

**DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
FARMINGTON FIELD OFFICE**

Project: February 2014 Competitive Oil and Gas Lease Sale

EA Log Number: DOI-BLM-NM-F010-2013-0451-EA

Location: Locations in Rio Arriba, San Juan, & Sandoval Counties, New Mexico.

Finding of No Significant Impact

Based on the analysis of potential environmental impacts contained in the attached Environmental Assessment (EA) prepared for the February 2014 Competitive Oil and Gas Lease Sale, and considering the significance criteria in 40 CFR 508.27, I have determined that selection of the No Action - Preferred Alternative is not expected to have significant impacts on the human environment. Therefore, preparation of an Environmental Impact Statement is not warranted.

Reviewed by:

Date _____
Gary Torres, Farmington Field Office Manager

Approved by:

Date _____
Jesse Juen, New Mexico State Director

**BUREAU OF LAND MANAGEMENT
FARMINGTON FIELD OFFICE**

**ENVIRONMENTAL ASSESSMENT FOR
February 2014 COMPETITIVE OIL AND GAS LEASE SALE
DOI-BLM-NM-F010-2013-0451-EA**

1.0 INTRODUCTION

It is the policy of the Bureau of Land Management (BLM) as derived from various laws, including the Mineral Leasing Act of 1920 (MLA), as amended [30 U.S.C. 181 *et seq.*], and the Federal Land Policy and Management Act of 1976 (FLPMA), as amended, to make mineral resources available for disposal and to manage for multiple resources which include the development of mineral resources to meet national, regional, and local needs.

The BLM New Mexico State Office (NMSO) conducts a quarterly competitive lease sale to offer available oil and gas lease parcel(s) in New Mexico, Oklahoma, Texas, and Kansas. A Notice of Competitive Lease Sale (NCLS), which lists lease parcel(s) to be offered at the auction, is published by the NMSO at least 90 days before the auction is held. Lease stipulations applicable to each parcel(s) are specified in the Sale Notice. The decision as to which public lands and minerals are open for leasing and what leasing stipulations are necessary, based on information available at the time, is made during the land use planning process. Surface management of non-BLM administered land overlaying federal minerals is determined by the BLM in consultation with the appropriate surface management agency or the private surface owner.

In the process of preparing a lease sale the NMSO sends a draft parcel list to any Field Offices in which parcel(s) are located. Field office staff then review the legal descriptions of the parcel(s) to determine if they are in areas open to leasing; if new information has become available which might change any analysis conducted during the planning process; if appropriate consultations have been conducted; what appropriate stipulations should be included; and if there are special resource conditions of which potential bidders should be made aware. The parcels nominated for this sale, along with the appropriate stipulations from the 2003 Farmington Resource Management Plan (RMP) and subsequent amendments, are posted online for a two week public scoping period. Comments received are reviewed and incorporated into the Environmental Assessment (EA).

Once the draft parcel review is completed and returned to the NMSO, a list of nominated lease parcel(s) with specific, applicable stipulations is made available online to the public through a NCLS. On rare occasions, additional information obtained after the publication of the NCLS may result in deferral of certain parcel(s) prior to the lease sale.

This EA documents the Farmington Field Office (FFO) review of thirty eight (38) parcels nominated for the February 2014 Competitive Oil and Gas Lease Sale that are under the administration of the FFO. It serves to verify conformance with the approved land use plan,

provides the rationale for deferring or dropping parcel(s) from a lease sale, as well as providing rationale for attaching additional notice to specific parcel(s).

The parcels and applicable stipulations were posted online for a two week public scoping period starting on July 22, 2013. Scoping comments were received and are represented in the Identification of Issues (Section 1.4). In addition, this EA was made available for public review and comment for 30 days beginning September 3, 2013. Comments were received.

1.1 Purpose and Need

The purpose is to consider opportunities for private individuals or companies to explore for and develop oil and gas resources on public lands through a competitive leasing process.

The need of the action is established by the BLM's responsibility under the MLA, as amended, to promote the exploration and development of oil and gas on the public domain. The MLA also establishes that deposits of oil and gas owned by the United States are subject to disposition in the form and manner provided by the MLA under the rules and regulations prescribed by the Secretary of the Interior, where consistent with the FLPMA, the National Environmental Policy Act (NEPA) of 1969, as amended (Public Law 91-90, 42 USC 4321 et seq.), and other applicable laws, regulations, and policies.

The BLM will decide whether or not to lease the nominated parcel(s) and, if so, under what terms and conditions.

1.2 Conformance with Applicable Land Use Plan and Other Environmental Assessments

The applicable land use plan for this action is the 2003 Farmington RMP. The RMP designated approximately 2.59 million acres of federal minerals open for continued oil and gas development and leasing under Standard Terms and Conditions. The RMP, along with the 2002 Biological Assessment, also describe specific stipulations that would be attached to new leases offered in certain areas. Therefore, it is determined that the alternatives considered conform to fluid mineral leasing decisions in the 2003 Farmington RMP and subsequent amendment and are consistent with the goals and objectives for natural and cultural resources.

Pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21, this EA is tiered to and incorporates by reference the information and analysis contained in the 2003 Farmington RMP Final Environmental Impact Statement. While it is unknown precisely when, where, or to what extent well sites or roads would be proposed, the analysis of projected surface disturbance impacts, should a lease be developed, is based on potential well densities listed in the Reasonable Foreseeable Development (RFD) Scenario included in the 2003 Farmington RMP and the 2002 Biological Assessment. While an appropriate level of site-specific analysis of individual wells or roads would occur when a lease holder submits an Application for Permit to Drill (APD), assumptions based on the RFD scenario may be used in the analysis of impacts in this EA.

FLPMA established guidelines to provide for the management, protection, development, and enhancement of public lands (Public Law 94-579). Section 103(e) of FLPMA defines public

lands as any lands and interest in lands owned by the U.S. For split-estate lands where the mineral estate is an interest owned by the U.S., the BLM has no authority over use of the surface by the surface owner; however, the BLM is required to declare how the federal mineral estate will be managed in the RMP, including identification of all appropriate lease stipulations (43 CFR 3101.1 and 43 CFR 1601.0-7(b); BLM Manual Handbook 1601.09 and 1624-1).

1.3 Federal, State or Local Permits, Licenses or Other Consultation Requirements

Purchasers of oil and gas leases are required to comply with all applicable federal, state, and local laws and regulations, including obtaining all necessary permits required should lease development occur.

Farmington Field Office biologists reviewed the proposed action and determined it would be in compliance with threatened and endangered species management guidelines outlined in Biological Opinions Cons. #2-22-01-I-389. No further consultation with the U.S. Fish and Wildlife Service (USFWS) is required at this stage.

Federal regulations and policies require the BLM to make its public land and resources available on the basis of the principle of multiple-use. At the same time, it is BLM policy to conserve special status species and their habitats, and to ensure that actions authorized by the BLM do not contribute to the need for the species to become listed as threatened or endangered by the USFWS.

Compliance with Section 106 responsibilities of the National Historic Preservation Act (NHPA) are adhered to by following the Protocol Agreement between New Mexico BLM and New Mexico State Historic Preservation Officer (Protocol Agreement), which is authorized by the National Programmatic Agreement between BLM, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers, and other applicable BLM handbooks. When draft parcel locations are received by the FFO, cultural resource staff reviews the locations to determine if any are within known areas of concern.

Native American consultation is conducted by certified mail regarding each lease sale activity. If Traditional Cultural Properties (TCP) or heritage-related issues are identified, such parcel(s) are withheld from the sale while letters requesting information, comments, or concerns are sent to the Native American representative. If the same draft parcel(s) appear in a future sale, a second request for information is sent to the same recipients and the parcel(s) will be held back again. If no response to the second letter is received, the parcel(s) are allowed to be offered in the next sale (third sale).

If responses are received, BLM cultural resources staff will discuss the information or issues of concern with the Native American representative to determine if all or portions of a parcel need to be withdrawn from the sale, or if stipulations need to be attached as lease stipulations. If the nominated parcels are private surface owners, no Tribal Consultation is necessary.

In Section 1835 of the Energy Policy Act of 2005 (43 U.S.C. 15801), Congress directed the Secretary of the Interior to review current policies and practices with respect to management of federal subsurface oil and gas development activities and their effects on the privately owned

surface. The Split Estate Report, submitted in December 2006, documents the findings from consultation on the split estate issue with affected private surface owners, the oil and gas industry, and other interested parties.

In 2007, the Legislature of the State of New Mexico passed the Surface Owners Protection Act. This Act requires operators to provide the surface owner at least five business days' notice prior to initial entry upon the land for activities that do not disturb the surface; and provide at least 30 days' notice prior to conducting actual oil and gas operations. At the New Mexico Federal Competitive Oil and Gas Lease Sale conducted on October 17, 2007, the BLM announced the implementation of this policy. Included in this policy is the implementation of a Notice to Lessees (NTL), a requirement of lessees and operators of onshore federal oil and gas leases within the State of New Mexico to provide the BLM with the names and addresses of the surface owners of those lands where the Federal Government is not the surface owner, not including lands where another federal agency manages the surface.

The BLM NMSO office would then contact the surface owners and notify them of the expression of interest and the date the oil and gas rights would be offered for competitive bidding. The BLM would provide the surface owners with its website address so they may obtain additional information related to the oil and gas leasing process, the imposition of any stipulations on that lease parcel(s), federal and state regulations, and best management practices (BMPs). The surface owners may elect to protest the leasing of the minerals underlying their surface.

If the BLM receives a protest, the parcel(s) would remain on the lease sale; however, the BLM would resolve any protest prior to issuing an oil and gas lease for that parcel(s). If the protest is upheld, the BLM would return the payments received from the successful bidder for that parcel(s). After the lease sale has occurred, the BLM would post the results on its website and the surface owner may access the website to learn the results of the lease sale.

1.4 Identification of Issues

Planning issues are points of disagreement, debate, or dispute with a proposed action based on some anticipated environmental effect. Based on external and internal scoping and the scoping comments that were received, the following planning issues were identified:

Nominated parcels included the Alternatives along with the appropriate stipulations from the RMP were posted online at: http://www.blm.gov/nm/st/en/prog/energy/oil_and_gas/oil_and_gas_lease.html for a two week public scoping period beginning July 22 through August 5, 2013. Scoping comments were received from The Wilderness Society, State of New Mexico Department of Cultural Affairs Historic Preservation Division, National Trust for Historic Preservation, Advisory Council on Historic Preservation, and National Parks Conservation Association.

Based on these efforts the following issues have been determined relevant to the analysis of this action:

- *What effects will the proposed action have on the wildlife and special status species?*
- *What effects will the proposed action have on air quality and climate?*

- *What effects will the proposed action have on water quality?*
- *What effects will the proposed action have on soil resources?*
- *What effects will the proposed action have on visual resources?*
- *What effects will the proposed action have on cultural resources?*
- *What effects will the proposed action have on recreation?*
- *What effects will the proposed action have on socio economics?*
- *What effects will the proposed action have on Environmental Justice?*
- *What effects will the proposed action have on rangeland resources?*

Issues considered during project scoping but dismissed from detailed analysis because there would be no potentially significant effects related to the issues resulting from any of the alternatives presented below. The following resources were determined by an ID Team of resource specialists, following their onsite visit and review of the RMP and other data sources to not be present were: Areas of Critical Environmental Concern, Floodplains, Wild and Scenic Rivers, Wetlands/Riparian Zones, and Wild Horses and Burros.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Alternative A - No Action – Preferred Alternative

In the case of a lease sale, an expression of interest to lease (parcel nomination) would be deferred, and the thirty eight (38) parcels would not be offered for lease during the February 2014 Competitive Oil and Gas Lease Sale. Surface management and any ongoing oil and gas development on surrounding federal, private, and state leases would continue under current guidelines and practices. Selection of the no action alternative would not preclude these parcels from being nominated and considered in future lease sale.

2.2 Alternative B – Proposed Action

The Proposed Action is to lease seven (7) nominated parcels of federal minerals, covering 2,160 acres administered by the FFO. Standard terms and conditions as well as lease stipulations listed in the RMP and RMPAs would apply.

Once sold, the lease purchaser has the exclusive right to use as much of the leased lands as is necessary to explore and drill oil and gas within the lease boundaries, subject to the stipulations attached to the lease (Title 43 CFR 3101.1-2).

Oil and gas leases are issued for a 10-year period and continue for as long thereafter as oil or gas is produced in paying quantities. If a lessee fails to produce oil and gas, does not make annual rental payments, does not comply with the terms and conditions of the lease, or relinquishes the lease, exclusive right to develop the leasehold reverts back to the federal government and the lease can be reoffered in another sale.

Drilling of wells on a lease is not permitted until the lease owner or operator secures approval of a drilling permit and a surface use plan specified under Onshore Oil and Gas Orders listed in Title 43 CFR 3162. A permit to drill would not be authorized until site-specific NEPA analysis is conducted.

All seven (7) parcels contain a Cultural Resources Lease Notice stating that all development activities proposed under the authority of these leases are subject to compliance with Section 106 of the NHPA and Executive Order 13007. In addition, all seven (7) parcels contain a Plan of Development Stipulation that requires a plan of development (POD) for the entire lease that must be submitted for review and approval, including NEPA analysis, by the Bureau of Land Management (BLM) authorized officer, prior to approval of development (APD, Sundry Notices) actions. Six (6) of the parcels would require a Notice to Lessee indicating additional protections that may be needed at the APD level because of the parcels proximity to Chaco Culture National Historical Park. In addition, site specific mitigation measures and Best Management Practices (BMPs) would be attached as Conditions of Approval (COAs) for each proposed exploration and development activity authorized on a lease.

The parcels recommended for leasing under Alternative B are presented below in Table 1. Alternative B:

Table 1. Alternative B:

Lease Parcel #	Legal Description			Acres	Lease Stipulations*	Action
NM-201401-137	22N	6W	Sec. 26-NW	160	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-138	22N	6W	Sec.30-E2SE	80	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-163	22N	10W	Sec. 20-SE	160	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-165	22N	10W	Sec. 28-NE, SW	320	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-166	22N	10W	Sec. 34-N2, SW	480	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-168	23N	11W	Sec. 17-All	640	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-171	30N	15W	Sec. 11-SESE	320	NM-11-LN Special Cultural Resource F-15-POD Plan of Development Stipulation	Lease(Includes 40 less acres due to active Coal Mining)
	Sec. 12-SENW, SW	Sec. 14-E2NE, NESE				

* See Appendix A for a description of stipulations

Standard terms and conditions as well as lease stipulations from the RMP and Lease Notices developed through the parcel review and analysis process would apply (as required by Title 43 CFR 3101.3) to address site specific concerns or new information not identified in the land use planning process.

2.3 Alternative C - Partial Leasing Alternative

Alternative C is to lease four (4) nominated parcels of federal minerals, covering 1,200 acres administered by the FFO. Standard terms and conditions as well as lease stipulations listed in the RMP and RMPAs would apply.

Once sold, the lease purchaser has the exclusive right to use as much of the leased lands as is necessary to explore and drill oil and gas within the lease boundaries, subject to the stipulations attached to the lease (Title 43 CFR 3101.1-2).

Oil and gas leases are issued for a 10-year period and continue for as long thereafter as oil or gas is produced in paying quantities. If a lessee fails to produce oil and gas, does not make annual rental payments, does not comply with the terms and conditions of the lease, or relinquishes the lease, exclusive right to develop the leasehold reverts back to the federal government and the lease can be reoffered in another sale.

Drilling of wells on a lease is not permitted until the lease owner or operator secures approval of a drilling permit and a surface use plan specified under Onshore Oil and Gas Orders listed in Title 43 CFR 3162. A permit to drill would not be authorized until site-specific NEPA analysis is conducted.

All four (4) parcels contain a Cultural Resources Lease Notice stating that all development activities proposed under the authority of these leases are subject to compliance with Section 106 of the NHPA and Executive Order 13007. In addition all four (4) parcels contain a Plan of Development Stipulation¹ that requires a plan of development (POD) for the entire lease that must be submitted for review and approval, including NEPA analysis, by the Bureau of Land Management (BLM) authorized officer, prior to approval of development (APD, Sundry Notices) actions. Three (3) of the parcels would require a Notice to Lessee indicating additional protections that may be needed at the APD level because of the parcels proximity to Chaco Culture National Historical Park. In addition, site specific mitigation measures and Best Management Practices (BMPs) would be attached as Conditions of Approval (COAs) for each proposed exploration and development activity authorized on a lease.

The parcels recommended for leasing under Alternative C are presented below in Table 2. Alternative C.

Table 2. Alternative C

Lease Parcel #	Legal Description			Acres	Lease Stipulations*	Action
NM-201401-137	22N	6W	Sec. 26-NW	160	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-138	22N	6W	Sec.30-E2SE	80	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of Development Stipulation	Lease
NM-201401-168	23N	11W	Sec. 17-All	640	NM-11-LN Special Cultural Resource F-42-LN Chaco Area F-15-POD Plan of	Lease

¹ This stipulation was developed pursuant to Settlement Agreement for San Juan Citizen’s Alliance v. Salazar, 10th Cr. No 08-2286.

					Development Stipulation	
	30N	15W	Sec. 11-SESE		NM-11-LN Special Cultural Resource F-15-POD Plan of Development Stipulation	Lease (Includes 40 less acres due to active Coal Mining)
	Sec. 12-SENW, SW		Sec. 14-E2NE, NESE			
NM-201401-171				320		

*See Appendix A for a description of stipulations

Standard terms and conditions as well as lease stipulations from the RMP and Lease Notices developed through the parcel review and analysis process would apply (as required by Title 43 CFR 3101.3) to address site specific concerns or new information not identified in the land use planning process.

2.4 Design Features

- The BLM encourages industry to incorporate and implement “Best Management Practices” (BMPs), which are designed to reduce impacts to air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include: adherence to BLM’s Notice to Lessees’ (NTL) 4(a) concerning the venting and flaring of gas on Federal leases for natural gas emissions that cannot be economically recovered, flare hydrocarbon gases at high temperatures in order to reduce emissions of incomplete combustion; water dirt roads during periods of high use in order to reduce fugitive dust emissions; co-locate wells and production facilities to reduce new surface disturbance; implementation of directional drilling and horizontal completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores; require that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored; and perform interim reclamation to re-vegetate areas of the pad not required for production facilities and to reduce the amount of dust from the pads.
- The FFO purchased an infrared camera designed to detect natural gas leaks on and around well pad and pipeline facilities. FFO inspection personnel have been trained to operate the camera and FFO is currently developing a strategy to implement the use of the camera in cooperation with oil and gas operators to detect and eliminate natural gas leaks in well pad and pipeline infrastructure.
- An application for permit to drill (APD) is required for each proposed well to develop a lease. Onshore Oil and Gas Order No. 1 issued under 43 CFR 3160 authorizes BLM to attach Conditions of Approval (COA) to APDs during the permitting process. As a result of recommendations from the Four Corners Air Quality Task Force, the New Mexico Environment Department, Environmental Protection Division requested FFO attach a COA to APDs requiring new and replacement internal combustion gas field engines of between 40 and 300 horsepower to emit no more than two grams of nitrogen oxides per

horsepower-hour. FFO has included a COA limiting nitrogen oxides since August of 2005.

- Required archaeological surveys would be conducted for all subsequent actions that are expected to occur from the lease sale to avoid disturbing cultural resources. No site-specific mitigation measures for cultural resources have been recommended at this time for the proposed parcels recommended to proceed for sale. Specific mitigation measures, including, but not limited to, site avoidance or excavation/data recovery would have to be determined when site-specific development proposals are received. BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations (e.g., State Historic Preservation Officer (SHPO) and tribal consultation) under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or won't approve any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.
- In the event that lease development practices are found in the future to have an adverse effect on Native American TCPs, the BLM, in consultation with the affected tribe, would take action to mitigate or negate those effects. Measures include, but are not limited to physical barriers to protect resources, relocation of practices responsible for the adverse effects, or other treatments as appropriate.
- To be in conformance with the Native American Graves Protection and Repatriation Act of 1991 (Public Law 101-610), the terms and conditions of the lease shall contain the following condition: In the event that the lease holder discovers or becomes aware of the presence of Native American human remains within the lease, they shall immediately notify the Bureau of Land Management in writing.
- The use of a plastic-lined reserve pits or closed systems or steel tanks; casing and cementing requirements; storm water management, silt traps, site recontouring, timely reseeded of disturbed areas and soil stabilization would be implemented.
- The operator would stockpile the topsoil from the surface of well pads which would be used for interim and final reclamation of the well pads. Reserve pits would be recontoured and reseeded as described in attached Conditions of Approval. Upon abandonment of the wells and/or when access roads are no longer in service the Authorized Officer would issue instructions and/or orders for surface reclamation/restoration of the disturbed areas as described in the attached Conditions of Approval. During the life of the development, all disturbed areas not needed for active support of production operations should undergo "interim" reclamation in order to minimize the environmental impacts of development on other resources and uses. Site specific mitigations, determined during the onsite, such as proper project placement, storm water management, silt traps, rounding of corners and soil stabilization, would reduce erosion and sediment migration. Earthwork for interim and final reclamation must be completed within 6 months of well completion or well plugging (weather permitting).

The operator shall submit a Sundry Notices and Reports on Wells (Notice of Intent), Form 3160-5, prior to conducting interim reclamation.

- Road constructions requirements and regular maintenance would alleviate potential impacts to access roads from water erosion damage.
- Mitigation would include, as needed to protect impacts to resources, revegetation with native plant species, soil enhancement practices, direct live haul of soil material for seed bank revegetation, reduction of livestock grazing, fencing of reclaimed areas, and the use of seeding strategies consisting of native grasses, forbs, and shrubs.
- In the event noxious weeds are discovered during construction of any access roads and well pads, mitigation would be deferred to the site specific development at the APD stage. Best management practices (BMPs) would be incorporated into the conditions of approval (COAs) of an approved APD.
- A biological survey may be required to determine any impacts on individual project proposals. Any potential impacts to special status species will be determined based on the biological survey report. Site specific stipulations may be attached to reduce impacts to any special status species. These stipulations include (but not limited to) timing stipulations, additional surveys, additional alternatives analyzed (including twinning), and constructions design stipulations.
- All construction activities will be confined to the permitted areas only. Site specific mitigation measures designed to protect migratory birds will be implemented to decrease direct impacts to nesting birds. If an active nest is observed during construction, construction activities that could result in take as defined by the MBTA would halt until practicable or reasonable avoidance alternatives are identified, the birds have fledged, or a migratory bird take permit has been granted from the USFWS. Any proposed action that would result in more than four acres of new surface disturbance; a preconstruction migratory bird nest survey may be required if any construction activities occur between May 15 – July 31 per BLM/FFO Instruction Memorandum No. NM-F00-2010.
- Special painting schemes may be required for all facilities to closely approximate the vegetation within the setting. All facilities, including the meter building, would be painted to blend with the surrounding vegetation. If the proposed project is determined to be in a scenic area, site specific COAs, proper project placement, tree screen, low profile equipment, may be required for the proposed action.

2.5 Reasonably Foreseeable Development

At the leasing stage, it is uncertain if Applications for Permit to Drill on leased parcels would be received, nor is it known if or to what extent development would occur. Such development may include constructing a well pad and access road, drilling a well using a conventional pit system or closed-loop system, hydraulically fracturing the well, installing pipelines and/or hauling produced fluids, regularly monitoring the well, and completing work-over tasks throughout the

life of the well. In Farmington, typically, all of these actions are undertaken during development of an oil or gas well; it is reasonably foreseeable that they may occur on leased parcels. See Appendix 1 for a complete description of the phases of oil and gas development.

Drilling of wells on a lease would not be permitted until the lease owner or operator secures approval of a drilling permit and a surface use plan as specified under Onshore Oil and Gas Orders (43 CFR 3162). A permit to drill would not be authorized until site-specific NEPA analysis is conducted.

Standard terms and conditions, stipulations listed in the Farmington RMP, and any new stipulations would apply as appropriate to each lease. In addition, site specific mitigation measures and BMPs would be attached as Conditions of Approval (COAs) for each proposed exploration and development activity authorized on a lease.

2.6 Alternatives Considered but Eliminated from Detailed Analysis

The alternatives considered but eliminated from detailed analysis identify those parcels that are not in conformance with the current land use plans or need more time for evaluation. Therefore this alternative will not be carried through the remainder of this environmental assessment. Table 3 identifies those nominated parcels that are not in conformance with current land use plans, and also describes why these parcels were not carried forward into the proposed action. An inventory for lands with wilderness characteristics has not been completed on a number of the nominated parcels. These parcels are being deferred from leasing until that effort occurs. An inventory of wilderness characteristics is being planned.

