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Huntington Energy, LLC's

CLU 25-6-1 No. 2H
Basin Mancos
&
CLU 25-6-6 No. 2H
Devil's Fork Gallup

Horizontal Oil and Gas Wells

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TABLE OF CONTENTS

1. Purpose and Need for Action 1
   1.1. Background 1
   1.2. Purpose and Need for Action 2
   1.3. Decision to be Made 2
   1.4. Conformance with Applicable Land Use Plan(s) 2
   1.5. Relationship to Statutes, Regulations or Other Plans 3
   1.6. Scoping, Public Involvement, and Issues 4
2. Proposed Action and Alternative(s) 6
   2.1. Proposed Action 6
   2.2. No Action 15
   2.3. Alternatives Considered but Eliminated from Detailed Study 15
3. Affected Environment and Environmental Consequences 16
   3.1. Air Resources 16
   3.2. Cultural Resources 21
   3.3. Upland Vegetation 22
   3.4. Wildlife 23
   3.5. Special Status Species 26
   3.6. Water Resources 28
   3.7. Livestock Grazing 29
4. Supporting Information 31
   4.1. Tribes, Individuals, Organizations, or Agencies Consulted 31
   4.2. List of Preparers 31
   4.3. References 31

Appendix A. Maps 35
Appendix B. Plats 40
Appendix C. Surface Reclamation Plans 41

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1. PURPOSE AND NEED FOR ACTION

1.1. Background

Huntington Energy, LLC (Huntington) has submitted two Applications for Permit to Drill (APDs) with the Bureau of Land Management - Farmington Field Office (BLM-FFO) for the CLU 25-6-1 No. 2H and CLU 25-6-6 No. 2H horizontal oil and gas wells. The proposed action includes the construction of two new well pads in order to drill and develop federal mineral resources in the Canyon Largo Unit administered by the BLM-FFO. Huntington would also construct two new resource roads to access the proposed well sites. Once the wells have been drilled and prove to be viable, two new subsurface well-tie pipelines would be constructed to transport produced natural gas to an existing pipeline gathering system. The proposed pipelines would be operated by Enterprise Field Services, LLC (Enterprise). Enterprise will apply separately for two ROW Grants from the BLM-FFO for the authorization to construct, operate, and maintain the well-tie pipeline corridors on public lands. Huntington would receive approved APDs to develop their lease. EPCO would receive approved ROW Grants to develop pipeline corridors on public lands. The proposed action is the approval of the APDs and ROW Grants by the BLM-FFO, located in Farmington, New Mexico.

New surface disturbance associated with the proposed project areas would be approximately 12.7 acres, total. The proposed CLU 25-6-1 No. 2H project would result in approximately 7.2 acres of new surface disturbance. This would include the construction of the well pad within a total permitted area of 5.74 acres, 0.24 acre of new surface disturbance for the construction of the resource road, and 1.2 acres of new surface disturbance for the construction of the pipeline. The proposed CLU 25-6-6 No. 2H project would result in approximately 5.5 acres of new surface disturbance. This would include the construction of the well pad within a total permitted area of 5.17 acres, 0.11 acre of new surface disturbance for the construction of the access road, and 0.2 acre for the construction of the pipeline.

The well pads would be reclaimed to BLM-approved working areas. Production equipment will be placed on the locations in such a manner to allow proper safe access to produce and service the well/facilities while minimizing long-term disturbance and maximizing interim reclamation. As practical, access will be provided by a tear-drop shaped road through the production areas. Final travel surface width on the resource roads will be approximately 14 feet. All new surface disturbances associated with the pipeline corridors would be reclaimed during interim reclamation.

Oil and natural gas, vital components of the nation's energy supply, account for approximately 36 and 25 percent of total energy consumed in the U.S., respectively (U.S. Energy Information Administration 2012). Natural gas is used in homes, commercially, in industry, and in the transportation sector. Common uses for natural gas include space heating, water heating, cooling, cooking, waste treatment and incineration, metals preheating, drying and humidification, glass melting, food processing, fueling industrial boilers, vehicle fueling, and electricity generation. Gases such as butane, ethane, and propane can be extracted from natural gas to be used for products such as fertilizers and pharmaceuticals. Natural gas can also be used to create methanol, which is utilized in the production of formaldehyde, acetic acid, fuel cell sources, and additives for cleaner burning gasoline (Natural Gas Supply Association 2010). Most oil goes into fuels, including gasoline, jet fuel, and home-heating oil. Additionally, non-fuel compounds extracted from oil are used to develop lubricants; asphalt for roads; tar for roofing; waxes for food wrapping; solvents for paints; cosmetics and dry-cleaning products; plastics; and foams (U.S. Energy Information Administration 2012).

Most of the oil and natural gas found in North America is concentrated in distinct basins. The BLM-FFO management area is within the San Juan Basin, one of the most prolific gas-producing basins in the country. Currently, the San Juan Basin produced small amounts of oil (BLM 2003a).

Taxes and royalties on oil, natural gas, and carbon dioxide production contribute approximately 25 percent of New Mexico's general fund, and the oil and gas industry is one of the largest private sector employers in the state (New Mexico Bureau of Geology and Mineral Resources 2012). Additionally, the federal government receives royalties, or a share of the production income, for extracted federal minerals. In 2011, federal natural gas royalties totaled over 2 billion dollars (Office of Natural Resources Revenue 2012).

1.2. Purpose and Need for Action

The purpose of the proposed action is to allow Huntington reasonable access to BLM managed lands to develop their mineral lease and Enterprise access to BLM public lands for the construction of two natural gas pipeline corridors.

The need for the proposed action is established by the BLM's responsibility under the Mineral Leasing Act of 1920, as amended (30 USC [United States Code] 181 et seq.), to respond to the APDs, and BLM's responsibility under the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1701 et seq.) to respond to requests for ROW Grants over public lands.

1.3. Decision to be Made

Based on the information in this environmental assessment (EA), the BLM-FFO will decide whether or not to issue APDs and ROW Grants, and if so, under what terms and conditions. Under the National Environmental Policy Act (NEPA) (Public Law [PL] 91-90, 42 USC 4321 et seq.), the BLM-FFO must determine if there are any significant environmental impacts associated with the proposed actions warranting further analysis in an Environmental Impact Statement (EIS). The BLM-FFO Field Manager is the responsible officer who will decide either:

- To approve the APDs and ROW Grants with design features as submitted;
- To approve the APDs and ROW Grants with additional mitigations;
- To analyze the effects of the proposal in an EIS; or
- To deny the APDs and ROW Grants.

1.4. Conformance with Applicable Land Use Plan(s)

Pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21, this site-specific EA tiers to and incorporates by reference the information and analysis contained in the Farmington Proposed Resource Management Plan/Final Environmental Impact Statement [(PRMP/FEIS) BLM 2003a]. This EA is in conformance with the management goals set forth in the Resource Management Plan (RMP) for the Farmington Field Office (FFO) of the BLM, which was approved by the Record of Decision (ROD) signed September 29, 2003, and updated in December 2003 (BLM 2003b).

Specifically, the proposed action supports the following BLM policy:

> It is the policy of the BLM to make mineral resources available for disposal and to encourage development of mineral resources to meet national, regional, and local needs, consistent with national objectives of an adequate supply of minerals at reasonable market prices. At the same time, the BLM strives to ensure that mineral development is carried out in a manner that minimizes environmental damage and provides for the rehabilitation of affected lands (2003b, 2-2 – 2-3).

The PRMP/FEIS, RMP, and ROD are available for review at the BLM Farmington Field Office, 6251 College Blvd., Suite A, Farmington, NM, or electronically at: http://www.nm.blm.gov/ffo/ffo_home.html.

Development of energy-related ROWs, such as pipelines, is one of the primary activities of the BLM-FFO lands program. Such ROWs receive environmental review on a case-by-case basis (BLM 2003b). As required by NEPA, this EA addresses site-specific resources and effects of the proposed action that were not specifically covered within the PRMP/FEIS.

1.5. Relationship to Statutes, Regulations or Other Plans

Huntington and Enterprise would comply with applicable federal, state, and local laws and regulations. Necessary permits and approvals for the proposed project would be obtained prior to project implementation.

Many requirements regulating specific environmental elements are found in the appropriate elements sections of this EA (Chapter 3). Several permits, licenses, consultations, or other requirements are discussed below.

1.5.1. Clean Water Act

Recognizing the potential for the continued or accelerated degradation of the Nation's waters, the U.S. Congress enacted the Clean Water Act (CWA), formerly known as the Federal Water Pollution Control Act (33 USC 1344). The objective of the CWA is to maintain and restore the chemical, physical, and biological integrity of the waters of the United States.

Under Section 401 of the CWA, an applicant for a federal license or permit to conduct an activity that may result in a discharge into a water of the U.S. must provide the federal agency with a Section 401 certification declaring that the discharge would comply with the CWA. The certification would be granted by the New Mexico Environment Department (NMED).

Under Section 402 of the CWA, the U.S. Environmental Protection Agency (EPA) regulates storm water discharges from industrial and construction activities under the National Pollution Discharge Elimination System (NPDES) program. Permits are required if discharge results in a reportable quantity for which notification is required (pursuant to 40 CFR 117.21, 40 CFR 302.6, or 40 CFR 110.6) or if the discharge contributes to a violation of a water quality standard.

Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredged or fill material into the waters of the U.S., including wetlands. The U.S. Army Corps of Engineers (USACE) has jurisdiction over "waters of the U.S." These jurisdictional waters include those that have a "significant nexus" to traditional navigable waters. The BLM-FFO and USACE Durango Regulatory Office have determined that jurisdictional waters may include USGS watercourses (i.e., "blue lines" on USGS 1:24,000 topographic maps).

1.5.2. National Historic Preservation Act

Compliance with Section 106 responsibilities of the National Historic Preservation Act are adhered to by following the BLM – New Mexico SHPO protocol agreement, which is authorized by the *National Programmatic Agreement between the BLM*, the *Advisory Council on Historic Preservation*, and the *National Conference of State Historic Preservation Officers*, and other applicable BLM handbooks.

1.5.3. Clean Air Act

The Clean Air Act of 1972, as amended (CAA; 42 USC 7401 et seq.), establishes national ambient air quality standards (NAAQS) to control air pollution. In New Mexico, the NMED has adopted most of the CAA into the New Mexico Administrative Code (NMAC). The NMED issues construction and operating permits for air quality and enforces air quality regulations and permit conditions.

1.6. Scoping, Public Involvement, and Issues

1.6.1. Scoping and Public Involvement

The Farmington Field Office (FFO) publishes a NEPA log for public inspection. This log contains a list of proposed and approved actions in the field office. The log is located on the BLM New Mexico website (http://www.blm.gov/nm/st/en/prog/planning/nepa_logs.html).

Onsite meetings, attended by Huntington, BLM-FFO representatives, Enterprise, and an environmental consultant (Adkins Consulting, Inc. [ACI]), were held for the proposed projects on June 10, 2014. A public invitation to the on-site meetings was posted online (http://www.blm.gov/nm/st/en/fo/Farmington_Field_Office/ffo_oil_and_gas/ffo_onsites.html); no private citizens or groups attended the meetings. A BLM-FFO Interdisciplinary Team meeting was held on June 16, 2014 to discuss the proposed action. At the aforementioned meetings, potential issues of concern were identified by the BLM-FFO and ACI.

Based on the size and scale, routine nature, and potential impacts associated with the proposed action, no additional external scoping was conducted. No public comments were received for the proposed action.

1.6.2. Issues

Issues Analyzed

The following issues were identified during internal scoping as potential issues of concern for the proposed action. These issues will be addressed in this EA.

- How would the proposed projects impact air resources?
- How would surface-disturbing activities associated with construction of the proposed projects impact cultural resources?
- How would vegetation-clearing, proposed project activities, and final reclamation associated with the proposed projects impact upland vegetation?
- How would vegetation-clearing, proposed project activities, and final reclamation associated with the proposed projects impact wildlife, including migratory birds?
- How would vegetation-clearing, proposed project activities, and final reclamation associated with the proposed projects impact the following BLM Special Status Species (SSS): Bendire's thrasher (*Toxostoma bendirei*), ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), and prairie falcon (*Falco mexicanus*)?
- How would the proposed projects impact water resources?
- How would with the proposed projects impact livestock grazing?

Issues Considered but not Analyzed

The following issues were identified during scoping as issues of concern that would not be impacted by the proposed action or that have been covered by prior environmental review. These issues will not be analyzed in this EA.

Endangered Species Act Species

The Endangered Species Act (ESA) of 1973 requires all federal departments and agencies to conserve threatened, endangered, and critical and sensitive species and the habitats on which they depend, and to

consult with the U.S. Fish and Wildlife Service (USFWS) on all actions authorized, funded, or carried out by the agency to ensure that the action will not likely jeopardize the continued existence of any threatened and endangered species or adversely modify critical habitat. Consultation with the USFWS, as required by Section 7 of the ESA, was conducted as part of the Farmington PRMP/FEIS (Consultation No. 2-22-01-I-389) to address cumulative effects of RMP implementation. The consultation is summarized in Appendix M of the PRMP/FEIS. Water used to construct, produce, and maintain the proposed wells would be acquired from the Gonzales Mesa water well #1 (New Mexico Office of the State Engineer [NMOSE] point of diversion [POD] authorization number SJ-201); no unaccounted-for water depletions within USFWS-listed fish habitat would occur. Therefore, there is no need for additional Section 7 consultation.

