | Project Role |
|---------------------------------------|---|--|
| U.S. Fish and Wildlife Service | | |
| Connie Young-Dubovsky | | Regional NEPA Coordinator |
| Mike Blenden | | Project Leader |
| Mike Artmann | | Wildlife Biologist |
| Meg Van Ness | | Regional Archaeologist/Native American Consultation |
| Laura Archuleta | | Contaminants Biologist |
| Ron Garcia | | Refuge Manager |
| ENSR | | |
| William Berg | M.S. Geology, 27 years experience | Project Manager, Geology, Minerals, Soils, Hydrology, Air, Noise |
| Chantal Cagle | M.A. Anthropology 23 years experience | Project Coordinator Socioeconomics |
| Merlyn Paulson | M.L.A. (Landscape Architecture) 33 years experience | Visual Resources |
| Erin Bergquist | M.S. Ecology, 6 years experience | Vegetation and Wetlands |
| Charles Johnson | M.A. Ecology 14 years experience | Wildlife Biology |
| Matt Brekke | B.S. Wildlife Biology, 2 years experience | Wildlife Biology |
| Kim Munson | M.A. Anthropology 12 years experience | Cultural Resources Native American Traditional Values |
| Drew Ludwig | M.S. Zoology 35 years experience | NEPA Specialist |

5.3 Persons and Agencies Contacted

The following persons and agencies were contacted in the process of preparing this EA.

- Tom Lennon, Western Cultural Resource Management;
- Michael Menefee-Environmental Review Coordinator, Colorado Natural Heritage Program;
- Ron Rivale-District Wildlife Manager, Colorado Division of Wildlife; and
- City of Alamosa Chamber of Commerce.

5.4 Summary of Public Participation

NEPA does not require public involvement in the development of an EA. However, the public must be informed of a completed EA.

The USFWS recognized the importance of public involvement in the Baca Refuge Gas Exploration project and held an open house meeting on August 17, 2007, at the Baca Grande Property Owners Association Hall; the purpose of the meeting was to provide information to the public on gas exploration activities being conducted on the Refuge and the purpose of the EA and to solicit public input. Seventy-nine members of the public attended the meeting, and five comments were submitted at the meeting. USFWS allowed the public an additional 30 days in which to submit written comments.

The San Luis Valley Ecosystem Council encouraged community input and provided suggested comments and alternatives on their website (<http://www.slvac.org/lexam/scoping.html>), and many of these comments were included in the letters received from the local communities. The Colorado College student community sent in several hundred form letters with personal comments added. The Natural Resources Defense Council (NRDC) stimulated many additional letters and widened the geographical coverage by providing an internet form letter on their website.

In all approximately 48,500 individual letters or Emails were received. Approximately 97 percent (47,245) of the letters received were form letters generated through the NRDC website. Some of these letters had been edited prior to being sent, providing additional personal comments or opinions (including three that were in favor of the planned gas exploration). All of these comments were reviewed in preparation of the EA.

The majority of the comments related to whether gas exploration activities should occur on the Refuge. In general, these comments raised issues and concerns relating to the potential impact of gas exploration activities on:

- Groundwater (specifically the aquifers beneath the Refuge);
- Air quality;
- Wildlife and the Refuge ecosystem;
- Cultural resources; and
- Aesthetic resources (e.g., noise and visual impacts).

Additionally, letters expressed concerns about the use and disposal of hazardous materials, heavy equipment traffic on local roads, and the issue of liability and mitigation of damages. A number of letters expressed discontent with the NEPA process and requested additional meetings or time to respond with comments, suggested an EIS be required, or that drilling be delayed until a comprehensive management plan has been developed for the Refuge.

Prior to the NEPA process, USFWS hosted three public meetings specifically to gather public input and solicit concerns regarding Lexam's proposed gas exploration on the Refuge.

Special speakers, including the COGCC Director, representatives from Lexam, and citizens from areas where oil and gas activities occur were brought in for these meetings, the meeting minutes were posted on various community websites, and newspaper articles were published in the Valley Courier, Crestone Eagle and the Pueblo Chieftain about the planned activities to provide maximum public involvement.