Table 3. Alternatives Considered but Eliminated from Detailed Analysis

Lease Parcel	Legal Description					Acres	County	Rationale
NM-2014-01-135	32N	5W	7-Lots 1-4;	8-Lots 1-4; S2N2, S2	9- Lot 4; SWNW, W2SW	975.58	Rio Arriba	Closed to leasing in RMP (Carracas Mesa)
NM-201401-136	32N	5W	17- All	20-All	21-W2W2	1440	Rio Arriba	Closed to leasing in RMP (Carracas Mesa)
NM-201401-139	21N	8W	22- E2,NW			480	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-140	22N	9W	4-Lots 1-2; S2NE, SW			321.83	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-142	22N	9W	7-Lots 1-4; NE,E2W 2,N2SE,			599.50	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires

	SWSE					Deferment (IM-NM-2011-021)
NM-201401-143	22N	9W	9-NE,SW	320.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-144	22N	9W	14- E2, NW	480.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-145	22N	9W	15-All	640.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-146	22N	9W	18-Lots3-4; W2NE, E2SW, SE	400.27	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-147	22N	9W	20-All	640.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-148	22N	9W	21- NE,SW	320.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-149	22N	9W	22-All	640.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-150	22N	9W	23-All	640.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-151	22N	9W	29-All	640.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-

				2011-021)
NM-201401-152	22N 9W	30- Lots 1-4; E2, E2W2	640.48	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-153	22N 9W	31-Lots 1-4; E2, E2W2	640.15	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-154	22N 9W	32- NW,S2	480.00	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-155	22N 9W	34-N2	320.00	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-156	22N 10 W	1- Lots 1- 4; S2N2,S2	639.36	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-157	22N 10 W	3-E2SE	80.00	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-158	22N 10 W	10- SENW; N2SW	120.00	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-159	22N 10 W	11-S2	320.00	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-160	22N 10 W	12-All	640.00	San Juan Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)

NM-201401-161	22N	10 W	13-All		640.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)	
NM-201401-162	22N	10 W	14- W2SW	15-S2	400.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)	
NM-201401-164	22N	10 W	21-N2	22-All	23-W2NE, W2	1,360.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-166	22N	10 W	34-N2, SW			480.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-167	22N	10 W	24-SW	25-E2		480.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-169	23N	11 W	21-N2			320.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-170	23N	11 W	28- NE,N2N W			240.00	San Juan	Information on Lands With Wilderness Characteristics is Incomplete- Requires Deferment (IM-NM-2011-021)
NM-201401-172	30N	15W	30- Lots 5,6,8,9			163.38	San Juan	Closed to leasing in RMP (Hogback ACEC)

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This section describes the environment that would be affected by implementation of alternatives described in Section 2. Elements of the affected environment described in this section focus on the relevant resources and issues.

3.2 Air Resources

Air quality and climate are components of air resources which may be affected by BLM applications, activities, and resource management. Therefore, the BLM must consider and analyze the potential effects of BLM and BLM-authorized activities on air resources as part of the planning and decision making process. Additional information on air quality in this area is contained in Chapter 3 of the Farmington Field Office (FFO) Resource Management Plan (RMP) and Final Environmental Impact Statement (FEIS; USDI BLM, 2003) which this analysis tiers to and incorporates. Much of the information referenced in this section is incorporated from the Air Resources Technical Report for BLM Oil and Gas Development in New Mexico, Kansas, Oklahoma, and Texas (herein referred to as Air Resources Technical Report, USDI BLM 2013). This document summarizes the technical information related to air resources and climate change associated with oil and gas development and the methodology and assumptions used for analysis.

3.2.1 Air Quality

The Air Resources Technical Report describes the types of data used for description of the existing conditions of criteria pollutants (USDI BLM 2013), how the criteria pollutants are related to the activities involved in oil and gas development (USDI BLM 2013), and provides a table of current National and state standards. EPA's Green Book web page (EPA, 2010a) reports that all counties in the Farmington Field Office area are in attainment of all National Ambient Air Quality Standards (NAAQS) as defined by the Clean Air Act. The area is also in attainment of all state air quality standards (NMAAQS). The current status of criteria pollutant levels in the Farmington Field Office are described below. Total emissions of criteria pollutants from each source sector were calculated by adding together the emissions from the four counties that are located in FFO: San Juan, McKinley, Rio Arriba, and Sandoval.

“Design Concentrations” are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. The 2011 design concentrations of criteria pollutants are listed below. There is no monitoring for CO and lead in San Juan County, but because the county is relatively rural, it is likely that these pollutants are not elevated. PM10 design concentrations are not available for San Juan County.

Table 4 summarizes monitored values for other criteria pollutants in San Juan County.

Table 4. Criteria Pollutant Monitored Values in San Juan County shows monitored values for ozone in recent years for each of the three San Juan County ozone monitoring stations.

Table 4. Criteria Pollutant Monitored Values in San Juan County

Pollutant	2011 Design Concentration	Averaging Time	NAAQS	NMAAQS
O ₃	0.063 ppm	8-hour	0.075 ppm ¹	
NO ₂	13 ppb	Annual	53 ppb	50 ppb
NO ₂	39 ppb	1-hour	100 ppb ²	
PM _{2.5}	4.5 µg/m ³	Annual	12 µg/m ^{3,3}	*60 µg/m ³
PM _{2.5}	14 µg/m ³	24 hour	35 µg/m ^{3,2}	150 µg/m ³
SO ₂	20 ppb	1-hour	75 ppb ⁴	

¹ Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
² 98th percentile, averaged over 3 years
³ Annual mean, averaged over 3 years
⁴ 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

In 2005, the EPA estimates that there was less than 0.01 ton per square mile of lead emitted in FFO counties, which is less than 2 tons total (EPA, 2010b). Lead emissions are not an issue in this area, and will not be discussed further.

Air quality in a given region can be measured by its Air Quality Index value. The air quality index (AQI) is reported according to a 500-point scale for each of the major criteria air pollutants, with the worst denominator determining the ranking. For example, if an area has a CO value of 132 on a given day and all other pollutants are below 50, the AQI for that day would be 132. The AQI scale breaks down into six categories: good (AQI<50), moderate (50-100), unhealthy for sensitive groups (100-150), unhealthy (>150), very unhealthy and hazardous. The AQI is a national index, the air quality rating and the associated level of health concern is the same everywhere in the country. The AQI is an important indicator for populations sensitive to air quality changes.

Mean AQI values for San Juan County were generally in the good range (AQI<50) in 2011 with 78% of the days in that range. The mean AQI in 2011 was 43, which indicates “good” air quality. The maximum AQI in 2011 was 140, which is “unhealthy for sensitive groups”.

Although the AQI in the region has reached the level considered unhealthy for sensitive groups on several days almost every year in the last decade, there are no patterns or trends to the occurrences (Table 5). On 8 days in the past decade, air quality has reached the level of “unhealthy” and on two days, air quality reached the level of “very unhealthy”. In 2009, there were no days that were “unhealthy for sensitive groups” or worse in air quality.

Table 5. Number of Days classified as “unhealthy for sensitive groups” (AQI 101-150) (EPA, 2012a)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Days	10	6	3	6*	9	18	1	0	12**	9

* in addition, there was 1 day that was “unhealthy” during the year.
** in addition, there were 5 “unhealthy” days that year and 2 “very unhealthy” days.

3.2.2 Hazardous Air Pollutants

The Air Resources Technical Report discusses the relevance of hazardous air pollutants (HAPs) to oil and gas development and the particular HAPs that are regulated in relation to these

activities (USDI BLM 2013). The EPA conducts a periodic National Air Toxics Assessment (NATA) that quantifies HAP emissions by county in the U.S. The purpose of the NATA is to identify areas where HAP emissions result in high health risks and further emissions reduction strategies are necessary. A review of the results of the 2005 NATA shows that cancer, neurological and respiratory risks in San Juan County are generally lower than statewide and national levels as well as those for Bernalillo County where urban sources are concentrated in the Albuquerque area (EPA, 2011a).

3.2.3 Climate

The planning area is located in a semiarid climate regime typified by dry windy conditions and limited rainfall. Summer maximum temperatures are generally in the 80s or 90s (Fahrenheit) and winter minimum temperatures are generally in the teens to 20s. Temperatures occasionally reach above 100 °F in June and July and have dipped below zero in December and January. Precipitation is divided between summer thunderstorms associated with the Southwest Monsoon and winter snowfall as Pacific weather systems drop south into New Mexico.

Table 6. 1981-2010 Climate Normals for Chaco Canyon National Monument

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Precip (inches)	0.68	0.63	0.62	0.63	0.48	0.51	1.37	1.36	1.15	0.81	0.71	0.67
Min. Temp. (F)	13.4	19.1	23.8	30.4	38.9	47.7	55.6	53.9	45.0	32.3	21.3	14.2
Avg. Temp. (F)	28.5	34.1	40.9	48.5	57.8	67.0	72.7	70.4	62.6	50.2	37.9	29.1
Max. Temp. (F)	43.6	49.1	58.0	66.7	76.7	86.3	89.8	86.9	80.3	68.1	54.5	44.0

The Air Resources Technical Report summarizes information about greenhouse gas emissions from oil and gas development and their effects on national and global climate conditions. While it is difficult to determine the spatial and temporal variability and change of climatic conditions; what is known is that increasing concentrations of GHGs are likely to accelerate the rate of climate change.

3.3 Heritage Resources

3.3.1 Cultural Resources

The nominated parcels are located within the archaeologically rich San Juan Basin of northwestern New Mexico. In general, the prehistory of the San Juan Basin can be divided into five major periods: PaleoIndian (ca. 10000 B.C. to 5500 B.C.), Archaic (ca. 5500 B.C. to A.D. 400), Basketmaker II-III and Pueblo I-IV periods (A.D. 1-1540), and the Historic (A.D. 1540 to present), which includes Native American as well as later Hispanic and Euro-American settlers.

Detailed description of these various periods and select phases within each period is provided in the Bureau of Land Management Farmington Field Office Final Environmental Impact Statement and Resource Management Plan (2003) and will not be reiterated here. Additional information is also included in an associated document (SAIC 2002).

BLM Manual 8100, *The Foundations for Managing Cultural Resources* (2004) defines a cultural resource as "*a definite location of human activity, occupation, or use identifiable through field inventory (survey), historical documentation, or oral evidence. The term includes archaeological, historic, or architectural sites, structures, or places with important public and scientific uses, and may include definite locations (sites or places) of traditional cultural or religious importance to specified social and/or cultural groups. (cf. "traditional cultural property"). Cultural resources are concrete, material places and things that are located, classified, ranked, and managed through the system of identifying, protecting, and utilizing for public benefit described in this Manual series. They may be but are not necessarily eligible for the National Register (a.k.a. "historic property").*

Section 106 of the National Historic Preservation Act requires federal agencies to consider what effect their licensing, permitting, or otherwise authorizing of an undertaking, such as mineral leasing, may have on properties eligible for the National Register. Pursuant to 36 CFR 800.16 (i), "*Effect means alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the National Register.*"

The National Register of Historic Places (36 CFR Part 60) is the basic benchmark by which the significance of cultural resources are evaluated by a federal agency when considering what effects its actions may have on cultural resources. To summarize, to be considered eligible for the National Register a cultural resource must have integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following criteria: *a) are associated with events that have significantly contributed to the broad patterns of our history; or b) are associated with the lives of persons significant in our past; or c) embody distinctive characteristics of the type, period, or method of construction, or represents the work of a master, or possesses high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; or d) have yielded, or maybe likely to yield, information is important in a pre-history or history.*

Cultural resources vary considerably and may include but are not limited to simple artifact scatters, domiciles of various types with a myriad of associated features, rock art and inscriptions, ceremonial/religious features, and roads and trails. In the broadest sense cultural resources include sites, buildings, structures, objects, and districts/landscapes (NPS 1997).

- A "site" is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archeological value regardless of the value of any existing structure. A site need not be marked by physical remains if it is the location of a prehistoric or historic event or pattern of events and if no buildings, structures, or objects marked it at the time of the events.

- A "building" is created principally to shelter any form of human activity. "Building" may also be used to refer to a historically and functionally related unit, such as a courthouse and jail or a house and barn. If a building has lost any of its basic structural elements, it is usually considered a "ruin" and is categorized as a site.
- The term "structure" is used to distinguish from buildings those functional constructions made usually for purposes other than creating human shelter. If a structure has lost its historic configuration or pattern of organization through deterioration or demolition, it is usually considered a "ruin" and is categorized as a site.
- The term "object" is used to distinguish from buildings and structures those constructions that are primarily artistic in nature or are relatively small in scale and simply constructed. Although it may be, by nature or design, movable, an object is associated with a specific setting or environment.
- A "district" possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development. A district can contain buildings, structures, sites, objects, or open spaces that do not contribute to the significance of the district. A district can also be a grouping of archeological sites related primarily by their common components; these types of districts often will not visually represent a specific historic environment. In archeological districts, the primary factor to be considered is the effect of any disturbances on the information potential of the district as a whole.

3.3.2 Cultural Landscapes

Cultural landscapes “represent the 'combined works of nature and of man'... [and] are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal" (UNESCO 2008). The term embraces a diversity of manifestations of the interaction between humans and the natural environment and often reflects specific techniques of sustainable land use, considering the characteristics and limits of the natural environment they are established in, and a specific spiritual relation to nature. UNESCO (2008) further defined cultural landscapes as falling into three main categories

1. *Designed and created intentionally by man.* This embraces garden and parkland landscapes constructed for aesthetic reasons which are often (but not always) associated with religious or other monumental buildings and ensembles.
2. *Organically evolved.* This results from an initial social, economic, administrative, and/or religious imperative and has developed its present form by association with and in response to its natural environment. They fall into two sub-categories:
 - a. A relict (or fossil) landscape is one in which an evolutionary process came to an end at some time in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form.
 - b. Continuing landscape is one which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time.

3. *Associative cultural landscape*. Such landscapes are defined by virtue of the powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.

The National Park Service has defined cultural landscapes as “a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values” (Birnbaum 1994; Birnbaum and Peters 1996). Under National Park Service guidance cultural landscapes have four definitions that are not mutually exclusive.

1. *Historic Designed Landscape*. A landscape that was consciously designed or laid out by a landscape architect, master gardener, architect, or horticulturist according to design principles, or an amateur gardener working in a recognized style or tradition.
2. *Historic Vernacular Landscape* - a landscape that evolved through use by the people whose activities or occupancy shaped that landscape.
3. *Historic Site* - a landscape significant for its association with a historic event, activity, or person.
4. *Ethnographic Landscape* - a landscape containing a variety of natural and cultural resources that associated people define as heritage resources.

Landscape characteristics are the tangible evidence of the activities and habits of the people who occupied, developed, used, and shaped the land to serve human needs and they may reflect the beliefs, attitudes, traditions, and values of these people. There is no comprehensive guidance on what characteristics to evaluate with regards to the landscape, or how to “read a landscape” (Birnbaum 1994). Whatever approach is taken should provide a broad overview. The National Park Service (1999; Birnbaum and Peters 1996) has offered a number of character defining features and organizational elements that should be examined when considering human use or activity in a geographic area for cultural landscapes:

- | | |
|---|--|
| 1. Land uses and activities | 7. Water features |
| 2. Patterns of spatial organization | 8. Boundary demarcations |
| 3. Response to the natural environment | 9. Vegetation related to land use |
| 4. Cultural traditions | 10. Buildings, structures, and objects |
| 5. Circulation networks (e.g. roads, paths) | 11. Clusters |
| 6. Topography | 12. Archaeological sites |
| | 13. Small-scale elements. |

Zvelebil et al. (1992) identified seven major problems associated with landscape approaches to archaeological remains. To summarize, they include 1) lack of chronological resolution, 2) the palimpsest effect, 3) definition of a regional scale, 4) biases introduced through taphonomic processes, 5) variation over the landscape, 6) paleoenvironmental reconstruction, and 7) modern land use. Van Dyke (2007:8, 39) observed that “*the contemporary archaeological landscape is but a distorted remnant of the ancient landscape, and interpretations of both are and were culturally situated*” and that “*past landscapes no longer exist.*” Compounding the difficulty in defining the “Chaco Landscape” is that it is a composite of designed and vernacular/organic characteristics and at the same time represents a relic or fossil landscape to some and a continuing ethnographic/associative landscape to others.

A cultural landscape is also one of the categories of property qualifying for listing in the National Register as a historic site or district. A district (e.g. landscape) must be a definable geographic area that can be distinguished from surrounding properties by changes such as density, scale, type, age, style of sites, buildings, structures, and objects, or by documented differences in patterns of historic development or associations. It is seldom defined, however, by the limits of current parcels of ownership, management, or planning boundaries. The boundaries must be based upon *shared relationship* among the properties constituting the district. A district is usually a single geographic area of contiguous historic properties; however, a district can also be composed of two or more definable significant areas separated by nonsignificant areas. Clement (1999:17) advised that "*As a general rule, it is preferable to identify a reasonably defensible smaller landscape rather than stretching boundaries to distant horizons, and perhaps threatening the credibility of the process.*"

Landscapes can be read on many levels: landscape as nature, habitat, artifact, system, problem, wealth, ideology, history, place and aesthetic. A single landscape approach does not exist (Clark and Scheiber 2008; Van Dyke 2007). When developing a strategy to document a cultural landscape, it is important to attempt to read the landscape in its context of place and time (Birnbaum 1994). Within the Farmington Field Office there is an abundance of cultural resources representative of numerous cultural traditions that are spatially and temporally discrete and diffuse. These resources most assuredly represent a multitude of distinct and overlapping cultural landscapes.

For instance, Largo Canyon is a well-defined and distinct geographic area that was an important route of travel in prehistoric and historic periods and on that level there is a shared relationship among the properties related to travel and transportation. Native American trails passed through the canyon and numerous related trails lead out of the canyon to adjacent mesa tops via hand-and-toe-hold routes and built features. Spanish military incursions in the 1700s and subsequent exploration and travel in both the 18th and 19th centuries followed Largo Canyon. Historic settlements on the San Juan River used Largo Canyon as a main thoroughfare to reach more established locations such as Santa Fe and Albuquerque. At one point, a railroad right-of-way was granted through Largo Canyon, and the original route of New Mexico Route 44 followed Largo Canyon to the San Juan River. Today it serves as a major access to natural gas wells and related industrial development. Largo Canyon seems an intuitively obvious candidate as a cultural landscape.

Area of Potential Affect and Cultural Resource Identification

As previously noted, pursuant to Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations (36 CFR Part 800) a federal agency is required to consider the effects of its actions or "undertakings", such as leasing, on properties that are listed or eligible for the National Register of Historic Places. This is completed by a process of collaborative identification, normally including field surveys of some kind with subsequent evaluations of significance for any districts, sites, buildings, structures, and objects that have been identified within the Area of Potential Effect (APE).

Pursuant to 36 CFR Part 800.4(a) and 800.4(b), BLM has consulted with the NPS, participating tribes (Navajo, Acoma, Hopi, Zuni), NGOs (National Trust for Historic Preservation, Chaco Alliance, San Juan Citizens Alliance), and the New Mexico SHPO by correspondence and face-to-face meetings about defining the area of potential effect and the level of identification necessary. Those tribes, agencies, and groups have often referred to a "Chaco Landscape" verbally and in writing as the APE without clarification or definition. By letter to the BLM dated May 29, 2013, the NPS suggested that a large-scale cultural landscape of 50,000+ square miles can be defined by the location and patterning of monumental architecture (e.g. Chaco great houses, great kivas) and Chaco road alignments. That would include most of northwest New Mexico, and portions of southwest Colorado, southeast Utah, and northeast Arizona. An additional definition of the cultural landscape of Chaco Culture National Historical Park, "the park cultural landscape," has been offered by NPS historical landscape architect Jill Cowley (July 9, 2013) that *"encompasses the whole park, and includes the viewshed into and from adjacent lands, dark night sky, air quality, and resources and values of traditionally associated peoples. The Chaco World Heritage Site and regional Chacoan landscape of course extends much further than park boundaries."*

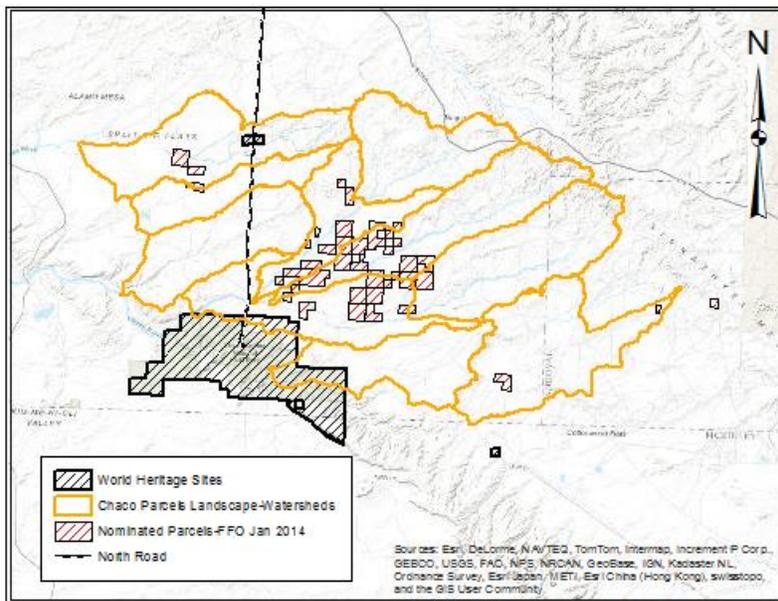
Chaco Canyon was the axis mundi of the Chaco world and its influence, often punctuated, was felt throughout the Colorado Plateau (and probably beyond). As such the "Chaco Landscape" is a palimpsest subject to a variety of units of measure that cross different temporal and spatial scales (Wandsnider 1998), and those units of measure and scale will vary upon one's perspective or orientation. At a certain level any notion of landscape imposed on an archaeological entity, be it Chaco or cultures preceding them by millennia or following them by centuries will be fraught with issues of both natural and cultural preservation, and visibility. This landscape could be defined geographically at several levels: Chaco Canyon and immediately adjacent mesas, the San Juan Basin, or much of the Colorado Plateau. The various consulting parties have indicated to BLM that the viewshed (an area that is visible from a specific location) from Key Observation Points (KOPs) at CCNHP is a critical component of the "Chaco Landscape", although this may be in part a modern perspective and it's uncertain if the Chacoans would agree.

Pursuant to guidance in 36 CFR Part 800.16(d) BLM has identified two levels of APE for this undertaking: 1) the lease parcel themselves for undertakings that could affect aspects of a historic properties physical integrity including location, design, materials, and workmanship; and 2) a viewshed area corresponding to the "foreground/middle ground" (< 5 mi) and "background" (>5 mi <15 mi) distance zones (BLM Handbook H-8410) from NPS designated KOPs in the park (Pueblo Alto, Penasco Blanco, Tsin Kletsin, Pueblo Pintado) and BLM designated KOPs at Pierre's Ruin's for related undertakings that could not only affect physical integrity but also a historic properties integrity of setting, feeling, and association. Parcels lying in the "seldom seen" (> 15 mi) from the NPS designated KOP's are only analyzed at the parcel level while those parcels lying within the "foreground/middle ground" and "background" distance zones are analyzed at the parcel and viewshed level and are hereafter designated as "Chaco Parcels."

To characterize the existing environment of the "Chaco Parcels", USGS and NRCS designated hydrologic units are used. The United States is divided and sub-divided into successively smaller hydrologic units which are classified into six levels nested within each other, from the largest geographic area (region) to the smallest geographic area (subwatershed). The boundaries are

distinguished by hydrographic and topographic criteria that delineate an area of land upstream from a specific point on a river, stream or similar surface waters (USGS 2013, NRCS 2013). Ten subwatersheds generally corresponding to the foreground and middle ground viewshed were selected as the unit of measure for characterizing the existing environment of the "Chaco Parcels" and the 10 collective watersheds are hereafter referred to as the "Chaco Parcels Landscape" (CPL; Figure 1).

Figure 1. Chaco Parcel Landscape



Identification of cultural resources within the nominated parcels and the CPL involved use of computerized cultural resources data maintained by the New Mexico Cultural Resource Information System (NMCRIS; June 2013), BLM site location maps, ethnographic records from previously conducted small and large scale cultural resource surveys, reconnaissance survey, General Land Office (GLO) records, assorted published and unpublished records, and correspondence and face-to-face consultation with the NPS, the New Mexico SHPO, participating tribes including Navajo Nation, Acoma, Zuni, and Hopi, and various NGOs.

NMCRIS Data

Previous cultural resource studies and surveys in all the nominated lease areas have been generally limited to inventories related to various land use authorizations that include various public and industrial infrastructure, ranching, and energy extraction. Within the CPL this also includes archaeological surveys for BLM sponsored land use planning and predictive modeling (e.g. Huse et al. 1978; Kemrer 1982), proposed energy extraction (Nelson et al. 1976; Wilson et al. 1979), or infrastructure development such as residential water lines, powerlines, and road improvements (Ford 1993). From the NMCRIS data review, there are 50 archaeological sites on record in all of the 38 nominated parcels (7) and approximately 4825 acres of that acreage (25%) has been inventoried for cultural resources. For the proposed action there are eight known sites

and approximately 275 acres (13%) has been archaeologically inventoried. For the action alternative there are 5 archaeological sites on record and approximately 77 acres (6%) have been inventoried for cultural resources. The figures may be likely slightly higher because not all known surveys have been electronically captured in a GIS environment.