Native American Religious Concerns

For the proposed action, identification efforts for Native American Religious Concerns were limited to a review of existing published and unpublished literature (e.g., Van Valkenburgh 1941, 1974; Brugge 1993; Kelly, et al. 2006), development of the site-specific Class III survey reports prepared for the proposed action (Division of Conservation Archaeology [DCA] Report 14-DCA-004 [Simpson 2014] and 14-DCA-010 [Simpson 2014]), and a review by the BLM's cultural resources program regarding the presence of Traditional Cultural Properties (TCPs) identified through ongoing BLM tribal consultation efforts. There are currently no known remains that fall within the purview of the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA; 25 USC 3001) or the Archaeological Resources Protection Act (ARPA; 16 USC 470) within the proposed project area. The proposed action would not impact any known TCPs, prevent access to sacred sites, prevent the possession of sacred objects, or interfere with or hinder the performance of traditional ceremonies and rituals pursuant to the American Indian Religious Freedom Act of 1978 (AIRFA; 42 USC 1996) or Executive Order (EO) 13007.

Paleontology

The San Juan Basin in northwestern New Mexico is rich in paleontological resources. The BLM used the Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands (Instruction Manual 2008-009) to identify areas with a high potential to produce significant fossil resources (BLM 2008d). Under this system, all lands within the BLM-FFO management area were designated as Class 5 (Very High Potential) for paleontological resources. Class 5 areas require an assessment of paleontological resources at the project level (BLM 2009). If a paleontological site is discovered during the construction phase of the proposed project, the site would be avoided by personnel, personal vehicles, and company equipment. Therefore, no impacts to paleontological resources are anticipated as a result of the proposed project.

2. PROPOSED ACTION AND ALTERNATIVE(S)

2.1. Proposed Action

The proposed action is the BLM-FFO approval of the APDs and ROW Grants associated with Huntington's CLU 25-6-1 No. 2H and CLU 25-6-6 No. 2H horizontal oil and gas well projects. The proposed action includes the construction of two new well pads, two new resource roads, and the development of two new natural gas pipeline corridors on public lands managed by the BLM-FFO. The proposed wells would develop federal mineral resources administered by the BLM-FFO in the Canyon Largo Unitized Area. Huntington would utilize a temporary surface line to supply water to construct, drill, and complete the CLU 25-6-1 No. 2H well. The water supply line would consist of a single 4-inch poly pipeline laid within existing roadside ditch, and would be approximately 17,300 feet in length. Following the drilling and completion of the CLU 25-6-1 No. 2H well, the temporary surface water supply line will no longer be needed and will be removed from the project area. Water would be hauled by truck to the CLU 25-6-6 No. 2H location. Enterprise will apply separately for two natural gas pipeline ROW Grants from the BLM-FFO. The proposed pipeline for the CLU 25-6-1 No. 2H project is 2,209.68 feet in length, and the proposed pipeline for the CLU 25-6-6 No. 2H project is 270.62 feet in length. The proposed project would commence after the APDs and ROW Grants are issued.

Construction plats associated with the proposed projects are provided in Appendix B. Pre-disturbance site photographs are provided in the Surface Reclamation Plans (Appendix C).

2.1.1. Location of Proposed Project Area

Maps of the proposed project area and proposed development are provided in Appendix A on USGS topographic quadrangle and aerial imagery base maps.

The proposed project area is located within the BLM-FFO management area on public lands managed by the BLM within the San Juan Basin of northwest New Mexico in Rio Arriba County. The proposed project area is located approximately 35 miles southeast of Bloomfield, 25 miles west-northwest of Lindrith, and 15 miles north of Counselor.

The proposed CLU 25-6-1 No. 2H project area is contained to the east half of Section 1, while the proposed CLU 25-6-6 No. 2H project area is contained to the northwest quarter of the southwest quarter of Section 5 and the northeast quarter of the southeast quarter of Section 6, Township 25 North, Range 6 West, New Mexico Principle Meridian (NMPM).

The general region surrounding the proposed project area is characterized by rolling mesas, deep canyons, and relatively flat lowland valleys. The proposed CLU 25-6-1 No. 2H project area is situated within gradually sloping sagebrush shrubland on Gonzales Mesa above the Tapicito Creek drainage. The proposed CLU 25-6-6 No. 2H project area is situated within gently rolling sagebrush shrubland interspersed with piñon pine and Utah juniper trees on Pine Tree Mesa between Julian Canyon and Pine Tree Canyon. The proposed CLU 25-6-1 No. 2H well head is located at 6,687 feet above mean sea level (AMSL). The proposed CLU 25-6-6 No. 2H well head is located at 6,826 feet AMSL.

2.1.2. Description of Proposed Project

For a detailed description of design features and construction practices associated with the proposed action, refer to the APDs and ROW Grant applications on file at the BLM-FFO. Construction plats associated with the proposed projects are provided in Appendix B and provide additional details. Pre-disturbance site photographs are provided in the Surface Reclamation Plans (Appendix C).

Design Features and Best Management Practices

Huntington and Enterprise would adhere to the stipulations attached to approved APDs and ROW Grants from the BLM-FFO. The following general design features and best management practices (BMPs) would occur.

Control of Waste

Liquid and solid wastes would be disposed of at an appropriate waste-disposal site. The proposed project areas would be maintained in a sanitary condition. Hazardous substances would be handled and disposed of according to federal law. Waste resulting from construction activities would be removed from the proposed project area and disposed of in an authorized area, such as an approved landfill.

Protection of Paleontological Resources

If a paleontological site is discovered, the BLM would be notified and the site would be avoided by personnel, personal vehicles, and company equipment. Workers would be informed that it is illegal to collect, damage, or disturb such resources, and that such activities are punishable by criminal and/or administrative penalties.

Protection of Cultural Resources

All cultural resource stipulations would be followed as indicated in the Cultural Resource Records of Review, attached to the stipulations in an approved APD and/or ROW Grant. These stipulations could include, but would not be limited to, temporary or permanent fencing or other physical barriers, monitoring of earth disturbing construction, reduction of the proposed project areas and/or establishment of specific construction avoidance zones, and employee education.

Employees, contractors, and sub-contractors associated with the proposed project would be informed that cultural sites are to be avoided by personnel, personal vehicles, and company equipment. These individuals would be informed that it is illegal to collect, damage, or disturb cultural resources, and that such activities are punishable by criminal and/or administrative penalties under the provisions of ARPA.

In the event of a cultural discovery during construction, all construction activities would immediately stop in the immediate vicinity of the discovery and the archaeological monitor, if present, or the BLM would be immediately notified. The BLM would then evaluate or cause the site to be evaluated. Should a discovery be evaluated as significant (e.g., eligible for the National Register of Historic Places [NRHP] or protected under NAGPRA or ARPA), it would be protected in place until mitigating measures could be developed and implemented according to guidelines set by the BLM.

Protection of Flora and Fauna, including SSS and Livestock

Under the Migratory Bird Treaty Act – BLM/FFO Interim Management Policy (IM No. NM-F00-2010-001), timing limitations on use authorizations will be enforced for projects during the nesting period of May 15 to July 31 to avoid or minimize the possibility of the unintentional take of migratory birds. These timing limitations will be enforced for projects during the nesting period of May 15 to July 31 under the following conditions:

- For proposed projects 4.0 acres or more of vegetative disturbance, no construction activities from May 15 to July 31 will be permitted without a migratory bird nest survey. These surveys will be conducted by a BLM/FFO approved biologist using a survey protocol provided by a BLM/FFO biologist. If any active nests are located within the proposed project area, projects activities will not be permitted until written approval by a BLM/FFO biologist. The BLM/FFO will monitor any active nests located from a nest survey.

- The use of prescribed fire and mechanical thinning equipment (i.e. hydromower and tree axe) during this period (5/15-7/31) will be avoided. Exceptions to this policy will be considered where

repeated complications due to weather have prevented the attainment of resource objectives through the use of prescribed fire. In these situations a thorough environmental analysis will be prepared assessing the effects of conducting the burn during the restricted period. The decision to proceed or not will be based upon this analysis. It should be noted also that this policy does not apply to natural ignitions in areas that the District Fire Management Plan has designated as a "wildland fire use area" nor does it apply to treatments 4.0 acres or less in size. In addition, should state or national guidance be issued that differs from this policy; the FFO policy will be modified to conform to it.

- Should active nests be observed, the contractor has determined that project activities cannot be avoided until after the birds have fledged (left the nest), and if no practicable or reasonable avoidance alternatives are identified, then the contractor must contact the USFWS's Migratory Bird Permit Office in Albuquerque, NM at (505) 248-7882. The contractor may proceed with work on the affected project activities following receipt of the approved permit from the USFWS.

Should any active raptor nests be observed within one-third mile of the proposed project areas or should any additional SSS (listed by the USFWS or BLM) be observed within the proposed project areas prior to or during project implementation, construction would cease and the BLM-FFO would be immediately contacted. The BLM-FFO would then ensure evaluation of the resource. Should a discovery be evaluated as significant (protected under the ESA, etc.), it would be protected in place until mitigation could be developed and implemented according to guidelines set by the BLM.

The proposed project areas are within the Superior Mesa Allotment Number 5115 and the Rancho Largo Allotment Number 5119 managed by the BLM-FFO. Huntington and/or Enterprise would notify the grazing lease operator(s) at least 10 business days prior to beginning the construction phase of the proposed projects in order to ensure that there would be no conflicts between construction activities and livestock grazing operations. Huntington and/or Enterprise would not cease or delay construction unless directed by the authorized BLM-FFO officer. If present, any range improvements (e.g., fences, pipelines, and ponds) disturbed by construction activities would be repaired to the condition they were in prior to disturbance. Repairs, if needed, would take place immediately following construction.

The following design features would apply to the proposed action:

- All construction and/or maintenance resulting in surface disturbance would be done in accordance to the BLM Surface Operating Standards and Guidelines for Oil and Gas Development, Fourth Edition-Revised 2007 (The Gold Book).

- Backfilling operations would be performed within a reasonable amount of time to ensure that a pipeline trench is not left open for more than 24 hours. If a trench is left open overnight, it will be fenced with a temporary fence or a night watchman will be utilized. In addition, an inspection of the trench will be made for any small mammals or reptiles that may have fallen into the trench. Any animals discovered will be removed at least 150 yards (450 feet) from the trench before pipe laying and back-filling operations begin.

- All permanent (on location for 6 months or longer) above-ground equipment constructed or installed, including pumping units, will be painted Covert Green as specified by the BLM-FFO. All production facilities will be painted within 6 months of installation. Facilities that are required to comply with Occupation Health and Safety Rules and Regulations will be excluded from this painting requirement.

- The proposed temporary surface water supply line for the CLU 25-6-1 No. 2H project would be contained to existing roadside ditches. Upon completion of the well, the water supply line will be removed from the project area.

Protection of Topsoil

Topsoil, which would be stripped from the surface during the construction phase of the proposed projects, would be stored and protected until it is redistributed during reclamation. The topsoil would be stored separately from subsoil or other excavated material within the permitted project area. The topsoil would be free of brush and tree limbs, trunks, and roots. Vehicle/equipment traffic would not be allowed to cross topsoil stockpiles. The topsoil would be protected using wattles or other BMPs so that erosion is minimized. If topsoil is stored for a length of time such that nutrients are depleted from the topsoil, amendments would be added to the topsoil as advised by an appropriate agent/contractor.

Protection of the Public

The hauling of equipment and materials for the proposed project on public roads would comply with Department of Transportation regulations. No toxic substances would be stored or used within the proposed project areas. Huntington and/or Enterprise would have inspectors present during construction. Any accidents involving persons or property would immediately be reported to the BLM-FFO. The public would be notified of potential hazards by posted signage, as necessary.

Prevention and Control of Weeds

Prior to construction equipment entering the proposed project areas, construction equipment would be inspected for noxious weeds and cleaned.

It would be the applicant's responsibility to monitor, control, and eradicate all invasive, non-native plant species within the proposed project area throughout the life of the projects. The applicant's weed-control contractor would contact the BLM-FFO regarding acceptable weed-control methods. If the contractor does not hold a current Pesticide Use Permit, a Pesticide Use Permit would be submitted prior to pesticide application. Only pesticides authorized for use on BLM lands would be used. The use of pesticides would comply with federal and state laws. Pesticides would be used only in accordance with their registered use and limitations. The applicant's weed-control contractor would contact the BLM-FFO prior to using these chemicals.

Protection of Air Resources

BMPs for dust suppression would be utilized within the proposed project areas to reduce fugitive dust during the construction phase of the proposed project. Fresh water application, using a rear-spraying truck or other suitable means, would be the primary method of dust suppression within the proposed project area. Any additional dust-suppression practices would include the BLM-standard BMPs found in the Gold Book (BLM and USFS 2007) and the BMPs outlined in the stipulations attached to an approved APD or ROW Grant.