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Appendix A

Protection Measures and Conditions 3-D Seismic Survey

**Protective Measures and Conditions for Lexam Explorations (USA)
To Conduct 3-D Seismic Survey
USFWS, Baca National Wildlife Refuge
Winter 2006-2007**

The USFWS management and operational procedures for the seismic survey which are designed to eliminate avoidable impacts to natural and cultural resources and physical infrastructure on the Baca National Wildlife Refuge (Refuge), and to control or reduce unavoidable adverse impacts. Those management and operational procedures are list below:

- 1) The Refuge Manager and environmental monitors will retain the right to "stop work" in any situation that imperils a Threatened or Endangered species or its habitat, that causes significant harm to Refuge resources, that threatens cultural or historic resources, or that endangers public safety. Any sightings of cultural features or artifacts or sightings of threatened or endangered species by employees or contractors of Lexam will be immediately reported to the Environmental Monitor or the Refuge Manager.
- 2) Lexam will, to the greatest extent practicable, conduct all exploration in such a manner as to minimize damage, erosion, pollution or contamination to the lands, waters, facilities, vegetation and other resources of the refuge.
- 3) As far as is practicable, all operations must be conducted without interference with the operation of the Refuge or disturbance to the wildlife thereon.
- 4) The physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations.
- 5) Upon the cessation of operations, the area shall be restored as nearly as possible to its condition prior to the commencement of seismic operations.
- 6) Third-party environmental monitor(s) may be hired at Lexam's expense to ensure compliance with Refuge regulations and protective measures. Lexam will pay reasonable total cost of this requirement, as mutually agreed with the Refuge Manager prior to the hiring of the environmental monitors. The environmental monitor(s) will be hired with prior approval of the Refuge Manager, and will report directly to the Refuge Manager. The environmental monitors will be provided a radio and a cell phone for communications with crews.
- 7) Lexam is responsible for any damage caused by it's employees or contractors hired by Lexam involved in the operations, and for restoring impacted areas as closely as possible to original conditions prior to the end of operations. Lexam will be responsible for restoration of and/or mitigation for all damages to Refuge habitats, and for repairing any damages to Refuge facilities and infrastructure including roads, parking areas, levees, fences and water control structures.

8) The USFWS will enforce all applicable Federal statutes and regulations, including all Refuge specific regulations.

9) Monitoring Program: One or more environmental monitors should be on duty at all times. Additional monitors will be on duty when determined necessary by the Refuge Manager. Daily operations logs shall be kept by the environmental monitors and the operations project manager. These logs should document all daily activities as well as any damages to habitats or infrastructure. Daily updated logs will be made available to the Refuge Manager (or assignee) and Lexam (or assignee) each morning and a final composite log will be given to the Refuge Manager and Lexam upon completion of the program.

10) The shot line and receiver line pattern will be designed and operations conducted so as to minimize mechanized equipment traffic along the line and lessen the overall time required to conduct recording operations.

11) The seismic program will be initiated in the southwest portion of the Refuge and will progress from southwest to northeast.

12) Training Program. Training of all seismic program personnel will be conducted prior to commencing seismic activities through orientation meetings. Training will include review of the provisions and protection measures and review of Refuge-specific and general regulations applicable to national wildlife refuges. Training will be repeated periodically throughout the program prior to each phase of the operations and/or as new personnel begin work on the Refuge.

13) In the event of adverse weather conditions, the Refuge Manager may halt all seismic operations. Should work be delayed for this reason the Refuge Manager is authorized to extend the period of operation up to an additional thirty (30) days.

14) Measures to Protect Cultural Resources

- A file search to be performed by an archaeologist to identify any known cultural sites. The archaeologist will also identify and map high probability areas within the area of the seismic survey, and mapped buffer zones around all known sites and high probability areas.
- All cultural resources identified in the file search and all high probability areas will be mapped and/or flagged in the field by the archaeologist prior to beginning seismic operations, and such sites will be avoided by seismic field crews during all phases of the seismic survey. No seismic survey activities will occur in buffer zones of 100' radius around identified sites and high probability areas.
- The seismic survey will only use the low-impact seismic survey methodology specified in the "Seismic Methodology and Sensitive Area Avoidance Plan."