Table 7. Archaeological Sites on Record

Lease Parcel #NM-201401-	Surface	Acres	Survey (AC)	% Surveyed	Known Sites	Site Type	GLO Maps
135	BLM	976	0	0	2	BM III/PI habitations	1887-no sites 1926-Trail
136	BLM	1440	18	1%	8	P I artifact scatters (2); P I habitations (3); P I/Protohistoric Navajo artifact scatter; Protohistoric Navajo habitation?; Protohistoric Navajo roasting pit	1926-Trail
137	BLM	160	0	0%	0	n/a	1882-no sites
138	BLM	80	8	10%	1	Middle-Late Archaic lithic scatter with features	1882-no sites
139	BLM	480	205	43%	2	Mid-20th century Navajo habitations	1882-no sites
140	BLM	322	6	2%	0	n/a	1882-no sites
141	BLM	883	23	3%	0	n/a	1882-no sites
142	BLM	600	24	4%	0	n/a	1882-no sites
143	BLM	320	13	4%	0	n/a	1882-road
144	BLM	480	29	6%	2	Unknown lithic scatters	1882-no sites
145	BLM	640	640	100%	2	Post World War II corral; 1920s-1940s Navajo habitation	1882-no sites
146	BLM	400	19	5%	0	n/a	1882-road
147	BLM	640	640	100%	1	Unknown stone circle-Navajo?	1882-no sites
148	BLM	320	10	3%	1	Unknown lithic quarry	1882-no sites
149	BLM	640	28	4%	1	Post World War II Enemyway site	1882-no sites
150	BLM	640	26	4%	1	Post World War II Navajo habitation	1882-no sites
151	BLM	640	35	5%	1	Archaic lithic scatter and unspecified ceramics	1882-no sites
152	BLM	640	66	10%	2	Unknown lithic scatter; PII-III unknown	1882-ranch
153	BLM	640	22	3%	1	Post World War II Navajo sweat lodge	1882-no sites

154	BLM	480	21	4%	1	Unknown stains in bladed road-uncertain if cultural	1882-no sites
155	BLM	320	14	4%	1	Post World War II Navajo habitation and sweat lodge	1882-no sites
156	BLM	639	639	100%	2	Archaic/unknown lithic scatters	1883-road
157	BLM	80	1	1%	0	n/a	1883-No sites
158	BLM	120	2	2%	0	n/a	1883-No sites
159	BLM	320	13	4%	0	n/a	1883-road and trail
160	BLM	640	31	5%	3	Unknown lithic scatters	1883-No sites
161	BLM	640	14	2%	3	Unknown lithic and ceramic scatter; Unknown lithic scatter; Unknown Navajo corral	1883-trail and ranch (?)
162	BLM	400	400	100%	3	Post World War II Navajo habitation; Archaic lithic scatters (2)	1883-road
163	BLM	160	160	100%	0	n/a	1883-No sites
164	BLM	1360	1360	100%	3	Post World War II Navajo habitation; PII-III scatter; Unknown	1883-road
165	BLM	320	5	2%	1	PII road/trail	1883-No sites
166	BLM	480	33	7%	2	Unknown Navajo habitation; 1880-1920 Navajo habitation	1883-No sites
167	BLM	480	11	2%	1	Post World War II Navajo sweat lodge	1883-No sites
168	State	640	16	3%	0	n/a	1883-No sites
169	BLM	320	178	56%	1	P II-III artifact scatter; Post World War II historic trash and stock tanks	1883-No sites
170	BLM	240	20	8%	0	n/a	1883-No sites
171	Fee	360	53	15%	4	PII-III ceramic/lithic scatters (3); PII habitation;	1910-no sites
172	BLM	163	42	26%	0	n/a	1910-no sites
TOTALS		19103	4,825	25%	50		

Cultural resource surveys in the CPL have been extensive (8). By sub-watershed the percentage of survey varies from 16-57%, with an overall survey coverage of 27%.

Table 8. Cultural Survey Acreage by Sub-Watershed in the CPL

Sub Watershed Name	Watershed Acreage	Acres Inventoried	Percent Inventoried	Sites
Ah-shi-sle-pah Wash	26,945	4,226	16%	71
Bettonie Tsosie Wash	34,130	6,710	20%	123
Black Lake	15,083	7,383	49%	136
Coal Creek	32,827	14,461	44%	412
Gallo Wash	24,070	13,756	57%	278
Headwaters Escavada Wash	36,265	6,003	17%	134
Headwaters Kimbeto Wash	26,784	4,463	17%	156
Outlet Canada Alemito	36,850	7,958	22%	146
Outlet Escavada Wash	29,760	7,299	25%	275
Outlet Kimbeto Wash	20,238	3,476	17%	39
Totals	282,952	75,734	27%	1770

Within the CPL there are on record approximately 1,770 cultural resource sites (263 within the park): 632 = prehistoric, 566 = historic, 129 = prehistoric and historic, 434 unknown (). Approximately 67% (1,180) are classified as "structural," meaning that there is some form of built feature present at the site (e.g., hearth, windbreak, carin, hogan, sweat lodge, masonry room block, kiva). Those sites represent 2094 separate cultural components (Figure 2; **Error! Reference source not found.**), indicating that some of the 1770 locations have been repeatedly used, such as a Navajo site occupying the same space as a Chacoan artifact scatter. This repeated use of locations over the long-term occupation of a region may be similar to what Schlanger (1992:92) called the "persistent place."

Figure 2. Known Sites in the CPL

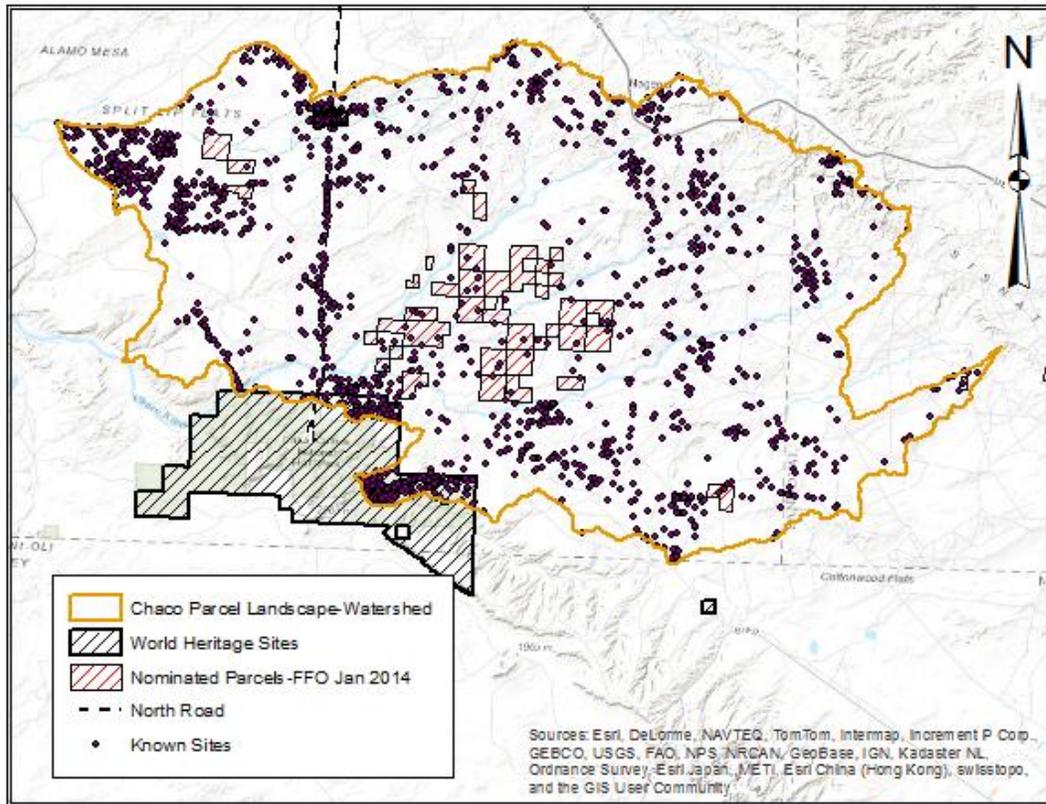


Table 9. Cultural Components in the CPL

Culture Designation	Count
Pueblo	1
Ute	1
Unspecified	2
Hispanic	6
Paleoindian	7
Anglo	25
Unknown Native American	32
Mogollon	34
Archaic	175
Unknown	556
Navajo	626
Anasazi	629
Total	2094

The large number of "Unknown" most likely indicates an absence of culturally or temporally diagnostic artifacts or features, such as a scatter of stone tool debris without any diagnostic specimens. A small percentage may represent an absence of data in the record. The majority of these unknown sites are likely to be Native American and probably pre-Columbian in age.

PaleoIndian sites are few in number. The majority occur in the vicinity of Black Lake (Black Lake subwatershed). Archaic sites are widely distributed across all the watersheds with particularly heavy concentrations in the Black Lake/Tanner Lake area (Black Lake/Coal Creek subwatersheds) as well as in the Gallo Wash subwatershed. Puebloan sites are scattered throughout the CPL with noticeable concentrations along two major Chacoan roads (Ah-Shi-Sle-Pah Road and the North Road: see below), along the south bank the Escavada Wash (Greasy Hill Ruin and Bis sani communities), Gallo Wash (inside and outside CCNHP), and the Black Lake/Tanner Lake area (Black Lake/Coal Creek subwatersheds). The Black Lake area may have been attractive to the Archaic and Puebloan cultures as it occurs in a closed hydraulic basin that historically has had seasonally standing water. There are significant blocks of survey with little or no Puebloan remains within the CPL. Navajo sites (predominantly late 19th-mid 20th century) are found throughout the CPL that seem to be concentrated along Gallo Wash (inside CCNHP), along the Escavada Wash near its confluence with Betonnie Tsosie and Kimbeto Wash, and the northern and eastern margins of the CPL. The age of the Navajo sites includes protohistoric as well as post Bousque Redondo (>1868) and matches general patterns found in Chaco Canyon proper (Brugge 1981)

Within the CPL there are no less than 2841 features represented at 1180 sites. These features are shown in Table .

Table 10. Distribution of Recorded Features in the CPL by Type

NMCRIS Feature Code	Feature Type	Count	NMCRIS Feature Code	Feature Type	Count
402	Agricultural field	2	118	Outhouse	1
317	Ash / charcoal stain	7	904	Petroglyph	82
301	Ash stain	49	905	Pictograph	5
202	Bedrock mortar	1	214	Pit, undefined	2
203	Bin / Cist	41	119	Pithouse	9
801	Burial / Grave	9	210	Plaza	1
303	Burned rock midden	9	311	Pottery kiln	1
220	Cache	7	607	Quarry	1
204	Cairn	81	120	Ramada / Shelter	89
901	Car body	1	701	Reservoir	1
102	Cavate room	2	312	Ring midden	3
304	Charcoal stain	30	504	Road / Trail	65
104	Cliff dwelling	2	313	Roasting pit	42
403	Corral	198	213	Rock alignment, undefined	83
913	Culturally modified tree	2	906	Rockshelter	3
205	Depression	42	121	Roomblock	118
105	Dugout	3	122	Sawmill	7
206	Dump	86	907	Scarecrow	14
405	Fence	5	123	Shed	2

314	Fire-cracked rock conc.	59
107	Forked stick hogan	12
404	Garden plot / Grid garden	1
903	Graffiti	19
108	Great kiva	5
215	Grinding slick	4
306	Hearth	371
109	Hogan	342
307	Horno / Oven	102
110	House extant	10
111	House foundation	12
401	Irrigation ditch / system	5
112	Isolated room	143
308	Kiln	1
113	Kiva	56
406	Lambing pen	16
602	Lithic quarry	12
208	Midden	49
116	Milled lumber structure	4
603	Mine shaft/tunnel	2
209	Mound	107
117	Outbuilding	1

908	Shrine	2
408	Soil control structure	11
702	Spring control structure	1
909	Stairway	15
212	Stone circle	11
134	Structure extant	1
133	Structure foundation	1
217	Survey monument	1
125	Sweat lodge	99
703	Tank	5
126	Tent base	59
128	Tower	1
130	Trailer	1
0	Unspecified other	86
131	Wall	29
704	Water catchment device	8
705	Water control device	26
706	Well	5
132	Wickiup	3
707	Windmill	2
910	Wood concentration	35

Some of these features are particular to the pre-Columbian resources of the CPL, such as pit houses, middens, and roomblock. Others are restricted to the historic periods of occupation such as dumps, corrals, hogans, sweat lodges etc. Some features may appear at sites of any age and cultural affiliation such as hearths and ash/charcoal stains. A complete description of what these features represent may be found in the NMCRIS Users Guide available online at <http://www.nmhistoricpreservation.org/arms.html>.

Outside of CCNHP and within the CPL, two reasonably distinct and unambiguous Chacoan features can be found; great houses and roads. Four Chacoan great houses are known to exist within the CPL: two along the Chaco North Road (Kin Indian Ruin, Pierre's Ruin) and two on the south bank of the Escavada Wash (Bis sani, Greasy Hill Ruin). With the exception of Kin Indian Ruin, each of those great houses seem to be associated with a contemporaneous community or constellation of smaller residential sites in close proximity. Great houses outside the immediate environment of Chaco Canyon are often referred to as outliers and tend to be smaller less massive versions of their larger counterparts such as Pueblo Bonito. Outliers often were established in the midst of existing communities or in some cases were part of the establishment of new communities. These newly established great house communities with no time depth are sometimes referred to as "scion communities" (Marshall, and Doyel 1981). Great kivas are often but not always associated with great houses, but none of the four noted have an associated great kiva. Research pertaining to Chacoan outliers and their associated communities

in the San Juan Basin has been ongoing for decades (e.g., Marshall et al. 1979; Powers et al. 1983; Harper et al. 1988; Breternitz et al. 1982).

The exact nature and functions of the outliers are unknown but they are probably associated with a suite of ceremonial, economic, and administrative tasks that served as a means of system integration. One observation by Marshall et al. (1979:337) was that no road associated great house located in areas of unproductive soils has a great kiva, suggesting that these sites may have had very specific road related duties unrelated to the production or management of economic resources. In support of this observation, not only do the great houses of Halfway House and Twin Angels north of the CPL not have great kivas, they do not have associated communities. One of the more unique site types within the CPL area are pre-Columbian "roads", two of which, the Ah-Shi-Sle-Pah Road and the North Road, are the most well-known and well-documented. Of those two the North Road is the most regional in scale extending from Chaco Canyon to Aztec Ruins. The Ah-Shi-Sle-Pah Road extends from the west end of Chaco Canyon to Ah-Shi-Sle-Pah Wash, and may continue to Black Lake, an area with a concentrated presence of Puebloan sites. On the Colorado Plateau and in the San Juan Basin prehistoric roads are essentially large trails that facilitated certain pedestrian traffic during the Pueblo II-III periods, and are most often associated with Chaco great houses, although not exclusively so, and are frequently referred to as "Chaco roads." A review of road attributes (Roney 1992) and GIS spatial analysis (Kantner 1997) has helped demonstrate that Chaco roads served no primary utilitarian function.

Obenauf (1980), Kincaid et al. (1983), Windes (1987), Roney (1992), and Vivian (1997a, 1997b) provide good thorough reviews and summaries of road research, road morphology, and the various interpretations of their possible function as economic, militaristic, or socially/religiously unifying features. Some roads connect with other Chaco great houses and communities or with geographic features; however, many just play out with no readily apparent destination. Most roads are short; a few kilometers at best. Many seem only to link community landscapes and important architecture and are most formalized in proximity to those landscapes. Outside Chaco Canyon or when not in proximity to Chaco great houses or communities, roads tend to be under engineered and were probably little more than cleared paths 5-10 m in width, and today are only visible on the ground as occasional linear swales.

After 900 years, roads can be maddeningly difficult to see. In many cases roads, including the North Road, are only visible through remote imagery, such as thermal infrared multispectral scanner (TIMS), aerial photography including low sun angle images taken to identify roads via the shadows created across road swales, or more recently by Light Detection and Ranging (LIDAR) imaging, courtesy of the National Trust for Historic Preservation and the Solstice Project. In the absence of ground level visible swales, distinct road associated features, remote imaging, or ceramic artifact trails (linear scatters of artifacts) are all that identify the location of roads (Stein 1983:8-7). Recent surveys along the North Road (Copeland 2010) have shown that between 98-100% of road associated artifacts, predominantly ceramic fragments, are within 30 m of the road centerlines: 94% are within 15 m of the centerlines. Lithic artifact specimens are rare (<5% of total specimens) and most may be associated with use of the area by aceramic cultures millennia before the North Road.

Judd (1954) referred to roads as ceremonial highways. Following on that lead some argue that the North Road was either a symbolic representation of Chacoan cosmology and a route of pilgrimage purposefully aimed at Kutz Canyon (Sofaer et al. 1989), was the Chacoan equivalent of an "Avenue of the Dead" (Marshall 1992), connected ritual landscape (Fowler and Stein 1992; Roney 1992), or was a constructed "monument" to signify a "meridian" of political power for an elite group that transferred their authority from Chaco Canyon to Aztec and Salmon Ruins (Lekson 1999). Copeland (2013) suggests that the North and South Road together are a terrestrial proxy for the Milky Way. Doxtater (1998, 2002) has suggested that the North Road may be a earth-based complement to a georitual landscape based "spirit trail." At least one example of a Chaco road aligned with winter solstice sun rise has been documented in the San Juan Basin (John Stein, personal communication 2012). Ultimately, plausible explanations about their place and use in Chacoan society may be the best that we can ever hope for (Roney 1992:130).

Reconnaissance Survey

BLM Manual 8100 - *The Foundations for Managing Cultural Resources* (2004) defines reconnaissance survey as a "field survey that is less systematic, less intensive, or otherwise does not fully meet inventory standards... Reconnaissance surveys may be useful for checking class I inventory or class II survey conclusions, or for developing recommendations about further survey needs in previously unsurveyed areas. Other terms sometimes applied to similar kinds of survey include "judgmental," "intuitive," "opportunistic," and "purposive."

Limited reconnaissance survey of parcels 141, 143, 144, 157, 158, and 167 was completed on July 26, 2013 by four BLM and one retired BLM archaeological staff. Parcels 165 and 166 were completed on July 31, 2013, by four Farmington BLM and two CCNHP NPS archaeological staff. Reconnaissance survey of parcel 168 was conducted on August 7, 2013 by two BLM archaeologists. Navajo Nation HPD staff were invited but were unable to participate. The objective of the reconnaissance was to determine if any cultural resources that might be located on the parcels were consistent with what would be reasonably expected based on the NMCRIS data on file. Parcels were selected by BLM staff. Parcels visited included those accessible and not currently accessible by vehicle, parcels in close and remote proximity to CCNHP and parcels with and without previously recorded cultural resources. All parcels visited fall within the CPL. On July 26 and 31, 2013, staff separated into two teams, and independently conducted a reconnaissance by inspecting areas likely to have cultural resources (e.g. ridge tops), relocating previously recorded sites if present, and walking transects across the parcel. Parcel 168 reconnaissance was cut short due to severe weather but sufficient observations were made regarding the character of the parcel and the likelihood of encountering cultural resources. A summary of the results of those reconnaissances are shown in 1. As seen by the data, cultural resources located were entirely consistent with what could be reasonably expected based on previous cultural resource surveys in and adjacent to the parcels. Paleontological specimens including exceptionally large fossil logs (>20m long, 2m dia.) and fossil bone were also observed in Parcels 143 and 167.

Table 1. Results of Reconnaissance Survey

Parcel	Description
141	Stone structure of undetermined origin. This location generally corresponds to a place where a Navajo man was reportedly hung in 1926.

141	Carin
141	Dismantled stone hogan and other features.
141	2 small lithic scatters
141	2 can/trash dumps
143	Previously recorded Anglo structure and corral (LA 78775). Outside of the parcel.
143	Previously recorded sweat lodge discard piles (LA 78776). Outside the parcel.
143	Dismantled stone hogan
143	Corral
143	Rock alignment of undetermined origin
143	Lithic scatter (fire cracked rock, lithics, metate)
144	Nothing. Inspected for reported antelope game trap in the area (Brugge 1986:27). Previous relocation attempts by BLM have also yielded negative results regarding the game trap.
157	Nothing. Low potential.
158	Nothing. Low potential.
165	Previously recorded possible Chaco road segment (LA 89244). Current field conclusion is that this is simply an entrenched arroyo. No associated features or artifacts were found.
165	Carin
165	Small Anasazi structure (1-2 rooms) with associated artifact scatter. Outside the parcel.
166	2 previously recorded dismantled hogan/habitations (LA 42377, LA 101282)
166	Anasazi structure (6+ rooms) with associated artifact scatter
166	Ceramic scatter
166	Bottle dump
166	Unknown mound. A "death hogan" is reported in this area (Kelly et al. 2006) but not observed during the reconnaissance.
167	Possible hogan foundation with small corral(?) and artifact scatter. 20th century.
167	Stone concentrations/structure possibly associated with nearby reservoir and road. Unknown age.
167	2 sweat lodges. One previously recorded (LA 51668)
167	Ash dump, glass, China
167	2 sweat lodge discard piles and hearths
167	Ash and burned rock with and Anasazi ceramics
167	4 carins
167	Hearth with old bottle fragments and cans
167	2 can/glass scatter/dumps
168	Nothing. Some potential for lithic scatters on dunal ridge tops

General Land Office (GLO) Records

Original GLO maps covering the area of the CPL were downloaded from the publicly available <http://www.gloreCORDS.blm.gov/> and imported and geo-referenced into a GIS map project. Any historic features such as "roads", "trails", or "ranches" were digitized. For an area encompassing 20 townships (720 mi.²) generally north and northeast of CCNHP and generally corresponding to the sub watershed defined landscape, a small number of residences (19) were identified by the GLO surveyors ("house", "cabin", "ranch", "Butler's", "Cordova's", "Stack's"). Whether this accurately

reflects a low resident population density in the early 1880s, or reflects a bias to documenting what appear to be non-Native American residential features is uncertain. Brugge (1981:101) noted that for Chaco Canyon "well dated [Navajo] sites do not appear until the 1890s." No prehistoric structural sites were identified on the maps. However, of particular note is a northwesterly trending "trail" identified in Sections 28, 29 and 33, T22N, R11W that closely parallels and appears in places to be co-located with a site known as the Ah-Shi-Sle-Pah Road, a pre-Columbian Chaco road heading generally northwest from near the Chaco site Penasco Blanco. The original survey notes do not elaborate and simply identify it as a trail.

Using the georeferenced and digitized locations attempts were made to relocate two of the ranches located in the vicinity of the parcels near Chaco. Although both of these ranches lie outside of the parcels, locating or not locating these ranches would serve as a partial check on the accuracy of 1882 locations of identified features within the landscape. Previous use of early 1900s GLO maps in the Largo and Gobernador Canyons to identify and locate 17th century Navajo defensive sites has been very successful (Copeland 2012): the locations of those sites on GLO maps were very accurate. However, use of 1880s GLO maps to locate historic ranches and springs in upper Largo Canyon was not very successful (Leckman et al. 2013) with actual ground truthed locations upwards to one half mile from GLO map locations. A "ranch" near parcel 167 in Section 19, T23N R9W remains unidentified. A "ranch" located in the Betonnie Tsosie Wash near parcel 143 and previously recorded as LA 78775 was relocated although approximately 3000 feet from its 1882 map location. The two track road that it lies along most likely corresponds to the road shown on the same 1882 map, although it to sufferers from a lack of precision in its mapped route.

3.3.3 Native American Religious Concerns

There are several pieces of legislation or Executive Orders that are considered when evaluating Native American religious concerns. These govern the protection, access and use of scared sites, possession of sacred items, protection and treatment of human remains, and the protection of archaeological resources ascribed with religious or historic importance. These include the following:

- The American Indian Religious Freedom Act of 1978 (AIRFA; 42 USC 1996, P.L. 95-431 Stat. 469).
 - Possession of sacred items, performance of ceremonies, access to sites
- Executive Order 13007 (24 May 1996).
 - Access and use of sacred sites, integrity of sacred sites
- The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA; 25 USC 3001, P.L. 101-601).
 - Protection, ownership, and disposition of human remains, associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony
- The Archaeological Resources Protection Act of 1979 (ARPA; 16 USC 470, Public Law 96-95).
 - Protection or archaeological resources on Federal and Indian lands

Traditional Cultural Properties (TCPs; Parker and King 1998) is a term that has emerged in historic preservation management and the consideration of Native American traditional concerns. TCPs are places that are eligible for the National Register of Historic Places and have cultural values, often sacred, that transcend for instance the values of scientific importance that are normally ascribed to cultural resources such as archaeological sites and may or may not coincide with archaeological sites. Native American communities are most likely to identify TCPs, although TCPs are not restricted to those associations. Some TCPs are well known, while others may only be known to a small group of traditional practitioners, or otherwise only vaguely known. Native American tribal perspectives on what is considered a TCP are not limited by a places National Register eligibility or lack thereof.

The identification of places of traditional religious and cultural importance (e.g. TCPs) within or near the CPL has been ongoing for decades. Most but not all of these efforts at identification were linked to land use planning efforts as well as evaluating potential energy extraction (e.g., coal, oil and gas) in the area (e.g. Brugge 1996; Condie et al. 1982; Fransted and Werner 1975; Fransted 1979; Kelly et al. 2006; York and Winter 1988; Van Valkenburgh 1941, Van Valkenburgh 1974). Identification of TCPs for the proposed action was limited to reviewing these existing published and unpublished literature, and ongoing BLM tribal consultation efforts with tribes and local Navajo chapters/communities.

Based on a review of this data there appears to be no less than about 165 locations that have been ascribed traditional religious and cultural importance within the CPL. Some places are co-located in the same area. The following kinds of places have been identified:

- Burials-marked/unmarked (*jishchaa'*)
- Plant and mineral gathering areas
- Ceremonial grounds (e.g. Enemyway)
- Sweat lodges (*tacheeh*)
- Offering places
- Springs
- Antelope traps (*needzii'*)
- Chaco North Road (*Anaa'sazi Bitiin*)
- Pierre's Ruin (multiple Navajo names)
- Place names related to origin history

Four of these locations lie within the proposed action (a plant gathering area, a location of *jishchaa'*, a historic deer hide tanning site, and *Sis Naateel* [a.k.a. Wide Belt Mesa]).

Sis Naateel is clearly described by Van Valkenburgh (1941:171) as a "large quasi-rectangular mesa standing isolated in the southwestern township of the Jicarilla Apache Indian reservation... Some 18 miles west of Cuba, New Mexico and 10 miles east of Counselors T. P." See also Van Valkenburgh 1974. This mesa is reported to be the home of several holy individuals important in Blessingway and where the Navajo acquired sheep and horses. The location described by Van Valkenburgh is somewhat at odds with the broad location shown on current USGS topographic maps as Sinsathyel Mesa. Commenting on the difficulty of correlating the names used on modern maps with those still used by Navajos, Brugge (1993:18) noted that "... the work of Van Valkenburgh has been of value. His descriptions are usually more detailed than those of other students of Navajo culture..."