Additional Design Features and BMPs

Vehicles would be restricted to proposed disturbance areas and existing areas of surface disturbance, such as existing roads and well pads.

Worker safety incidents would be reported to the BLM-FFO as required under Notice to Lessees (NTL) - 3A (USGS 1979). Huntington and Enterprise would adhere to company safety policies, Occupational Safety and Health Administration regulations, and Department of Transportation regulations.

Huntington and Enterprise would comply with Onshore Oil and Gas Order No. 2, issued under Onshore Oil and Gas Operations (43 CFR 3160).

Construction and maintenance activities would cease when soil or road surfaces become saturated to the extent that construction equipment is unable to stay within the proposed project area and/or when activities would cause irreparable harm to roads, soils, or watercourses.

Erosion-control and water-management features, such as berms, culverts, diversion ditches, and waterbars, would be applied as specified by the BLM-FFO Authorized Officer. Installation and maintenance of erosion-control features would be done in accordance to BLM Gold Book standards. Additional resource protection design features and mitigation associated with construction are listed above in “Design Features and Best Management Practices”, or are included in the site-specific reclamation plans (Appendix C).

Proposed Project Phases

Under the proposed action, the following phases would occur.

Construction Phase

Once the APDs and ROW Grants are approved, project construction can begin. The BLM-FFO would be notified at least 48 hours prior to the start of construction.

Within the proposed project areas, all vegetation would be cleared, and approximately the top 6 inches of topsoil would be salvaged and stockpiled. Vegetation removed during construction, including slash/brush, would be chipped or mulched and incorporated into the topsoil as additional organic matter. Trees that are 3 inches and greater in diameter will be cut, de-limbed, and stacked for public access.

Two new well pads would be constructed. Both pads would 400 feet by 400 feet and would include a construction buffer zone around the perimeter of the pads. The well pads would be constructed from earthen materials present on-site and gravel brought in from off-site. No concrete or other foreign materials would be brought in for use in construction of the well pads. Construction would involve preparing level areas for the equipment that would drill and complete the wells. Following removal of vegetation and stockpiling of viable soil material, the pads would be graded using standard, cut-and-fill techniques of construction using a bulldozer, grader, front-end loader, and/or backhoe. Construction of the CLU 25-6-1 No. 2H well pad would require between 8.3 and 12.5 feet of cut on the east side, and between 5.9 and 12.4 feet of fill on the west side. Construction of the CLU 25-6-6 No. 2H well pad would require a maximum cut of 12.1 feet and a maximum fill of 4.7 feet.

The newly constructed access roads will be designed, constructed, and maintained as resource roads in accordance with BLM Gold Book Standards, BLM Handbook 9113-1 (Roads Design), and BLM Handbook 9113-2 (Roads Inventory and Condition Assessment Guidance and Instructions).

The well-tie pipelines would be laid in a single trench within a 40-foot-wide pipeline ROW corridor. The proposed CLU 25-6-1 No. 2H pipeline is 2,209.68 feet in length. The CLU 25-6-1 No. 2H pipeline corridor would overlap existing well site disturbance, parallel existing and proposed roads, and overlap the proposed well pad. New surface disturbance as a result of CLU 25-6-1 No. 2H pipeline construction would be approximately 1.2 acres. The proposed CLU 25-6-6 No. 2H pipeline is 270.62 feet in length. The CLU 25-6-6 No. 2H pipeline corridor would overlap existing pipeline construction corridor, parallel the proposed access road, and overlap the proposed well pad. New surface disturbance as a result of CLU 25-6-6 No. 2H pipeline construction would be approximately 0.2 acres. Additional, related appurtenances, such as above ground valve assembly and above and below ground cathodic protection, would be installed within the proposed pipeline corridors as necessary.

Trenching activities would be conducted using a trencher or backhoe. The trenches would be 16 inches in width if a trencher is used or 24 inches in width if a backhoe is used. After a pipe has been welded and coated, a side-boom tractor would be used to place the pipe into a trench. The pipelines would be buried to a minimum depth of 3 feet.

After trenching and pipe placement in a trench, the soils excavated from the trench would be returned and compacted to prevent subsidence. The trench would be compacted after approximately two feet of fill is placed within the trench and after the ground surface has been leveled.

Prior to a pipeline being placed in service, the pipe would be pressure tested. Pipeline markers would be installed along the proposed pipeline corridors within the line of sight, without voiding safety measures. Pipeline markers will be standard yellow Carsonite.

Within 90 days of installation, aboveground structures not subject to safety requirements would be painted Covert Green to blend with the surrounding landscape and reduce visual resource impacts.

Erosion control and/or water management features would be installed, as necessary. Additional resource protection design features and mitigation associated with construction are listed above, in “Design Features and Best Management Practices”.

Drilling Operations

A drilling rig would be transported in sections and erected on the well sites following construction of the well pad. Additional equipment and materials needed for drilling operations would be trucked into the well sites. Drilling is a 24-hour operation taking an average of 25 days to drill a horizontal gas well. To protect fresh water zone, surface casing is utilized. A 12 ¼-inch (diameter) hole is drilled to a depth of 500 to 1,000 feet, depending on the depth necessary to penetrate the fresh-water zones. Steel casing is lowered into the hole, and then specially designed cement is pumped down inside the casing out the shoe (at the bottom of the pipe) and up the outer annulus of the pipe to protect aquifers above the top of the casing shoe and to secure the base of the pipe. Surface casing is set to below the depth of the nearest potable water well within ½ mile of the surface location, or to a depth as required by the BLM. After setting the surface casing, drilling resumes. Depending on well bore conditions, additional strings of casings may be run, using the same cementing practices before the well reaches the objective depth (total depth).

After setting the surface casing, directional drilling would begin with a “kick-off” (kick-off point) at which drilling would “build angle” and begin angle drilling which typically cumulates at an angle of 0-50 degrees to reach the bottom hole location and the target formation. A pipe casing is then installed from the surface of the bore hole through the production zone and cemented in place to prevent interzonal communication between gas bearing zones and water zones.

Most of the water used during the life of a producing well is consumed during drilling operations. A small amount of water is used for dust suppression or equipment installation during other phases of development. Recirculating mud systems are used to reduce the total volume of water needed. Drilling mud can be recycled to the next drilling location. Produced water from wells in the area can be used for most drilling operations except mixing cement. Water used to construct, produce, and maintain the proposed wells would be acquired from the Gonzales Mesa water well No. 1 (SJ-201) via a temporary surface pipeline.

The drilling fluid, called “mud,” is a mixture of water, bentonite, caustic soda, barite, and polymers. Drilling mud cools and lubricates the bit, while lifting the well cuttings caused by the bit to the surface for examination and disposal. The mud in the well bore prevents the hole walls from sloughing off into the hole, keeps underground pressures stable, and seals the sides of the well bore through formation of a thin “mud cake”. Mud properties are carefully supervised, and several measurements of the mud are made by a mud specialist during daily visits to the well site. The drilling mud is mixed on location and stored in steel pits or lined earthen pits. Drill cuttings are separated from the drilling mud and buried in a trench dug on the well location at the end of the drilling operation or hauled off-site to an approved disposal facility. The mud can be recycled to another drilling operation.

In the event formation evaluation determines a well would not be economically feasible to complete, then the well would be a dry hole, and would be plugged and abandoned in accordance with BLM procedures.

Completion Operations

A smaller completion rig is used for the final phase of completing a well. Casing is run to the producing zone and cemented in place. To ensure isolation and protection of all zones between the surface and

total depth, the BLM requires cement to be circulated from total depth to surface on the production casing, as well as on the surface casing. Remedial measures are taken if cement cannot be circulated to the surface.

If formation pressure can raise oil/gas to the surface, the well would be completed as a flowing well. Several downhole acid or fracture treatments may be necessary to enhance the formation permeability, to make the well flow. At the end of the treatment, the treatment water flows back to the surface and is captured in temporary tanks on location. This fluid is hauled to injection wells or evaporation ponds for disposal with other produced water.

Acidizing a well requires introducing acid in the well bore across the productive interval, which causes the solution of some of the mineral materials (e.g., calcite, dolomite, etc.) around the pore space. Upon solution and removal of these minerals, porosity and permeability are enhanced.

Hydrofracturing is conducted using fluid pumped down the well through perforations in the casing and into the formation. Pressures are increased to the point that the formation fractures or breaks, and sand is added to the injection fluid to “prop open” the crack, once the pressure is released. The pressure required to fracture a given formation is generally predictable. However, some coals require very high pressures to fracture the formation.

Before wells begin producing gas for sale, the well bore and surrounding reservoir must be "cleaned up" (e.g., any fluids, sand, coal particles, or drill cuttings within the well bore must be removed). The conventional method for doing this is to pump air down the well bore, which lifts the waste fluids and solids out. The solid and liquid waste materials are then dumped into a pit or tank, and any gas that is removed is flared or vented to the atmosphere. In some flareless or green completions, natural gas, rather than air, is pumped down the well bore to clean it out.

The green completion technique is used on some wells in the San Juan Basin, which eliminates flaring and testing. With the existence of a pipeline onsite for the pad wells, the gas from flowback is run through a special separator and then placed in the pipeline for gathering. This technique reduces flaring and venting overall. The additional equipment for green completion may include considerably more tankage, special gas-liquid-sand separator traps, and portable gas dehydration. In addition to reducing methane emissions, green completions produce an immediate revenue stream with the produced natural gas and gas liquids, less solid waste and water pollution, and a safer operating practice.

During completion and testing of the wells, flaring may be used to safely removed gas from the rig and work area. During the process produced gas is ignited and burned rather than directing that gas to sales. Produced gas is piped away from the well bore into a pit constructed on the well pad, ignited and allowed to burn. A berm is usually constructed around the pit to aid in containing the flame and any materials that might be blown out with the gas.

A free flowing well is closed off with an assemblage of valves, pipes, and fittings to control the flow of oil and gas to other production facilities. If the well is not free flowing, artificial-lift (pump) methods would be used.

Production Facilities

The production equipment and facility layout will be deferred until the well’s production characteristics can be evaluated after completion.

Routine production operations occur throughout the year and require use and maintenance of access roads and well pads on a periodic, as needed basis. Maintenance of the various mechanical components used in production occurs at intervals recommended by manufacturers or as needed, based on site inspections. A pumper would visit the producing well to ensure that equipment is functioning properly. Pumpers may visit the wells on a daily basis. A pumper may visit the well sites once a week by utilizing off site computer based automation systems. Solar panels are used to power the radio telemetry equipment.

When a problem is identified through the system a pumper is dispatched to the location. Control and monitoring of well production by radio telemetry reduces regular site inspections of the wells, and vehicular traffic.

Periodically, a workover on a well is required. A unit similar to a completion rig is used to conduct maintenance procedures for efficient operation. Workover rigs can include repairs to the well bore equipment (casing, tubing, etc.), the well head, or the production formation itself. These repairs occur during daylight hours only and are usually completed in one day. Some situations may require several days to finish a workover. The frequency for this type of work cannot be accurately projected, since workover rigs vary and depend on site specific circumstances.

Interim Reclamation

Following the above mentioned phases of the proposed projects, interim reclamation would occur within all new disturbance areas, excluding BLM-approved working areas. Following drilling and completion of a well, the drilling pad is contoured and seeded up to the anchors set in the pad during “interim reclamation”. Stored topsoil would be spread over the area to be reclaimed area and then seeded. This practice is considered interim reclamation for the well site. The BLM-FFO would be notified at least 48 hours prior to surface reclamation activities.

During this phase, a bulldozer and a tractor with seeding capabilities would be used for reclamation purposes.

In areas that would be reclaimed, slopes would be re-contoured to pre-construction topographical contours, if possible. Additionally, stockpiled topsoil would be redistributed and the surface would be ripped and seeded.

During the June 10, 2014 pre-disturbance onsite meetings, it was determined that the Sagebrush/Grass Community best represents the proposed project areas. Details of the interim reclamation process (including species included in the seed mixtures) are provided in the Surface Reclamation Plans (Appendix C). The BLM-FFO would monitor reclaimed surfaces to document successful interim reclamation; monitoring and reporting are discussed in the Surface Reclamation Plans.

Final Reclamation and Abandonment

Once the well sites are no longer necessary and would not be expected to be utilized in the foreseeable future, they would be abandoned. Abandonment of a well would be carried out under current BLM regulations. Aboveground facilities would also be removed.

Final reclamation would occur within any portion of the project area that would be disturbed to bare soil during the abandonment phase of the proposed project, if these areas meet the acreage requirements for reclamation. These acreage requirements are summarized below:

- If final abandonment activities would disturb less than or equal to 0.1 acre to bare soil, the area(s) would be expected to revegetate naturally (no reclamation or monitoring activities will be required).

- If final abandonment activities would disturb more than 0.1 acre to bare soil, final abandonment reclamation activities would be the same as described for interim reclamation.