- Staging areas for the seismic survey will be off Refuge property.
- Any discovery of cultural artifacts or features during the course of the seismic survey will be immediately reported to the USFWS and the SHPO. The Refuge Manager and the environmental monitor(s) will have "stop work" authority for any activity that may threaten a cultural artifact or feature.

15) Measures to Protect Migratory Birds, Other Wildlife, and Habitats

- The timeframe for conducting the seismic survey will be January 01, 2007 to February 28, 2007, to reduce or altogether eliminate disturbance impacts to migrating/breeding migratory birds including waterfowl, shorebirds and wading birds. T-C understands that an earlier completion date is preferable, and will strive to complete the survey at the earliest possible date.
- Shifting of the seismic source or receiver lines and subsequent operations will be required to avoid active unanticipated wildlife concentrations or other sensitive wildlife features.
- Killing or harassing all wildlife on the Refuge is prohibited. Spotlighting of wildlife by crews will be prohibited.
- Potential vegetation damage and soil compaction/rutting along source and receiver lines will be reduced by: 1) restricting the number of vehicle passes along the lines to the absolute minimum required. Polaris will limit receiver line checks to the absolute minimum possible. Wherever possible, laying and servicing receiver equipment will be accomplished by walking. Natural and man-made travel lanes, (roads and trails) will be utilized whenever possible; 2) using four-wheelers where necessary in uplands and drier transitional sites; 3) minimizing turning by tracked vehicles (no locking tracks); 4) prohibiting all "cross-country travel" by mechanized vehicles.
- Damage to levees, ditches, and other waterway banks and shorelines will be minimized to the extent possible by: 1) conducting recording activities all on one side of a waterway in a portion of the project area before proceeding to the opposite side, thereby minimizing crossings; and 2) avoiding lateral travel along banks and shorelines.
- Polaris will pressure wash and chemically decontaminate with approved herbicides all vehicles and receiving equipment prior to deployment on the Refuge to avoid introducing any foreign plants or animals. Vehicles and receiving equipment will be inspected by the environmental monitor(s) prior to entering the Refuge.
- All work will be conducted during daylight hours unless approved or requested by refuge manager.

- Staging areas, and vehicle travel lanes will be approved by the Refuge Manager following a coordinated field review with Polaris.
- Sensitive habitats including Riparian and wet areas will be identified and avoided by shifting source and receiver lines and subsequent operations.
- All vegetation damage and soil compaction/rutting will be restored by Polaris as nearly as possible to its condition prior to commencement of seismic operation, or will be mitigated for as specified by the Refuge manager.

16) Other Measures

- Polaris will establish and identify to the USFWS a designated point of contact who will be available at all times for communication and coordination with the USFWS.
- All water control structures, wells and water gauges will be avoided except as authorized by the Refuge Manager.
- The USFWS and Polaris will cooperatively develop a Contingency Plan to cover the potential occurrence of project-related or other incidences of wildfire during the seismic survey. Survey crews will carry basic fire suppression equipment (shovels, fire extinguishers, etc.). Crews will report any occurrence of wildfire to Refuge management.
- Possession of firearms is prohibited by Refuge regulation. Possession of firearms is also prohibited by Polaris policy and is enforceable by dismissal from employment.
- In the event that any roads, trails, parking areas, levees, and other infrastructure are impacted by the seismic survey, these resources will be immediately repaired at Polaris' expense. Polaris will be required to maintain all Refuge facilities used during the seismic survey, and repair any damages caused by Polaris' use of these facilities.
- All damaged fences (barbed and electric) breached by the seismic survey will be repaired at Lexam's expense in a timely manner, and in a manner agreed upon by the Refuge Manager.
- Field oil or fluid changes will be permitted on the Refuge in selected staging (administrative) areas determined by the Refuge Manager. Any spilled oil will require immediate cleanup. Therefore, oil absorbent pads will be required on site at all times as a precautionary measure.
- Polaris will provide the Refuge Manager with proof of environmental liability insurance or post a bond prior to the initiation of seismic surveys.

