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Final Environmental Impact Statement for Proposed Magdalena Ridge Observatory

Cibola National Forest
Socorro County, New Mexico

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Proposed Magdalena Ridge Observatory
Final
Environmental Impact Statement
Socorro County, New Mexico

Lead Agency: **USDA Forest Service**

Responsible Official: **Liz Agpaoa**
Supervisor, Cibola National Forest
2113 Osuna Road, NE
Albuquerque, NM 87113
(505) 346-3900

For Information Contact: **Laura Hudnell**
203 First Street
Magdalena, NM 87825
(505) 854-2281

ABSTRACT

This Final Environmental Impact Statement (EIS) was prepared by Science Applications International Corporation (SAIC) for the Forest Service in compliance with the National Environmental Policy Act (NEPA). This Final EIS evaluates the potential impacts from a proposal by the New Mexico Institute of Mining and Technology (NMIMT) to construct and operate an observatory in the Magdalena Mountains. The proposed observatory project, called Magdalena Ridge Observatory (MRO), would be located on the Magdalena Ranger District (MRD) of the Cibola National Forest in central New Mexico. The decision to be made by the Forest Service is whether or not to modify the existing Special Use Permit (SUP) for Langmuir Laboratory to allow NMIMT to construct and operate the new observatory and its associated facilities, or to select one of three other alternatives or a combination of alternatives. The observatory and its associated facilities would consist of two main parts: 1) the scientific equipment consisting of an Interferometer Array of 16 telescopes at full buildout and its associated infrastructure, including a Beam-Combining Facility, a single 7.9-foot (2.4-meter [m]) stand-alone telescope, and a telescope pair; 2) educational and research support facilities including an Operations Center, parking areas, utility provisions, and roadways. Construction would take place over 4 to 5 years. The No Action and three additional alternatives, representing variations in the location of the observatory facilities on the ridge, were evaluated.

In response to issues raised by the public during scoping, NMIMT identified alternate sites and simplified infrastructure options that were being considered. Alternative 3 is selected as the Preferred Alternative and differs from the Proposed Action in that the Operations Center and main cluster of support facilities would be located farther south on the ridge, closer to the Interferometer Array. This site is flatter and less visible from off-

site locations, and construction in this location would require less excavation, and would be less prone to erosion. This location would also improve operational efficiency for the proposed MRO. Utility distribution trenches would be designed to minimize disturbance and would be placed in roadbeds to the extent possible. For these combined reasons, this is the Preferred Alternative.

No significant adverse impacts are predicted with the incorporation of mitigation measures and Best Management Practices (BMP) identified in the Final EIS. Various monitoring will also ensure that no significant adverse effects will occur.

Public comments were provided to the Forest Service during the 45-day review period of the Draft EIS. Comments were analyzed and responded to by the Forest Service. The information acquired from the public comment period was used in the preparation of the Final EIS and the decisionmaking process.

SUMMARY

Introduction

This Final Environmental Impact Statement (EIS) was prepared by Science Applications International Corporation (SAIC) for the U.S. Forest Service (Forest Service) in compliance with the National Environmental Policy Act (NEPA). It evaluates the potential impacts from a proposal by the New Mexico Institute of Mining and Technology (NMIMT) to construct and operate an observatory in the Magdalena Mountains. The proposed observatory project, called Magdalena Ridge Observatory (MRO), would be located in the Magdalena Ranger District (MRD) of the Cibola National Forest (CNF) in central New Mexico. NMIMT is part of a consortium including other universities and the United States (U.S.) Navy, Naval Research Laboratory (NRL), which are proposing to develop the proposed MRO.

Changes Between the Draft and the Final EIS

In response to comments received on the Draft EIS, additional information and clarification was added to the Final EIS to provide the following:

- Clarify the sources of water for the Proposed MRO project.
- Clarify the effects of proposed water use on wildlife.
- Clarify habitat type and wildlife species occurrence in the project area.
- Clarify agency coordination for maintenance of Water Canyon Road.
- Correct the information on the expected reduction in grazing.
- Incorporate additional mitigation measures.
- Add comments received on the Draft EIS and document responses to those comments.

Project History

The proposed MRO project started with initial discussions among potential collaborators in 1995. NMIMT and U.S. Army staff visited Magdalena Ridge to determine its general feasibility. In 1996 and 1997, the U.S. Air Force, New Mexico State University, and the University of Puerto Rico joined the consortium. NMIMT received the 7.9-foot (2.4-meter [m]) mirror in 1998. The mirror was then transported to Socorro where it remains in storage. The first formal consortium meeting was held at the University of Puerto Rico the same year. Late in the year, New Mexico Highlands University joined the consortium. Two consortium meetings were held in 1999 and a design and engineering firm was retained to develop a conceptual design of the proposed facilities. In 2001, sponsorship of the project was transferred to the U.S. Navy, and the University of Cambridge joined the consortium. A conceptual layout of the proposed facilities was developed in 2002.

Purpose and Need for the Proposed Action

The observatory's primary purposes would be astronomical and optical research and education. A secondary purpose would be to support White Sands Missile Range (WSMR) with passive observing techniques for identifying satellites and tracking missiles during tests. The facility would provide a location for state-of-the-art telescopes, cameras, spectrometers, and associated equipment. There is an acute need for high-tech education in New Mexico, where the economy is closely tied to science and engineering.