2.1.3. Proposed Surface Disturbance

New surface disturbance associated with the proposed project areas would be approximately 12.6 acres, total. The proposed CLU 25-6-1 No. 2H project would result in approximately 7.2 acres of new surface disturbance. This would include the construction of the well pad within a total permitted area of 5.74 acres, 0.24 acre of new surface disturbance for the construction of a 343-foot resource road, and 1.2 acre of new surface disturbance for the construction of a 2,209.68-foot pipeline. The proposed CLU 25-6-6 No. 2H project would result in approximately 5.5 acres of new surface disturbance. This would include the

construction of the well pad within a total permitted area of 5.17 acres, 0.11 acre of new surface disturbance for the construction of a 157-foot resource road, and 0.2 acre for the construction of a 270.62-foot pipeline. Depictions of the surface-disturbing activity locations are provided in Appendices A (Proposed Development Maps) and B (Plats).

Table 1. Proposed Project Surface Impacts

Surface Disturbance Description (Approximate Stationing)	Existing/Previously Permitted Surface Disturbance	New Surface Disturbance	Temporary Surface Disturbance
CLU 25-6-1 No. 2H			
Well Pad			
Well pad construction	-	400’ long x 400’ wide (3.67 acres)	-
Construction buffer zone	-	1800’ long x 50’ wide (2.07 acres)	-
Access Road			
Resource road construction (0+00 to 3+42.57)	-	343’ long x 30’ wide (0.24 acre)	-
Natural Gas Pipeline			
Buried pipeline construction (0+00 to 0+92.99)	93’ long x 40’ wide (0.09 acre)	-	-
Buried pipeline construction (0+92.99 to 21+35.97)	2043’ long x 15’ wide (0.7 acre)	2043’ long x 25’ wide (1.17 acre)	-
Water Supply Pipeline			
Surface water supply pipeline	-	-	17300’ long x 4” wide (0.13 acre)
Subtotal	**0.79 acre**	**7.15 acres**	**0.13 acre**
CLU 25-6-6 No. 2H			
Well Pad			
Well pad construction	-	400’ long x 400’ wide (3.67 acres)	-
Construction buffer zone	-	1.5 acre	
Access Road			
Resource road construction (0+00 to 1+57.00)	-	157’ long x 30’ wide (0.11 acre)	-
Natural Gas Pipeline			
Buried pipeline construction (0+00 to 1+12.98)	-	113’ long x 40’ wide (0.11 acre)	-
Buried pipeline construction (1+12.98 to 2+56.90)	-	144’ long x 25’ wide (0.08 acre)	-
Subtotal	**-**	**5.47 acres**	**-**
Total	**0.79 acre**	**12.62 acres**	**0.13 acre**

2.2. No Action

Under the No Action Alternative, the APDs and ROW Grants associated with the proposed CLU 25-6-1 No. 2H and CLU 25-6-6 No. 2H projects would not be approved. The proposed well pads, resource roads, and pipelines would not be constructed. Current land and resource uses would continue to occur in the proposed project area.

2.3. Alternatives Considered but Eliminated from Detailed Study

No alternatives have been developed that would result in significantly fewer impacts or any clear advantages over the proposed action.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Under the No Action alternative, current land and resource issues within the proposed project area would continue; there would be no new impacts from oil and gas development. The No Action alternative will serve as the baseline for comparing the environmental impacts of the analyzed alternatives, and will not be further evaluated in this EA (BLM 2008b).

3.1. Air Resources

3.1.1. Affected Environment

The proposed projects are located in Rio Arriba County, New Mexico. Additional general information on air quality in the area is contained in Chapter 3 of the Farmington PRMP/FEIS. In addition, new information about greenhouse gases (GHGs), and their effects on national and global climate conditions has emerged since this document was prepared. On-going scientific research has identified the potential impacts of GHG emissions such as carbon dioxide (CO_2) methane (CH_4); nitrous oxide (N_2O); water vapor; and several trace gases on global climate. Through complex interactions on a global scale, GHG emissions may cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and burning of fossil carbon sources have caused GHG concentrations to increase measurably, and may contribute to overall climatic changes, typically referred to as global warming.

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; (U.S. Department of Interior Bureau of Land Management, 2014). 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.

The Environmental Protection Agency (EPA) has the primary responsibility for regulating air quality, including six nationally regulated ambient air pollutants (criteria pollutants). These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2) and lead (Pb). EPA has established National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. The NAAQS are protective of human health and the environment. EPA has approved New Mexico's State Implementation Plan and the state enforces state and federal air quality regulations on all public and private lands within the state, except for tribal lands and within Bernalillo County. Air quality is determined by atmospheric pollutants and chemistry, dispersion meteorology and terrain, and also includes applications of noise, smoke management, and visibility. Climate is the composite of generally prevailing weather conditions of a particular region throughout the year, averaged over a series of years. EPA has proposed or completed actions recently to implement Clean Air Act requirements for greenhouse gas emissions. Climate has the potential to influence renewable and non-renewable resource management.

Air Quality

Criteria Air Pollutants

The Air Resources Technical Report describes the types of data used for description of the existing conditions of criteria pollutants, how the criteria pollutants are related to the activities involved in oil and gas development, and provides a table of current National and state standards. EPA's Green Book web page (U.S. Environmental Protection Agency, 2013) 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 2012 design concentrations of criteria pollutants are listed below in Table 2. 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 2. 2012 Criteria Pollutant Monitored Values in San Juan County (U.S. Environmental Protection Agency, 2014)

Pollutant	2012 Design Concentration	Averaging Time	NAAQS	NMAAQS
O_3	0.071 ppm	8-hour	0.075 ppm[1]	
NO_2	13 ppb	Annual	53 ppb[2]	50 ppb
NO_2	38 ppb	1-hour	100 ppb[3]	
$PM_{2.5}$	4.7 µg/m^3	Annual	12 µg/m^3[3,4]	60 µg/m^3[3,6]
$PM_{2.5}$	14 µg/m^3	24 hour	35 µg/m^3[3,3]	150 µg/m^3[3,6]
SO_2	19 ppb	1-hour	75 ppb[5]	

[1] Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
[2] Not to be exceeded during the year
[3] 98th percentile, averaged over 3 years
[4] Annual mean, averaged over 3 years
[5] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
[6] The NMAAQS is for Total Suspended Particulate (TSP)

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 (U.S. Environmental Protection Agency, 2012). 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 2013 with 80% of the days in that range. The median AQI in 2013 was 42, which indicates "good" air quality. The maximum AQI in 2013 was 156, which is "unhealthy".

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 3). 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 and 2012, there were no days that were "unhealthy for sensitive groups" or worse in air quality. In 2005 and 2013, there was one day that was "unhealthy" during each year. In 2010, there were five "unhealthy" days and two "very unhealthy days".

Table 3. Number of Days classified as "unhealthy for sensitive groups" (AQI 101-150) or worse (U.S. Environmental Protection Agency, 2013a)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Days	3	6	9	18	1	0	12	9	0	1

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 (U.S. Department of Interior Bureau of Land Management, 2014). 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 (U.S. Environmental Protection Agency, 2012).

Climate

The analysis area is located in a semiarid climate regime typified by dry windy conditions and limited rainfall. Summer maximum temperatures are generally in the range of 80 or 90 degrees Fahrenheit (°F), 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 4 shows climate normals for the 30-year period from 1981 to 2010 for the Farmington, New Mexico, area.

Table 4. Climate Normals for the Farmington Area, 1981-2010

Month	Average Temperature (^{O}F [1])	Average Maximum Temperature (^{O}F)	Average Minimum Temperature (^{O}F)	Average Precipitation (inches)
January	30.5	40.8	20.3	0.53
February	35.8	46.8	24.8	0.59
March	43.2	56.1	30.3	0.78
April	50.4	64.7	36.2	0.65
May	60.4	74.8	46.1	0.54
June	69.8	85.1	54.5	0.21
July	75.4	89.6	61.2	0.90
August	73.2	86.5	59.8	1.26
September	65.4	79.1	51.7	1.04
October	53.3	66.4	40.1	0.91
November	40.5	52.2	28.8	0.68
December	31.0	41.2	20.7	0.50

Source: data collected at New Mexico State Agricultural Science Center - Farmington
[1] degrees Fahrenheit

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.

3.1.2. Impacts from the Proposed Action

Methodology and assumptions for calculating air pollutant and greenhouse gas emissions are described in the Air Resources Technical Report. This document incorporates the sections discussing the modification of calculators developed by the BLM to address emissions for one horizontal gas well. The calculators give an approximation of criteria pollutant, HAP, and greenhouse gas (GHG) emissions to be compared to regional and national emissions levels (USDI/BLM 2013b). Also incorporated into this

document are the sections describing the assumptions used in developing the inputs for the calculator (U.S. Department of Interior Bureau of Land Management, 2014).

Direct and Indirect Impacts

Criteria Pollutants

Table 5 shows estimated emissions from one proposed horizontal gas well for criteria pollutants, volatile organic compounds (VOC) and greenhouse gas (GHG). For comparison, Table 6 shows total human-caused emissions for each of the counties in the FFO and La Plata County, Colorado, based on USEPA's 2011 emissions inventory (U.S. Environmental Protection Agency, 2014).

Table 5. Criteria Pollutant and VOC Emissions Estimated for Construction of One Horizontal Gas Well; Average 25 Days to Drill and Complete

Activity	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	CH4	CO2
One time operations (tons)*								
Construction	5.5	1.5	0.5	2.5	0.25	0.1	0.007	598.85
Completion	0.5	0.1	0.03	0.025	0.025	-	-	55.00
Interim Reclamation	0.006	0.006	0.006	0.001	-	0.003	-	1.24
Final Reclamation	0.006	0.006	0.006	0.001	-	0.004	-	1.66
Ancillary Operations (tons)								
Workover	0.129	0.04	0.01	0.01	0.01	-	-	10.59
Road Maintenance	-	-	-	-	-	-	-	0.26
Road Traffic	-	-	-	-	-	-	-	0.06
Annual operations (tons/yr)								
Equipment Leaks	-	-	-	-	-	-	0.013	-
Field Compression	0.14	0.29	0.10	0.01	0.01	-	-	19.30
Total	**6.28**	**1.94**	**0.65**	**2.55**	**0.30**	**0.11**	**0.02**	**686.96**

Table 6. Analysis Area Emissions in Tons/Year, 2011

County	NO_X (1)	CO (2)	VOC (3)	PM_{10} (4)	$PM_{2.5}$ (5)	SO_2 (6)
McKinley	11,952.9	17,007.8	3,891.2	70,096.4	7,645.2	1,381.1
Rio Arriba	12,012.3	27,344.6	19,149.8	33,761.2	4,130.6	60.4
San Juan	42,231.5	63,568.9	26,110.8	76,638.3	9,201.0	5,559.3
Sandoval	4,143.8	19,513.9	4,373.1	39,343.0	4,510.8	109.3
Total	**70,340.5**	**127,435.2**	**53,525.0**	**219,838.9**	**25,487.6**	**7,110.0**

(1) NO_X – nitrogen oxides
(2) CO – carbon monoxide
(3) VOC – volatile organic compounds
(4) PM_{10} – 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) SO_2 – sulfur dioxide

Table 7 displays the percent increase in total emissions in the analysis area from the proposed action to construct and operate one horizontal gas well.

Table 7. Percent Increase in Analysis Area Emissions from the Proposed Action

	NO_X[1]	CO[2]	VOC[3]	PM_{10}[4,5]	$PM_{2.5}$[5,6]	SO_2[5,7]
Total Emissions	70,340.5	127,435.2	53,525.0	219,838.9	25,487.6	7,110.0
Horizontal Gas Well Emissions	6.28	1.94	0.65	2.55	0.30	0.13
Percent Increase	**0.008**	**0.002**	**0.001**	**0.001**	**0.001**	**0.002**

(1) NO_X – nitrogen oxides
(2) CO – carbon monoxide
(3) VOC – volatile organic compounds
(4) PM_{10} – particulate matter with an aerodynamic diameter equal to or less than 10 microns
(5) Values derived from average emissions for any well drilling in the analysis area. Calculated results available upon request.
(6) $PM_{2.5}$ – particulate matter with an aerodynamic diameter equal to or less than 2.5 microns
(7) SO_2 – sulfur dioxide

Hazardous Air Pollutants

The formulas used for calculating HAPs in the calculators are very imprecise. For many processes it is assumed that emission of HAPs will be equivalent to 10 percent of VOC emissions. Therefore, the estimated HAP emissions 0.065 tons/year should be considered a very gross estimate.

Total Greenhouse Gases

The available statewide GHG summary combines GHG emissions from CO_2 and CH_4. To compare the GHG emissions from the Proposed Action estimated by the calculator with statewide GHG emissions, CO_2e emissions for both CH_4 and CO_2 were summed. The total statewide GHG emission estimate for 2007 was 76,200,000 metric tons CO_2e (76.2 million metric tons; (New Mexico Environment Department, 2010)). The estimated CO_2e metric tons emissions from one conventional gas well (623.2 metric tons) would represent a 0.0008 percent increase in New Mexico CO_2 emissions.