In both the published and gray literature the known places of traditional religious and cultural importance noted above are heavily weighted towards places of Navajo knowledge. This most likely is a byproduct of ongoing and historic occupancy of the area and retention of knowledge pertaining to that area. For example Brugge (1993:54) notes that in a research area of approximately 810 mi.² with very minimal Navajo occupancy around Navajo Reservoir, Gobernador and Largo Canyons, only 66 place names and localities of Navajo use and knowledge had been recorded in the literature or otherwise identified by fieldwork. With over 200 place names and localities identified in a 540 mi.² area around Chaco Canyon with significant Navajo occupation (Fransted and Werner 1975), it's clear that occupancy is an important factor in the retention of specific knowledge.

In the same area reported by Brugge (1993) there was only one specific geographical location identified through extensive and generally unproductive efforts to engage 20 pueblos in identifying and documenting places of traditional religious and cultural importance. Places like Mesa Verde, Chaco Canyon, and Aztec Ruin were often mentioned, and the precise location of a number of other named places generally attributed to northwest New Mexico remains uncertain (Brugge 1993:111). Whether or not these unproductive results indicate an absence of information, a lack of interest in the area, or polite way of safeguarding sensitive information is unknown. Without a doubt the pre-Columbian archaeological sites of the San Juan Basin and those in the vicinity Chaco are culturally affiliated with several pueblos (e.g. Acoma, Zuni, Hopi) and in correspondence and face-to-face meetings, representatives from those pueblos have made it very clear that those sites and their environment are of traditional religious and cultural importance to them. For example, by letter dated April 2, 2013 to New Mexico Senators Udall and Heinrich and Congressman Lujan concerning leasing in the vicinity of CCNHP, the chairman of the Hopi Tribe stated that "*Hisatsinom*, People of Long Ago... migrated to and settled on the land in and around Chaco Canyon, and then migrated to Hopi... [and that] Chaco Canyon, *Yupqoyvi*, the Place Beyond the Horizon, is a Traditional Cultural Property of the Hopi Tribe."

3.3.4 World Heritage Sites

Chaco Culture NHP, Aztec Ruins National Monument, and the BLM managed Chaco outlier sites of Pierre's, Halfway House, Twin Angels, Casamero, and Kin Nizhoni were named as United National Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Sites on December 8, 1987. The World Heritage listing includes the 34,000 acres in Chaco Canyon NHP, 318 acres in Aztec Ruins National Monument, and 518 acres within the five sites managed by the BLM. The following is largely summarized from The World Heritage nomination (USA 1987).

The inclusion of Aztec Ruins and the BLM managed sites was done to recognize that the Chacoan culture and its remains were not confined to Chaco Canyon proper and they illustrate the vast extent of the Chaco World in the 10th through the 12th centuries. A complex landscape of emblematic monumental architecture is interconnected by a network of constructed road alignments, portions of which are protected within the five BLM Chaco communities. Chaco Culture NHP has been identified as the center of a complex prehistoric culture that administered a socioeconomic and religious network of widespread outlying communities.

Chacoans are distinguished as a sub group within the prehistoric Anasazi culture. Distinctions of subgroups within a culture rely on slight variations in life style, material culture and technology. However, slight variations are not what characterize the Chaco Anasazi. Their deviations are of considerable scope and magnitude.

The structures in Chaco Culture are the most outstanding examples of the communities that were built during the 10th through the 12th centuries. Chaco Canyon with 2800 archaeological sites including 795 prehistoric structures represents the nucleus of the Chaco culture. The structure of the prehistoric Chaco Canyon society is not exactly known. However there is evidence to indicate that it supported positions of high social status and that the economy involved the redistribution of resources among outlying communities, as well as possible pilgrimages of large numbers of people to the central canyon area.

The development of the Chaco phenomenon in the canyon began as early as AD 900 with the construction of large masonry structures. Eventually the system comprised scores of outlying communities, encompassing most of northwestern New Mexico and extending across the Colorado Plateau into Arizona, southeast Utah and southwest Colorado. After the basic network became formalized, the people enjoyed approximately 150 years of the system's success before it collapsed, resulting in the ultimate extinction of the Chacoan adaptation soon after AD 1150. The scale of effort depicted in almost all Chacoan features surpasses anything achieved by their contemporary neighbors. At the very least, Chaco is a remarkable example of early massive pueblo architecture. The scale and planning of these buildings, which is most evident in the geometry and symmetry of their plan or layout, and labor investment, is unique in the Southwest. The buildings preserved at Chaco Canyon are by far the earliest examples of the modern Pueblo Indian building tradition: terraced room blocks massed around plazas, with central kivas. This concept continues over 1,000 years later in the modern pueblos.

The Chaco road system is specifically named in the World Heritage statement of significance as a vital aspect of its universal value, Portions of the roads are within the boundaries of Chaco Culture NHP, including sections of the North Road at Pierre's Site and Halfway House. Most of the North Road and other road alignments are outside the World Heritage boundaries but those roads contribute to the outstanding universal value of The World Heritage sites.

What was derived from Chaco was the ability to organize and manage highly dispersed resources and to control the cultural values of others. Chaco was not merely an influence over a span of time; it dominated and altered the traditional social, economic, and religious practices over a large area in a marginal environment.

3.4 Recreation

3.4.1 Chaco National Historical Park

Chaco Culture National Historical Park (NHP) was originally established as a national monument in 1907 for the purpose of reserving lands containing prehistoric remains of extraordinary interest due to their number, their great size, and their value. In 1980, Congress redefined Chaco Canyon National Monument as Chaco Culture NHP, recognized a more representative area that depicts the unique cultural remains of the prehistoric Chacoans, and

provided for continued preservation, protection, research, and interpretation of the Chacoan culture.

CCNHP covers approximately 34,000 acres and is comprised of the main canyon area and three detached units: Kin Bineola, Kin Ya'a, and Pueblo Pintado (USA 1987).

CCNHP receives approximately 40,000 visitors a year. Recreational activities within Chaco Culture NHP include viewing prehistoric ruins, visiting a museum, camping, hiking, and star gazing. The interpretive program of the NHP consists of ranger- and self-guided tours of some of the major ruins, a wayside exhibit, and daily availability of a park interpreter (USA 1987). Four backcountry hiking trails lead visitors to remote Chacoan sites, passing ancient roads, petroglyphs, stairways, and spectacular overlooks of the valley (NPS 2013b).

Of the approximately 4,000 archaeological sites identified within the CCNHP boundaries, 37 are open to visitors. These are located on the loop road and on some of the 19 miles of backcountry trails. Trails in the backcountry area and the mesa tops are rough and not easily discerned (de la Torre, et al., 2003).

CCNHP strives to provide visitors with a quality experience. The 1995 CCNHP Resource Management Plan and the 2002 draft Resource Management Plan identify a quality visitor experience as: sweeping, unimpaired views; an un-crowded park; appreciation of ancient sites with minimal distractions; clear air; no intrusions of man-made noise or light (at night); clean water and adequate facilities; access to a ranger for personal interpretation (de la Torre, 2002).

The University of Montana conducted a visitor survey for CCNHP in 2009. Important findings from that survey include: Ninety percent of visitors surveyed were from the U.S.; Seventy-five percent of visitors were day visitors with the average visit lasting five hours. The average length of stay for the 25% of visitors that stayed more than one day was 2.2 days. On average, park visitors stop at six sites, including the Visitor's Center, while in CCNHP. Nearly all visitors stopped at the Visitor's Center and Pueblo Bonito (97% and 98%, respectively). The next most popular sites were Chetro Ketl (69%), Hungo Pavi (52%), Una Vida (42%), and Casa Rinconada (41%) (Freimund and Dalenberg, 2010).

The visitor survey identified a variety of reasons that people visited CCNHP.

A desire to learn and curiosity about the park were the most highly ranked reasons for visiting the park and were important to almost all visitors. A majority of visitors felt that "getting away", "being with family" and "get away from crowds" were of neutral importance but these reasons for visiting the park were extremely important to some visitors and not important to some visitors. Being alone, developing spirituality and experiencing night skies were important to a smaller group of visitors and unimportant to many (Freimund and Dalenberg, 2010).

Visitors also identified what they believed to be the purpose of CCNHP. "Results suggest that visitors view preserving the cultural and historic resources as the most important values of the park (Table 19). Values associated with escape from society, tourism, recreation and socialization were seen as least important in what makes Chaco National Historical Park a valuable place" (Freimund and Dalenberg, 2010).

Visitors identified aspects that added to or detracted from their experience at CCNHP. CCNHP's remoteness and ability to explore the features of the park added to their experience. Encountering large groups or disruptive visitor behavior, especially noise, and access restrictions detracted from the experience (Freimund and Dalenberg, 2010).

In 2011, CCNHP identified several key observation points (KOPs) from which visitors could overlook BLM-managed lands. Table 6 displays registered trail user counts from three of the backcountry trails that contained KOPs.

Table 6. Visitation at Key Observation Points in Chaco Culture NHP

Trail	KOP	2011	2012
Penasco Blanco	Penasco Blanco	2,497	2,822
Pueblo Alto	Pueblo Alto	8,315	7,989
South Mesa Trail	Tsin Kletsin	1,468	1,565
Total		12,280	12,376

Source: Von Haden, 2013

3.4.2 Night Skies

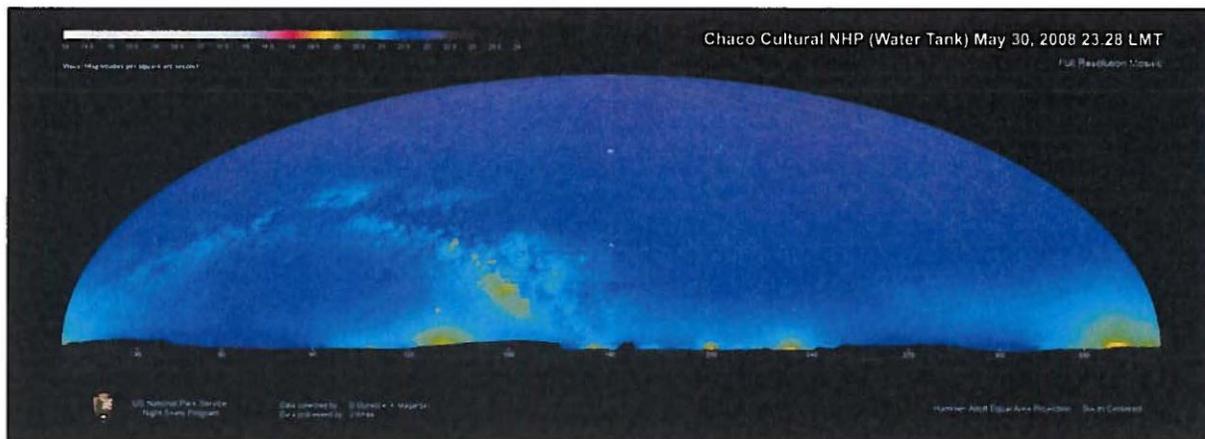
Chaco Culture NHP has a long history of stargazing, starting with the Ancestral Puebloan culture that inhabited the area. Chaco Culture NHP has been the focus of substantial research in cultural astronomy, and there are multiple examples in the park where manmade and natural features were used to mark the positions of the sun, moon, and other astronomical phenomena. For the past two decades, Chaco Culture NHP has partnered with the astronomy community. Amateur astronomers regularly host stargazing events under the guidance of a park ranger with a background in archaeoastronomy. The park built a public observatory in 1998 to help accommodate the hundreds of thousands of visitors who have enjoyed the night sky at the park. The modern connection with the night sky is a substantial recreation interest and a way for the public to connect and better understand the ancient culture that once thrived in the canyon.

The park was one of the first units to receive an inventory of night sky quality in 2002. Subsequent data collection in 2008 provided higher resolution and accuracy than what was available in 2002, using the methods described by Duriscoe, Luginbuhl, and Moore 2007. Sky quality in the park is very good. Views from the canyon floor typically reach Class 2 on the nine-step Bortle Dark-Sky Scale. The lightscape from the canyon rim, representative of sites such as Pueblo Alto, is slightly altered from natural conditions, described as Bortle Class 3 (almost reaching Class 3). Conditions remain among the best in the NPS system. The NPS charge-coupled device (CCD) camera system is able to precisely measure the photic environment in a wavelength mimicking human vision. From these images, quantitative measurements of existing conditions are derived and expressed in absolute terms as well as ratios of the natural sky (the natural sky is comprised of the Milky Way, the Zodiacal light, airglow, and starlight). The 2008 data (Figure 2) shows that the amount of artificial light was 15% of natural amounts; in other words, the Anthropogenic Light Ratio was 0.153. This indicates a very good condition. Though many discrete light sources are visible in the image, they are either distant cities, or small nearby towns.

Figure 2 shows the view from the canyon rim (36.0315 N, 107.9065W) looking southward. False color provides contrast. Visible in the image is the arch of the Milky Way and several small light sources dotting the horizon. This data from 2008 was taken under atmospheric conditions

commonly found at Chaco Culture NHP and is representative of clear air conditions roughly at the 75th percentile of air quality for this region. Under conditions of diminished air quality light sources within 19 miles would tend to be amplified, and light sources at distances greater than 19 miles would tend to be suppressed.

Figure 2. Artificial Light Visible from Chaco Culture NHP, 2008



Zenith brightness measures (22.15 magnitudes per square arc second) indicate that there is very little or no artificial light straight overhead. The brightest artificial light source in the image (19.91 magnitudes per square arc second) is slightly dimmer than the brightest part of the Milky Way. Therefore, the natural features of the night sky predominate a condition that is rarely found in the lower 48 states today. To isolate artificial light, the NPS Natural Sounds and Night Skies Division (NSNSD) removed natural light sources from the dataset. This analysis resulted in a maximum vertical illuminance of 0.08 milliLux. This indicates that direct glare from point sources and discrete light domes is below the threshold where human dark adaptation can begin to be impacted. The level measured at Chaco Culture NHP is also below illuminance levels generated by Venus at its brightest (0.10 milliLux); Venus is the brightest natural light in the moonless sky. This data also indicates that natural features predominate over artificial ones. As seen from

Figure 2, there are five prominent light domes along the horizon. Each is attributed to urban centers in New Mexico. The largest light dome, visible at 345° is Farmington City, about 84 km from Chaco Culture NHP. The next prominent dome is generated from Albuquerque and Rio Rancho City, visible as a single light dome at 130° . Albuquerque is 153 km away from Chaco Culture NHP but still contributes a large portion of the visible light. Other smaller domes consist of Grants, 97 km away at 1760° ; Crownpoint CDP, 44 km away at 210° ; and Gallup, 94 km distant at 232° .

3.5 Rangeland Resources

Livestock grazing is authorized by FLPMA, the Taylor Grazing Act of 1937 and the Public Rangelands Improvement Act of 1978. The principle objective of the rangeland program is to promote healthy, sustainable rangeland ecosystems; to accelerate restoration and improvement of

public rangeland to properly functioning condition; to promote the orderly use, improvement and development of the public lands.

There are 167 grazing allotments managed by the Farmington Field Office with 351 grazing authorizations that permit cattle, sheep and horse grazing within the resource area. Of the 351 grazing authorizations, 317 are permitted under section 3 of the Taylor Grazing Act. Of the 167 grazing allotments, there are 4 authorizations issued under section 15 of the Taylor Grazing Act to the Navajo Tribe that authorized grazing on 35 allotments.

There are additional permits under section 15 authorizations that permit grazing on 30 allotments in the Lindrith, New Mexico Area. The FFO currently consults with grazing permittees on a site by site basis as part of the APD process. Additional information on the FFO grazing program can be found on pages 3-54 and 3-55 of the PRMP/FEIS.

The proposed nominated parcels are located in four BLM grazing allotments. Parcel 168 is located in the Black Lake #6010 allotment; parcels 163, 165 and 166 are located in the Kimbeto Community Allotment #6013; parcels 138 and 160 are in the Counselor Community Allotment #6015; and parcel 171 is located in the Shumway Arroyo Allotment #5005.

All of these allotments currently have mineral development on them in differing amounts. Two of the allotments (#6010 and #5005) are permitted to individuals or corporations. The other two allotments (#6013 and #6015) are Navajo community allotments permitted to sixty nine (69) and fifty nine (59) permittees respectively. With the exception of the Shumway Arroyo Allotment, the other three allotments are located in what's commonly referred to as the "Checkerboard" area. This area is called the Checkerboard because of the mixed surface ownership that occurs there.

3.6 Water Resources

The primary aquifers in the BLM/FFO area are the sandstone based Uinta-Animas and the Mesaverde. Figure 3 shows the geologic time column that relates to aquifers in the San Juan Basin. The Uinta-Animas aquifer is composed primarily of Lower Tertiary rocks consisting of the San Jose Formation, the underlying Animas Formation and its lateral equivalent, the Nacimiento Formation, and the Ojo Alamo Sandstone. The aquifer thickness generally increases toward the central part of the basin.

The Mesaverde aquifer comprises water-yielding units in the Upper Cretaceous Mesaverde Group and some adjacent Tertiary and Upper cretaceous formations. In the basin, the aquifer consists of sandstone, coal, siltstone, and shale of the Mesaverde Group. The aquifer has a maximum thickness of about 4,500 feet in the southern part of the basin. The quality of the Mesa Verde Aquifer is extremely variable. Sparse data indicate that the total dissolved solids (TDS) concentrations ranges from about 1,000 to 4,000 milligrams per liter (mg/L) in the basin (USDI/BLM 2003a, page 3-29) and also high in chlorides (USGS 1995). The available data in the San Juan Basin indicate recharge in the area of the Zuni Uplift, Chuska Mountains, and in northern Sandoval County, New Mexico. Transmissivity, the rate which groundwater flows horizontally through an aquifer, of the Mesaverde aquifer is less than 50 square feet per day in large areas of the Colorado Plateaus (USGS 1995).

Figure 3: Geologic Time Column of the San Juan Basin

Era	System	Formation	Thickness	Production	
CENOZOIC	TERTIARY	San Jose Formation	2500 ft.	Gas	
		Nacimiento Formation	500-1300 ft.	Gas	
		Ojo Alamo Sandstone	250 ft.	Gas	
MESOZOIC	CRETACEOUS	Kirtland Shale Farmington Sandstone	1500 ft.	Gas/Oil	
		Fruitland Formation	500 ft.	Gas	
		Pictured Cliffs Sandstone	250 ft.	Gas	
		Lewis Shale Huerfano Bentonite	500-1900 ft.	Gas	
	Mesaverde Group	Cliff House Sandstone	0-800 ft.	Gas	
		Menefee Formation	350-2200 ft.	Gas	
		Point Lookout Formation	100-300 ft.	Gas	
		Mancos Shale	Upper Mancos Shale/Tocito Sandstone	2300-2500 ft.	Gas/Oil
			Gallup Sandstone/Carlile Shale		Gas/Oil
	Greenhorn Limestone				
	Graneros Shale				
	Dakota Sandstone	150-200 ft.	Gas/Oil		
	JURASSIC	Morrison Formation	400-900 ft.		
		Wanakah Formation	50-200 ft.		
		Todilto Limestone			
	Entrada Sandstone	100-300 ft.	Oil		
	TRIASSIC	Chinle Formation	500-1600 ft.		
PALEOZOIC	PERMIAN	Cutler Formation	1500-2500 ft.		
	PENNSYLVANIAN	Hermosa Formation	Honaker Trail Formation		
			Paradox Formation	200-3000 ft.	Gas?
			Pinkerton Trail Formation		
			Molas Formation	0-100 ft.	
	MISSISSIPPIAN	Leadville Limestone	0-165 ft.		
	DEVONIAN	Elbert Formation	0-325 ft.		
	CAMBRIAN	Ignacio Quartzite	0-100 ft.		
PRECAMBRIAN					

Source: USDI/BLM 2003a

Groundwater is readily available in most of the FFO planning area and is of fair to poor quality. Generally TDS exceed 1,000 mg/L and ranges from 400 up to 4,000 mg/L. The water is hard to very hard with chemical composition dependent on location of withdrawal and the producing aquifer. Calcium or sodium is usually the predominant cation with bicarbonate or sulfate the predominant anion (USDI/BLM 2003a, page 3-30).

Most onshore produced water (water that is produced along with oil or gas from target formations) is injected deep underground for either enhanced recovery or disposal. With the passage of the Safe Drinking Water Act in 1974, the subsurface injection of fluids came under federal regulation. In 1980, the USEPA promulgated the Underground Injection Control regulations. The program is designed to protect underground sources of drinking water. The NMOCD regulates oil and gas operations in New Mexico. The NMOCD has the responsibility to gather oil and gas production data, permit new wells, establish pool rules and oil and gas allowables, issue discharge permits, enforce rules and regulations of the division, monitor underground injection wells, and ensure that abandoned wells are properly plugged and the land is responsibly restored. The New Mexico Environment Department (NMED) administers the major environmental protection laws. The Water Quality Control Commission (WQCC), which is administratively attached to the NMED, assigns responsibility for administering its regulations to constituent agencies, including the NMOCD. The NMOCD administers, through delegation by

the WQCC, all Water Quality Act regulations pertaining to surface and groundwater (except sewage not present in a combined waste stream). According to the NMOCD, produced water if predictable in salt concentration, can be used for drilling and completion and possibly cementing (Jones, pers. comm. 2012).

According to NMED data, there are no drinking water sources located in or near the proposed parcels. Wells registered with the NM Office of the State Engineer (OSE) are located in and near parcel -171, but these wells appear to be associated with coal exploration. A domestic water well registered with NMOSE is located between parcels -167 and -156. A few other wells located in or near the nominated parcels are described as being used either for livestock, wildlife, or oil and gas use. All of the nominated parcels are located in the San Juan declared ground water basin.

All of the nominated parcels are located in the San Juan River surface watershed, which flows into the Colorado River in northeastern Arizona. Intermittent arroyos are present in many of the nominated parcels. The San Juan, Animas, and La Plata Rivers and Navajo Lake are waters in the FFO listed as impaired under section 303(d) of the Clean Water Act. Parcels -171 and -172 are located north of the San Juan River. Parcels -135 and -136 are located northwest of Navajo Lake.

3.7 Fragile Soils

Fragile soils have a high erosion risk due to a combination of soil erodibility characteristics, slope length, and slope gradient. FFO reviewed Natural Resource Conservation Service (NRCS) soil surveys and has identified three soil types in San Juan County (BA, GY, and RT) and three soil types in Rio Arriba County (9, 10, and 220) that are potentially fragile depending on the percent of slope. The parcels in Table 7 display the fragile soil type if it is present.

Table 7. Soil Types

Lease Parcel #	Fragile Soil Type	Fragile Soil Acres	Total Acres
NM-201401-137	Rock Outcrop	16	160
NM-201401-138	None	0	80
NM-201401-163	Badland	30	160
NM-201401-165	None	0	320
NM-201401-166	Badland	20	480
NM-201401-168	None	0	640
NM-201401-171	None	0	320

BA Badland

The Badland soil type consists of non-stony barren shale uplands that are dissected by deep intermittent drainages and gullies, and is located on slopes ranging from 5 to 80 percent. The badland soils do not support vegetation in significant quantities, but can be utilized by wildlife.

RT Rock Outcrop-Travessilla-Weska Complex

The Rock Outcrop-Travessilla-Weska soil unit is found hills, breaks, and mesas with slopes of 30 to 70 percent. This unit is about 40 percent Rock outcrop, 30 percent, Travessilla sandy loam, 20 percent Weska silty clay loam, and 10 percent other soil inclusions. The Rock outcrop is exposed areas of barren sandstone. The Travessilla soil is very shallow and well drained, and is formed in residuum derived dominantly from sandstone. The surface layer is typically pale brown sandy loam about 1 inch thick. This soil has moderately rapid permeability, very low available water capacity, rapid runoff, and the hazard of water erosion is severe. The Weska soil is very shallow and well drained, and is formed in residuum derived dominantly from shale. This soil has moderately slow permeability, very low available water capacity, rapid runoff, and the hazard of water erosion is very severe. The potential plant community for this soil unit includes juniper, pinyon, sideoats grama, and blue grama.

220 Rock Outcrop-Vessilla-Menefee Complex

The Rock Outcrop-Vessilla-Menefee Complex is comprised of 15 to 45% slopes. The complex is comprised of 40% Rock Outcrop, 15 to 45% slopes; 30% Vessilla sandy loam, 15 to 45% slopes; 20% Menefee clay loam, 15 to 45% slopes; and 10% minor components. The Rock Outcrop consists of barren or nearly barren areas of exposed bedrock on ridges, ledges, and escarpments. Vessilla soils, found on breaks, is shallow and well drained. Permeability is moderately rapid with a very low available water capacity. Effective rooting depth varies from 6 to 10 inches. Runoff is rapid with the potential for water erosion severe. The hazard of soil blowing is severe. Menefee soil, found on breaks, is shallow and well drained. Permeability is slow with a very low available water capacity. Effective rooting depth is 6 to 10 inches. Runoff tends to be rapid with the potential for water erosion severe. The potential for wind erosion is also severe. The unit has limitations due to lack of soil depth and slopes. Roads can be protected from erosion by construction of water bars and by seeding of cuts and fills. Minor components include badlands, 5% and rubble land, 5%. The major use for this soil type is wood products.