Description of the Project Area

The proposed location for the new MRO facilities is within the existing Langmuir Research Site, a 31,000-acre area in the Magdalena Mountains of New Mexico set aside by Congress in 1980 under Public Law (P.L.) 96-550. The Langmuir Research Site was established to encourage scientific research into atmospheric processes and astronomical phenomena. The site is located within the MRD within the CNF in central New Mexico. The proposed MRO would be located on Magdalena Ridge below South Baldy Peak in the Magdalena Mountains.

Access to the site is via Water Canyon Road, which originates off U.S. Highway 60 (US 60) about 13 miles (21 km) west of Socorro and 10 miles (16 km) east of the Village of Magdalena. The first four miles (6.4 km) are a paved, county-maintained road to Water Canyon Campground. From the campground, the road is narrow, with an effective roadbed width of 12 feet (3.7 m), native-surfaced, and rises over 3,000 feet (910 m) to the Magdalena Ridge.

The Langmuir Research Site operates under the existing Langmuir Laboratory Special Use Permit (SUP) issued by the CNF. This SUP allows for operation of the research facilities and other general caretaking and operational uses. An Annual Operations and Maintenance Plan is developed by NMIMT and approved each year by the CNF, and provides for more specific coordination, accountability, and designation of responsibilities.

The project area within which most direct impacts and activities from implementation and operation of the proposed MRO would occur includes the ridgetop development area, utility corridors, and 74.25 feet (22.5 meters) either side of the centerline of Water Canyon Road. These three areas comprise about 980 acres.

Decision to be Made

Given the purpose and need, the Forest Service will review the Proposed Action and other alternatives and their environmental consequences to make the following decision:

- Whether or not to amend the existing Langmuir Laboratory SUP to include the Proposed Action;
- Whether to select another alternative in response to identified issues;
- Whether to select a combination of alternatives; or
- Whether to take no action at this time.

The decision would be consistent with the 1985 CNF Land and Resource Management Plan (LRMP), as amended, and would not require a plan amendment.

Location Selection

Several locations in central New Mexico (see **Table S-1**) were considered for the proposed MRO. Locations were evaluated for conformity with both scientific and operational criteria. The selection process also considered the extent to which existing infrastructure would minimize the amount of new construction and thereby limit change to the environment. Locations in Wilderness Areas (WA) were not considered. Magdalena Ridge was determined to be the only reasonable location because it offers superior conditions for the scientific functions and provides the best opportunity to use existing infrastructure. Because no locations other than Magdalena Ridge satisfied all the criteria, others were not considered viable alternatives.

Table S-1. Comparison of Location Options

Criteria	Site[1]							
	Mt. Withington	Nogal Peak	Sierra Blanca Peak	Manzano Peak	Ladrone Peak	Caballo Mountains	Polvadera Peak	Magdalena Ridge
Scientific Needs								
Known levels of wind-blown dust								X
Low levels of nighttime light pollution	X							X
Large number of clear nights per year				X	X			X
Above 7,500 feet (2,286 m)	X	X	X	X	X			X
Proven good astronomical seeing				X				X
Flat area[2]				X				X
Operational and Environmental Needs								
Previously developed site			X			X	X	X
Pre-existing environmental studies								X
Electricity available			X			X	X	X
Water available			X					X
Physically accessible by road	X		X			X	X	X
Reasonable distance from campus				X	X		X	X
Support facilities present							X	X
Uninterrupted view to Ft. Wingate area	X	X	X	X	X			X
Straight-line visibility to N. Oscura Peak, White Sands Missile Range	X	X	X	X	X			X
Criteria Satisfied	**5**	**3**	**7**	**7**	**5**	**3**	**5**	**15**

Note: (1) All sites are in New Mexico.
(2) Large enough for **Y**-shaped array with arms 787 feet (240 m) in length. This is represented by a 39-acre circular area.

Public Involvement

The Forest Service prepared a Public Information and Communication Plan in September 2002, outlining tasks and strategies to involve the public during the NEPA process. Some of the chosen methods included open houses, field trips, direct mailings, announcements, and publications in local newspapers. Following is a summary of the public involvement activities conducted for the proposed MRO (**Table S-2**).

Table S-2. Summary of Public Involvement Activities for the Proposed MRO Project

Activity	Date	Action Implemented
SOPA	Oct. 2000 to July 2003	Listing of Proposed Action.
Pre-Scoping Letter	Oct. 3, 2002	Over 900 letters and information packets mailed to individuals and organizations on the CNF's established mailing list.
Legal Notice	Oct. 3, 2002 Sept. 19, 2003	Notice of Intent (NOI) to prepare a Draft EIS was published in the Federal Register. Notice of Availability (NOA) for Draft EIS public comment period was published in the Federal Register.
News Releases	Oct. 24, 29, 30 Nov. 5, 14, 18, 2002; April 16, July 10, 2003	Articles placed in several local news papers requesting comments on the Proposed Action and information on activities.
Fact Sheets to other Forest Service offices	Oct. 28, 2002	Information distributed on the proposed MRO project, time lines, and activities to the CNF offices and posted on the CNF's web site.
Student Education	Oct. 28, 2002	MRO Education and Outreach Group began work with the local school districts, sharing information on the proposed MRO project.
Public Tours	Nov. 2, 2002, April 26, 2003, and Oct. 4, 2003	Public tours held of the proposed MRO site location with the general public, the CNF ID Team members, and NMIMT research scientists.
Scoping Letter	Nov. 8, 2002	Letter sent to over 160 individuals and organizations that identified continued interest in being contacted based on responses from the pre-scoping letter and the CNF's established mailing list.
Open Houses	Nov. 13, 19, and 21, 2002	Public Open Houses held to meet one-on-one with the public and solicit comments.
Draft EIS	Sept. 19, 2003 to Nov. 3, 2003	Draft EIS available to the public for 45 day comment period.