Cumulative Impacts

The FFO manages Federal hydrocarbon resources in San Juan, Sandoval, Rio Arriba, and McKinley Counties. There are approximately 21,150 wells in the San Juan Basin. About 14,843 of the wells in these counties are Federal wells. Analysis of cumulative impacts for reasonable development scenarios and RFDS of oil and gas wells on public lands in the FFO was presented in the 2003 RMP. This included modeling of impacts on air quality. A more detailed discussion of Cumulative Effects can be found in the Air Resources Technical Report (U.S. Department of Interior Bureau of Land Management, 2014).

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 Quality 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 (U.S. Department of Interior Bureau of Land Management, 2014). 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.

The emissions calculator estimated that there could be very small direct and indirect increases in several criteria pollutants, HAPs, and GHGs as a result of implementing the proposed alternative. The very small increase in emissions that could result would not be expected to result in exceeding the NAAQS for any criteria pollutants in the analysis area.

The very small increase in GHG emissions that could result from implementing the proposed alternative 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 action alternatives 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 action alternatives on global or regional climate.

The Air Resources Technical Report (U.S. Department of Interior Bureau of Land Management, 2014) 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.

3.2. Cultural Resources

3.2.1. Affected Environment

The proposed project is located within the archaeologically rich San Juan Basin of northwest New Mexico. In general, the history 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 (aka Anasazi; 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 descriptions of these various periods are provided in the Bureau of Land Management Farmington Field Office Final Environmental Impact Statement (2003) and will not be reiterated here. Additional information can also be found in an associated documented, Cultural Resources Technical Report (CRTR; SAIC 2002).

Cultural sites vary considerably, and can 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.

The entire Area of Potential Effect (APE) for the Proposed Action was archaeologically surveyed by DCA at a BLM Class III (100 percent) level. The archaeological reports were prepared and submitted to the BLM in accordance with the *Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities* (BLM 2005).

The Class III inventories identified one new archaeological site within the APE for the CLU 25-6-6 No. 3H (14-DCA-004 and 14-DCA-010; BLM Reports *******). No TCPs are known to exist in the APE.

3.2.2. Impacts from the Proposed Action

Direct and Indirect Impacts

Direct impacts normally include alterations to the physical integrity of a cultural site. If a cultural site is significant for other than its scientific information, direct impacts may also include the introduction of audible, atmospheric, or visual elements that are out of character for the cultural site. A potential indirect impact from the proposed action is the increase in human activity or access to the area with the increased potential of unauthorized removal or other alteration to cultural sites in the area.

Significant cultural sites (e.g. NRHP eligible/listed) are being avoided with the implementation of design features such as but not limited to reduction of construction areas, temporary barriers, and site monitoring. These design features are detailed in the Cultural Resource Record of Review, attached to the COAs in approved APD and/or ROW Grant. The proposed action is not known to physically threaten any TCPs, prevent access to sacred sites, prevent the possession of sacred objects, or interfere or otherwise hinder the performance of traditional ceremonies/rituals. The proposed action will have no direct or indirect impact on significant cultural sites.

Cumulative Impacts

There will be no negative cumulative impact on cultural resources as significant cultural sites are being avoided. A positive cumulative effect is the additional scientific information yielded by the archaeological survey.

3.3. Upland Vegetation

3.3.1. Affected Environment

The analysis area is located within the United States Environmental Protection Agency (USEPA) designated Arizona/New Mexico Plateau Level III ecoregion. The Arizona/New Mexico Plateau occurs primarily in Arizona, Colorado, and New Mexico, with a small portion in Nevada. This ecoregion is approximately 45,870,500 acres (185,632 square kilometers), and the elevation ranges from 2,165 to 11,949 feet AMSL. The ecoregion's landscapes include low mountains, hills, mesas, foothills, irregular plains, alkaline basins, some sand dunes, and wetlands. This ecoregion is a large transitional region between the semiarid grasslands to the east, the drier shrublands and woodlands to the north, and the lower, hotter, less vegetated areas to the west and south. Vegetation communities include shrublands with big sagebrush, rabbitbrush, winterfat, shadscale saltbush, and greasewood; and grasslands of blue grama, western wheatgrass, green needlegrass, and needle-and-thread grass. Higher elevations may support piñon pine and juniper forests. The ecoregion includes the urban areas of Santa Fe and Albuquerque. Important land uses include irrigated farming, recreation, rangeland, wildlife habitat, and some natural gas production (Griffith, et al. 2006).

The general region surrounding the proposed project areas is characterized by gently rolling to relatively flat mesas containing sagebrush shrubland, steep canyons, and previously disturbed areas. The analysis area lies within the Sagebrush/Grass Community. Both proposed project areas are located within relatively dense sagebrush shrubland. Dominant vegetation consists of big sagebrush (*Seriphidium tridentatum*), blue grama (*Bouteloua gracilis*), New Mexican prickly pear cactus (*Opuntia phaeacantha*), spiny-star nipple cactus (*Coryphantha vivipara* ssp. *radiosa*), and rabbitbrush (*Chrysothamnus* sp.). Approximately 40 piñon pine (*Pinus edulis*) and Utah juniper (*Sabina osteosperma*) trees were documented within the proposed CLU 25-6-6 No. 2H project area. Russian thistle (*Salsola australis*) was found in previously disturbed sites, primarily along existing roads.

3.3.2. Impacts from the Proposed Action

Direct and Indirect Impacts

Within the proposed project areas, all vegetation would be cleared, and the top 6 inches of topsoil would be salvaged and stockpiled. Vegetation removed during construction, including slash/brush, would be chipped or mulched and incorporated into the topsoil as additional organic matter. Trees greater than 3 inches in diameter will be cut, de-limbed, and stacked for public access. The subsurface portion of any trees (tree stumps) would be placed in adjacent areas needing soil stabilization, or hauled to an approved disposal facility.

The proposed action would result in the removal of approximately 12.6 acres of Sagebrush/Grass Community and 40 trees.

During interim reclamation, the BLM-approved Sagebrush/Grass Community Seed Mixture would be utilized; the species included in this mixture are included in the Surface Reclamation Plans (Appendix C). Reestablished vegetation would consist of native grass, forb, and shrub species included in the seed mixture, as well as native species that are not deliberately planted. It is also possible that invasive, nonnative species could become established within the proposed project area, as such species could be transported by project equipment and tend to thrive in disturbed areas. Following the reclamation

process, the resulting vegetation communities could differ from the native plant communities surrounding the proposed project area. Within reclaimed areas, it is not expected that the vegetation communities would return to native conditions within 20 years (BLM 2003a, 4-18).

During final reclamation, any portions of the proposed project area that would be disturbed to bare soil as a result of final abandonment earthwork activities (if such areas total greater than 0.1 acre) would be fully reclaimed. The BLM-approved Sagebrush/Grass Community Seed Mixture would again be utilized for final reclamation activities.

The deposition of fugitive dust generated during vegetation-clearing activities and during wind events could reduce photosynthesis and productivity of the surrounding vegetation (Thompson, et al. 1984; Hirano, et al. 1995), increase water loss in plants near the proposed project area (Eveling and Bataille 1984), and result in injury to leaves of surrounding vegetation.

Cumulative Impacts

The spatial analysis area is the proposed project areas and immediately adjacent lands. Within the spatial analysis area, the following vegetative disturbances have occurred or are anticipated to occur in the reasonably foreseeable future:

- Approximately 37 oil and gas wells have been drilled within a one-mile radius of the proposed CLU 25-6-1 No. 2H.
- Approximately 14 oil and gas wells have been drilled within a one-mile radius of the proposed CLU 25-6-6 No. 2H.
- A complex of collector and resource roads has been developed to service active well sites and associated facilities on Gonzales Mesa and Pine Tree Mesa.

Indirectly, fugitive dust or deposition associated with existing roads, well pads, utility corridors, and public use in the immediate area could impact the vegetation within the analysis area, and could continue to do so throughout the life of the proposed project. Aside from those discussed above, no additional impacts to vegetation are expected within the analysis area for the reasonably foreseeable future.

The proposed project would contribute to direct and indirect vegetation disturbance and fugitive dust and/or deposition within the spatial analysis area.

3.4. Wildlife

3.4.1. Affected Environment

Migratory Birds

Executive Order 13186 dated January 17, 2001 calls for increased efforts to more fully implement the Migratory Bird Treaty Act (MBTA) of 1918. In keeping with this mandate, the BLM/FFO has issued an interim policy to minimize unintentional take as defined by the EO 13186 and to better optimize migratory bird efforts related to BLM/FFO activities (BLM 2010). 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 BLM-FFO area and may be affected by various types of perturbations. Table 8 lists these priority species that have the potential to occur within the proposed project areas. During the biological survey of the proposed project areas, no priority birds of conservation concern were observed or heard.

Table 8. Priority Birds of Conservation Concern with Potential to Occur in the Analysis Area

Species Name	Habitat Associations	Potential to Occur in the Project Area
Black-throated sparrow (*Amphispiza bilineata*)	Xeric habitats dominated by open shrubs with areas of bare ground.	Suitable habitat is present within the action area.
Brewer's sparrow (*Spizella breweri*)	Closely associated with sagebrush, preferring dense stands broken up with grassy areas.	Suitable habitat is present within the action area.
Gray vireo (*Vireo vicinior*)	In northern NM, open stands of piñon pine and Utah juniper (5,800 – 7,200 ft) 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.	Marginal habitat for species to occur was documented within the action area. Lack of significant woodland characteristics likely a limiting factor.
Loggerhead shrike (*Lanius ludovicianus*)	Open country interspersed with improved pastures, grasslands, and hayfields. Nests in sagebrush areas, desert scrub, and woodland edges.	Suitable habitat is present within the action area.
Mountain bluebird (*Sialia currucoides*)	Open piñon-juniper woodlands, mountain meadows, and sagebrush shrublands; requires larger trees and snags for cavity nesting.	Marginal habitat documented within the action area. Lack of montane/woodland characteristics likely a limiting factor for species to occur.
Mourning dove (*Zenaida macroura*)	Open country, scattered trees, and woodland edges. Feeds on ground in grasslands and agricultural fields. Roost in woodlands in the winter. Nests in trees or on ground.	Marginal habitat documented within action area for species to occur. Lack of significant woodland characteristics likely a limiting factor.
Sage sparrow (*Amphispiza belli*)	Large and contiguous areas of tall and dense sagebrush. Negatively associated with seral mosaics and patchy shrublands and abundance of greasewood.	Suitable habitat is present within the action area.
Sage thrasher (*Oreoscoptes montanus*)	Shrub-steppe dominated by big sagebrush.	Suitable habitat is present within the action area.
Scaled quail (*Callipepla squamata*)	Brushy arroyos, cactus flats, sagebrush or mesquite plains, desert grasslands, Plains grasslands, and agricultural areas. Good breeding habitat has a diverse grass composition, with varied forbs and scattered shrubs.	Suitable habitat is present within the action area.
Swainson's hawk (*Buteo swainsoni*)	A mixture of grassland, cropland, and shrub vegetation; nests on utility poles and in isolated trees in rangeland. Nest densities higher in agricultural areas.	Marginal foraging habitat within the action area; lack of suitable nesting habitat likely a limiting factor for species to occur.

Vesper sparrow (*Pooecetes gramineus*)	Dry montane meadows, grasslands, prairie, and sagebrush steppe with grass component; nests on ground at base of grass clumps.	Suitable habitat is present within the action area.

General Wildlife

The analysis area is located within Sagebrush/Grass Community. Wildlife encountered in this habitat type may include American badger (*Taxidea taxus*), black-tailed jackrabbit (*Lepus californicus*), common gray fox (*Urocyon cinereoargenteus*), cottontail rabbit (*Sylvilagus* sp.), coyote (*Canis latrans*), deer mouse (*Peromyscus maniculatus*), kit fox (*Vulpes velox*), mule deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus elaphus*), squirrel (*Spermophilus* sp.), and various reptiles (snakes and lizards) and birds. Wildlife or signs observed in the analysis area included common raven, cottontail rabbit, and Western scrub-jay.

Prior to the June 2014 biological survey of the proposed project area, no prairie dog colonies had been recorded within the proposed project areas (BLM 2012b). A rather large prairie dog colony has been documented on Gonzales Mesa approximately 3 miles southwest of the proposed CLU 25-6-1 No. 2H project area.

3.4.2. Impacts from the Proposed Action

Direct and Indirect Impacts

The proposed action would result in the direct removal of approximately 12.6 acres of sagebrush shrubland and 40 trees. The well pads would be reclaimed to BLM-approved working areas. All new surface disturbance within the proposed pipeline corridors would be reclaimed. The newly constructed resource roads would be maintained in accordance with BLM Gold Book Standards, BLM Handbook 9113-1 (Roads Design), and BLM Handbook 9113-2 (Roads Inventory and Condition Assessment Guidance and Instructions). The proposed project areas would be converted to reseed communities following interim reclamation. The impacts to the vegetation communities are described in detail in Section 3.3 (Upland Vegetation).

There is available, similar habitat in the surrounding area that wildlife could utilize. However, the clearing of vegetation and ground disturbing activities would remove potential habitat. The transformation of the proposed project areas to reseed communities could remove potential habitat for numerous wildlife species.

If interim reclamation is successful, Sagebrush/Grass Community would become re-established within the proposed project areas. However, as discussed in Section 3.3 (Upland Vegetation), the re-establishment of a mature, native plant community could require decades, and it is possible that the plant community could never fully recover from disturbance (BLM 2003a, 4-18).