- Strict adherence to Polaris Drug and Alcohol Policy will be enforced for all employees, contractors, and subcontractors. Violation of this policy will be grounds for immediate dismissal.
- All cans, bottles, paper, and other trash generated by the seismic crew will be removed from the Refuge daily. Trash receptacles provided by Polaris for its employees/contractors must be emptied and trash removed from the Refuge on a daily basis.
- All equipment and debris incidental to the survey, such as flagging, wires, poles, etc., will be removed following the cessation of activities on each line.
- Polaris will advise the Refuge Manager at least 72 hours in advance of the initial survey activities and shall coordinate all activities during the seismic survey on the Refuge with the Refuge Manager.
- The Refuge Manager will be provided detailed maps showing the exact locations of all seismic survey lines and shot holes promptly after survey completion.
- All applicable Federal and State regulations, including all Refuge-specific regulations shall be in force and adhered to by all seismic personnel at all times, except where explicitly exempted by the Refuge Manager. Seismic personnel shall comply with all, applicable ordinances, laws, decrees, statutes, rules and regulations of all federal and state entities.
- The USFWS can request add or modify the protective measures during the seismic survey should additional or modified stipulations be needed to protect Refuge resources or public safety.

Appendix B

USFWS Manual, Land Use Series, 612 FW 2, Oil and Gas

Appendix C

COGCC Permits Issued for Baca#5 and Baca #6

Colorado Oil And Gas Conservation Commission
Conditions Of Approval
April 3, 2007

Lexam Explorations (U.S.A) Inc.:

Baca No. 5 Well NE $\frac{1}{4}$ SW $\frac{1}{4}$, Section 28, Township 43 North, Range 11 East,
N.M.P.M.

Baca No. 6 Well SE $\frac{1}{4}$ NE $\frac{1}{4}$, Section 33, Township 43 North, Range 11 East,
N.M.P.M.

1. Notify David Shelton - COGCC Engineering Supervisor (303-894-2100 x 108) or David Dillon – COGCC Engineering Manager (303-894-2100 x 104) 48 hours prior to moving onto the location with drilling equipment. Advise Mr. Shelton or Mr. Dillon at least 24 hours prior to running any casing string to provide COGCC Field Inspectors sufficient notification time to witness cementing operations and pressure testing of blowout preventers. If the well is a dry hole, notify Mr. Shelton or Mr. Dillon 24 hours prior to plugging and abandoning this well.
2. Any changes to the approved drilling plan and procedures must be approved in writing by the COGCC.
3. Immediately notify the COGCC of any major problems encountered during the drilling, cementing, or completion process.
4. Conductor casing and surface casing will be cemented to surface.
5. Surface casing depth will be set at a depth of 3000 feet. This depth was determined by COGCC staff based upon review of available relevant data, including data from the deep water well located approximately one mile from the drill sites, and after consultation with the Division of Water Resources staff.
6. Prior to commencing operations, an inventory of all chemicals and products that will be used or stored on site must be provided to the COGCC, the surface owner, and local emergency response personnel prior to bringing those substances on to the Baca National Wildlife Refuge. If additional chemicals or products are required, then information about these substances must be provided to the COGCC, the surface owner, and the local emergency response personnel prior to bringing them on to the Baca National Wildlife Refuge.
7. Prior to commencing operations, a meeting with the local emergency response personnel will be held to establish an adequate safety and response plan for drilling, completion, and production activities.

8. A closed loop mud and cutting system will be used and cuttings will be placed in an above ground and lined enclosure, unless landowner approval to use an alternative mud and cutting system is obtained in writing.
9. The drill cuttings will not be left at or buried on the drill site or elsewhere on the Baca National Wildlife Refuge, unless landowner approval is obtained in writing. Cuttings will be disposed in accordance with COGCC Rule 907.
10. Formation temperatures will be recorded and the data provided to the COGCC and the surface owner.
11. If pumping tests are conducted on discrete zones below deepest neighboring water well (2,180 feet below surface), then water samples will be collected for basic water quality tests, including TDS, dissolved metals, common anions, pH and alkalinity. The analytical results will be provided to the COGCC and the surface owner.
12. If production casing is run, then all hydrocarbon and water bearing formations must be covered with cement and a cement bond log must be run to verify coverage. Cementing requirements will be determined by COGCC staff from open-hole logs and other well information obtained during the drilling of the well.
13. If the well is plugged as a dry hole, then the COGCC must be contacted for plugging instructions, which will be based on log and geologic data, and the actual wellbore configuration. Cement plugs will be set to confine all fluids to the reservoirs in which they originally occurred. The plugging procedure will assure that all aquifers are properly isolated and protected.
14. A guard, provided by Lexam, shall be stationed at the property gate on County Road T during all drilling and completion activities. The guard will limit access to the property to Lexam employees, Lexam contractors, and other authorized personnel.
15. Baseline water quality data will be acquired from both near surface (unconfined aquifer) and deeper aquifers in proximity to proposed wells prior to the spud of the wells and again within six months after the wells are completed and/or plugged. Sampling and analysis procedures must be approved by the COGCC staff prior to conducting this work. Data will be provided to the COGCC and the surface owner. Data will be used to assess any possible long-term effects on ground water quality.