Scoping Issues

The scoping period included several activities to involve the public, such as site tours, informational public meetings, news releases, and mailings with information about the proposal. About 20 written respondents provided input on a range of issues and concerns. These issues and concerns helped NMIMT to incorporate appropriate design measures into their proposal. Several people expressed support for the project based on its educational and scientific purpose. The Forest Service identified the following significant issues based on input during the scoping process:

- Issue 1. The amount of ground disturbance during construction of utility corridors, road repairs, and ridgetop development could lead to increases in erosion. The unit of measure for comparison of alternatives is acres of ground disturbance.
- Issue 2. Implementation of the project facilities and infrastructure may change the visual character of the area and reduce aesthetic quality. The unit of measure for comparison of alternatives is changes to Visual Quality Objectives (VQO).

Draft EIS Comments

Nine reviewers submitted comments on the Draft EIS for the proposed Magdalena Ridge Observatory during the 45-day public comment period. Comments were received via email (1), conventional mail (7), and hand delivered (1). The submittals were indexed by author, and individual comments were categorized by topic. The comments were then reviewed by the Cibola National Forest Supervisor to determine whether they are substantive, clarification, or other types of comments, defined as follows:

- Substantive comments are defined as those comments that are eligible for appeal.
- Clarification comments are comments or questions concerning information or analysis that was included in the Draft EIS, and additional information has been provided in the Final EIS, either in the response provided in Appendix B or in the document itself.
- Other comments include comments that are: concurrence, opinion, correction, and/or outside the scope of this EIS.

The comments and responses are included in Appendix B.

Proposed Action and Alternatives

Under all alternatives, except the No Action Alternative, implementation of the proposed MRO would include construction of new structures and infrastructure on the ridgetop near South Baldy Peak and expansion of utility services to the ridge to meet the needs of the new observatory. Maintenance and repair of Water Canyon Road would continue as outlined in the existing SUP under all alternatives, including No Action.

In response to scoping issues, NMIMT identified sites for facilities different from those described in the Proposed Action (Alternative 1) and simplified the infrastructure options being considered. Two additional alternatives, representing variations in the location of the observatory facilities on the ridge, were developed and evaluated. In addition, the Final EIS includes the No Action Alternative. All four alternatives are described below.

Alternative 1: Proposed Action

The observatory and its associated facilities would consist of two main parts: 1) the scientific equipment consisting of an interferometer telescope array of 16 telescopes at full buildout and its associated infrastructure (Beam-Combining Facility, single 7.9-foot [2.4-m] stand-alone telescope, and a telescope pair); 2) educational and research support facilities consisting of an Operations Center, parking areas, utility provisions, and roadways. Construction would take place over 4 to 5 years, with 75 percent of the construction occurring during the first year.

Facilities

Table S-3 lists the proposed scientific equipment and associated infrastructure and the educational and research support facilities as described in the Proposed Action.

Table S-3. Proposed MRO Ridgetop Development

Facility	Description	Size (sf)
7.9-ft (2.4-m) Telescope	7.9-ft (2.4-m) mirror, 30-ft (9.1-m) diameter structure with dome roof, 38 ft (11.6 m) in height, with equipment room and lab.	600 (55.7 sm)
Interferometer Array	Sixteen telescopes at full buildout, each with a mirror about 4.9 ft (1.5 m) in diameter, arranged in a **Y** shape. Each arm would extend for 800 ft (244 m) from the center. The arms would radiate from the center at 120 degrees. Along each arm, there would be as many as 11 concrete pads with domes, each 12 ft by 12 ft (3.7 m by 3.7 m).	5,000 (464.5) sm
Beam-Combining/ Delay Line Building	The facility would be at least 600 ft (182.9 m) in length and about 30 ft (9.1 m) wide, with adjacent combiner room.	20,500 (1,904.5 sm)
Large Telescope Pair	Two 7.9-ft (2.4-m telescopes on circular track (165 ft [50.3 m] in diameter), with enclosures, beam-combining room, and parking “shed.”	6,600 (613.2 sm)
Operations Center	Operations Center with lab areas, dining and dormitories, bathrooms, office spaces, etc., 2 stories high.	18,600 (1,728.4 sm)
Interferometer Support Facility	An Interferometer Support Facility (about 1,500 sf [139.4 sm]) would be located close to the Beam-Combining Facility.	1,500 (139.4 sm)
Site Characterization Facility	Small domed building with telescope and associated equipment in vicinity.	100 (9.3 sm)
Electric Substation	The substation would also be located on the east slope, near the Operations Center.	2,500 (232.3 sm)
Storage Facility	This 5,000-sf (464.5 sm) storage facility would have indoor maintenance and shop areas, with compacted gravel surface for outdoor storage and parking areas (10,000 sf [929.0 sm]).	15,000 (1,393.5 sm)
Parking Areas	Gravel parking areas (about 2,000 sf [185.8 sm] each) located adjacent to Operations Center, 7.9-ft (2.4-m) telescope, and Interferometer Array for vehicle parking.	6,000 (557.4 sm)
Temporary Structure	A round temporary structure (about 40 ft [12.2 m] in diameter and 22 ft [6.7 m] in height) made of a white plastic fabric over an aluminum frame would be erected on an as-	1,260 (117.1 sm)