Audial and visual disturbances associated with the proposed projects could temporarily deter wildlife (including migratory birds) from utilizing the proposed project areas and immediately adjacent lands.

Migratory Birds

As discussed in Section 2.1.2 (Description of Proposed Project – Protection of Flora and Fauna, Including SSS and Livestock), under the Migratory Bird Treaty Act – BLM/FFO Interim Management Policy (IM No. NM-F00-2010-001), timing limitations on use authorizations will be enforced for projects during the nesting period of May 15 to July 31 to avoid or minimize the possibility of the unintentional take of migratory birds. If proposed project activities would occur during the migratory bird breeding season, birds nesting outside of but near the proposed project area could abandon existing nests as a result of visual and audial disturbances.

General Wildlife

It is possible that burrowing animals could be killed or injured during the construction phase of the proposed project, as equipment digs into the earth and rolls over the surface of the ground.

During the construction phase of the proposed project, terrestrial wildlife could fall into an open pipeline trench and be injured, stressed, or killed. The presence of an open trench could also disrupt normal wildlife movements to and from water and/or food sources. Wildlife could have to skirt the open-trench portions of the proposed pipeline corridor to access water and/or food; this disruption could stress wildlife and result in the loss of valuable energy resources. As discussed in Section 2.1.2 (Description of Proposed Project – Protection of Flora and Fauna, Including SSS and Livestock), design features and BMPs would be implemented during the construction phase of the proposed project to assist in the prevention of injury, stress, or death of wildlife.

Cumulative Impacts

Reasonably foreseeable development within the Largo sub-watershed may include an estimated additional 1,811 oil and gas wells and related facilities, and 147 miles of new roads. Surface-disturbing activities that would be associated with these actions may affect an estimated 6,756 acres of potential wildlife habitat (USDI/BLM 2003a, page 4-7 and 4-8). Other reasonably foreseeable actions such as continued livestock grazing, vegetation treatments, and community development would cumulatively impact wildlife, including migratory birds, through direct and effective habitat loss. The proposed action would contribute to the direct loss of approximately 12.6 acres of potential wildlife habitat. The intensity of indirect effects would be dependent upon the species, its life history, time of year and/or day and the type and level of human and vehicular activity occurring.

3.5. Special Status Species

3.5.1. Affected Environment

The BLM manages certain species which are 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. BLM SSS include BLM Sensitive Species and BLM-FFO Special Management Species (SMS).

New Mexico BLM State Directors have developed a list of BLM Sensitive Species for the State of New Mexico (BLM 2011a, BLM 2011b, BLM 2011c, BLM 2012a). In accordance with BLM Manual 6840, the BLM-FFO has prepared a list of BLM-FFO SMS to focus species management efforts toward maintaining habitats under a multiple-use mandate (BLM 2008a, BLM 2008c). BLM-FFO SMS include some BLM Sensitive Species and other species for which the BLM-FFO has determined special management is appropriate (BLM 2008c). The authority for this policy and guidance is established by the ESA; Title II of the Sikes Act, as amended (16 USC 670a-670o, 74 Stat. 1052); FLPMA; and Department of Interior Manual 235.1.1A.

It was determined that the following species have the potential to occur or are known to occur within the proposed project area:

- **Bendire's thrasher**: Potential foraging and nesting habitat is available within the proposed project area. No sign of this species was recorded during the biological survey.
- **Ferruginous hawk**: Potential foraging habitat is available within the proposed project area; however, no suitable nesting habitat is present within the analysis area. No sign of this species was recorded during the biological survey.
- **Golden eagle**: Potential foraging habitat is available within the proposed project area; however, no suitable nesting habitat is present within the proposed project area. The nearest previously recorded golden eagle nest site is located approximately 2.2 miles west-southwest of the

proposed CLU 25-6-6 No. 3H project area. No sign of this species was recorded during the biological survey.

- **Prairie falcon**: Potential foraging habitat is available within the proposed project area; however, no suitable nesting habitat is present within the proposed project area. No sign of this species was recorded during the biological survey.

3.5.2. Impacts from the Proposed Action

Direct and Indirect Impacts

There is similar habitat available in the surrounding area that BLM SSS could utilize for foraging. However, the proposed project would result in the removal of approximately 12.6 acres of potential Bendire's thrasher breeding habitat and raptor foraging habitat. As discussed in Section 2.1.2 (Description of Proposed Project – Protection of Flora and Fauna, Including SSS and Livestock), under the Migratory Bird Treaty Act – BLM/FFO Interim Management Policy (IM No. NM-F00-2010-001), timing limitations on use authorizations will be enforced for projects during the nesting period of May 15 to July 31 to avoid or minimize the possibility of the unintentional take of migratory birds.

The proposed well pads would be reclaimed to BLM-approved working areas. All new surface disturbances associated with the proposed pipeline corridors would be reclaimed during interim reclamation. The proposed project area would be converted to a reseed community following interim reclamation. The impacts to Sagebrush/Grass Community are described in Section 3.3 (Upland Vegetation). Habitat loss likely reduces the carrying capacity for wildlife, although the exact level of reduction cannot be quantified (BLM 2003a, 4-26 – 4-27). The proposed activities would contribute to habitat fragmentation on Gonzales Mesa.

If interim reclamation is successful, Sagebrush/Grass Community would become re-established within the proposed project areas. However, as discussed in Section 3.3 (Upland Vegetation), the re-establishment of mature, native plant communities could require decades, and it is possible that plant communities could never fully recover from disturbance (BLM 2003a, 4-18).

Bendire's Thrasher

Bendire's thrasher is found in southwest United States and northwest Mexico, from southern Nevada, southern Utah, and southwestern Colorado, south to central Sonora. Status in Baja California is unresolved. Distribution is patchy and in some cases poorly known. The Bendire's thrasher breeds in scattered locations in central and western portions of New Mexico; most common in the southwest part of the state.

Due to the mobility of adult birds, it is unlikely that adult birds would be directly impacted by the proposed project. No active nests within the action area are expected to be directly impacted if project activities occur outside of Bendire's thrasher breeding season. If proposed project activities would occur during their breeding season, birds nesting outside of but near the proposed project area could abandon existing nests as a result of visual and audial disturbances.

Audial and visual disturbances associated with the proposed project could temporarily deter this species from utilizing the proposed project area and immediately adjacent lands.

Ferruginous Hawk, Golden Eagle, and Prairie Falcon

No nesting habitat for any of these three SSS raptor species is available within the proposed project area. The three raptor species could potentially utilize the proposed project area for foraging. Due to the mobility of adult birds, it is unlikely that these raptors would be directly harmed by activities associated with the proposed project.

Audial and visual disturbances associated with the proposed project could temporarily deter these species from utilizing the proposed project area and immediately adjacent lands.

Cumulative Impacts

The FFO would continue to manage non-federally listed species according to BLM policies and guidelines, with the goal of contributing to the conservation of these species to reduce the potential for being listed under the ESA of 1973, as amended (USDI/BLM 2003a, 4-111). For reasonably foreseeable actions on federal lands, direct impacts to SSS would be avoided through the BLM's siting criteria. Development on federal and private land would result in the removal or modification of potential SSS habitat. These effects would be related to availability of undisturbed habitat in the area and the amount of disturbance that would occur within the area. The PRMP/FEIS determined that cumulatively up to 5.5 percent (128,000 acres) of vegetation in the planning area could be impacted by oil and gas development (USDI/BLM 2003a, page 4-125). Other reasonably foreseeable actions within the planning area that could impact SSS would include livestock grazing, agriculture, commercial and residential development, mining, wildfire, and vegetation management.

3.6. Water Resources

3.6.1. Affected Environment

Groundwater

The planning area is underlain by sandstone aquifers and unconsolidated sand and gravel aquifers. The Colorado Plateaus Aquifers are sandstone while the Rio Grande Aquifer system is unconsolidated sand and gravel. The primary Colorado Plateaus Aquifers that underlie the planning area are the Unita-Animas Aquifer, which underlies the vast majority of the San Juan Basin, and the Mesaverde aquifer (USGS 2001a).

The Unita-Animas aquifer is composed primarily of Lower Tertiary rocks in the San Juan Basin. It consists of the San Jose Formation, the underlying Animas Formation and its lateral equivalent, the Nacimiento Formation, and the Ojo Alamo Sandstone. The San Jose Formation is the uppermost significant bedrock formation in the San Juan Basin and primarily consists of permeable, coarse, arkosic sandstone interlayered with mudstone. The Animas and Nacimiento Formations and the Ojo Alamo Sandstone consist primarily of permeable conglomerate and medium to very coarse sandstone interlayered with relatively impermeable shale and mudstone. The thickness of the Unita-Animas aquifer generally increases toward the central part of each basin. In the northeastern part of the San Juan Basin, the maximum thickness of the aquifer is about 3,500 feet (USGS 2001a).

Surface Water

As discussed in Section 1.5.1 (Clean Water Act), the BLM-FFO and USACE Durango Regulatory Office have determined that USACE-jurisdictional waters may include USGS watercourses. No USGS watercourses were documented within the analysis area.

3.6.2. Impacts from the Proposed Action

Direct and Indirect Impacts

Groundwater

Stimulation (i.e., hydraulic fracturing or "fracking") is a process used to maximize the extraction of underground resources by allowing oil or natural gas to move more freely from the rock pores to production wells that bring the oil or gas to the surface. Fluids, commonly made up of water (99 percent) and chemical additives (1 percent), are pumped into a geologic formation at high pressure during hydraulic fracturing (USEPA 2004). Chemicals added to stimulation fluids may include friction reducers, surfactants, gelling agents, scale inhibitors, acids, corrosion inhibitors, antibacterial agents, and clay

stabilizers. When the fracking pressure exceeds the rock strength, the fluids open or enlarge fractures that typically extend several hundred feet away from the well bore, and may occasionally extend up to 1,000 feet from the well bore. After the fractures are created, a propping agent (usually sand) is pumped into the fractures to keep them from closing when the pumping pressure is released. After fracturing is completed, a portion of the injected fracturing fluids returns to the wellbore and is recovered for future fracturing operations (USEPA 2004) or disposal. 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 have allowed development of gas fields that previously were uneconomic, including the San Juan Basin.

Hydraulic fracturing is a common process in the San Juan Basin and applied to nearly all wells drilled. The producing zone targeted by the proposed wells is well below any underground sources of drinking water. The Mancos Shale Formation is overlain by a continuous confining layer. The geological confining layer is the Lewis Shale Formation that is located above both the Mancos Shale and Mesaverde Group Formations and provides an impermeable layer that isolates the Mancos Shale and Mesaverde Group Formations from both identified sources of drinking water and surface water. Fracturing could possibly extend into the Mancos Shale Formation; however, the Mancos Shale Formation has not been identified as an underground source of drinking water based on its depth and relative high levels of TDS. No impacts to surface water or freshwater-bearing groundwater aquifers are expected to occur from hydraulic fracturing of the proposed wells.

Water used to construct, produce, and maintain the proposed wells would be acquired from the Gonzales Mesa water well No. 1 (NMOSE POD No. SJ-201).

Surface Water

The analysis area does not contain a USGS watercourse. The propose actions may result in increased sedimentation through the removal of approximately 12.6 acres of existing vegetation. Water management and erosion control design features are discussed in Section 2.1.2 (Description of Proposed Project).

Cumulative Impacts

The primary cumulative impacts on water quality would result from an increase in the amount of surface disturbance due to increased oil and gas development activity and other earthmoving activities in the Largo sub-watershed of the planning area. The proposed surface disturbances and increased sediment yields, along with an increase in roads that would direct sedimentation to stream crossings, would occur mainly in the high development area. Other vegetation damaging practices, such as OHV use cross-country and in drainageways, livestock grazing, and vegetation management on non-public lands, could contribute to increased sedimentation.

As population increases in the planning area, domestic water consumption would also increase, but no data are available to quantify the amount.

3.7. Livestock Grazing

3.7.1. Affected Environment

The proposed CLU 25-6-1 No. 2H project is located within the Rancho Largo Allotment Number 5119 managed by the BLM-FFO. The Rancho Largo Allotment has a grazing authorization that permits 300 head of cattle with a grazing period from June 1 to December 31 annually. The term grazing authorization permits the utilization of 1,752 active AUMs of forage. An AUM is the amount of forage needed to sustain a cow (1,000 lb.) or cow/calf pair for one month. The Rancho Largo Allotment is 88,579 acres in size and contains 83 percent public lands. The average rangeland carrying capacity for the Rancho Largo Allotment is approximately 50.6 acres/AUM.

The proposed CLU 25-6-6 No. 2H project is located within the Superior Mesa Allotment Number 5115 managed by the BLM-FFO. The Superior Mesa Allotment has two grazing authorizations. One permits the utilization of 753 active AUMs of forage with 240 head of cattle during a grazing period from November 15 to February 28 annually. The second permits the utilization of 760 active AUMs of forage with 240 head of cattle during a grazing period from March 1 to June 15 annually. The Superior Mesa Allotment is 29,105 acres in size and contains 90 percent public lands. The average rangeland carrying capacity for the Superior Mesa Allotment is approximately 19.2 acres/AUM.