3.8 Special Status Species

3.8.1 USFWS Threatened or Endangered Species

Under Section 7 of the Endangered Species Act of 1973 (as amended), the BLM is required to consult with the U.S. Fish and Wildlife Service (USFWS) on any proposed action which may affect federal listed threatened or endangered species or species proposed for listing. Based on FFO's field inspection and reviews, it was determined that there are no known threatened or endangered species located within the area of analysis. The proposed action would be in compliance with the 2002 Biological Assessment for the 2003 BLM/FFO RMP (Cons. #2-22-01-I-389). No further consultation with the USFWS is required at this stage. Any proposed project within the proposed leases would require another effects determination on federally-listed species under Section 7 of the Endangered Species Act. Table 8 lists all the federally-listed and Candidate species in San Juan, Rio Arriba and Sandoval Counties.

Table 8. Habitat Descriptions and Presence of Federally-Listed Threatened, Endangered, and Candidate Species in San Juan, Rio Arriba and Sandoval Counties.

Species Name	Conservation Status	Habitat Associations	Potential to Occur in the Proposed Action Area
---------------------	----------------------------	-----------------------------	---

BIRDS			
Southwestern willow flycatcher (<i>Empidonax traillii extimus</i>)	Federal-Endangered	Riparian habitats along rivers, streams, or other wetlands with dense growths of willows or other shrubs and medium sized trees.	There are no riparian habitats suitable for willow flycatchers in the proposed action area.
Mexican spotted owl (<i>Strix occidentalis lucida</i>)	Federal-Endangered	Mature montane forest and in shaded, woody, and steep canyons.	No montane forests are located within the proposed action area.
Yellow-billed cuckoo (<i>Coccyzus americanus</i>)	Federal-Candidate	Low to mid-elevation riparian woodlands, deciduous woodlands, and abandoned farms and orchards.	There are no large cottonwood galleries in, or near the proposed action area.
Whooping crane (<i>Grus americana</i>)	Experimental, non-essential population; Rocky Mountain population	Nests at shallow diatom ponds that contain bulrush. Migration: wetland mosaics most suitable. Feeding: primarily use shallow, seasonally and semi permanently flooded palustrine wetlands for roosting, and various cropland and emergent wetlands.	No suitable wet areas or cropland occur in or near the analysis area. Rocky Mountain experimental population has been discontinued.
Least tern-interior pop. (<i>Sterna antillarum</i>)	Federal-Endangered	Breeds on sandbars or sandy shorelines along perennial rivers, lakes, and reservoirs east of the Continental Divide and forages over open waters.	There are no perennial water bodies in the proposed action area.
FISH			
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	Federal-Endangered	Large rivers with strong currents, deep pools, and quiet backwaters.	USFWS designated critical habitat within one mile of Parcel #73.
Razorback sucker (<i>Xyrauchen texanus</i>)	Federal-Endangered	Habitats include slow areas, backwaters and eddies of medium to large rivers; impoundments.	Habitat within one mile of Parcel #73.
Rio Grande cutthroat trout (<i>Oncorhynchus clarki virginalis</i>)	Federal-Candidate	Small streams and Lakes at High Elevations 7500-10750 feet in elevation	There are no perennial high elevation streams or lakes within the proposed action area.
Rio Grande silvery minnow (<i>Hybognathus amarus</i>)	Federal-Endangered	River with silty substrates in eddies, and backwaters of the Rio Grande River and its tributaries.	There are no perennial rivers with eddies and backwaters located in the proposed action area.
Roundtail chub (<i>Gila robusta</i>)	Federal-Candidate	Occurs in cool to warm water, mid-elevation streams and rivers with deep pools adjacent to swifter riffles and runs. Cover is usually present (large boulders, tree rootwads, submerged large trees, etc.)	Proposed action area does not contain suitable habitat.
MAMMAL			
Black footed ferret (<i>Mustela nigripes</i>)	Federal-Endangered	Grassland plains where it occurs in association with prairie dogs. At a minimum, the black-footed ferret requires prairie dog towns of at least 80 acres for suitable habitat.	No prairie dog colonies are located within the proposed action area.
New Mexico jumping mouse (<i>Zapus hudsonius luteus</i>)	Federal-Candidate	Riparian zones along permanent waterways with dense and diverse vegetation consisting of grasses, sedges, and forbs	No riparian zones occur within the proposed action area.
Gunnison's prairie dog (<i>Cynomys gunnisoni</i>)	Federal-Candidate	Open, brushy country, oft sagebrush with scattered juniper, typically > 5000ft elev.	Proposed action area contains suitable habitat but no known p-dog colonies.
Canada lynx (<i>Lynx canadensis</i>)	Federal-Candidate	Mature subalpine coniferous forests with uneven-aged stands, boulder outcrops,	No subalpine forests occur within the proposed action

		and downed logs.	area; elevation too low. No riparian corridors suitable for migration occur in or near the proposed action area.
PLANTS			
Knowlton's cactus (<i>Pediocactus knowltonii</i>)	Federal- Endangered	Alluvial deposits that form rolling, gravelly hills in piñon-juniper and sagebrush communities (6,200-6,400 ft.).	Soils in the proposed project area are clay and sandy in texture and do not contain a high content of organic matter
Mancos milkvetch (<i>Astragalus humillimus</i>)	Federal- Endangered	Cracks of Point Lookout Sandstone of the Mesa Verde series (5,000-6,000 ft.).	Point Lookout Sandstone does not occur in the proposed action area.
Mesa Verde cactus (<i>Sclerocactus mesae-verde</i>)	Federal- Threatened	Highly alkaline soils in sparse shale or adobe clay badlands of the Mancos and Fruitland formations (4,000-5,550 ft.).	Parcel #73 does include Mancos or Fruitland Shale Formations.

3.8.2 Other Special Status Species

In accordance with BLM Manual 6840, the Farmington Field Office of the Bureau of Land Management (FFO) has prepared a list of special management species to focus species management efforts toward maintaining habitats under a multiple use mandate, called FFO Special Management Species (SMS). The BLM manages certain sensitive species not federally listed as threatened or endangered in order to prevent or reduce the need to list them as threatened or endangered in the future (IM-NM-200-2008-001). Table 9 provides an evaluation of the potential for Special Management Species, BLM Sensitive Species and other special status species to occur in the proposed action area. The FFO has mapped potential habitats for those species which have readily defined habitat characteristics. The San Juan milkweed and the Mancos saltbush habitat have yet to be mapped due to their recent addition to the BLM Sensitive Species list (2011).

Table 9. Habitat Descriptions and Presence of BLM FFO Special Status Species

Species Name	Conservation Status		Habitat Associations	Potential to Occur in Analysis Area
	BLM/ USFWS	State of NM		
Birds				
Golden Eagle (<i>Aquila chrysaetos</i>)	SMS		In the West, mostly open habitats in mountainous, canyon terrain. Nests primarily on cliffs and trees.	The proposed action area contains suitable habitat for foraging, but nesting habitat marginal.
Ferruginous hawk (<i>Buteo regalis</i>)	SMS		Grasslands and semi-desert shrub; occasionally piñon-juniper edge habitat. Nest on rock spires in NW New Mexico.	The proposed action area contains suitable piñon-juniper edge habitat for foraging with some nesting habitat.
Prairie falcon (<i>Falco mexicanus</i>)	SMS		Arid, open country, grasslands or desert scrub, rangeland; nests on cliff ledges, trees, power structures.	The proposed action area contains suitable habitat for foraging and nesting.
Mountain plover (<i>Charadrius montanus</i>)	SMS		Semi desert, grasslands, open arid areas, bare fields, breeds in open plains or prairie.	The proposed action area does not contain flat, open grasslands for suitable habitat.
Yellow-billed cuckoo	SMS		Low to mid-elevation riparian	The proposed action area

<i>(Coccyzus americanus)</i>	BLM-S FWS-C		woodlands, deciduous woodlands, and abandoned farms and orchards. Rare in the San Juan River valley.	does not contain riparian areas for suitable habitat.
American peregrine falcon <i>(Falco peregrinus anatum)</i>	SMS FWS-SC	NM-T	Open country near lakes or rivers with rocky cliffs and canyons. Tall city bridges and buildings also inhabited.	The proposed action area lacks suitable habitat for nesting.
Bald eagle <i>(Haliaeetus leucocephalus)</i>	SMS BLM-S	NM-T	Near lakes, rivers and cottonwood galleries. Nests near surface water in large trees. May forage terrestrially in winter.	The proposed action area does not contain suitable habitat for nesting, foraging opportunities possible.
Western Burrowing owl <i>(Athene cucularia)</i>	SMS BLM-S FWS-SC		Associated with prairie dog towns. In dry, open, short-grass, treeless plains	The proposed action area does contain suitable habitat for foraging and nesting. Historic prairie dog colonies occur in the planning area but not active.
Plants				
Brack's hardwall cactus <i>(Sclerocactus cloveriae ssp. brackii)</i>	SMS BLM-S FWS-SC	NM-E	Sandy clay slopes of the Nacimiento Formation in sparse semi desert, piñon-juniper grasslands and open arid areas of badland habitat (5,000-6,000 ft).	The proposed action area meet suitable habitat requirements for this species.
Aztec gilia <i>(Aliciella formosa)</i>	SMS BLM-S FWS-SC	NM-E	Arid and sparsely vegetated Badland /Salt desert scrub communities in soils of the Nacimiento Formation (5,000-6,000 feet).	The proposed action area meet suitable habitat requirements for this species.
Gramma grass cactus <i>(Sclerocactus papyracanthus)</i>	BLM-S		Open grasslands mixed with juniper-piñon woodlands, 5,000-7,000 ft. elevation.	The proposed action areas may meet suitable habitat requirements for this species.
Gypsum Townsend's aster <i>(Townsendia gypsophila)</i>	BLM-S	NM-SOC	Weathered gypsum outcrops of the Jurassic-age Todilto and overlying Morrison formations, 5,900-6,450 ft. elevation.	The proposed action areas are not known to include suitable habitat requirements for this species.
Knight's milkvetch <i>(Astragalus knightii)</i>	BLM-S	NM-SOC	Rimrock ledges of Dakota Formation sandstone in juniper savannah and grassland, 5,700-5,900 ft. elevation.	The proposed action areas may meet suitable habitat requirements for this species.
Mancos Saltbush <i>(Proatriplex pleiantha)</i>	BLM-S	NM-SOC	Desert badlands of Colorado Plateau on saline clay soils of the Mancos and Fruitland shale formations; 5,000-5,500 ft.	The proposed action areas meet suitable habitat requirements for this species.
Parish's alkali grass <i>(Puccinellia parishii)</i>	BLM-S	NM-E	Alkaline springs, seeps, and seasonally wet areas that occur at the heads of drainages or on gentle slopes, 2,600-7,200 ft. elevation.	The proposed action areas are not known to include suitable habitat requirements for this species.
San Juan milkweed <i>(Asclepias sanjuanensis)</i>	BLM-S	NM-SOC	Sandy loam soils, usually in disturbed sites, in juniper	The proposed action areas smeeet suitable habitat

			savanna and Great Basin desert scrub; 5,000-5,500 ft.	requirements for this species
Tufted sand verbena (<i>Abronia bigelovii</i>)	BLM-S	NM-SOC	Hills and ridges of gypsum in the Todilto Formation, 5,700-5,400 ft. elevation.	The proposed action areas are not known to include suitable habitat requirements for this species.
<small>NM-T = State of New Mexico Threatened Species; NM-E = State of New Mexico Endangered Species; NM-SOC=State of New Mexico Species of Concern; BLM-S BLM Sensitive Species; FWS-SC = USFWS Species of Concern; SMS = FFO Special Management Species.</small>				

3.9 Wildlife

The Piñon-Juniper plant communities in the northeastern part of the FFO provide habitat for herds of wintering and resident populations of mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*). Mule deer and elk are found most often on FFO land north of US Highway 550, and are much less common south of the highway due to the lack of suitable habitat. The BLM lands found in the Lindrith area north of Cuba provide yearlong habitat for a variety of wildlife species but most notably, deer and elk. The area between Lajara and Regina is utilized each fall/spring as a migration corridor for elk that migrate from the San Pedro Parks Wilderness, which is adjacent to the BLM and private lands, on their way to winter range in the Chaco area. Deer also migrate from the surrounding Apache Reservation into the Lindrith area to winter. Their numbers vary depending upon the severity of the winter. Deer and elk population density on FFO land varies by location and time of year.

Several small populations of pronghorn antelope (*Antilocapra americana*) reside in the area north and east of US Highway 550 and are much less common south of the highway due to the lack of suitable habitat. Deer and elk population density on FFO land varies by location and time of year.

Detailed information on other wildlife species and habitats in the FFO is contained on pages 3-39 to 3-42 of the PRMP/FEIS and the background biological resources analysis (SAIC 2002) prepared for the RMP.

3.10 Migratory Birds

A Memorandum of Understanding (MOU) between the BLM and USFWS dated April 12, 2010 calls for increased efforts to more fully implement the Migratory Bird Treaty Act of 1918 (DOI 2010a). In keeping with this mandate, the BLM/FFO has issued an interim policy to minimize unintentional take as defined by the MOU and to better optimize migratory bird efforts related to BLM/FFO activities (DOI 2010b). In keeping with this policy, a list of priority birds of conservation concern which occur in similar eco-regions as the proposed action area was compiled through a review of existing bird conservation plans including:

- Fish and Wildlife Service (USFWS) Birds of Conservation Concern (BCC)
- New Mexico Partners in Flight (NMPIF) New Mexico Bird Conservation Plan
- Comprehensive Wildlife Conservation Strategy for New Mexico (CWCS)
- Gray Vireo Recovery Plan
- The North American Waterbird Conservation Plan

Recovery plans and conservation plans/strategies prepared for federally-listed candidate species.

The selected species have a known distribution in the FFO area within the piñon-juniper vegetation community and may be affected by the proposed action. These species and a brief assessment of their habitat can be found in Table 10.

Table 10. Migratory Birds with Potential to Occur in the Proposed Action Area

Species Name	Habitat Associations	Potential to Occur in the Proposed Action Area
Montezuma quail (<i>Cyrtonyx montezumae</i>)	Open oak, pine-oak, or piñon-juniper with well-developed grassy understory; prefers 70% or more tall grass cover.	Lack of significant grassy understory within the analysis area limits habitat.
Broad-tailed hummingbird (<i>Selasphorus platycercus</i>)	Piñon-juniper woodlands, montane riparian areas and thickets, and open, mixed conifer forests.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Cassin's kingbird (<i>Tyrannus vociferans</i>)	Found in open country with scattered trees (savannahs) or open woodlands including piñon-juniper.	Piñon-juniper/sagebrush edge of the analysis area may provide preferred habitat.
Loggerhead shrike (<i>Lanius ludovicianus</i>)	Open country interspersed with improved pastures, grasslands, and hayfields. Nests in sagebrush areas, desert scrub, and woodland edges.	No open country interspersed with grassy areas occurs in or near the project area.
Gray vireo (<i>Vireo vicinior</i>)	In northern NM, stands of piñon pine and Utah juniper 5800 - 7200 ft, open with a shrub component and mostly bare ground; antelope bitterbrush, mountain mahogany, Utah serviceberry and big sagebrush often present. Broad, flat or gently sloped canyons, in areas with rock outcroppings, or near ridge-tops.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Plumbeous vireo (<i>Vireo plumbeus</i>)	Denser piñon-juniper woodland at higher elevations (and ponderosa forests) with some deciduous understory.	Low elevation sparse woodland not likely to provide habitat.
Western scrub-jay (<i>Aphelocoma californica</i>)	Scrub and open woodland habitats.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Piñon jay (<i>Gymnorhinus cyanocephalus</i>)	Piñon-juniper habitat, due to the species' tightly co-evolved relationship with piñon pines.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Juniper titmouse (<i>Baeolophus griseus</i>)	Open, mixed woodland areas at mid-elevations, most common where juniper is dominant; high overstory cover; requires large, mature trees for cavity nesting.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Western bluebird (<i>Sialia mexicana</i>)	Open piñon-juniper, often burned or moderately logged areas; requires larger trees and snags for cavity nesting.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Mountain bluebird (<i>Sialia currucoides</i>)	Open piñon-juniper woodlands, mountain meadows, and sagebrush shrublands; requires larger trees and snags for cavity nesting.	Piñon-juniper woodland in the analysis area could provide suitable habitat for the species.
Bendire's thrasher (<i>Toxostoma bendirei</i>)	On the Colorado Plateau, inhabits open sagebrush with scattered junipers; sparse or degraded understory, lower elevations.	While juniper does occur in the analysis area, it is associated with piñon in a woodland setting. There is no dry open habitat typical of the preferred habitat.
Virginia's warbler (<i>Vermivora virginiae</i>)	Coniferous woodland or forest mixed with deciduous shrubs or trees; dense understory is critical; steep draws or scrubby hillsides especially favored	Lack of significant deciduous component limits preferred habitat.
Black-throated gray warbler (<i>Dendroica nigrescens</i>)	Large stands of mature piñon-juniper woodland often with brushy undergrowth.	Lack of mature woodland limits preferred habitat.

Species Name	Habitat Associations	Potential to Occur in the Proposed Action Area
Black-chinned sparrow (<i>Spizella atrogularis</i>)	Moderately dense montane shrubs from 3-7 ft tall mixed with rocky outcroppings; large grass component and openings.	No montane shrub dominated areas exist in or near the project area.
Cassin's finch (<i>Carpodacus cassinii</i>)	Breeds in higher mountains. Fall and winter moves into lower mountains and foothills, especially areas where piñon pine cone crops are excellent.	Piñon-juniper woodland in the analysis area could provide suitable winter habitat for the species.

3.11 Visual Resources

The BLM classifies visual resources through a Visual Resource Inventory (VRI). The VRI has three components: scenic quality, sensitivity, and distance zone. Scenic quality is a measure of the visual appeal of a tract of land. In the VRI process, BLM-managed lands are given an A, B, or C rating based on the apparent scenic quality. Scenic quality is determined by using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. Areas with the most visual appeal are rated A, while areas with the least visual appeal are rated C.

Sensitivity is a measure of the public concern for scenic quality. During the sensitivity rating, public lands are assigned high, medium, or low sensitivity by analyzing six indicators of public concern: type of user, amount of use, public interest, adjacent land uses, special areas, and other factors.

The distance zone analysis is conducted to determine the relative visibility from travel points or observation points. The distance zone for this area is foreground/midground meaning the area can be seen from travel routes of observation points within a distance of 3 to 5 miles. This indicates activities and development may be able to be viewed in detail.

VRI Information for the nominated parcels is displayed in Table 11.

Table 11. Visual Resource Inventory for Parcels

Lease Parcel #	Scenic Quality Rating Unit (SQRU)
NM-201401-137	<p>SQRU 030: Sisnathyel Scenic Quality: C The area contains a band of badland landscape in the middle of a large, open complex of rolling hills and dry drainages. The low buttes and mesas of the badlands add diagonal lines to the otherwise horizontal landscape. Scattered clusters of pinon/juniper add greens and grays to the browns, reds, whites, and yellows of the soils.</p> <p>Sensitivity: Medium</p> <p>VRI Class: IV</p>
NM-201401-138	<p>SQRU 030: Sisnathyel Scenic Quality: C The area contains a band of badland landscape in the middle of a large, open complex of rolling hills and dry drainages. The low buttes and mesas of the badlands add diagonal lines to the otherwise horizontal landscape. Scattered clusters of pinon/juniper add greens and grays to the browns, reds, whites, and yellows of the soils.</p>

	<p>Sensitivity: Medium</p> <p>VRI Class: IV</p>
NM-201401-163	<p>SQRU 030: Sisnathyel (115 acres) Scenic Quality: C The area contains a band of badland landscape in the middle of a large, open complex of rolling hills and dry drainages. The low buttes and mesas of the badlands add diagonal lines to the otherwise horizontal landscape. Scattered clusters of pinon/juniper add greens and grays to the browns, reds, whites, and yellows of the soils.</p> <p>Sensitivity: Medium</p> <p>VRI Class: IV</p> <p style="text-align: center;">&</p> <p>SQRU 029: Tanner Lake (45 acres) Scenic Quality: C The area contains flat, rolling hills vegetated with sparse, low shrubs and grasses and some scattered juniper. There are only subtle changes in landform and vegetation with a few scattered rims and outcrops. Colors are mostly browns, greens, and grays.</p> <p>Sensitivity: Medium</p> <p>VRI Class: III</p>
NM-2014041-165	<p>SQRU 030: Sisnathyel Scenic Quality: C The area contains a band of badland landscape in the middle of a large, open complex of rolling hills and dry drainages. The low buttes and mesas of the badlands add diagonal lines to the otherwise horizontal landscape. Scattered clusters of pinon/juniper add greens and grays to the browns, reds, whites, and yellows of the soils.</p> <p>Sensitivity: Medium</p> <p>VRI Class: IV</p>
NM-2014041-166	<p>SQRU 030: Sisnathyel Scenic Quality: C The area contains a band of badland landscape in the middle of a large, open complex of rolling hills and dry drainages. The low buttes and mesas of the badlands add diagonal lines to the otherwise horizontal landscape. Scattered clusters of pinon/juniper add greens and grays to the browns, reds, whites, and yellows of the soils.</p> <p>Sensitivity: Medium</p> <p>VRI Class: IV</p>
NM-2014041-168	<p>SQRU 029: Tanner Lake Scenic Quality: C The area contains flat, rolling hills vegetated with sparse, low shrubs and grasses and some scattered juniper. There are only subtle changes in landform and vegetation with a few scattered rims and outcrops. Colors are mostly browns, greens, and grays.</p> <p>Sensitivity: Medium</p> <p>VRI Class: III</p>
NM-2014041-171	<p>SQRU 002:Hutch Canyon</p>

	<p>Scenic Quality: B</p> <p>This area contained rolling hills incised by draws in addition to eroded hills and low, table mesas. The primarily horizontal landscape is muted gray, buff, and brown in color. The vegetation is comprised of green juniper with a grass understory.</p> <p>Sensitivity: Low</p> <p>VRI Class: IV</p>
--	--

The BLM has developed VRM classification system designed to maintain or enhance visual qualities and describe the different degrees of modification to the landscape. There are four VRM classes (Classes I through IV) which identify suggested degrees of allowed human modification in a landscape. Class I allows the least modification and Class IV allows the most (RMP 2003).

VRM classes only apply on public lands and are conducted in accordance with BLM Handbook 8410 and BLM Manual 8411.

3.12 Socioeconomics and Environmental Justice

Executive Order 12898, issued on 11 February 1994, addresses concerns over disproportionate environmental and human health impacts on minority and low-income populations. The impetus behind environmental justice is to ensure that all communities, including minority, low-income, or federally recognized tribes, live in a safe and healthful environment and the February 2013 Oil and Gas Lease Sale will not be out of conformance with this executive order.

4.0 ENVIRONMENTAL IMPACTS

4.1 No Action Alternative

Under the No Action Alternative (Preferred Alternative) the proposed parcels would be deferred and not offered for sale in the February 2014 Competitive Oil and Gas Lease Sale. There would be no subsequent impacts from oil and/or gas construction, drilling, and production activities. The No Action Alternative would result in the continuation of the current land and resource uses in the proposed lease areas.

4.1.1 Mineral Resources

There would be no new impacts from oil and gas production on the proposed parcel land. Oil and gas development of federal, state, private, and Indian minerals would continue on the land surrounding the proposed parcels. No additional natural gas or crude oil from the proposed parcels would enter the public markets and no royalties would accrue to the federal or state treasuries. An assumption is that the No Action Alternative (no lease option) would not affect current domestic production of oil and gas. However, this may result in reduced Federal and State royalty income, and the potential for Federal land to be drained by wells on adjacent private or state land. Oil and gas consumption is driven by a variety of complex interacting factors including energy costs, energy efficiency, availability of other energy sources, economics, demography, and weather or climate. If the BLM were to forego leasing and potential development of the proposed parcels, the assumption is that the public's demand for the resource would not be expected to change. Instead, the mineral resource foregone would be replaced in the short- and long-term by other sources that may include a combination of imports, using alternative energy sources (e.g. wind, solar), and other domestic production. This offset in supply would result in a no net gain for oil and gas domestic production.

4.1.2 Environmental Justice

By not leasing the proposed parcels under the No-Action Alternative (Preferred Alternative), there may be negative effects on the overall employment opportunities related to the oil and gas and service support industry, as well as a loss of the economic benefits to state and county governments related to royalty payments and severance taxes. However, there would be no increases in activity and noise associated with areas used for other purposes.

4.1.3 All Other Resources

No other resources would be affected under the No-Action Alternative (Preferred Alternative), as there would be no potential surface disturbance that could detrimentally affect these resources. The No Action Alternative would result in the continuation of the current land and resource uses on the parcels. However, the selection of the no action alternative would not preclude these parcels from being nominated and considered in a future lease sale, which would result in impacts as described under the action alternatives.

4.2 Analysis of the Action Alternatives

4.2.1 Assumptions for Analysis

The act of leasing the parcel would, by itself, have no impact on any resources in the FFO. All impacts would be linked to as yet undetermined future levels of lease development.

If the lease parcels were developed, short-term impacts would be stabilized or mitigated within five years and long-term impacts are those that would substantially remain for more than five years. Potential impacts and mitigation measures are described below.

Cumulative impacts include the combined effect of past projects, specific planned projects and other reasonably foreseeable future actions such as other infield wells being located within this lease. Potential cumulative effects may occur should an oil and gas field be discovered if this parcel was drilled and other infield wells are drilled within this lease or if this lease becomes part of a new unit. All actions, not just oil and gas development may occur in the area, including foreseeable non-federal actions.