Facility	Description	Size (sf)
	needed basis.	
Water Storage Tanks	One 120,000-gallon tank would be placed underground and would hold non-potable water for fire suppression. One or two underground tanks totaling 80,000 gallons would hold potable water for domestic water use. Alternatively, several smaller tanks could be used for potable water within the same area.	11,000 (1,021.9 sm)
Water Treatment Plant and Enclosure	A small potable water treatment ozonation facility would be located on-site.	100 (9.3 sm)
Wastewater System	Local septic tanks and fields would handle wastewater septic flows from the various occupied sites.	2,600 (241.6 sm)
Liquid Fuel Storage Building	Liquid fuels storage tanks enclosed (as per applicable federal and state standards) for emergency generator and water pump.	100 (9.3 sm)
Emergency Water Pump Enclosure	Small concrete block enclosure for back-up water pump.	100 (9.3 sm)
Emergency Generator Enclosure	Small concrete block enclosure for emergency power generator.	100 (9.3 sm)
Avalanche Winch and Cable	Two concrete pads to anchor winch and cable.	50 (4.7 sm)
New Roads	A total of about 1 mile (1.6 km) of new gravel roadway. Includes rerouted ridge road around east arm of array, and new road to West Knoll.	1 mile (1.6 km)

Notes: sf = square feet
ft = feet
m = meters
sm = square meters
km = kilometers

Utility Provision

Three options are being considered for providing utilities. They differ primarily in the method in which water would be provided for the proposed MRO.

The existing power supply to the ridge would be upgraded. Service for electricity and communication would be added to the existing power poles. Emergency generators would be installed to provide backup power. Three water sources are being considered. Option 1 would develop a groundwater source near Hardy Spring on the west side of the ridge and convey the water to the proposed MRO project area through an aboveground pipe. A portion of the piping on the ridgetop would be buried. Option 2 would use a new aboveground pipeline along a new route to convey water from the existing surface water source in the East Fork of Sawmill Canyon Creek, which supplies water for Langmuir Laboratory, to the proposed MRO water storage tanks. Option 3 would use the existing pipeline from the East Fork of Sawmill Canyon Creek and extend it to the proposed MRO water storage tanks. Under Options 2 and 3, water would be drawn from East Fork of Sawmill Canyon Creek as provided for in the existing state permit, up to the authorized water use of 84,375 gallons per year. Additional water would be hauled if the need exceeds the state permitted amount. For all options, water would be pumped to new water storage and treatment facilities. An 80,000-gallon supply of treated (potable) water would be stored on the ridgetop. The projected water demand for the proposed MRO is about 150,000 gallons per year (gpy). Maximum daily demands would be about 2,000 gallons. A new tank would hold 120,000 gallons of non-potable water for fire suppression. Rainwater would be collected off the Beam-Combining Building to supply this water source.

Road Access and Maintenance

The existing Water Canyon Road would be used for access. The portion between US 60 and Water Canyon Campground is paved. The condition of this road would be monitored before and after construction, and any required repairs would be performed in accordance with an agreement developed among NMIMT, the Forest Service, and Socorro County.

Between Water Canyon Campground and the ridgetop, the existing native-surfaced road is currently and would continue to be maintained and repaired as needed in accordance with the existing Langmuir Laboratory SUP and the Annual Operations and Maintenance Plan. The road would remain classified as a Level 2 FR, suitable for high clearance vehicles.

Construction

Construction would take place over a 4 to 5 year period with 75 percent of the earthwork and major concrete work occurring in the first year. A total of 12,800 round trips to the site are projected to be made by heavy and light trucks over the construction period. The first-year construction effort would involve about 200 full-time equivalent workers.

Construction on the ridgetop, including staging and construction areas, is estimated to disturb slightly less than 24 acres (**Table S-4**). Areas that are not directly covered by a building, road, or gravel, about 17 acres, would be revegetated using appropriate native plant species. Maintenance and repair of Water Canyon Road could disturb another 24 acres. About 80 trees total on the ridgetop and along the road may be removed. Mitigation measures to protect the environment during construction and Best Management Practices (BMP) would be used in design and construction of facilities.

Table S-4. Estimated Acres of Ground Disturbance and Revegetation

Project Activity/Location	Ground Disturbance (acres)	Revegetated (acres)
Ridgetop:	23.4	16.8
Temporary Staging Area	3.4	3.4
Operations Center complex	4.4	3.5
Interferometer Array	8.9	6.2
Storage Area	2.0	1.7
Additional utility trenches, roads, and driveways	2.9	2.0
Large telescope pair	1.8	0
Water Supply Development: Spring Area	<0.1	<0.1
Water Canyon Road Maintenance and Repair	24.0	6.0
Total (approximate)	**47.4**	**22.8**

Operations

Initially after construction, about two or three engineers/technicians would be on-site on a 24-hour basis to manage and maintain the site and scientific equipment. Once fully operational, the facility would be able to accommodate up to 20 researchers and students on-site, with sporadic overnight visits. On average, the proposed MRO is expected to add an additional two round trips on Water Canyon Road each day. In addition, about 300 scientists per year would visit the proposed MRO, staying in Socorro for a few weeks and spending a few days at the proposed MRO. The public would be able to walk around the exterior of facilities throughout the site, with access only excluded to fenced areas around the array and paired telescope facilities.