3.7.2. Impacts from the Proposed Action

Direct and Indirect Impacts

The proposed CLU 25-6-1 No. 2H project would result in approximately 7.2 acres of new surface disturbance within the Rancho Largo Allotment. This would result in the loss of approximately 0.14 AUM. The proposed CLU 25-6-6 No. 2H project would result in approximately 5.5 acres of new surface disturbance within the Superior Mesa Allotment. This would result in the loss of approximately 0.3 AUM.

Additional short term impacts may include displacement of permitted livestock during construction activities or exposure of livestock to hazards. After construction, livestock should become acclimated to the wells and traffic associated with its maintenance. Vehicle traffic associated with these wells could pose impacts to livestock considering that the area is open range and livestock may be found on roads in the area.

Direct impacts to livestock occur when holes or ditches are not excluded properly. Any type of hole or ditch is potentially a hazard to livestock while grazing. Cow or calf injuries may occur when they fall into a ditch-type cavity or in process of trying to get out. Cow or calf leg injuries also may occur when any type of small hole is left uncovered. Livestock can step into the hole and break a leg.

Impacts to livestock may occur when containment of livestock is compromised (i.e., fencing cutting). This could result in injury to livestock or individuals in the event of a vehicular accident. Indirect impacts include extra time required by the permittee to locate livestock or potential trespass issues for the respective livestock owner if the livestock cross allotment boundaries.

Cumulative Impacts

Reasonably foreseeable development within the Largo sub-watershed may include an estimated additional 1,811 oil and gas wells and related facilities, and 147 miles of new roads. Surface-disturbing activities that would be associated with these actions may affect an estimated 6,756 acres (USDI/BLM 2003a, page 4-7 and 4-8). Other reasonably foreseeable actions such as continued oil and gas development, vegetation treatments, and community development would cumulatively impact livestock grazing through direct and effective rangeland loss.

4. SUPPORTING INFORMATION

4.1. Tribes, Individuals, Organizations, or Agencies Consulted

- Division of Conservation Archaeology (DCA)
- Enterprise Field Services, LLC
- Mike Mankin, E2M2 Consultants
- Scorpion Survey & Consulting
- Cathy Smith, Huntington Energy

4.2. List of Preparers

- Jim Copeland, Archaeologist – BLM-FFO
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4.3. References

Brooks, M.L. and D. Pyke. 2001. Invasive Plants and Fire in the Deserts of North America. In Proceedings of the Invasive Species Workshop: The Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: The First National Congress on Fire, Ecology, Prevention and Management, ed. K. Galley and T. Wilson, 1-14. Miscellaneous Publications No. 11. Tallahassee, Florida: Tall Timbers Research Station.

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.

Climate Change SIR. 2010. *Climate Change Supplementary Information Report for Montana, North Dakota, and South Dakota, Bureau of Land Management*. Report on Greenhouse Gas Emissions and Climate Change for Montana, North Dakota, and South Dakota. Technical report prepared for the Montana/Dakotas Bureau of Land Management by URS Corporation. URS Project 22241790.

Enquist, Carolyn and Gori, Dave. 2008. *Implications of Recent Climate Change on Conservation Priorities in New Mexico*. April 2008.

EPA Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007. Environmental Protection Agency, Washington, D.C. April 2009.

Eveling, D.W., and A. Bataille. 1984. The effect of deposits of small particles on the resistance of leaves and petals to water loss. Environmental Pollution. 36:229-238.

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)

Griffith, G.E., J.M. Omernik, M.M. McGraw, G.Z Jacobi, C.M. Canavan, T.S. Schrader, D. Mercer, R. Hill, and B.C. Moran. 2006. Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey (map scale 1:1,400,000).

Hirano, T., M. Kiyota, and I. Aiga. 1995. Physical effects of dust on the leaf physiology of Cucumber and Kidney bean plant. Environmental Pollution 89(3):225-261.

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.

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.

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)

Natural Gas Supply Association. 2010. NaturalGas.org – Uses of Natural Gas. Available at: http://www.naturalgas.org/overview/uses.asp.

Natural Resources Conservation Service (NRCS). 2010. Federal Noxious Weeds. http://plants.usda.gov/java/noxious?rptType=Federal.

New Mexico Environment Department (NMED). 2010. *Inventory of New Mexico Greenhouse Gas Emissions: 2000-2007*. http://www.nmenv.state.nm.us/cc/index.html.

NMED. 2012. *Northwest New Mexico Monitoring Network Presentation to BLM*. June 26, 2012. Presented by Mark Jones New Mexico Environment Department.

New Mexico Natural Heritage Program. 2005. Available at: http://nmnhp.unm.edu.

New Mexico Office of the State Engineer. 2014. New Mexico Water Rights Reporting System. Online Water Column Report. (Available at: http://nmwrrs.ose.state.nm.us/nmwrrs/waterColumn.html).

New Mexico Rare Plant Technical Council. 1999. *New Mexico Rare Plants*. Albuquerque, NM: New Mexico Rare Plants Home Page. (Available at: http://nmrareplants.unm.edu Latest update: 18 January 2006).

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

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.

Simpson, Erik. 2014. *The Cultural Resources Inventory of Huntington Energy's Proposed Canyon Largo Unit 25-6-1 No. 2H Well Pad, an Access Road Reroute, a Temporary Surface Waterline, and an Enterprise Products Company Well Connect Pipeline, Rio Arriba County, New Mexico.* Report No. 14-

DCA-004. San Juan County Museum Association, Division of Conservation Archaeology, Bloomfield, New Mexico.

Simpson, Erik. 2014. *The Cultural Resources Inventory of Huntington Energy's Proposed Canyon Largo Unit 25-6-6 No. 3H Well Pad and Access Road and an Enterprise Well Tie Pipeline, Rio Arriba County, New Mexico.* Report No. 14-DCA-010. San Juan County Museum Association, Division of Conservation Archaeology, Bloomfield, New Mexico.

Thompson, J. R., P.W. Mueller, W. Fluckiger, A.J. and Rutter. 1984. The effects of dust on photosynthesis and its significance for roadside plants. Environmental Pollution 34(2):171-190.

U.S. Department of the Interior (USDI) and U.S. Department of Agriculture (USDA). 2007. *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development*. BLM/WO/ST-06/021+3071/REV 07. Bureau of Land Management. Denver, Colorado.

USDA, Natural Resources Conservation Service (NRCS). 2006. Web Soil Survey. Version 1.1. NRCS. http://websoilsurvey.nrcs.usda.gov/app.

USDI, Bureau of Land Management (BLM). 2003a. *Farmington Proposed Resource Management Plan and Final Environmental Impact Statement*. Farmington, New Mexico.

USDI, BLM. 2003b. *Farmington Resource Management Plan with Record of Decision*. Farmington, New Mexico.

USDI, BLM. 2005. *Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities.* BLM Manual Supplement H-8100-1. New Mexico, Oklahoma, and Texas.

USDI, BLM and USDA Forest Service, San Juan Public Lands Center (SJPLC). 2006. *Final Environmental Impact Statement, Northern San Juan Basin Coal Bed Methane Project*. Durango, Colorado.

USDI, BLM, Farmington Field Office. 2010. *Migratory Bird Treaty Act - BLM/FFO Interim Management Policy*. Instruction Memorandum No. NM-F00-2010-001.

USDI, BLM. 2011a. BLM New Mexico Sensitive Birds List. Revised August 2011.

USDI, BLM. 2011b. BLM New Mexico Sensitive Mammals List. Revised July 2011.

USDI, BLM. 2011c. BLM New Mexico Sensitive Molluscs, Crustaceans, and Arthropods List. Revised August 2011.

USDI, BLM. 2012a. BLM New Mexico Sensitive Plants List. January.

USDI, BLM. 2012b. prairie_dog_colonies.shp (Shapefile of recorded prairie dog colonies within the general BLM-FFO region). Provided by BLM-FFO 2012.

USDI, BLM. 2013a. aztec_gilia_habitat (Shapefile of the new Aztec gilia and Brack's fishhook cactus Potential habitat "zone"). Provided by the BLM-FFO September 26, 2013.

USDI, BLM. 2013b. Air Resources Technical Report for Oil and Gas Development. New Mexico, Oklahoma, Texas, and Kansas. Bureau of Land Management, New Mexico State office. Santa Fe, New Mexico.

U.S. Department of Interior Bureau of Land Management. 2014. *Air Resources Technical Report for Oil and Gas Development.* Santa Fe: U.S. Department of Interior Bureau of Land Management.

USDI, BLM, and U.S. Department of Energy (DOE). 2010. Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States. Chapter 5 (Impacts and Mitigation).

U.S. Energy Information Administration. 2012. Energy in Brief. Available at: http://www.eia.gov/energy_in_brief/major_energy_sources_and_users.cfm.

U.S. Environmental Protection Agency. (2012, May 21). 2005 National-Scale Air Toxics Assessment. Retrieved February 27, 2014, from U.S. Environmental Protection Agency: http://www.epa.gov/ttn/atw/nata2005/

U.S. Environmental Protection Agency. (2013, December 5). The Green Book Nonattainment Areas for Criteria Pollutants. Retrieved February 25, 2014, from U.S. Environmental Protection Agency: http://www.epa.gov/airquality/greenbook/

U.S. Environmental Protection Agency. (2013a, November 15). Air Quality Index Report. Retrieved March 12, 2014, from U.S. Environmental Protection Agency: http://www.epa.gov/airdata/ad_rep_aqi.html

U.S. Environmental Protection Agency. (2014, February 7). Air Trends: Design Values. Retrieved February 25, 2014, from U.S. Environmental Protection Agency: http://www.epa.gov/airtrends/values.html

U.S. Environmental Protection Agency. (2014, February 3). The 2011 National Emissions Inventory. Retrieved February 27, 2014, from U.S. Environmental Protection Agency: http://www.epa.gov/ttn/chief/net/2011inventory.html

U.S. Geological Survey (USGS). 1979. Notice to Lessees and Operators of Onshore Federal and Indian Oil and Gas Leases (NTL-3A). Reporting of Undesirable Events.

USGS. 2001a. “Groundwater Atlas of the United States—Arizona, Colorado, New Mexico, Utah: HA 730-C. Colorado Plateau Aquifer.” http://sr6capp.er.usgs.gov/gwa/ch_c/C-text8.html.

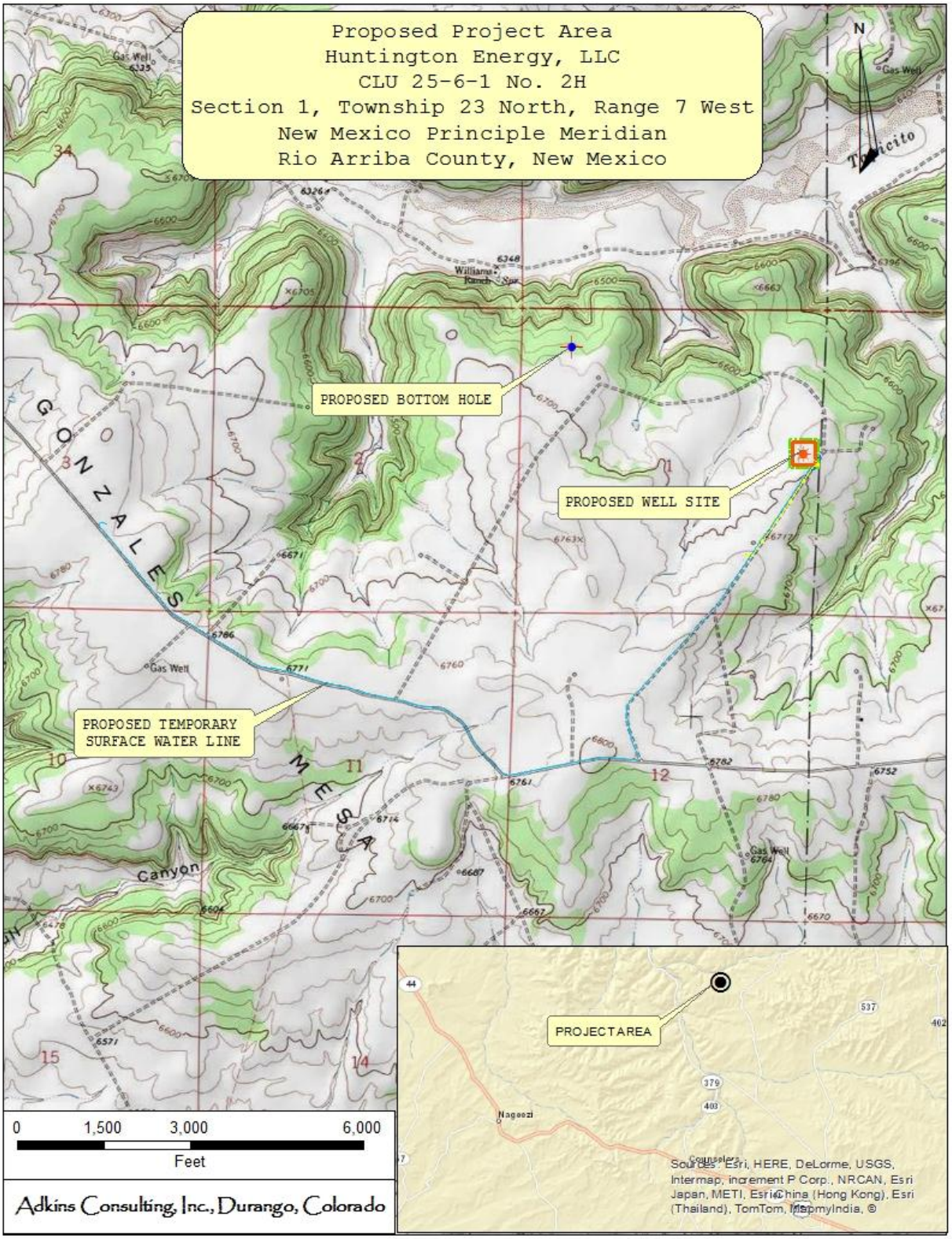
Valkenburgh, Richard F. Van. 1941. *Diné Bikeyah*. Department of the Interior, Office of Indian Affairs, Navajo Services, Window Rock. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Van Valkenburgh, Richard F. 1974. *Navajo Sacred Places*. Edited by Clyde Kluckhohn. Garland Publishing. New York.