The reasonable and foreseeable development scenario developed for the Farmington RMP forecasted 497 wells would be drilled annually on existing and new leases for Federal minerals. Since 2000, an average of 459 wells has been drilled annually

Considering spacing requirements and potential formation development, Table 18 displays the number of wells and number of well pads that may be required to develop the parcels. Surface disturbance assumptions and impacts associated with oil and gas exploration and development drilling activities are based on this development scenario.

Table 12. Development Scenario by Lease Parcel

Lease Parcel #	Acres	Number of Wells	Number of Pads
NM-201401-137	160	1 Horizontal Gallup Well	1
NM-201401-138	80	1 Chacra Well	1
NM-201401-163	160	1 horizontal Gallup well	1
NM-201401-165	320	2 horizontal Gallup wells	2
NM-201401-166	480	3 horizontal Gallup wells	2
NM-201401-168	640	4 horizontal Gallup wells 4 Fruitland Coal wells	6
NM-201401-171	320	4 potential horizontal Gallup wells with 2 pads; will require additional leasehold to develop	2

One typical horizontal well pad is approximately 3.67 acres of disturbance with 0.65 acres of total long term and 3.02 acres with interim reclamation.

4.2.2 Air Resources

Methodology and assumptions for calculating air pollutant and greenhouse gas emissions are described in the Air Resources Technical Document (USDI BLM, 2013). This document incorporates the sections discussing the modification of calculators developed by the BLM to address emissions for one well. The calculators give an approximation of criteria pollutant, HAP

and GHG emissions to be compared to regional and national levels (USDI BLM 2013). Also incorporated into this document are the sections describing the assumptions that the FFO used in developing the inputs for the calculator (USDI BLM 2013).

Although the fracking of wells within a lease parcel is hard to predict, it is anticipated that with more wells being drilled, there will be an increase in the amount of wells being fracked and completed (see Appendix 1). Volatile organic compounds are emitted during the completion of hydraulically fractured wells. There is a higher probability of dust particulates in the atmosphere from the increase in vehicular traffic due to hydraulically fracturing wells.

4.2.2.1 Air Quality

Under both action alternatives, leasing the subject tracts would have no direct impacts to air quality. Any potential effects to air quality from sale of lease parcel would occur at such time that the lease is developed. Potential impacts of development of the proposed lease could include increased air borne soil particles blown from new well pads or roads, exhaust emissions from drilling equipment, compressors engines, vehicles, flares, and dehydration and separation facilities, and volatile organic compounds during drilling or production activities.

There are three phases in the development of a well that result in different levels of emissions. The first phase occurs during the first year of development and may include pad construction, drilling, completion, interim reclamation, and operation of the completed well. The first year results in the highest level of emissions due to the large engines required during the construction and drilling, and the potential release of natural gas to the atmosphere during completion.

The second phase of the well begins after the well is completed and is put on line for production. Emissions during the production phase may include vehicle traffic, engines to pump oil if necessary, compressor engines to move gas through a pipeline, venting from storage tanks, and storage tank heaters. A workover of the well may occasionally be required, but the frequency of workovers is not predictable.

The final phase is to plug and abandon the well and rehab the pad. The life of the well is unknown and emission estimates for this phase are not presented.

4.2.2.2 Criteria Pollutants

Table 13 shows total human caused emissions for each of the counties in the FFO based on EPA's 2005 emissions inventory (EPA, 2011b).

Table 13. Analysis Area Emissions in Tons/Year, 2008

County	NO _x ⁽¹⁾	CO ⁽²⁾	VOC ⁽³⁾	PM ₁₀ ⁽⁴⁾	PM _{2.5} ⁽⁵⁾	SO ₂ ⁽⁶⁾
McKinley	12,595.0	31,885.2	37,509.0	66,590.7	6,977.5	1,659.8
Rio Arriba	4,276.6	27,352.9	45,841.5	46,321.6	4,746.2	89.1
San Juan	35,651.7	54,549.5	46,994.9	69,655.7	8,108.3	11,471.0
Sandoval	4,780.1	33,290.5	31,733.6	36,232.3	4,056.3	123.4
Total	57,303.4	147,078.1	160,079	218,800.3	23,897.3	13,343.3

Source: EPA 2008 National Emissions Inventory (<http://www.epa.gov/ttn/chief/net/2008inventory.html>)

⁽¹⁾ NO_x – nitrogen oxides

- | |
|---|
| <p>⁽²⁾ CO – carbon monoxide
⁽³⁾ VOC – volatile organic compounds
⁽⁴⁾ PM₁₀ – particulate matter with an aerodynamic diameter equal to or less than 10 microns
⁽⁵⁾ PM_{2.5} – particulate matter with an aerodynamic diameter equal to or less than 2.5 microns
⁽⁶⁾ SO₂ – sulfur dioxide</p> |
|---|

While all of San Juan County is in attainment of all NAAQS including ozone, the Navajo Dam monitoring station is the most closely watched due to the current design value of 0.066ppm zone. While 0.066ppm is well below the attainment value of 0.075ppm, it is the highest design value of the three monitoring stations in San Juan County. The potential amounts of ozone precursor emissions of NO_x and VOCs are not expected to impact the current design value for ozone in San Juan County under either of the action alternatives.

In October 2012, USEPA promulgated air quality regulations for completion of hydraulically fractured gas wells. These rules require air pollution mitigation measures that reduce the emissions of volatile organic compounds during gas well completions.

4..2.2.3 Greenhouse Gases

Information about (GHGs) and their effects on national and global climate is presented in the Air Resources Technical Report (USDI BLM 2013). Analysis of the impacts of the proposed action on GHG emissions will be reported below. Only the GHG emissions associated with exploration and production of oil and gas will be evaluated here because the environmental impacts of GHG emissions from oil and gas consumption, such as refining and emissions from consumer-vehicles, are not effects of the proposed action as defined by the Council on Environmental Quality because they do not occur at the same time and place as the action. Thus, GHG emissions from consumption of oil and gas do not constitute a direct effect that is analyzed under NEPA. Nor is consumption an indirect effect of oil and gas production because production is not a proximate cause of GHG emissions resulting from consumption. However, emissions from consumption and other activities are accounted for in the cumulative effects analysis.

Leasing the subject tracts under either action alternative would have no direct impacts to climate change as a result of GHG emissions. Any potential effects to air quality from sale of a lease parcel would occur at such time that the lease was developed. The potential full development of the proposed lease sale is estimated at 13 horizontal oil wells (see Assumptions for Analysis for more information).

The two primary GHGs associated with the oil and gas industry are carbon dioxide (CO₂) and methane (CH₄). Because methane has a global warming potential that is 21-25 times greater than the warming potential of CO₂, the EPA uses measures of CO₂ equivalent (CO₂e) which takes the difference in warming potential into account for reporting greenhouse gas emissions. Emissions will be expressed in metric tons of CO₂ equivalent in this document.

Oil and Gas production in New Mexico is concentrated in the northwest corner, the San Juan Basin, and the southeast corner, the Permian Basin. Production in the San Juan Basin is mostly natural gas while production in the Permian Basin is mostly oil. Production statistics developed from EPA and New Mexico Oil Conservation Division for 2010 are shown in Table 14 for the US, New Mexico and for wells on federal leases in each basin.

Table 14. 2010 Oil and Gas Production

	Oil Barrels (bbl)	% U.S. Total	Gas (MMcf)	% U.S. Total
United States	1,999,731,000	100	26,836,353	100
New Mexico	65,380,000	3.27	1,341,475	5.00
Federal leases in New Mexico	31,533,000	1.58	824,665	3.07
San Juan Basin	1,468,000	0.07	630,060	2.35
Permian Basin	30,065,000	1.5	194,065	0.73

Table 15 shows an estimate of greenhouse gas emissions for oil and gas field production for the U.S., New Mexico, and Federal leases by basin based on the assumption that greenhouse gas emissions are proportional to production. Because oil and gas leaves the custody and jurisdiction of the BLM after the production phase and before processing or refining, only emissions from the production phases are considered here. It should also be remembered that following EPA protocols, these numbers do not include fossil fuel combustion which would include such things as truck traffic, pumping jack engines, compressor engines and drill rig engines. Nor does it include emissions from power plants that generate the electricity used at well sites and facilities.

Table 15. 2010 Oil and Gas Field Production Emissions

(Metric Tons CO ₂ ^e)	Oil		Gas		Total O&G Production	%U.S. Total GHG emissions
	CO ₂	CH ₄	CO ₂	CH ₄		
United States	300,000	30,600,000	10,800,000	126,000,000	167,700,000	2.6
New Mexico	9,810	1,000,620	540,000	6,300,000	7,850,430	0.12
Federal leases in New Mexico	4,740	483,480	331,560	3,868,200	4,687,980	0.07
San Juan Basin	210	21,420	253,800	2,961,000	3,236,430	0.05
Permian Basin	4,500	459,000	78,840	919,800	1,462,140	0.03

Table 15 provides an estimate of direct emissions that occur during exploration and production of oil and gas. This phase of emissions represents a small fraction of overall emissions of GHG from the life cycle of oil and gas. For example, acquisition (drilling and development) for petroleum is responsible for only 8% of the total GHG emissions, whereas transportation of the petroleum to refineries represents about 10% of the emissions, and final consumption as a transportation fuel represents fully 80% of emissions (U.S.DOE, NETL, 2008).

To estimate the potential emissions from the proposed lease sale, an estimate of emission per well is useful. To establish the exact number of federal wells in the San Juan Basin is problematic due to the ongoing development of new wells, the abandonment of unproductive wells, land sales and exchanges, and incomplete or inaccurate data bases. To determine the most transparent and publicly accessible method of estimating the number of active federal wells in the New Mexico portion of the San Juan Basin, FFO utilized BLM New Mexico Geographic

Information System (GIS) and the New Mexico Conservation Division ONGARD Data Search Page. ONGARD was searched for all active, new, and temporarily abandoned wells in NM.

**Potential Greenhouse Gas Emissions Resulting from Proposed Lease Sale
Referenced to Latest Available Estimates from 2010**

Total U.S. GHG Emissions From All Sources	6,372,900,000 metric tons	100.00 %
Total U.S. GHG Emissions From Oil & Gas Field Production	167,700,000 metric tons	2.6%
Total New Mexico Emissions From Oil & Gas Field Production	7,850,430 metric tons	.12%
Total San Juan Basin Emissions From Oil & Gas Field Production (15,811 wells)	4,384,230 metric tons	.07%
Total Permian Basin Emissions From Oil & Gas Field Production (11,216 wells)	3,175,830 metric tons	.05%
Total Potential GHG Emissions From Oil & Gas Field Production at Full Development (20 Wells)	4,159.3metric tons	0.00007%

The table above shows estimated annual emissions from 2010 San Juan Basin federal leases at 4,384,230 metric tons CO₂e. Therefore, the estimate of emission per well is 277.3 metric tons CO₂e annually. In the unlikely event that 15 separate wells were drilled on the proposed leases, the maximum emissions resulting from the lease sale would be 4,159.3 metric tons CO₂e per year.

Potential Mitigation: The EPA’s inventory data describes “Natural Gas Systems” and “Petroleum Systems” as the two major categories of total US sources of GHG gas emissions. The inventory identifies the contributions of natural gas and petroleum systems to total CO₂ and CH₄ emissions (natural gas and petroleum systems do not produce noteworthy amounts of any of the other greenhouse gases). Within the larger category of “Natural Gas Systems”, the EPA identifies emissions occurring during distinct stages of operation, including field production, processing, transmission and storage, and distribution. “Petroleum Systems” sub-activities include production field operations, crude oil transportation and crude oil refining. Within the two categories, the BLM has authority to regulate only those field production operations that are related to oil and gas measurement, and prevention of waste (via leaks, spills and unauthorized flaring and venting).

The EPA data show that improved practices and technology and changing economics have reduced emissions from oil and gas exploration and development (Inventory of US Greenhouse

Gas Emissions and Sinks: 1990-2006). One of the factors in this improvement is the adoption by industry of the BMPs proposed by the EPA's Natural Gas Energy Star program. The Field Office will work with industry to facilitate the use of the relevant BMPs for operations proposed on Federal mineral leases where such mitigation is consistent with agency policy. While EPA data shows that methane emissions increased from oil and gas exploration and development from 1990-2010, reductions in methane emissions from oil and gas exploration and development should occur in future years as a result of EPA's recently finalized oil and gas air emissions regulations.

4.2.3 Heritage Resources

4.2.3.1 Cultural Resources

While the act of leasing a parcel would produce no impacts, subsequent development of the lease could have impacts/effects on cultural resources/historic properties.

Potential threats to cultural resources from leasing are variable and dependent upon the nature of the cultural resource and the nature of the proposed development. Effects normally and most often include alterations to the physical integrity of a cultural resource. The greatest potential impact to cultural resources stems from the construction of associated lease related facilities such as pipelines, power lines, roads, and well locations, as well as an increase in human activity or access to the area with the increased potential of unauthorized removal or other alteration to cultural resources in the area. These activities could affect one or more aspects of a historic properties physical integrity including location, design, materials, and workmanship. If a cultural resource is significant for other than its scientific information, effects may also include the introduction of audible, atmospheric, or visual elements that are out of character for the cultural site and diminish one or more of the historic properties aspects of integrity including setting, feeling, and association, if those aspects of integrity contribute to conveying the significance of the historic property.

Conversely, cultural resource investigations associated with development add to an understanding of the prehistory/history of the area under investigation, and cultural resources that would otherwise remain undiscovered and unevaluated are identified. Most of the cultural resources identified within the proposed action and within the CPL were identified by investigations associated with the planning of proposed development.

The BLM has applied the criteria of adverse effect as defined in 36 CFR 800.5(1) to the proposed action and has concluded that the effect will not be adverse provided that the design features enumerated for the proposed action are adhered to and avoidance and protective measures associated with the preservation of cultural resources are considered the preferred course of action during individual lease development analysis and authorizations, including any effects that could reasonably involve the seven aspects of integrity for historic properties that may occur later in time, be further removed in distance or be cumulative.

4.2.3.2 Cultural Landscapes

The proposed action would not adversely affect the capability of considering NPS (or other) identified landscape characteristics of human use or activity in the CPL (National Park Service 1999, Birnbaum and Peters 1996), nor would it compound the inherent problems associated with landscape approaches to archaeological remains (Zvelebil et al. 1992).

The proposed action is not expected to threaten or diminish the integrity of the various components of the Chaco Parcels Landscape.

4.2.3.3 Native American Religious Concerns

The proposed action is not known to physically threaten the integrity of any sacred places/TCPs, prevent access to sacred sites, prevent the possession of sacred objects, or interfere or otherwise hinder the performance of traditional ceremonies and rituals pursuant to AIRFA or EO 13007. There are currently no known remains that fall within the purview of NAGPRA or ARPA that are threatened by leasing. Use of lease notice NM-11-LN and other design features, such as Native American consultation (including Navajo Nation Chapters) and cultural resource avoidance will help ensure that new information is incorporated and taken into account during individual lease development analysis and authorizations.

4.2.3.4 World Heritage Sites

If the parcel is visible from an established KOP in the visual foreground/midground distance range (0-5 miles), the types of structures that may be seen include access roads, well pads, and facilities such as condensate and produced water or oil storage tanks that rise above eight feet. These facilities would provide a geometrically strong vertical and horizontal visual contrast in form and line to the characteristic landscape and vegetation, which have flat, horizontal to slightly rolling form and line.

Oil and gas development on parcels visible from the KOP's could impact visitor experience of sweeping, unimpaired views; appreciation of ancient sites with minimal distractions; and no intrusions of man-made noise or light (at night) at those points by introducing man-made structures into the landscape.

Three of the four parcels of the proposed action are in the seldom seen distance zone (>15 miles; NM-201401-137, 138, 171) from any established KOP at CCNHP and Pierre's Ruin ACEC, and one parcel (NM-201401-166) cannot be seen from any established KOP within the foreground/middle ground distances. The remaining three parcels (NM-201401-163, 165, 168) have varying amounts of acreage (22-63%) within the foreground/middle ground view of a KOP.

Pierre's Ruin ACEC World Heritage Site (BLM)

Error! Reference source not found. displays the visibility of each lease parcel from Pierre's Ruin ACEC under the proposed action. Only lease parcel NM-201401-168 would be visible from the ACEC.

Table 16. Lease Parcel Visibility from Pierre's Ruin ACEC under the Proposed Action

Lease Parcel #	Total Acres	Visible from Pierre's ACEC KOP	Total Acres Visible from Pierre's ACEC KOP	Percent of Parcel Visible
Foreground/Middleground (0-5 miles)				
NM-201401-168	640	Yes	126	20%
Background/Seldom Seen (greater than 5 miles)				
NM-201401-137	160	No	0	0
NM-201401-138	80	No	0	0
NM-201401-163	160	No	0	0
NM-201401-165	320	No	0	0
NM-201401-166	480	No	0	0
NM-201401-168	640	Yes	18	3%
NM-201401-171	320	No	0	0

Since only 34% of parcel NM-201401-168 is visible from the Pierre's Ruin KOP, there may be opportunities to obscure development from the view of visitors to that site by locating some or all facilities in areas of the parcel not otherwise seen from Pierre's Ruin, or by implementing mitigating measures such as but not limited to minimizing structures, orienting facilities to minimize contrast, and coloring facilities to be less noticeable.

4.2.4 Recreation

4.2.4.1 Chaco National Historical Park

Table 17 displays the visibility of each lease parcel from KOPs within Chaco Culture NHP under the proposed alternative. Only lease parcels NM-201401-163 and NM-201401-165 would be visible from at least one KOP. Parcels within the foreground/middleground are within 0 to 5 miles of the key observation points. The outer boundary of this distance zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape. Activities that occur within the foreground/middleground might be viewed in detail. Activities that occur in the background might be visible, but not in detail. Activities in the seldom seen areas are not likely to be visible even if the viewer has a line of sight.

Table 17. Lease Parcel Visibility from Chaco Culture NHP KOPs under the Proposed Alternative

Lease Parcel #	Total Acres	Visible from Chaco NHP KOPs	Total Acres Visible from Chaco NHP KOPs	Percent of Parcel Visible
Foreground/Middleground (0-5 miles)				
NM-201401-163	160	Yes	100	63%
NM-201401-165	320	Yes	75	23%
Background/Seldom Seen (greater than 5 miles)				
NM-201401-137	160	No	0	0
NM-201401-138	80	No	0	0
NM-201401-166	480	No	0	0
NM-201401-168	640	Yes	100	6%

NM-201401-171	320	No	0	0
---------------	-----	----	---	---

Since 63% of parcel NM-201401-163 is visible from at least one KOP, it's likely that some aspect of development of that parcel would be visible. There may be opportunities to obscure development from the view of visitors by locating some or all facilities in areas of the parcel not otherwise seen from the KOPs, or by implementing mitigating measures such as but not limited to minimizing structures, orienting facilities to minimize contrast, and coloring facilities to be less noticeable.

Since 23% of parcel NM-201401-165 is visible from at least one KOP, there may be opportunities to obscure development from the view of visitors by locating some or all facilities in areas of the parcel not otherwise seen from the KOPs, or by implementing mitigating measures such as but not limited to minimizing structures, orienting facilities to minimize contrast, and coloring facilities to be less noticeable.

Even though 6% of parcel NM-201401-168 is visible from a KOP, the parcel is nearly 20 miles away from CCHNP, making it unlikely that structures or activities could be seen.

More information on impacts to visual resources can be found in the Visual Resources section.

These parcels would not be leased under the preferred alternative, so there would be no impacts to recreation in Chaco Culture NHP.

4.2.4.2 Night Skies

Light sources associated with drilling an oil and gas well include a light plant or generator, a light on the top of the rig, vehicle traffic, and flaring. The number of light sources and the duration of each source are identified in Table 18 for each lease parcel under the proposed alternative. Flaring could occur in locations where pipelines are not available to transport gas to sale; however, the necessity for flaring and the duration of flaring varies widely from well to well and is difficult to predict.

Table 18. Light Sources by Lease Parcel under the Proposed Alternative

Light Source			Duration	
Location	Type	Number ¹	Days (average)	Hours ²
Foreground/Middleground (0-5 miles)				
NM-201401-163 (1 well)				
Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	12	3	24
Light Tower	Explosion Proof	4	3	24
Light Tower	Explosion Proof	2	30	24
Rig Floor	Explosion Proof	2	17	24
Sub	Explosion Proof	4	17	24
Mud Tank	Explosion Proof	9	17	24
Mud Pump	Explosion Proof	6	17	24
Catwalk	Explosion Proof	2	17	24
Tool Shed	4-foot Fluorescent	4	17	24
Housing Unit	12-Volt	10	17	12
NM-201401-165 (2 wells)				

Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	24	3	24
Light Tower	Explosion Proof	8	3	24
Light Tower	Explosion Proof	4	30	24
Rig Floor	Explosion Proof	4	17	24
Sub	Explosion Proof	8	17	24
Mud Tank	Explosion Proof	18	17	24
Mud Pump	Explosion Proof	12	17	24
Catwalk	Explosion Proof	4	17	24
Tool Shed	4-foot Fluorescent	8	17	24
Housing Unit	12-Volt	20	17	12
Background/Seldom Seen (greater than 5 miles)				
NM-201401-137 (1 well)				
Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	12	3	24
Light Tower	Explosion Proof	4	3	24
Light Tower	Explosion Proof	2	30	24
Rig Floor	Explosion Proof	2	17	24
Sub	Explosion Proof	4	17	24
Mud Tank	Explosion Proof	9	17	24
Mud Pump	Explosion Proof	6	17	24
Catwalk	Explosion Proof	2	17	24
Tool Shed	4-foot Fluorescent	4	17	24
Housing Unit	12-Volt	10	17	12
NM-201401-138 (1 well)				
Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	12	3	24
Light Tower	Explosion Proof	4	3	24
Light Tower	Explosion Proof	2	30	24
Rig Floor	Explosion Proof	2	17	24
Sub	Explosion Proof	4	17	24
Mud Tank	Explosion Proof	9	17	24
Mud Pump	Explosion Proof	6	17	24
Catwalk	Explosion Proof	2	17	24
Tool Shed	4-foot Fluorescent	4	17	24
Housing Unit	12-Volt	10	17	12
NM-201401-166 (3 wells)				
Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	36	3	24
Light Tower	Explosion Proof	12	3	24
Light Tower	Explosion Proof	6	30	24
Rig Floor	Explosion Proof	6	17	24
Sub	Explosion Proof	12	17	24
Mud Tank	Explosion Proof	27	17	24
Mud Pump	Explosion Proof	18	17	24
Catwalk	Explosion Proof	6	17	24
Tool Shed	4-foot Fluorescent	12	17	24
Housing Unit	12-Volt	30	17	12
NM-201401-168 (8 wells)				
Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	96	3	24
Light Tower	Explosion Proof	32	3	24
Light Tower	Explosion Proof	16	30	24
Rig Floor	Explosion Proof	16	17	24
Sub	Explosion Proof	32	17	24
Mud Tank	Explosion Proof	72	17	24
Mud Pump	Explosion Proof	48	17	24
Catwalk	Explosion Proof	16	17	24

Tool Shed	4-foot Fluorescent	32	17	24
Housing Unit	12-Volt	80	17	12
NM-201401-171 (4 wells)				
Rig Derrick	4-foot Fluorescent (1 Explosion Proof)	48	3	24
Light Tower	Explosion Proof	16	3	24
Light Tower	Explosion Proof	8	30	24
Rig Floor	Explosion Proof	8	17	24
Sub	Explosion Proof	16	17	24
Mud Tank	Explosion Proof	36	17	24
Mud Pump	Explosion Proof	24	17	24
Catwalk	Explosion Proof	8	17	24
Tool Shed	4-foot Fluorescent	16	17	24
Housing Unit	12-Volt	40	17	12
¹ The number reflects the total number of light sources that may be required to drill wells necessary to develop the parcel. The total number of light sources present at any given time is likely to be lower as is unlikely that all wells will be drilled at the same time. ² This number reflects the number of hours the light may be on during a 24-hour period. Because the number of night-time hours varies depending on the time of year the well is drilled, lighting will not impact night skies during all of the hours identified.				

The table provides the total number of light sources required for the development of the parcel; however, for parcels requiring more than one well, it is unlikely that all of the wells would be drilled at one time. With the exception of a few yearly events, visitors are not allowed access to the canyon rim after sunset, minimizing the chance that visitors would see the direct light. While these lights could reduce the general darkness of the night sky as seen from the Chaco Cultural NHP campground, it is likely the impact would be imperceptible. These activities could result in minor, short-term impacts to night skies as well locations typically do not have lighting as a permanent feature upon completion.

The parcels near Chaco Culture NHP (i.e., NM-201401-163, NM-201401-165, NM-201401-166) would not be leased under the preferred alternative, so there would be no impacts to night skies.

4.2.5 Rangeland Resources

Oil and gas development could result in a loss of vegetation for livestock grazing (e.g., direct removal, introduction of unpalatable plant species, etc.), decrease the palatability of vegetation due to fugitive dust, disrupt livestock management practices, involve vehicle collisions, and decrease grazing capacity. These impacts could vary from short-term impacts to long-term impacts depending on the type of exploration or development, the success of reclamation, and the type of vegetation removed for the oil and gas activities.

Recent mineral development in the checkerboard area has revealed some impacts to grazing operations on public grazing allotments. Complaints from grazing operators include; poor planning of road construction and maintenance, increased vehicle collisions with livestock, poor maintenance of cattle guards, loss of integrity to allotment boundaries, and increased access by the public which contributes to vandalism of range improvements and livestock rustling.