One person trained as an Emergency Medical Technician would be on-site. Also, there would be personnel trained in suppression of small fires on-site at all times. An emergency vehicle and pumper truck would augment emergency capabilities at the facility.

Minor cleaning of telescope mirrors using household solvents would take place at the proposed MRO, but major cleaning would be performed in a facility at the NMIMT campus in Socorro.

Alternative 2: No Action

Under the No Action Alternative, current management plans would continue to guide management of the Langmuir Research Site under the existing SUP and Annual Operations and Maintenance Plan. The activities associated with operation and maintenance of Langmuir Laboratory would continue, including continued use of water from East Fork Sawmill Canyon Creek under the existing state authorization. Water Canyon Road would continue to be maintained and repaired as needed in accordance with the existing Annual Operations and Maintenance Plan.

Alternative 3: Preferred Alternative

Alternative 3, the Preferred Alternative, differs from the Proposed Action in the location of some of the facilities on the ridge. In response to issues concerning ground disturbance and changes in aesthetic quality raised during scoping, NMIMT identified a location for the Operations Center and main cluster of support facilities farther south on the ridge and closer to the Interferometer Array. This alternate site is flatter and less visible from off-site locations. Construction in this location would also require less excavation, responding to public concern about ground disturbance. This location would also improve operational efficiency for the proposed MRO by locating the facilities closer together. Utility distribution trenches would be designed to minimize disturbance and would be placed in roadbeds to the extent possible. For these combined reasons, this is the Preferred Alternative.

The following additional differences from the Proposed Action would apply under this alternative:

- The Operations Center would be smaller in size (9,800 square feet [sf] [910.5 square meters] [sm]) and one story high.
- There would be no need for a separate Interferometer Support Facility because the Operations Center would be close by.

- The 7.9-foot (2.4-m) telescope would need a separate nearby support building (about 1,500 sf [139.4 sm]) for labs, offices, sleeping quarters and equipment.
- The electric substation would be downsized to about 1,500 sf (139.4 sm).

With slightly smaller building footprints, there would be a very slight reduction in ground disturbance compared to Alternative 1 (less than 1 acre on the ridgetop). All three utility options described for Alternative 1 would be considered. While the location of some facilities would differ, the construction process and operational phase under this alternative would be the same as described for Alternative 1.

Alternative 4

Alternative 4 was also developed in response to public concerns about ground disturbance and change in aesthetic character of the area. It differs from the Proposed Action in the location of the Operations Center and associated support buildings on the ridge. The Operations Center would be located farther north on the ridge, near the existing visitor kiosk. As with Alternative 3, this location is flatter and is less visible from off-site locations. Construction in this location would also require less excavation, responding to pubic concern about ground disturbance. Alternative 4 differs from Alternative 3 only in the location of the facilities and the inclusion of the Interferometer Support Facility. The following differences from the Proposed Action would apply under this alternative:

- The Operations Center would be smaller in size (9,800 sf [910.5 sm]) and one story high.
- The 7.9-foot (2.4-m) telescope would need a separate nearby support building (about 1,500 sf [139.4 sm]) for labs, offices, sleeping quarters, and equipment.
- The electric substation would be downsized to about 1,500 sf (139.4 sm).

All three utility options described for Alternative 1 would be considered. While the location of some facilities would differ, the construction process and operational phase under this alternative would be the same as described for Alternative 1.

Mitigation Measures to Reduce Impacts

All alternatives, except the No Action Alternative, incorporate several methods to reduce potential impacts that may be associated with proposed MRO construction and operations. The mitigation measures were designed to reduce the following potential impacts:

- Increase in water consumption;
- Visibility of new facilities and infrastructure;
- Ground disturbance leading to soil loss, erosion, and resulting impairment to water quality, habitats, and wildlife;
- Safety and access along Water Canyon Road and on the ridgetop;
- Protection for sensitive species in the project area, particularly the federally listed Mexican spotted owl (MSO), but also other rare and sensitive species;
- Fire hazards; and
- Dust and air quality.

Affected Environment and Environmental Consequences

The following paragraphs summarize the affected environment and environmental consequences for each resource analyzed in the Final EIS. See Tables S-5 and S-6 for a more detailed comparison of the alternatives. See Table S-7 for mitigation measures.

Geology and Soils

The project area, most of which is above about 10,000 feet (3,050 m) in elevation, lies within a cluster of five large overlapping calderas formed from volcanoes that emitted great quantities of ash before collapsing. The bedrock geology consists primarily of rhyolite and multiple volcanic flows of densely welded ash. Intracaldera successions of rhyolite ash-flow tuff, several thousand feet thick, underlie the crest of the range at South Baldy Peak. Locally derived alluvial gravels and sandstones (the Popotosa formation) shed from the tilted volcanic strata, then filled in structural depressions above the evolving fault blocks. The volcanic bedrock and the Popotosa formation around South Baldy Peak form the primary aquifers that could serve as water sources in the area.

Most soils in the project area are well drained and formed from residual materials derived primarily from igneous rock. None are hydric soils. Approximately 27 percent of the soils are highly erodible if left bare. Approximately 53 percent have a high probability of moving as a mass from one place to another under the force of gravity, and 22 percent have a moderate probability of doing so. Approximately 73 percent of the soil types in the project area have severe limitations that may cause problems for construction and maintenance of unsurfaced roads. Almost 70 percent of the soils offer a low probability of successful reseeding efforts, and 30 percent offer a moderate probability of doing so. More than 99 percent of the soil is rated as poor for topsoil, approximately 77 percent of the soils would be poor road fill, and 23 percent would be fair.