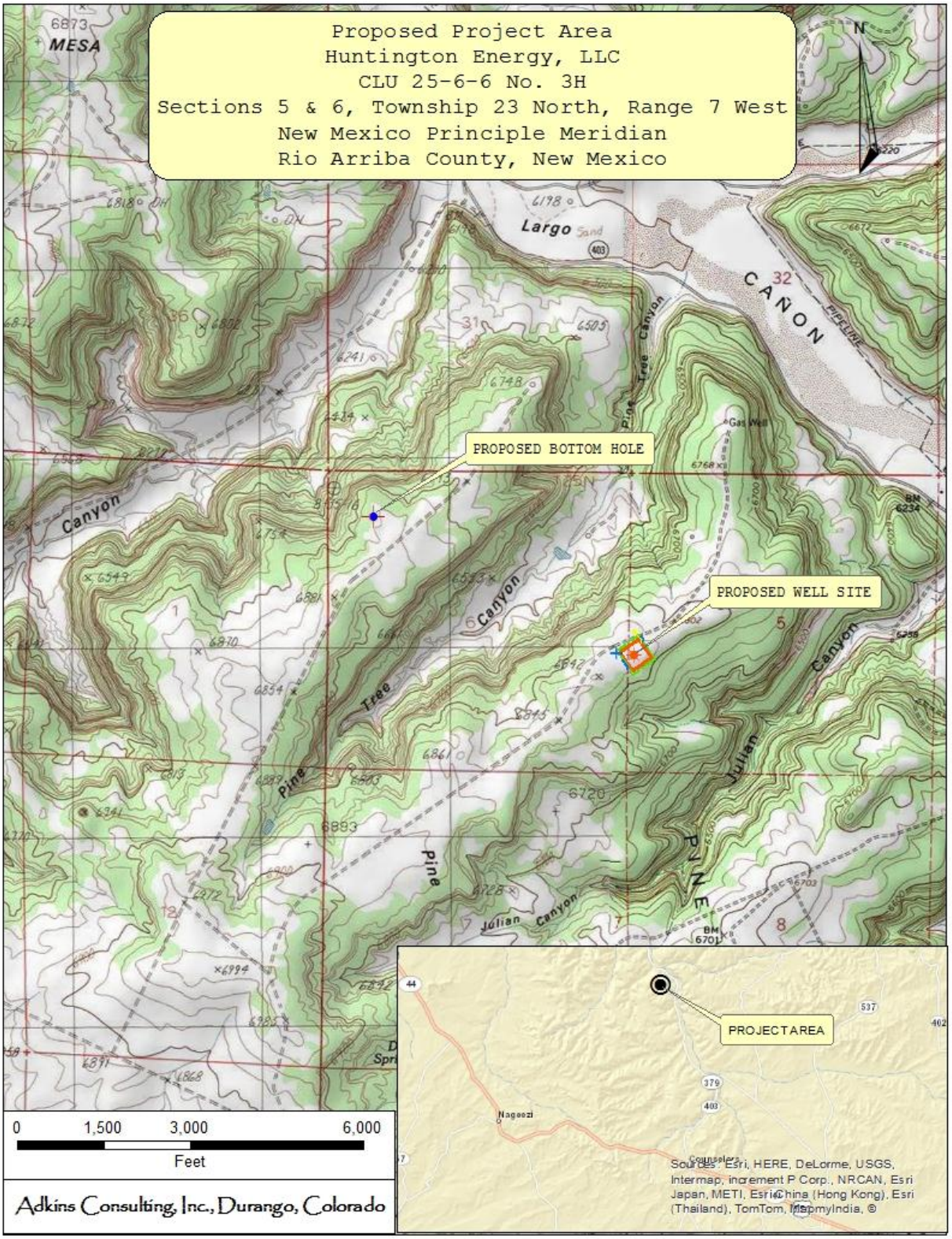
Whitson, Tom D., Larry C. Burrill, Steven A. Dewey, David W. Cudney, B.E. Nelson, Richard D. Lee, and Robert Parker. 1992. Weeds of the West, Revised. Edited by Tom D. Whitson. The Western Society of Weed Science in Cooperation with the Western United States Land Grant Universities Cooperative Extension Services.

APPENDIX A. MAPS

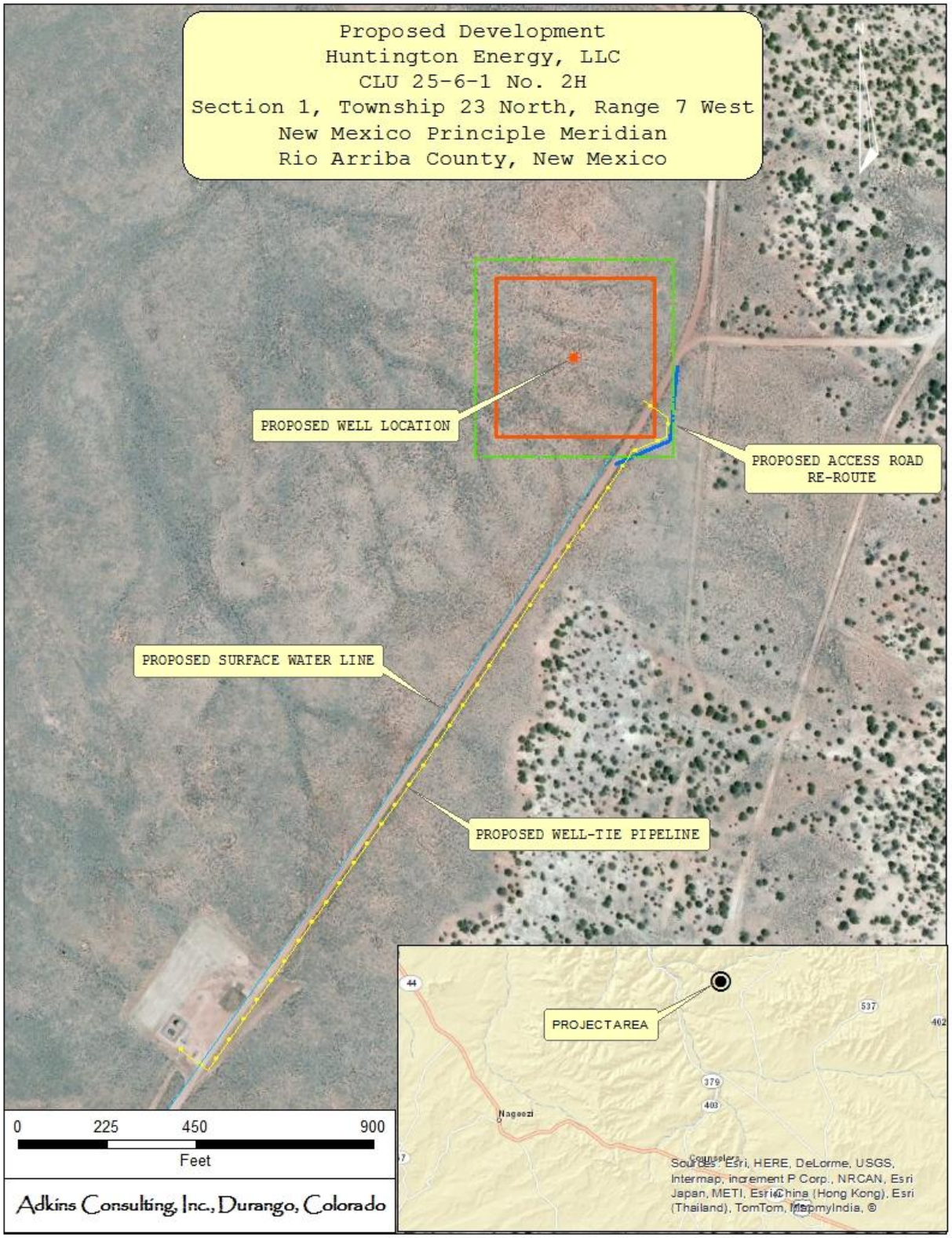
A.1. Project Area Map



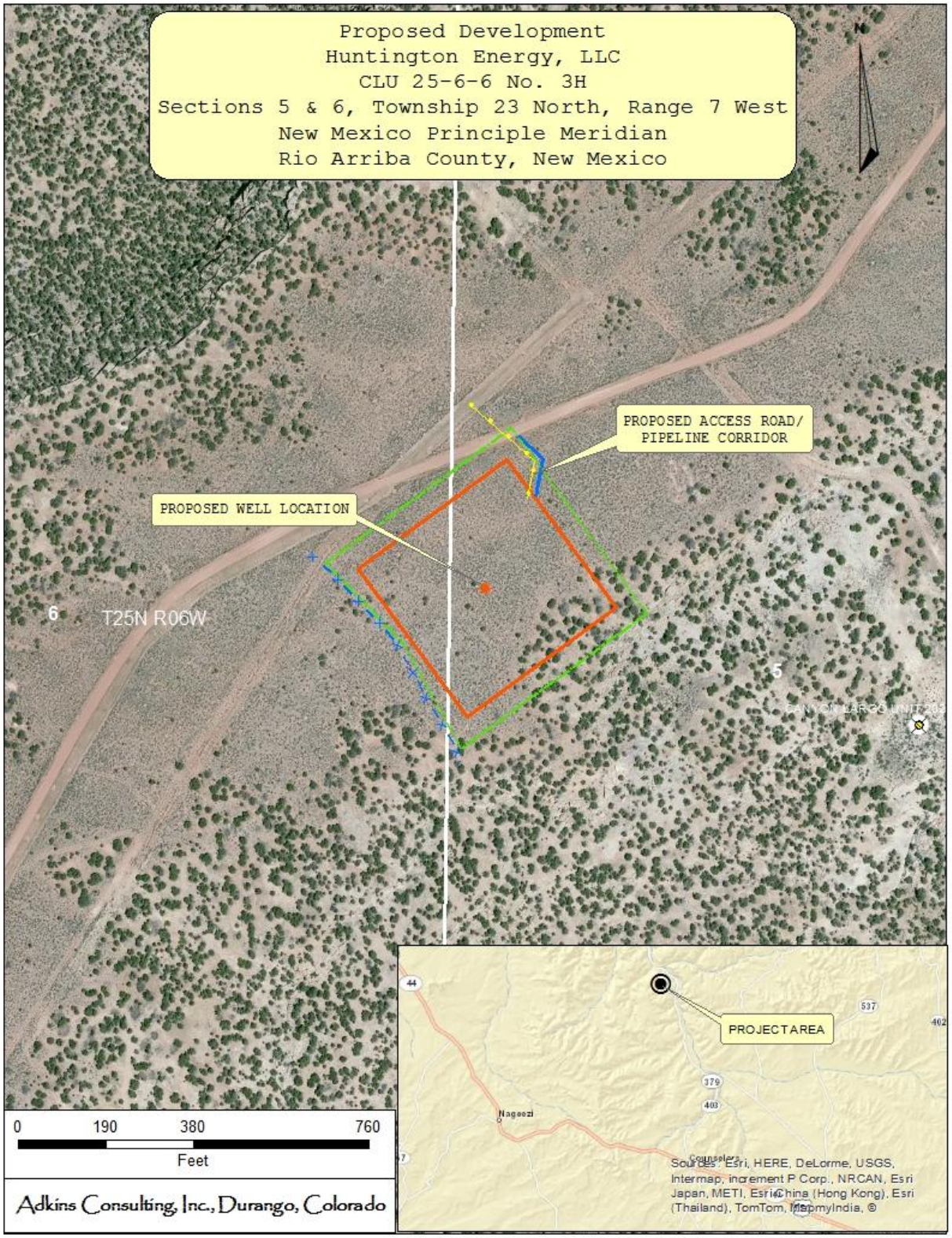
A.2. Project Area Map



A.3. Proposed Development Map



A.4. Proposed Development Map



APPENDIX B. PLATS

APPENDIX C. SURFACE RECLAMATION PLANS