Poor road planning has led to many “loop” type roads. Roads with loop type access, instead of in and out access, to wells allows for more public access and vandalism. Vandalism to water wells, drinking troughs, springs, storage tanks and fences have been reported. Loop type roads

allow for the public to enter in to areas and then leave through a different area without risk of being seen on the way out of an area. Increased complaints of greenwood cutting, trash dumping and off road travel have also been made. During the winter and spring months there were numerous complaints about poor road conditions. Large trucks making deep ruts made it difficult for people to drive on the roads they use on a daily basis.

4.2.6 Water Resources

Hydraulic fracturing is a common process in the San Juan Basin and applied to nearly all wells drilled (see Appendix 1). There are no verified instances of hydraulic fracturing adversely affecting groundwater in the San Juan Basin (USDI/BLM 2011*a*, page 54). The producing zone targeted by both action alternatives is well below any underground sources of drinking water. Typical depth of water wells in the San Juan Basin is 500 feet or less. The Mancos Shale formation is also overlain by a continuous confining layer. On average, total depth of each well bore would be 6,700 feet below the ground surface. Fracturing in the Basin Mancos formation is not expected to occur above depths above 5,700 feet below the ground surface. Fracturing could possibly extend into the Mesaverde formation overlying the Basin Mancos; however, the formation has not been identified as an underground source of drinking water based on its depth and relative high levels of TDS.

Hydraulic fracturing fluid is roughly 99 percent water but also contains numerous chemical additives as well as propping agents, such as sands. Chemicals added to stimulation fluids include friction reducers, surfactants, gelling agents, scale inhibitors, acids, corrosion inhibitors, antibacterial agents, and clay stabilizers. Stimulation techniques have been used in the United States since 1949 and in the San Juan Basin since the 1950s. Over the last 10 years, advances in multi-stage and multi-zone hydraulic fracturing has allowed development of gas fields that previously were uneconomic, including the San Juan Basin.

The water used for hydraulic fracturing in the Farmington Field Office generally comes from permitted groundwater wells, although surface water sources may occasionally be used. Because large volumes of water are needed for hydraulic fracturing, the use of groundwater for this purpose might contribute to the drawdown of groundwater aquifer levels. Groundwater use is permitted and managed by the New Mexico Office of the State Engineer, and these water rights have already been designated. In addition, the use of water for hydraulic fracturing is one of many uses of groundwater in the Farmington Field Office. Other uses include irrigation, industrial mining operations, and domestic and livestock use.

Contamination of groundwater could occur without adequate cementing and casing of the proposed well bore. Casing specifications are designed and submitted to the BLM. The BLM independently verifies the casing program, and the installation of the casing and cementing operations are witnessed by certified Petroleum Engineering Technicians. Surface casing setting depth is determined by regulation. Adherence to APD COAs and other design measures would minimize potential effects to groundwater quality. The potential for impacts to groundwater from the well bores would be long term for the life of the wells.

There would be the potential for accidental spills or releases of these materials, which could impact local water quality. The potential for surface water quality impacts from accidental spills or releases of hazardous materials on the well pads would be long term for the life of the wells.

4.2.7 Soil

While the act of leasing a tract would produce no direct impacts under the action alternatives, subsequent development of the lease would physically disturb the topsoil and would expose the substratum soil on subsequent project areas. Direct impacts resulting from the oil and gas construction of well pads, access roads, and reserve pits include removal of vegetation, exposure of the soil, mixing of horizons, compaction, loss of top soil productivity and susceptibility to wind and water erosion. Wind erosion would be expected to be a minor contributor to soil erosion with the possible exception of dust from vehicle traffic. These impacts could result in increased indirect impacts such as runoff, erosion and off-site sedimentation. Activities that could cause these types of indirect impacts include construction and operation of well sites, access roads, gas pipelines and facilities.

Contamination of soil from drilling and production wastes mixed into soil or spilled on the soil surfaces could cause a long-term reduction in site productivity. Some of these impacts can be reduced or avoided through proper design, construction and maintenance and implementation of best management practices.

Additional soil impacts associated with lease development would occur when heavy precipitation causes water erosion damage. When water saturated segment(s) on the access road become impassable, vehicles may still be driven over the road. Consequently, deep tire ruts would develop. Where impassable segments are created from deep rutting, unauthorized driving may occur outside the designated route of access roads.

The impact to the soil would be remedied upon reclamation of well pads when the stockpiled soil that was specifically conserved to establish a seed bed is spread over well pads and vegetation re-establishes.

Fragile soils may be difficult for the project proponent to stabilize and establish vegetation. The proponent is required to follow the FFO Bare Soil Reclamation Procedure (procedure) for all projects that result in bare soil in areas of 0.1 acre or more that have an onsite visit after February 5, 2013. The procedure utilizes 8 habitat community descriptions; each community description contains recommendations for effective reclamation. Some additional recommendations for fragile soils include:

- Provide temporary stabilization of disturbed areas that are not actively under construction.
- Apply erosion controls such as excelsior netting, geotextile materials, silt fences, and silt traps to prevent/minimize soil erosion from vehicular traffic and during construction activities.
- Minimize the amount of land disturbed as much as possible and minimize vegetation removal.
- Design runoff control features to minimize soil erosion.

Regulations and policy require a project proponent to submit a plan for surface reclamation, and the FFO Bare Soil Reclamation Procedure requires a revegetation plan to be incorporated into

the site specific project EA. FFO reviews permit applications and site specific project EAs for adequate plans for soil stabilization and revegetation for all proposed projects, including proposed projects located on fragile soils.

4.2.8 Special Status Species

4.2.8.1 USFWS Threatened or Endangered Species

The action alternatives would be in compliance with the 2002 Biological Assessment for the 2003 BLM/FFO RMP (Cons. #2-22-01-I-389). No further consultation with the USFWS is required at this stage. Any proposed project within the proposed leases would require another effects determination on federally-listed species under Section 7 of the Endangered Species Act.

4.2.8.2 Other Special Status Species

A review of the GIS data indicates there are currently no concerns with SMS or other special status species relative to the lease sale parcels in either action alternative. In 2012, a new area of Brack's cactus habitat was discovered in the southern portion of the BLM/FFO management area near Counselor, NM, within the badland vegetation complex. The BLM/FFO is currently collecting data to map this new habitat area. Currently, biological surveys, including plant surveys, are required within this badland habitat for ground disturbing projects. Management prescriptions for Brack's cactus are applied to occupied habitat, as written within the BLM/FFO Special Management Species Policy (IM-NM-200-2008-001). The proposed action has two proposed parcels that may fall within Brack's cactus habitat; Parcels 137 and 138. The BLM/FFO may require specific plant surveys within these parcels and apply the appropriate mitigation to reduce impacts to this species

No other special status species is expected to be directly impacted by the action alternatives. The proposed parcels may include to undocumented Gunnison's prairie dog towns, a BLM Sensitive Species. Prairie dog towns are nesting habitat for burrowing owls, as well as, important foraging areas for raptors and other predator species. Project specific analysis will be conducted on any new ground disturbing activity to eliminate or minimize impacts to Gunnison prairie dog towns. Timing stipulations will be required for any proposed project that would impact burrowing owl nesting activities. No documented SMS raptor nests are known to occur within the proposed action area, however, some raptor nests may be discovered during project specific activities. Raptor timing stipulations will be applied for raptor nests that may be impacted by proposed project activities during the nesting season.

In addition, special status species may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the timeframe during which drilling operations associated with hydraulic fracturing occur, typically several weeks (see Appendix 1).

4.2.9 Wildlife

The types and extent of impacts expected from oil and gas development to wildlife species and habitats from development are similar to those described in the 4.9 Special Status Species Section. Although reclamation and restoration efforts for surface disturbance could provide for the integrity of other resources, these efforts may not always provide the same habitat values (e.g. structure, composition, cover, etc.) in the short or in some instance, the long-term in complex vegetative community types (e.g., shrub oak communities). The short-term negative impact to wildlife would occur during the construction phase of the operation due to noise and habitat destruction under the action alternatives. In addition, wildlife may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the timeframe during which drilling operations associated with hydraulic fracturing occur, typically several weeks (see Appendix 1).

In general, most wildlife species would become habituated to the new facilities. For other wildlife species with a low tolerance to activities, the operations on the well pad would continue to displace wildlife from the area due to ongoing disturbances such as vehicle traffic, noise and equipment maintenance. The conditions of approval would alleviate most losses of wildlife species, such as; fencing the reserve pits, netting storage tanks, installation or other modifications of cones on separator stacks, and timing stipulations. The magnitude of above effects would be dependent on the rate and location of the oil and gas development, but populations could likely not recover to pre-disturbance levels until the activity was completed and the vegetative community restored.

4.2.10 Migratory Birds

Potential effects on birds from the action alternatives are difficult to predict. Ongoing studies have shown mixed effects of oil and gas development, including compressor noise on nesting migratory birds. Frances and Ortega (2006 unpublished report to BLM/FFO) found no significant difference in nest density or nest success between sites with or without wellhead compressors. Some species, such as black-chinned hummingbird (*Archilocus alexandri*) and house finch (*Carpodacus erythrinus*), were more common on sites with compressors while others, such as mourning dove (*Zenaida macroura*) and spotted towhee (*Pipilo erythrophthalmus*), appeared to either avoid or nest further from compressors. Holmes *et al.* (2003) found that sage sparrow had lower nest survival in an area with ongoing gas development, while Brewer's sparrow (*Spizella breweri*) had higher survival rates when compared with populations in an undeveloped control area.

Site-specific analysis will be conducted to determine the impacts on migratory birds as proposed projects are submitted to the BLM. The BLM/FFO bird policy requires migratory bird nest surveys for any proposed project (and related activities) with new disturbance that exceeds 4.0 acres. The bird policy also has other protective measures to reduce bird risks once a project is completed (Instruction Memorandum No. 2013-033). Impacts to migratory birds will be reduced significantly with these management measures in place. However, not all impacts will be eliminated. Impacts such as habitat fragmentation and habitat loss will continue to impact birds and their habitat. The BLM/FFO will apply Best Management Practices (BMPs) to reduce impacts on migratory birds. Examples of these BMPs can be found in the BLM/FFO bird policy and the MOU between USFWS and BLM (DOI 2010a).

4.2.11 Visual Resources

The construction of an access road, well pad and other ancillary facilities, other than facilities greater in height than eight feet, would modify the existing area visual resources under both action alternatives.

Depending on the production nature of the well site, multiple tanks such as condensate, oil or produced water tanks would be necessary to accommodate the project. Visual impacts can be mitigated by color manipulation, by painting well facilities to blend with the surrounding vegetation and/or landform setting, the view is expected to favorably blend with the form, line, color and texture of the existing landscape. A site specific color will be chosen during the onsite and all facilities, including the meter building, would be painted this color. Tree screens and proper project placement can also reduce the visual impacts.

Any structures would be required to meet the VRM Classes for the specific parcel.

4.2.12 Socio-economics and Environmental Justice

While the act of leasing federal minerals itself would result in no social impacts, subsequent development of a lease may generate impacts to people living near or using the area in the vicinity of the lease. Oil and gas exploration, drilling, or production could create an inconvenience to these people due to increased traffic and traffic delays, air pollution, noise and visual impacts. This could be especially noticeable in rural areas where oil and gas development has been minimal. The amount of inconvenience would depend on the activity affected, traffic patterns within the area, noise levels, length of time, and season these activities occurred. In addition, any nearby residents may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the timeframe during which drilling operations associated with hydraulic fracturing occur, typically several weeks (see Appendix 1).

Creation of new access roads into an area could allow increased public access and exposure of private property to vandalism. For leases where the surface is privately owned and the subsurface is BLM managed, surface owner agreements, standard lease stipulations, and BMPs could address many of the concerns of private surface owners.

Employment and associated population increases would be more likely to occur in the larger communities where the social effects would be less noticeable. Any new employment and population would probably be welcomed in the very small communities that are currently losing population. There would also be an increase in revenues that accrue to the counties where production occurs. Depending on where production actually occurs, these revenues would benefit any receiving county but would be more notable in counties with smaller populations and less current revenue.

If and when lease parcels are developed in the future, effects to American Indians would be analyzed on a case by case basis at the APD state prior to development. In addition to American

Indian populations, there are low income people in the counties, but they do not appear to be associated with any specific BLM resources or activities.

5.0 CUMULATIVE IMPACTS

The NMSO manages approximately 41 million acres of Federal mineral estate. Of the 41 million acres, 35 million acres are available for oil and gas leasing. Approximately 16% of the 35 million acres is currently leased (73% of the leases are in production and 63% of the lease acres are in production). The NMSO received 236 parcel nominations (178,793 acres) for consideration in the February 14, 2013 Oil & Gas Lease Sale, and is proposing to lease 106 (73,642 acres) of the 236 parcels. If these 106 parcels were leased, the percentage of Federal minerals leased would change by 1%. The Carlsbad, Farmington, Las Cruces, Oklahoma (Kansas, Texas and Oklahoma) Rio Puerco and Roswell Field Office parcels are analyzed under separate EAs.

Table 5A. Actual - Acres of Federal Minerals/Acres Available/Acres Leased:

State	Federal O&G Mineral Ownership	Acres Available	Acres Leased	Percent Leased
KS	744,000	614,586	125,091	20%
NM	34,774,457	29,751,242	4,839,255	16%
OK	1,998,932	1,668,132	324,072	19%
TX	3,404,298	3,013,207	425,511	14%
Totals/Average	40,921,687	35,058,167	5,713,929	16%

Table 5B. Parcels Nominated & Offered in the February 2014 Oil & Gas Lease Sale:

Field Office	No. of Nominated Parcels	Acres of Nominated Parcels	No. of Parcels to be Offered	Acres of Parcels to be Offered
Carlsbad	34	12,302	20	4,981
Farmington	38	19,103	4	1,200
Kansas	1	120	1	120
Las Cruces	27	31,743	23	27,779
Oklahoma	11	657	10	617
Rio Puerco	76	74,650	0	0
Roswell	5	4,926	5	4,926
Texas	44	35,292	43	34,019
Totals	236	178,793	106	73,642

Table 5C. Foreseeable - Acres of Federal Minerals/Acres Available/Acres Leased:

State	Federal O&G Mineral Ownership	Acres Available	Acres Leased	Percent Leased
KS	744,000	614,586	125,211	20%
NM	34,774,457	29,751,242	4,878,141	16%
OK	1,998,932	1,668,132	324,689	19%
TX	3,404,298	3,013,207	459,530	15%
Totals/Average	40,921,687	35,067,167	5,787,571	17%

The cumulative impacts fluctuate with the gradual reclamation of well abandonments and the creation of new additional surface disturbances in the construction of new access roads and well pads. The on-going process of restoration of abandonments and creating new disturbances for drilling new wells gradually accumulates as the minerals are extracted from the land. Preserving as much land as possible and applying appropriate mitigation measures will alleviate the cumulative impacts.

Effects on Air Resources

The following analysis of cumulative impacts of the proposed action on air quality will be limited to the Four Corners area of New Mexico. The cumulative impacts of GHG emissions and their relationship to climate change are evaluated at the national and global levels in the Air Resources Technical Report (USDI BLM 2013).

Effects of Other Past, Present, and Reasonably Foreseeable Actions on Air Resources

The primary activities that contribute to levels of air pollutant and GHG emissions in the Four Corners area are electricity generation stations, fossil fuel industries and vehicle travel. The Air Resources Technical Report includes a description of the varied sources of national and regional emissions that are incorporated here to represent the past, present and reasonably foreseeable impacts to air resources (USDI BLM 2013). It includes a summary of emissions on the national and regional scale by industry source. Sources that are considered to have notable contributions to air quality impacts and GHG emissions include electrical generating units, fossil fuel production (nationally and regionally) and transportation.

Cumulative Effects of the Proposed Action on Air Quality

The very small increase in emissions that could result from approval of the proposed action would not result in any county in the FFO area exceeding the NAAQS for any criteria pollutants. The applicable regulatory threshold for HAPs is the oil and gas industry National Emissions Standards for Hazardous Air Pollutants, which are currently under review by the EPA. The emissions from any wells drilled in the leased areas are not expected to impact the 8-hour average ozone concentrations, or any other criteria pollutants in the Southern San Juan Basin.

Cumulative Effects of the Proposed Action on Climate Change

The very small increase in GHG emissions that could result from approval of the proposed action would not produce climate change impacts that differ from the No Action Alternative. This is because climate change is a global process that is impacted by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from the proposed action cannot be translated into effects on climate change globally or in the area of this site-specific action. It is currently not feasible to predict with certainty the net impacts from the proposed action on global or regional climate.

The Air Resources Technical Report (USDI BLM, 2013) discusses the relationship of past, present and future predicted emissions to climate change and the limitations in predicting local and regional impacts related to emissions. It is currently not feasible to know with certainty the net impacts from particular emissions associated with activities on public lands.

6.0 CONSULTATION/COORDINATION

This section includes individuals or organizations from the public, external agencies, the interdisciplinary (ID) team that was contacted during the development of this document.

Table 19. List of Preparers

ID Team Member	Title	Organization
Jim Copeland	Archaeologist	BLM
John Kendall	T & E Biologist	BLM
Sarah Scott	Natural Resource Specialist	BLM
Dave Mankiewicz	Assistant Field Manager, Minerals	BLM
Jeff Tafoya	Range Management Specialist	BLM
Lindsey Eoff	Project Manager	BLM
Janelle Alleman	Outdoor Planner	BLM
John Hansen	Wildlife Biologist	BLM
Amanda Nisula	Planning & Environmental Coordinator	BLM
Barney Wegener	Natural Resource Specialist	BLM
Dale Wirth	Range & Multiple Resource-Branch Chief	BLM
Stan Dykes	Weeds	BLM
Sherrie Landon	Paleontologist	BLM

Agencies, Persons and Organizations Consulted

Agencies

Michael Davis, US Forest Service

Matt Wunder, NM Dept. of Game & Fish Chief Conservation Services Division

Larry Turk, National Park Service

New Mexico State Office

Rebecca Hunt, State Natural Resource Specialist

Melanie Barnes, State Office NEPA Coordinator

Dave Goodman, State Office NEPA Coordinator

Mary Uhl, State Office Air Resources Specialist

On July 26th, 2013 a briefing for the BLM NM State Director was held at the New Mexico State Office to review Field Office recommendations for nominated parcels.

Public Involvement

The nominated parcels for this sale, along with the appropriate stipulations from the RMP were posted online for a two week scoping period July 22- August 5, 2013. Scoping comments were received from The Wilderness Society, State of New Mexico Department of Cultural Affairs Historic Preservation Division, National Trust for Historic Preservation, Advisory Council on Historic Preservation, and National Parks Conservation Association.

This EA was made available for public review and comment for 30 days beginning September 3, 2013. Comments were received from Ojo Encino Chapter Government (Navajo Nation), San Juan Citizens Alliance, WildEarth Guardians, Chaco Alliance, Counselor Chapter House, National Trust for Historic Preservation, Chaco Culture National Historic Park, Advisory Council on Historic Preservation, and State of New Mexico Department of Cultural Affairs

Historic Preservation Division. In addition, over 1,300 form letters were received from the general public supporting the BLM's Preferred Alternative C (offering for sale only four out of 38 nominated parcels). The comments received include the following:

- Concerns about lease parcel proximity to Tribal housing and assets;
- Impacts from roads and traffic within Chapter governmental area;
- Impacts to the viewshed of Chaco Cultural NHP and the Chaco World Heritage Site;
- Lack of information on cultural landscape;
- Impacts to night skies and sounds;
- No information and analysis on paleontological resources;
- Insufficient cumulative analysis;
- EA unlawfully tiers to the 2003 FFO RMP;
- 2003 FFO RMP did not reasonable foresee development of Mancos Shale/Gallup Sandstone Oil;
- Irretrievable commitment of resources not thoroughly analyzed;
- BLM must consider petition to designate the Greater Chaco Landscape as an ACEC;
- Hard look at impacts to Chaco Cultural NHP and surrounding landscape not considered;
- Air quality analysis is deficient;
- Environmental justice was not adequately considered;
- Lack of wilderness characteristics criteria in the EA;
- BLM failed to comply with NEPA, MLA, FLPMA and NHPA; and
- Master leasing plan, plans of development and an EIS are necessary.

Selection of the No Action Alternative would allow the BLM more time to evaluate the nominated parcels including the concerns raised by the commenters. The No Action Alternative has been identified as the Preferred Alternative.

7.0 REFERENCES

- Birnbaum, Charles A. 1994. Preservation Brief 36. Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes. U.S. Department of the Interior. National Park Service.
- Birnbaum, Charles A. and Christine Capelle Peters. 1996. Guidelines for the Treatment of Cultural Landscapes. U.S. Department of the Interior. National Park Service.
- Breternitz, Corey Dale, David E. Doyle, and Michael P. Marshall. 1982. Bis sa'ani: A Late Bonito Phase Community on Escavada Wash, Northwest New Mexico. Navajo Nation Papers in Anthropology 14. Window Rock, Arizona.
- Brugge, David M. 1981. The Historical Archaeology of Chaco Canyon. In, The Archaeological Surveys of Chaco Canyon, New Mexico, by Alden C. Hayes, David M. Brugge, and W. James Judge, pp. 69-106. Chaco Canyon Studies, Publications in Archaeology 18A. National Park Service.
- Brugge, David M. 1986. Tsegai: An Archaeological Ethnohistory of the Chaco Region. U.S. Department of the Interior.
- Brugge, David M. 1993. An Investigation of AIRFA Concerns Relating to the Fruitland Coal Gas Development Area. Office of Contract Archaeology, University of New Mexico. Ms. on file, Bureau of Land Management, Farmington, New Mexico.
- CCSP, 2008: *Climate Models: An Assessment of Strengths and Limitations*. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Bader D.C., C. Covey, W.J. Gutowski Jr., I.M. Held, K.E. Kunkel, R.L. Miller, R.T. Tokmakian and M.H. Zhang (Authors)]. Department of Energy, Office of Biological and Environmental Research, Washington, D.C., USA, 124 pp.
- Clark, Bonnie J. and Laura L. Scheiber. 2008. A Sloping Land: An Introduction to Archaeological Landscapes on the High Plains. In, Archaeological Landscapes on the High Plains pp. 1-16, edited by Laura L. Scheiber and Bonnie J. Clark. University press of Colorado.
- Clement, Dorene. 1999. General Guidelines for Identifying and Evaluating Historic Landscapes. Environmental Program, California Department of Transportation, Sacramento.
- Condie, Carol J. and Ruthan Knudson (editors). 1982. The Cultural Resources of the Proposed New Mexico Generating Station Study Area, San Juan Basin, New Mexico. Quivira Research Center Publication 39. Albuquerque.
- Copeland, James M. 2010. The North Road: Recent Investigations Along A Regional Chacoan Feature. Paper presented at the Philmont Archaeological Conference, October 2010.

Copeland, James M. 2012. Old Stone Towers, Ranches, and Springs: The General Land Office Surveys. Paper presented at the 77th Annual Meeting of the Society for American Archaeology, Memphis, Tennessee, April 2012.

Copeland, James M. 2013 (in press). Heaven on Earth: The Chacoan North Road. Conference on Archaeoastronomy of the American Southwest.

de la Torre, Marta, Margaret G. H. MacLean, and David Myers. 2003. Chaco Culture National Historical Park, U.S. National Park Service: A Case Study. The Getty Conservation Institute. Los Angeles, CA.

Doxtater, Dennis. 1998. Invisible Roads to Chaco Canyon: Evidence of and Anasazi "Georitual" Landscape? College of Architecture, Planning, and Landscape Architecture, University Of Arizona.

Doxtater, Dennis. 2002. A Hypothetical Layout of Chaco Canyon Structures Via Large-Scale Alignments between Natural Features. *Kiva* 68(1)23 – 47.

Environmental Protection Agency. 2011. Technology Transfer Network: Clearinghouse for Inventories and Emissions Factors. <http://www.epa.gov/ttn/chief/eiinformation.html>.

EPA (2010). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008. EPA 430-R-10-006, <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>.

EPA. (2010). FACT SHEET--PROPOSAL TO REVISE THE NATIONAL AMBIENT AIR QUALITY STANDARDS. Retrieved August 9, 2010, from <http://www.epa.gov/air/ozonepollution/pdfs/fs20100106std.pdf>

Environmental Protection Agency. 2010a. The Green Book Non Attainment Areas for Criteria Pollutants. <http://www.epa.gov/airquality/greenbk/> (Accessed 3/03/2011).

Environmental Protection Agency, 2010b. Air Trends. <http://www.epa.gov/airtrends/> (Accessed 3/14/11).

Environmental Protection Agency. 2011a. 2005 National-Scale Air Toxics Assessment. Summary of Results. <http://www.epa.gov/ttn/atw/nata2005>.

EPA. 2011b. 2008 National Emissions Inventory. <http://www.epa.gov/ttn/chief/net/2008inventory.html>.

EPA Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006. Environmental Protection Agency, Washington, D.C.

EPA, Natural Gas Star Program (2006 data) at: <http://www.epa.gov/gasstar/accomplish.htm>. Environmental Protection Agency, Washington, D.C.

Enquist, Carolyn and Gori, Dave. Implications of Recent Climate Change on Conservation

Priorities in New Mexico. April 2008.

Ford, Dabney. 1993. An Archaeological Survey of a Proposed Road Realignment of CR 7980, Escavada Wash Crossing on CR 7985, and Ah Shi Sle Pah Wash Crossing on CR 7870, and Use of Existing County Roads as Primary Park Entrance, North of Chaco Canyon, San Juan County, New Mexico. Ms on file, Laboratory of Anthropology, Santa Fe.

Fowler, Andrew P., and John Stein. 1992. 'The Anasazi Great House in Time, Space, and Paradigm.' In *Anasazi Regional Organization and the Chaco System*, ed. David E. Doyel. Maxwell Museum of Anthropology, Anthropological Papers No. 5. University of New Mexico, Albuquerque.