Alternative 1 would involve the most ground disturbance and Alternative 2 the least ground disturbance.

Water Resources

The CNF is located within the Middle Rio Grande watershed, which covers nearly 12,000 square miles (31,080 square kilometers). Many arroyos drain the Magdalena Mountains but none contain permanent streamflow. There are several canyon creeks in the project area including Water Canyon Creek, Hardy Canyon Creek, Bear Canyon Creek, and the East and West Forks of Sawmill Canyon Creek. The creeks, tributary to the Rio Grande, are primarily ephemeral and flow mostly in response to snowmelt and storm runoff. Flash floods are common during and following summer thunderstorms. Some reaches of the creeks flow intermittently and are fed by geologically controlled springs.

The springs in Water Canyon have the highest yields of those measured. All water tests indicated an alkaline (basic) pH. There are several springs located adjacent to the ridgetop. The closest spring is Baldy Spring located only 600 feet (182 m) lower than the elevation of the proposed MRO. This spring, however, is intermittent.

One stream that is perennial is the East Fork of Sawmill Canyon Creek, which is the source of a seasonal, potable water supply for the facilities at Langmuir Laboratory.

Current state authorized water use by Langmuir Laboratory is 84,375 gpy. Existing water storage tanks at the Laboratory can hold 80,000 gallons for both potable and fire suppression purposes. Historically, reliable water sources have been in short supply in the upper reaches of the Magdalena Mountains. Science facilities that have occupied these ridges and peaks south of South Baldy for the past 4 or 5 decades have relied upon local intermittent streams and upper slope runoff to supply their potable water needs.

Riparian areas include Bear Springs/Bear Canyon, Sawmill Canyon, Smith Canyon, and Agua Fria. The existing condition was reported as unsatisfactory for the major riparian areas, Water Canyon, and the East Fork of Sawmill Canyon Creek. However, the many small riparian areas include stream reaches less than a mile long, springs and seeps, and wet meadows that are important for vegetation and wildlife.

A recent site survey found no significant floodplains or wetlands in the 1,000-acre Langmuir site (defined in the SUP). A wetland determination in the bottom of the East Fork of Sawmill Canyon in the vicinity of the existing diversion for Langmuir Laboratory found that the species of plants in this riparian strip did not meet the U.S. Army Corps of Engineers (USACE) criteria for hydrophytic vegetation for a wetland.

Increases in water consumption would be the same for Alternatives 1, 3, and 4. Under Utility Options 2 and 3, any water demand beyond the state authorize use of 84,375 gpy from East Sawmill Canyon Creek would be met by hauling water to the site. Alternative 2 would have no increase in water consumption. No change in water quality is expected under any alternative.

Air Quality

The majority of air pollution affecting the CNF originates from other areas, primarily metropolitan areas and, to a lesser extent, unpaved roads and farming operations. Some temporary and localized pollution results from prescribed burning and wildfires in the CNF, other federal, and private lands. Socorro County is designated as in attainment for all criteria pollutants. Based on monitoring data collected since 1997, the U.S. Environmental Protection Agency (USEPA) projects that the entire State of New Mexico will be in attainment of the new 8-hour ozone (O_3) and particulate matter 2.5 microns or less ($PM_{2.5}$) National Ambient Air Quality Standards (NAAQS) when designations are made in 2004 or 2005.

The nonattainment areas nearest to the proposed MRO boundary are more than 155 miles (250 km) away and the closest maintenance area, Albuquerque, New Mexico, is approximately 80 miles (130 km) northeast of the proposed MRO site.

There are seven Class I areas located within 155 miles (250 km) of the project boundary. The closest is Bosque del Apache National Wildlife Refuge, in Socorro County, approximately 20 miles (30 km) southeast of the proposed MRO boundary. All the other Class I areas are about 80 miles (130 km) or farther from the proposed MRO boundary.

In April 2000, the USFWS began an air quality program at the Bosque del Apache National Wildlife Refuge. The monitoring program includes sampler monitors for PM_{10} and $PM_{2.5}$. The sampler has not recorded an exceedance of either particulate matter NAAQS since it began operation.

There are relatively few major stationary emission sources in the region within 60 miles (100 km) of the proposed MRO site, with the closest being the Dicaperl/Socorro Perlite Plant, about 20 miles (32 km) away.

Baseline emissions at the existing Langmuir Research Site are from vehicular traffic and other routine activities, including stationary sources (e.g., propane heaters and ranges, diesel generators), rocket launches, personal vehicle traffic and mobile heavy equipment (e.g., cranes, dozers, graders, heavy trucks, and forklifts). Each of these sources is expected to be less than 0.1 tons per year (TPY) for each criteria pollutant.

Alternative 1 would generate the most air pollutant emissions and Alternative 2 the least. Air pollutant emissions under Alternative 3 and 4 would be slightly less than Alternative 1. All alternatives would be in compliance with NAAQS.

Noise

Current noise levels in the project area result from human presence and ambient background noise. For the most part, the surrounding forest is quiet. The greatest source of intrusive noise probably results from vehicular traffic along Water Canyon Road and other more dispersed human activities. The road between Water Canyon and Langmuir Laboratory is used by laboratory staff, the public (for recreational access), the Forest Service (for management activities), and by others for limited purposes such as woodcutting and grazing operations. Vehicles mostly include a spectrum of light four-by-four trucks, some passenger cars, all-terrain vehicles, and occasional large trucks. A general estimate of 20 vehicle trips occur on the road each day, with surges on weekends and holidays. Given this use, the U.S. Department of Transportation's (USDOT) computer program STAMINA model calculated equivalent noise levels averaged over 24 hour ($L_{eq(24)}$) along Water Canyon Road to be 35.2 A-weighted decibels (dBA) at a distance of about 100 feet (30 m) from the road. This time-averaged level is very low and not appreciably higher than background levels, thus reflecting the low level of use.