16. A minimum of one up-gradient and two down-gradient monitoring wells will be installed around each drill pad. The wells will be completed in the shallow unconfined aquifer. The locations and elevations of the wells will be surveyed and depth to water will be measured. Water samples will be collected for chemical analysis before the wells are spud and at predetermined intervals thereafter, which will be agreed to by the United States Fish and Wildlife Service (USFWS) and Lexam. If spills or releases of drilling related chemicals at sites occur, then the sampling frequency may be increased to a frequency agreed to by the USFWS, Baca Grande Water and Sanitation District, and Lexam.
17. Equipment and vehicles brought onto the Baca National Wildlife Refuge from outside the San Luis Valley must be cleaned and decontaminated to minimize introduction of non-native species and noxious weeds.
18. Lexam will insure that all drilling and completion operations will be supervised by a WellCAP IADC certified supervisor. All blow prevention equipment shall be rated for 5000 psi and will be installed and tested in accordance with U.S. Bureau of Land Management Onshore Order #1.

Appendix D

Agreement Between Saguache County and Lexam Explorations (U.S.A.)

Appendix E

Baseline Surface Water and Groundwater Sampling Analytical Results

Baseline Chemistry for Ground Water

| Sample Name | 199723 | 375307 | C-18 | C-20 | C-22 | C-23 | C-24 | C-25 | C-27 | C-57 | C-7 | FL-3 | FL-4 | MOTEL WELL | DOMESTIC WELL | SW-5 From Pump | SW-5 From Bailer | WELL 14 | WELL 15 | WELL 17 | WELL 18 | WELL 2 | |
|--|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|-------------|
| Location Type | Flowing Well | Pumped Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Flowing Well | Pumped Well | Pumped Well | Pumped Well | Pumped Well | Pumped Well | Pumped Well | Pumped Well | Pumped Well | Pumped Well |
| Aquifer Treatment | Confined (a) | Unconfined (a) | Unconfined (a) | Unconfined (a) | Unconfined (a) | Unconfined (a) | Unconfined (a) | Unconfined (a) | Unconfined (a) | |
| Profile I (Major ions, metals, general) | | | | | | | | | | | | | | | | | | | | | | | |
| pH (std. units) | 8.53 | 8.35 | 8.45 | 8.15 | 8.3 | 8.38 | 8.38 | 8.39 | 8.29 | 8.17 | 8.31 | 8.48 | 8.01 | 7.36 | 7.64 | (f) | 7.47 | 7.44 | 7.66 | 6.8 | 6.83 | 7.06 | |
| pH - Field (s.u.) | 8.6 | 8.21 | 8.67 | 8.06 | 8.60 | 8.54 | 8.30 | 8.5 | 8.22 | 8.32 | 8.65 | 8.45 | 8.07 | 7.83 | 8.15 | 8.28 | 8.25 | 7.45 | 7.85 | 7.07 | 6.98 | 6.96 | |
| Conductivity - Field | 148.1 | 1147 | 366 | 832 | 313 | 145.5 | 741 | 1602 | 2410 | 126.6 | 174.2 | 1130 | 395 | 65.7 | 140.3 | 111.9 | 113.5 | 136.5 | 193.5 | 96.5 | 112.2 | 85.0 | |
| Temperature - Field | 31.3 | 25.1 | (e) | 14 | (e) | 18.4 | 16.7 | (e) | (e) | 16.2 | (e) | 18.8 | 18.0 | 13.4 | (e) | 14.2 | 12.1 | 10.6 | (e) | 11.2 | 13.5 | (e) | |
| Alkalinity (mg/L as CaCO3) | 434 | 661 | 210 | 298 | 136 | 166 | 384 | 813 | 1410 | 138 | 85.4 | 628 | 153 | 62.9 | 72.5 | (f) | 56.3 | 67.9 | 98.8 | 43.2 | 52.5 | 154 | |
| Bicarbonate (mg/L as CaCO3) | 416 | 654 | 202 | 298 | 134 | 161 | 377 | 800 | 1410 | 138 | 83 | 610 | 153 | 62.9 | 72.5 | (f) | 56.3 | 67.9 | 98.8 | 43.2 | 52.5 | 154 | |
| Carbonate (mg/L as CaCO3) | 18 | 7 | 8 | <1 | 2.1 | 2.1 | 5 | 7.2 | 12.8 | 5.3 | <1 | 2.5 | 17.9 | <1 | <1 | (f) | <1 | <1 | <1 | <1 | <1 | <1 | |
| Chloride | 10.3 | 7.87 | 2.74 | 3.1 | 2.02 | 2.05 | 4.77 | 9.08 | 19.3 | 1.92 | 2.1 | 4.85 | 9.07 | 1.17 | 1.02 | (f) | 0.97 | 0.36 | 1.18 | 0.4 | 0.65 | 2.09 | |
| Fluoride | 7.78 | 3.39 | 1.73 | 1.68 | 2.19 | 2.54 | 2.74 | 3.71 | 3.3 | 2.02 | 0.68 | 3.18 | 2.18 | <0.1 | 0.17 | (f) | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | 0.18 | |