Fransted, Dennis. 1979. An Introduction to the Navajo Oral History of Anasazi Sites in the San Juan Basin Area. Unpublished manuscript, Navajo Aging Services, Fort Defiance, Arizona.

Fransted, Dennis and Oswald Werner. 1975. Ethnogeography of the Chaco Canyon Navajo. Unpublished manuscript, Northwestern University. On file at Division of Chaco Research, Albuquerque.

Freimund, Wayne and Douglas Dalenberg. Chaco Culture National Historical Park: 2009 Visitor Survey. The University of Montana. January 1, 2010.

Goddard Institute for Space Studies. 2007. Annual Mean Temperature Change for Three Latitude Bands. Datasets and Images. GISS Surface Temperature Analysis, Analysis Graphs and Plots. New York, New York. (Available on the Internet: <http://data.giss.nasa.gov/gistemp/graphs/fig.B.lrg.gif>.)

Harper, Randy A, Marilyn K. Swift, and Barbara Mills. 1988. The Casamero and Pierre's Outliers Survey An Archeological Class III Inventory of the BLM Lands Surrounding the Outliers. University of New Mexico Office of Contract Archaeology Report 185-347A.

Holmes, A.L., D.C. Barton, and A. King. 2003. Sagebrush Bird Monitoring Handbook, Version 2.0. Point Reyes Conservation Science: Stinson Beach, CA.

Huse, Hannah, Bradley A. Noisat and Judith A. Halasi. 1978. The Bisti star lake Project: A Sample Survey of Cultural Resources in Northwestern New Mexico. New Mexico Bureau of Land Management Cultural Resource Series 1.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: The Physical Basis (Summary for Policymakers)*. Cambridge University Press. Cambridge, England and New York, New York. Available on the Internet: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>

Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2007, Synthesis Report. A Report of the Intergovernmental Panel on Climate Change.*

- Judd, Neil M. 1954. The Material Culture of Pueblo Bonito. Smithsonian Miscellaneous Collections 124.
- Kanter, John. 1997. Ancient Roads, Modern Mapping: Evaluating Chaco Anasazi Roadways Using GIS Technology. *Expeditions* 39(3): pp 49-61.
- Karl, Thomas L., Jerry M. Melillo, and Thomas C. Peterson, (eds.). *Global Climate Change Impacts in the United States*, Cambridge University Press, 2009.
- Kelly, Klara, Rena Martin, Richard Begay, Ted Neff, and Clifford Werito. 2006. "We Will Help You With What We Know": Diné Traditional Cultural Places In Dinétah. Museum of Northern Arizona Environmental Solutions, Inc, Flagstaff. Ms. on file, Bureau of Land Management, Farmington, New Mexico.
- Kemrer, Meade F. (editor). 1982. *Archaeological Variability within the Bisti – Star Lake Region, Northwestern New Mexico*. New Mexico Bureau of Land Management Cultural Resource Series III.
- Kincaid, Chris (ed). 1983. *Chaco Roads Project Phase 1: A Reappraisal of Prehistoric Roads in the San Juan Basin*. Bureau of Land Management, Santa Fe.
- Lekson, Stephen H. 1999. *The Chaco Meridian: Centers of Political Power in the Ancient Southwest*. Altamira Press.
- Leckman, Philip O., Jorge A. Provenzali, Carrie J. Gregory, Monica L. Murrell, Robert A. Heckman, Bradley J. Vierra. 2013. *Upper Largo Canyon Class III Inventory and Historical Landscape Study, Rio Arriba County, New Mexico*. Statistical Research Inc., Albuquerque.
- Marshall, Michael P., John R. Stein, Richard W. Loose, and Judith E. Novotny. 1979. *Anasazi Communities of the San Juan Basin*. Public Service Company of New Mexico, Albuquerque.
- Marshall, Michael P. and David E. Doyle. 1981. *An Interim Report on Bis sa'ani Pueblo, with Notes on the Chacoan Regional System*. Navajo Nation Cultural Resource Management Program. Window Rock.
- Marshall, Michael P. 1992. *The Chacoan Roads A Cosmological Interpretation*. In, *Proceedings: The Mesa Verde Symposium on Anasazi Architecture and American Design*, edited by Baker H. Morrow and V.B. Price, pp.123-137. Morrow and Company Ltd. Albuquerque.
- National Academy of Sciences. 2006. *Understanding and Responding to Climate Change: Highlights of National Academies Reports*. Division on Earth and Life Studies. National Academy of Sciences. Washington, D.C. (Available on the Internet: <http://dels.nas.edu/basc/Climate-HIGH.pdf>.)
- Nielson, Gary G. and Stanley D. Bussey. 1976. *An Intensive Archaeological Survey of Sections 14, 15, 22, 23, and the North 1/2 and Southeast 1/4 of Section 21, Township 22 North, Range 10*

West, San Juan County, New Mexico. NM State University Cultural Resource Management Division Report No. 61.

NRCS. 2013. <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/watersheds/dataset/>. Accessed July 30, 2013.

NPS. 1997. How to Apply the National Register Criteria for Evaluation. National Register Bulletin 15. Washington.

NPS. 1999. Guidelines for Evaluating and Documenting Rural Historic Landscapes. National Register Bulletin 30. Washington.

Obenauf, Margaret S. 1980. The Chacoan Roadway System. Unpublished Master's thesis, University of New Mexico, Department of Anthropology.

Parker, Patricia L. and Thomas F. King. 1998. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Park Service, National Register Bulletin 38. Washington.

Powers, Robert P., William B. Gillespie, and Stephen H. Lekson. 1983. The Outlier Survey: a Regional View of Settlement in the San Juan Basin. Reports of the Chaco Center 3. National Park Service, Albuquerque.

Roney, John R. 1992. Prehistoric Roads and Regional Integration in the Chacoan System. In, Anasazi Regional Organization and the Chaco System, edited by D. E. Doyel, pp. 123-131. Maxwell Museum of Anthropology Anthropological Papers No. 5. Albuquerque: University of New Mexico.

Schlanger, Sarah H. 1992. Anasazi Settlement Systems. In, Space, Time, and Archaeological Landscapes, edited by Jacqueline Rossignol and LuAnn Wandsnider, pp. 91-112. Plenum Press, New York.

Science Applications International Corporation. 2002. Cultural Resources Technical Report: Background Information on Cultural Resources for the Farmington Draft RMP/EIS. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Sofaer, Anna, Michael P. Marshall, and Roy M. Sinclair. 1989. The Great North Road: A Cosmographic Expression of the Chaco Culture of New Mexico. In, World Archaeoastronomy, edited by A. F. Aveni, pp. 365-376. Cambridge University Press, Cambridge.

Stein, John. 1983. Road Corridor Descriptions. In, Chaco Roads Project Phase 1: A Reappraisal of Prehistoric Roads in the San Juan Basin, edited by Chris Kincaid. Bureau of Land Management, Santa Fe.

UNESCO. 2008. Operational Guidelines for the Implementation of the World Heritage Convention. United Nations Educational, Scientific and Cultural Organization. Paris.

USA. 1987. Chaco Culture National Historical Park World Heritage List Nomination.

U.S. Department of Energy/National Energy Technology Laboratory (US DOE, NETL). 2008. Development of Baseline Data and Analysis of Life Cycle Greenhouse Gas Emissions of Petroleum Based Fuels. <http://www.netl.doe.gov/energy-analyses/pubs/NETL%20LCA%20Petroleum-Based%20Fuels%20Nov%202008.pdf>

U.S. Department of the Interior, Bureau of Land Management and U.S. Fish and Wildlife Service (DOI). 2010a. Memorandum of Understanding: To Promote the Conservation of Migratory Birds.

U.S. Department of the Interior, Bureau of Land Management. 2008. Manual 6840: Special Status Species Management.

U.S. Department of the Interior, Bureau of Land Management. 1986. Manual 8410: Visual Resource Inventory.

U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office. 2010b. Instruction Memorandum No. NM-F00-2010-001. Migratory Bird Treaty Act – BLM/FFO Interim Management Policy. February 22, 2010.

U.S. Department of the Interior, Bureau of Land Management. September 2003a. Farmington Proposed Resource Management Plan and Final Environmental Impact Statement. Farmington, New Mexico.

U.S. Department of the Interior, Bureau of Land Management. September 2003. Farmington Approved Resource Management and Plan Record of Decision. Farmington, New Mexico.

USDI. BLM. 2011. Air Quality Technical Report. New Mexico State Office. http://www.blm.gov/nm/st/en/prog/more/air_resources/air_resources_technical.html.

USGS. 2013. <http://water.usgs.gov/GIS/huc.html>. Accessed July 30, 2013.

Van Dyke, Ruth M. 2007. The Chaco Experience: Landscape and Ideology at the Center Place. School for Advanced Research, Santa Fe.

Van Valkenburgh, Richard F. 1941. Diné Bikeyah. Department of the Interior, Office of Indian Affairs, Navajo Services, Window Rock. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Van Valkenburgh, Richard F. 1974. Navajo Sacred Places. Edited by Clyde Kluckhohn. Garland American Indian Ethnohistory Series, Navajo Indians, 3 Vols. Garland Publishing. New York.

Vivian, R. Gwin. 1997a. Chacoan Roads: Morphology. *Kiva* 63(1)7-34.

Vivian, R. Gwin. 1997b. Chacoan Roads: Function. *Kiva* 63(1)35-68.

Von Haden, Jim. 2013. Personal Correspondence.

Windes, Thomas C. 1987. Investigations at the Pueblo Alto Complex, Chaco Canyon, New Mexico, 1975-1979, Volume 1: Summary of Summary of Tests and Excavations at the Pueblo Alto Community. Publications in Archeology 18F Chaco Canyon Studies. National Park Service U.S Department of the Interior Santa Fe New Mexico.

Wandsnider, LuAnn. 1998. Regional Scale Processes and Archaeological Landscape Units. In, *Unit Issues in Archaeology: Measuring Time, Space, and Material*, edited by Ann F. Ramenofsky and Anastasia Steffen , pp. 87-102. University of Utah Press.

Wilson, John P. A.H. Warren and David M. Brugge. 1979. Cultural Resources of the Alamito Coal Lease Area, Northwestern New Mexico. Alamito Coal Company, Tucson.

York, Frederick F., Joseph C. Winter. 1988. Report of an Ethnographic Study and Archaeological Review of Proposed Coal Lease Tracts In Northwestern New Mexico. Office of Contract Archaeology, University of New Mexico

Zvelebil, Marek, Stanton W. Green, Mark G. Macklin. 1998. Archaeological Landscapes, Lithic Scatters, and Human Behavior. In, *Space, Time, and Archaeological Landscapes*, edited by Jacqueline Rossignol and LuAnn Wandsnider, pp. 193-226. Plenum Press, New York.

Authorities

Code of Federal Regulations (CFR) 3100

40 CFR All Parts and Sections inclusive Protection of Environment, Revised as of October 1, 2001.

43 CFR, All Parts and Sections inclusive - Public Lands: Interior. Revised as of October 1, 2000.

U.S. Department of the Interior, Bureau of Land Management and Office of the Solicitor (editors). 2001. The Federal Land Policy and Management Act, as amended. Public Law 94-579.

Appendix A

FARMINGTON FIELD OFFICE LEASE STIPULATION SUMMARY

<u>Stipulation</u>	<u>Description/Purpose</u>
NM-11- LN	<p>LEASE NOTICE – CULTURAL RESOURCES</p> <p>All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the NHPA and Executive Order 13007. The lease area may contain historic properties, traditional cultural properties (TCP’s), and/or sacred sites currently unknown to the BLM that were not identified in the Resource Management Plan or during the lease parcel review process.</p> <p>Depending on the nature of the lease developments being proposed and the cultural resources potentially affected, compliance with Section 106 of the National Historic Preservation Act and Executive Order 13007 could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which will be borne by the lessee. The BLM may require modifications to or disapprove proposed activities that are likely to adversely affect TCP’s or sacred sites for which no mitigation measures are possible. This could result in extended time frames for processing authorizations for development activities, as well as changes in the ways in which developments are implemented.</p>
F-15-POD	<p>PLAN OF DEVELOPMENT (POD) STIPULATION</p> <p>A plan of development (POD) for the entire lease must be submitted for review and approval, including NEPA analysis, by the Bureau of Land Management (BLM) authorized officer, prior to approval of development (APD, Sundry Notices) actions. The POD must indicate planned access to well facilities (roads, pipelines, power lines), and the approximate location of well sites. Should it become necessary to amend the POD, the amendment must be approved prior to the approval of subsequent development action. Deviations from a current POD are not authorized until an amended POD has been approved by BLM.</p>
F-42-LN	<p>CHACO AREA LEASE NOTICE</p> <p>In order to protect the view from Chaco Culture National Historical Park, a designated World Heritage site, all or some of the following stipulations may be used on new and existing leases within the foreground and middle-ground viewshed from established key observation points .</p> <ul style="list-style-type: none"> • Where possible locations will be chosen so they are hidden from Key Observation Points (KOPs) in Chaco Culture National Historical Park. KOPs could be linear features – roads, byways, trails (a continually moving view) or points: scenic overlooks, cultural features (stationary long duration views). Directional drilling may be required to hide the well location from KOPs. • Where practical, wells will be co-located to reduce road, pad, and utility surface disturbance. • Production facilities will be positioned so that they allow maximum

	<p>room for recontouring of the well location and interim reclamation.</p> <ul style="list-style-type: none">• Special painting schemes, including camouflage patterns, may be required for any facilities.• Access roads will be designed to follow the contour of the landform and/or mimic lines in vegetation. This can necessitate constructing longer access roads.• Gates and fencing will be necessary to prevent access by the public to sensitive areas.• To minimize surface disturbance, roads, utilities and pipelines may share common rights-of-ways.• Interim reclamation of roads will be initiated immediately after construction with such measures as returning topsoil to cuts, fills and borrow ditches and reseeding with local native vegetation.• Seed mixes will be chosen based on the location of the proposed well.• Interim reclamation will be required for the reestablishment of local native vegetation on well locations. Where feasible, all surface disturbances will be recontoured to the original contour except for a flat area to enable setting up any workover rig. Stockpiled topsoil will be respread so that vegetation extends up to the production facilities.
--	---

Appendix 1: Phases of Oil and Gas Development

Construction Activities

Clearing of the proposed well pad and access road would be limited to the smallest area possible to provide safe and efficient work areas for all phases of construction. First all new construction areas need to be cleared of all vegetation. All clearing activities are typically accomplished by cutting, mowing and/or grading vegetation as necessary. Cut vegetation may be mulched and spread on site or hauled to a commercial waste disposal facility.

Next, heavy equipment including but not limited to bulldozers, graders, front-end loaders, and/or track hoes are used to construct at a minimum the pad, but other features, as needed for development, may include, but is not limited to an access road, reserve pit, pipeline, and/or fracturing pond. Cut and fills may be required to level the pad or road surfaces. If a reserve pit is authorized, it would be lined using an impermeable liner or other lining mechanism (i.e. bentonite or clay) to prevent fluids from leeching into the soil. Access roads may have cattle guards, gates, drainage control, or pull-outs installed, among a host of other features that may be necessary based on the site specific situation. Long-term surfaces are typically dressed with a layer of crushed rock or soil cemented. Construction materials come from a variety of sources. Areas not needed for long-term development (i.e. portions of the pipeline or road right-of-way) are reclaimed by recontouring the surface and establishing vegetation.

If a pipeline is needed, the right-of-way would be cleared of all vegetation. The pipeline would be laid out within the cleared section. A backhoe, or similar piece of equipment, would dig a trench at least 36 inches below the surface. After the trench is dug, the pipes would be assembled by welding pieces of pipe together and bending them slightly, if necessary, to fit the contour of the pipeline's path. Once inspected, the pipe can be lowered into the trench and covered with stockpiled subsoil that was originally removed from the hole. Each pipeline undergoes hydrostatic testing prior to natural gas being pumped through the pipeline. This ensures the pipeline is strong enough and absent of any leaks.

Drilling Operations

When the pad is complete, the drilling rig and associated equipment would be moved onsite and erected. A conventional rotary drill rig with capability matched to the depth requirements of the proposed well(s) would be used. The well could be drilled as a vertical or horizontal well to target the desired formation. The depth of the well is entirely dependent on the target formation depth and could be several hundred feet vertical depth to over 20,000 feet vertical depth.

When a conventional reserve pit system is proposed, drilling fluid or mud is 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 mud emerges from the hole, it enters into the reserve pit where it would remain until all fluids are evaporated and the solids can be buried.

A closed-loop system, operates in a similar fashion except that when the mud emerges from the hole, it passes through a series of equipment used to screen and remove drill cuttings (rock chips) and sand-sized

solids rather than going into the pit. When the solids have been removed, the mud would be placed into holding tanks, and from the tank, used again.

In either situation the mud is 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. Water-based or oil-based muds can be used and is entirely dependent on the site-specific conditions.

Completion Operations

Once a well has been drilled, completion operations would begin once crews and equipment are available. Well completion involves setting casing to depth and perforating the casing in target zones.

Wells are often treated during completion to improve the recovery of hydrocarbons by increasing the rate and volume of hydrocarbons moving from the natural oil and gas reservoir into the wellbore. These processes are known as well-stimulation treatments, which create new fluid passageways in the producing formation or remove blockages within existing passageways. They include fracturing, acidizing, and other mechanical and chemical treatments often used in combination. The results from different treatments are additive and complement each other.

Hydraulic Fracturing

Hydraulic fracturing (HF) is one technological key to economic recovery of oil and gas that might have been left by conventional oil and gas drilling and pumping technology. It is a formation stimulation practice used to create additional permeability in a producing formation, thus allowing gas to flow more readily toward the wellbore. Hydraulic fracturing can be used to overcome natural barriers, such as naturally low permeability or reduced permeability resulting from near wellbore damage, to the flow of fluids (gas or water) to the wellbore (GWPC 2009). The process is not new and has been a method for additional oil and gas recovery since the early 1900s; however, with the advancement of technology it is more commonly used.

Hydraulic fracturing is a process that uses high pressure pumps to pump fracturing fluid into a formation at a calculated, predetermined rate and pressure to generate fractures or cracks in the target formation. For shale development, fracture fluids are primarily water-based fluids mixed with additives which help the water to carry proppants into the fractures, which may be made up of sand, walnut hulls, or other small particles of materials. The proppant is needed to “prop” open the fractures once the pumping of fluids has stopped. Once the fracture has initiated, additional fluids are pumped into the wellbore to continue the development of the fracture and to carry the proppant deeper into the formation. The additional fluids are needed to maintain the downhole pressure necessary to accommodate the increasing length of opened fracture in the formation.

Hydraulic fracturing of horizontal shale gas wells is performed in stages. Lateral lengths in horizontal wells for development may range from 1,000 feet to more than 5,000 feet. Depending on the lengths of the laterals, treatment of wells may be performed by isolating smaller portions of the lateral. The

fracturing of each portion of the lateral wellbore is called a stage. Stages are fractured sequentially beginning with the section at the farthest end of the wellbore, moving uphole as each stage of the treatment is completed until the entire lateral well has been stimulated.

This process increases the flow rate and volume of reservoir fluids that move from the producing formation into the wellbore. The fracturing fluid is typically more than 99 percent water and sand, with small amounts of readily available chemical additives used to control the chemical and mechanical properties of the water and sand mixture (see discussion about Hazardous and Solid Wastes below). Because the fluid is composed mostly of water, large volumes of water are usually needed to perform hydraulic fracturing. However, in some cases, water is recycled or produced water is used.

Before operators or service companies perform a hydraulic fracturing treatment, a series of tests is performed. These tests are designed to ensure that the well, casing, well equipment, and fracturing equipment are in proper working order and will safely withstand the application of the fracture treatment pressures and pump flow rates.

To ensure that hydraulic fracturing is conducted in a safe and environmentally sound manner, the BLM approves and regulates all drilling and completion operations, and related surface disturbance on Federal public lands. Operators must submit Applications for Permit to Drill (APDs) to the agency. Prior to approving an APD, a BLM OFO geologist identifies all potential subsurface formations that would be penetrated by the wellbore. This includes all groundwater aquifers and any zones that would present potential safety or health risks that may need special protection measures during drilling, or that may require specific protective well construction measures.

Once the geologic analysis is completed, the BLM reviews the company's proposed casing and cementing programs to ensure the well construction design is adequate to protect the surface and subsurface environment, including the potential risks identified by the geologist and all known or anticipated zones with potential risks.

During drilling, the BLM is on location during the casing and cementing of the ground water protective surface casing and other critical casing and cementing intervals. Before hydraulic fracturing takes place, all surface casing and some deeper, intermediate zones are required to be cemented from the bottom of the cased hole to the surface. The cemented well is pressure tested to ensure there are no leaks and a cement bond log is run to ensure the cement has bonded to the casing and the formation. If the fracturing of the well is considered to be a "non-routine" fracture for the area, the BLM would always be onsite during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

Production Operations

Production equipment used during the life of the well may include a 3-phase separator-dehydrator; flow-lines; a meter run; tanks for condensate, produced oil, and water; and heater treater. A pump jack may be required if the back pressure of the well is too high. Production facilities are arranged to facilitate safety and maximize reclamation opportunities. All permanent above-ground structures not subject to safety considerations are painted a standard BLM or company color or as landowner specified.

Workovers may be performed multiple times over the life of the well. Because gas production usually declines over the years, operators perform workover operations which involve cleaning, repairing and maintaining the well for the purposes of increasing or restoring production.

Hazardous or Solid Wastes Associated with Oil and Gas Development

Anticipated use or produced hazardous materials during the development may come from drilling materials; cementing and plugging materials; HF materials; production products (natural gas, condensates, produced water); fuels and lubricants; pipeline materials; combustion emissions; and miscellaneous materials. Appendix 1, Table 1 includes some of the common wastes (hazardous and non-hazardous) that are produced during oil and gas development.

Appendix 1, Table 1. Common wastes produced during oil and gas development.

Phase	Waste
Construction	<ul style="list-style-type: none"> • Domestic wastes (i.e. food scraps, paper, etc.) • Excess construction materials • Used lubricating oils • Solvents • Woody debris • Paints • Sewage
Drilling	<ul style="list-style-type: none"> • Drilling muds, including additives (i.e. chromate and barite) and cuttings • Well drilling, completion, workover, and stimulation fluids (i.e. oil derivatives such as polycyclic aromatic hydrocarbons (PAHs), spilled chemicals, suspended and dissolved solids, phenols, cadmium, chromium, copper, lead, mercury, nickel) • Equipment, power unit and transport maintenance wastes (i.e. batteries; used filters, lubricants, oil, tires, hoses, hydraulic fluids; paints; solvents) • Fuel and chemical storage drums and containers • Cementing wastes • Production testing wastes • Excess construction materials • Scrap metal • Sewage • Rigwash • Excess drilling chemicals • Processed water • Contaminated soil • Domestic wastes
HF	See below

Production	<ul style="list-style-type: none"> • Power unit and transport maintenance wastes (i.e. batteries; used filters, lubricants, filters, tires, hoses, coolants, antifreeze; paints; solvents, used parts) • Discharged produced water • Production chemicals • Workover wastes (e.g. brines) • Tank or pit bottoms • Contaminated soil • Scrap metal
Abandonment/Reclamation	<ul style="list-style-type: none"> • Construction materials • Decommissioned equipment • Contaminated soil • Insulating materials • Sludge

Hydraulic Fracturing

Chemicals serve many functions in hydraulic fracturing, from limiting the growth of bacteria to preventing corrosion of the well casing. Chemicals are needed to insure the hydraulic fracturing job is effective and efficient. The fracturing fluids used for shale stimulations consist primarily of water but also include a variety of additives. The number of chemical additives used in a typical fracture treatment varies depending on the conditions of the specific well being fractured. A typical fracture treatment will use very low concentrations of between 3 and 12 additive chemicals depending on the characteristics of the water and the shale formation being fractured. Each component serves a specific, engineered purpose. The predominant fluids currently being use for fracture treatments in the shale gas plays are water-based fracturing fluids mixed with friction-reducing additives, also known as slickwater (GWPC 2009).

The make-up of fracturing fluid varies from one geologic basin or formation to another.

Because the make-up of each fracturing fluid varies to meet the specific needs of each area, there is no one-size-fits-all formula for the volumes for each additive. In classifying fracture fluids and their additives it is important to realize that service companies that provide these additives have developed a number of compounds with similar functional properties to be used for the same purpose in different well environments. The difference between additive formulations may be as small as a change in concentration of a specific compound (GWPC 2009).

Typically, the fracturing fluids consist of about 99 percent water and sand and about 1 percent chemical additives. The chemical additives are essential to the process of releasing gas trapped in shale rock and other deep underground formation.

NORM

Some soils and geologic formations contain low levels of radioactive material. This naturally occurring radioactive material (NORM) emits low levels of radiation, to which everyone is exposed on a daily basis. When NORM is associated with oil and natural gas production, it begins as small amounts of uranium and thorium within the rock. These elements, along with some of their decay elements, notably radium₂₂₆ and radium₂₂₈, can be brought to the surface in drill cuttings and produced water. Radon₂₂₂, a gaseous decay element of radium, can come to the surface along with the shale gas. When NORM is brought to the surface, it remains in the rock pieces of the drill cuttings, remains in solution with produced water, or,

Figure 3. Typical Chemical Additives Used In Fracturing Fluids (GWPC 2009)

Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring



under certain conditions, precipitates out in scales or sludges. The radiation is weak and cannot penetrate dense materials such as the steel used in pipes and tanks.