Daily activities at Langmuir Laboratory contribute to very localized noise on the ridgetop, mostly from operating diesel generators and support equipment, and from occasional use of heavy earthmoving equipment. These types of equipment produce sound levels of about 63 dBA at a distance of 125 feet (38 m) when operating at idle. Noise levels range from about 78 to 91 dBA at this distance when equipment is operating under a heavy load. Using this information and hypothetical zones of activity, 24-hour average noise levels of 54.8 dBA and above could affect areas within 100 feet (30 m) of equipment operating areas. However, these are fairly small areas, few in number, and dispersed throughout the entire ridgetop, which comprises several hundred acres.

Noise generated would be the same under Alternatives 1, 3, and 4. Alternative 2 would not include proposed MRO construction noise.

Fire Management

Typical of conditions throughout the MRD, the stands of trees within the project area are much more dense than they were before European settlement. Heavy cattle grazing at the turn of the century, combined with fire suppression, have increased the average number of trees per acre in ponderosa pine forests from as few as 23 to as many as 851 trees per acre today. As a result of these dense conditions and lack of fire, many stands within the analysis area have very little vegetation in the understory. Litter and duff layers are thick, and fuel loading is very high in many stands. Lightning-caused wildfires in the Southwest are growing larger and larger over time, with some fires involving 10,000 to 20,000 acres, in contrast to the 3,000-acre surface fires of presettlement times. With the current drought throughout the southwest and vegetative conditions as described throughout the MRD, the project area and surrounding areas have a high risk for fire under the right circumstances (i.e., an ignition source, wind, or low moisture content).

The potential for increased fire risk would be the same for Alternatives 1, 3, and 4 and less for Alternative 2.

Transportation

The primary access route to the proposed project site involves two interchanges in Socorro with Interstate 25 (I-25), a short portion of U.S. Highway 85 (US 85) in Socorro, Highway 1 in Socorro (locally known as California Street), and US 60 from Socorro to Water Canyon Road.

US 60, maintained by the New Mexico State Highway and Transportation Department (NMSHTD), intersects Water Canyon Road (FR 235), the only access road to the project area, approximately 28 miles (45 km) west of Socorro. The lower portion of Water Canyon Road from the US 60 interchange to the campground is paved and is generally in fair condition up to the first main stream crossing at the Water Canyon Campground. The upper portion of the road, extending southeast to the ridgeline, is unimproved from the campground to the project site. This stretch of road varies in width and condition. The Forest Service requires that this route remain the sole vehicular access route to South Baldy Peak and that the roadway remain a “primitive” corridor (Level 2, road suitable for high-clearance vehicles), with improvements limited to those necessary to provide a reasonable level of “life safety.” The MRD estimates that traffic on this road averages about 20 round trips daily, with more on weekends and holidays and less at other times.

Traffic increases would be the same under Alternatives 1, 3, and 4. Alternative 2 would involve less traffic on Water Canyon Road than the other alternatives.

Vegetation

The proposed MRO project area covers approximately 980 acres and includes eight major plant community types, though three of these predominate. The largest habitat type, covering 45 percent of the project area, is mixed conifer forest (consisting predominantly of Douglas fir, southwestern white pine, ponderosa pine and quaking aspen). Water Canyon Road passes through each of the major plant communities, including the mixed conifer forest. The next largest type is the mountain meadow on the ridgetop. It covers about 28 percent of the project area and consists predominantly of scattered mixed conifers and a variety of grasses including sedge, fescue, and junegrass. Subalpine conifer forest (Rocky Mountain maple, quaking aspen, Engelmann spruce, white pine, and Douglas fir) covers about 17 percent of the project area adjacent to the crest of the mountain on the east-facing slope. The rest of the project area (about 11 percent) is divided among piñon-juniper woodlands, oak woodlands, ponderosa pine forest, and mountain scrub.

There are no wetlands in or near the potentially affected areas. Invasive weeds appear to be only a minor problem along Water Canyon Road and on top of the mountain. Very few invasive weeds are found along the existing utility corridor.

A total of 37 special status plant species (federally listed species, Forest Service sensitive species, or state sensitive species) occur or have the potential to occur in the proposed MRO project area. Of the 13 federally listed plant species, only nine are known from Socorro County and occupy habitats that are similar to those found in the project area. Of these, only three have been found in or near the project area. The Black Range groundsel has been found on a talus slope at about 9,920 feet (3,024 m). The Sandia alumroot has been found in five locations near the project area on rock outcrops and cliffs near the top of the mountain. The San Mateo beardtongue is a common species on the mountaintop as well as in open areas in the subalpine coniferous forest near the grasslands. It also occurs along the upper reaches of Water Canyon Road and in the subalpine conifer and mixed conifer forests along the upper section of the utility corridor.

Alternative 1 would involve the largest amount of vegetation loss. Vegetation loss would be slightly less under Alternatives 3 and 4. Alternative 2 would not involve additional vegetation loss on the ridgetop and from utility improvements.