| Sulfate | 0.72 | 0.46 | 0.49 | 0.68 | <0.3 | 0.53 | <0.3 | 0.32 | <0.3 | 0.43 | 0.91 | 0.95 | <0.3 | 3.53 | 1.82 | (f) | 1.75 | 3.57 | 6.63 | 2.75 | 3.11 | 8.05 | |
| Total Dissolved Solids | 548 | 777 | 251 | 335 | 171 | 181 | 423 | 929 | 1560 | 182 | 153 | 722 | 228 | 85 | 103 | (f) | 90 | 94 | 125 | 55 | 67 | 175 | |
| Aluminum (mg/L) | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | (f) | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | |
| Antimony (mg/L) | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | (f) | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | |
| Arsenic (mg/L) | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | (f) | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | <0.025 | |
| Barium (mg/L) | 0.0122 | 0.0376 | 0.0223 | 0.0498 | 0.0319 | 0.0266 | 0.0283 | 0.0299 | 0.0619 | 0.0453 | 0.0315 | 0.0283 | 0.0783 | 0.0423 | 0.022 | (f) | 0.0347 | 0.0379 | 0.0701 | 0.0287 | 0.0367 | (b) | |
| Beryllium (mg/L) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | (f) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | |
| Boron (mg/L) | 1.67 | 0.85 | 0.15 | 0.26 | 0.13 | 0.19 | 0.36 | 0.99 | 1.49 | 0.12 | <0.04 | 0.93 | 0.13 | <0.04 | <0.04 | (f) | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | |
| Cadmium (mg/L) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | (f) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | |
| Calcium (mg/L) | 2.71 | 5.24 | 4.27 | 8.41 | 7.44 | 7.05 | 4.11 | 3.04 | 3.82 | 9.29 | 10.2 | 2.99 | 24.8 | 17.4 | 16.2 | (f) | 13.1 | 19.8 | 30.1 | 14.2 | 17 | (b) | |
| Chromium (mg/L) | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | (f) | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | |
| Copper (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | (f) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Iron (mg/L) | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | 0.07 | <0.06 | <0.06 | (f) | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | |
| Lead (mg/L) | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | (f) | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | |
| Magnesium (mg/L) | 0.61 | 2.3 | 0.91 | 2.77 | 1.03 | 1.32 | 1.47 | 1.88 | 5.19 | 1.68 | 0.7 | 1.84 | 3.94 | 3.59 | 2.41 | (f) | 3.83 | 3.25 | 3.73 | 1.7 | 2.11 | (b) | |
| Manganese (mg/L) | 0.006 | 0.038 | 0.017 | 0.074 | 0.018 | 0.015 | 0.027 | 0.026 | 0.034 | 0.033 | 0.012 | 0.011 | 0.044 | <0.004 | 0.005 | (f) | 0.024 | <0.004 | <0.004 | <0.004 | <0.004 | (b) | |
| Mercury (mg/L) | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | (f) | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | |
| Nickel (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | (f) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Potassium (mg/L) | 8.39 | 5.14 | 7.68 | 6.86 | 5.71 | 6.01 | 8.64 | 13 | 7.16 | 5.47 | 5.61 | 4.5 | 1.13 | 3.36 | (f) | 2.17 | 1.15 | 1.34 | 0.61 | 0.54 | 3.6 | (b) | |
| Selenium (mg/L) | 0.0092 | <0.003 | 0.0043 | 0.0082 | 0.0043 | <0.003 | <0.003 | 0.006 | 0.0042 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | (f) | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | |
| Silver (mg/L) | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | (f) | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | |
| Sodium (mg/L) | 188 | 297 | 77.4 | 109 | 44.6 | 53.7 | 149 | 339 | 485 | 46.9 | 20.1 | 279 | 40.8 | 4.81 | 8.02 | (f) | 4.71 | 4.45 | 7.91 | 2.05 | 2.51 | (b) | |
| Thallium (mg/L) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | (f) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | |
| Zinc (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.088 | (f) | 0.046 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Hydrocarbons | | | | | | | | | | | | | | | | | | | | | | | |
| Diesel (mg/L) | <0.1 | <0.1 | <0.1 | (e) | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | |
| Gasoline (mg/L) | <0.1 | <0.1 | <0.1 | (e) | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | |
| Ethane (mg/L) | 0.0186 | 0.0157 | 0.00304 | (e) | 0.00199 | 0.00231 | 0.00472 | 0.0179 | 0.0104 | 0.00165 | <0.001 | 0.013 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Methane (mg/L) | 11.7 | 25.8 | 18.1 | (e) | 7.23 | 9.33 | 25.7 | 15.8 | 9.12 | 7.92 | 23.7 | 0.929 | 0.00109 | 0.00354 | <0.001 | 0.0172 | <0.001 | <0.001 | <0.001 | 0.00129 | <0.001 | 0.0296 | |
| VOCs | | | | | | | | | | | | | | | | | | | | | | | |
| 1,1,1,2-Tetrachloroethane (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,1,1-Trichloroethane (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,1,2,2-Tetrachloroethane (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,1,2-Trichloroethane (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,1-Dichloroethane (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,1-Dichloroethene (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,1-dichloropropene (µg/L) | <0.5 | <0.5 | <0.5 | (e) | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | |
| 1,2,3-Trichlorobenzene (µg/L) | < | | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|------------------------------------|------|--|------|--|------|--|------|--|------|--|------|--|------|--|-------|--|
| bis(2-Chloroethoxy)methane (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| bis(2-Chloroethyl)ether (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| bis(2-chloroisopropyl)ether (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| bis(2-Ethylhexyl)phthalate (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | 3.33 | | 0.583 | |
| Butylbenzylphthalate (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Carbazole (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Chrysene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Dibenz[a,h]anthracene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Dibenzofuran (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Diethylphthalate (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Dimethylphthalate (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Di-n-butylphthalate (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Di-n-octylphthalate (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Fluoranthene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Fluorene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Hexachlorobenzene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Hexachlorobutadiene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Hexachlorocyclopentadiene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Hexachloroethane (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Indeno[1,2,3-cd]pyrene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Isophorone (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Naphthalene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Nitrobenzene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Nitrosodimethylamine (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| n-Nitroso-di-n-propylamine (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| n-Nitrosodiphenylamine (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Pentachlorophenol (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Phenanthrene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Phenol (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Pyrene (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |
| Pyridine (µg/L) | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | | <0.5 | |

Organic compound or gas above detection limit
Analyzed as part of December 2006 sampling event

(d) Field parameters not measured
(e) Due to lag time, measured temperature not reflective of in situ water temperature