Wildlife

All of the 16 species of reptiles detected during field surveys were observed along Water Canyon Road. Only four species of reptiles were detected on or near the top of the mountain in the project area.

A total of 200 species of birds have been recorded from the MRD, an area whose flora and fauna is a combination of Rocky Mountain and Madrean influences. A total of 95 birds have been observed in the mountaintop mountain meadow and conifer forests in the project area. A number of bird species have been detected along Water Canyon Road. Although breeding bird surveys have not been conducted along the existing utility corridor, it is expected that species recorded elsewhere in the project area would also occur in this area. In all areas, birds of prey have been observed including the red-tailed hawk, American kestrel, Cooper’s hawk and a golden eagle. The peregrine falcon and MSO are discussed below with other special status species.

Fifteen priority neotropical migratory bird species have the potential to occur in the project area. The largest number of these species has the potential to occur in ponderosa pine forest, followed by mixed conifer forest and piñon-juniper woodlands. Eight priority bird species have been found in conifer forests in the vicinity of the project area and are likely to occur within or near some of the project features.

Twenty-eight species of mammals have been detected on top of the mountain and along Water Canyon Road. The highest diversity of mammals (26 species) has been observed along Water Canyon Road. Only seven species have been recorded on top of the mountain. Elk and mule deer use the Magdalena Mountains year-round at the lower reaches of Water Canyon where browse shrubs such as Gambel oak, New Mexico locust, and mountain mahogany are common. Signs of other large mammals, such the porcupine, bobcat, mountain lion, gray fox, and coyote, have been observed in the project area. Although the presence of black bear was not detected during survey of the project area, it is known to occur in the MRD.

Of the 15 Management Indicator Species (MIS) that have been identified for the CNF, eight occur in the project area. Elk, mule deer, and black bear are mentioned above. The juniper titmouse, red-breasted nuthatch, pygmy nuthatch, Merriam's turkey, and hairy woodpecker have all been observed in the project area.

Of the 24 special status animal species that occur or have the potential to occur in the Magdalena Mountains, none of the aquatic species (fish, amphibians, springtail) actually do occur in the project area due to the lack of aquatic habitat. The American peregrine falcon is a known breeding species in the MRD that breeds on the cliffs near lower Water Canyon Road. The bald eagle and the loggerhead shrike have both been observed in the MRD. The northern goshawk is considered a breeding species in the MRD. However, no goshawk nests have been observed in the Magdalena Mountains.

The MSO is a breeding species in the Magdalena Mountains. Two MSO Protected Activity Centers (PAC) occur in the project area. Water Canyon Road runs through the edge of the Timber Peak PAC and part of the project area extends into the Baldy Spring PAC. In addition, other parts of Water Canyon Road and the utility corridor pass through MSO protected and restricted habitat. MSOs have been detected in the two PACs in recent years.

Modification to wildlife habitat, including threatened and endangered species, would be the similar under Alternatives 1, 3, and 4 and less under Alternative 2.

Rangelands

The rangelands within the project area are within two grazing allotments, Baldy Allotment and Muleshoe Allotment. Combined, these allotments provide grazing on about 45,000 acres and support about 293 cow/calf pairs. The elevation of the allotments ranges from 6,500 feet (1,981 m) to over 10,000 feet (3,050 m). The Baldy Allotment consists primarily of high ridges separated by steep-walled canyons, while the Muleshoe Allotment varies from flat terrain to areas of moderate and steep relief. The condition of the vegetation in these areas ranges from poor in riparian and piñon-juniper woodlands, to fair in ponderosa and subalpine conifer forest and mountain meadows. The project area on the ridgetop is primarily within this latter vegetation type and is considered full-capacity range on an upward trend in terms of its condition. This is all within the South Baldy pasture in the Baldy Allotment. Much of the land in the allotments is mountainous and does not support high levels of grazing. The portions of Muleshoe Allotment in the project area are non-capacity range and do not support grazing.

Alternatives 1, 3, and 4 would involve a decrease in Animal Unit Months (AUMs) in one grazing allotment while Alternative 2 would involve no change in AUMs.

Lands and Realty

The project site and most of the land in the vicinity is located on federal land administered by the Forest Service. Included within the area administered by the Forest Service are private lands, mineral patents, and lands administered by other agencies. Some of these lands have been developed with buildings and/or other facilities. Additionally, utility and communication facilities, residences, concessions, and rights-of-way are authorized by the Forest Service under SUPs. Private land and other federal agency inholdings within the area of potential project activities are located both along

Water Canyon Road and in the vicinity of the proposed utility corridors. Additionally, two mineral withdrawals are currently located in the project area, 960 acres located in the Langmuir Principle Research Facility and 95 acres in the Water Canyon Campground.

The proposed project area falls within four Management Areas designated by the CNF: Areas 7, 12, 13, and 16. Each area is managed to preserve the unique characteristics of that specific area. The majority of the project activities fall within Management Area 7, which is coincident with the Langmuir Research Site.

The 30,606-acre Langmuir Research Site was established in 1980 to encourage scientific research into atmospheric processes and astronomical phenomena. The area is managed consistent with the requirements of the National Forest Management Act of 1976 (Public Law 94-558) (16 U.S.C. 1604) under a SUP from the Forest Service. Dispersed recreation, grazing, and other uses which are determined to be compatible with scientific research are also permitted within the Langmuir Research Site. Roads are limited in the area and motor vehicle use is restricted to those roads.

The Langmuir Laboratory SUP would be amended under Alternatives 1, 3, and 4, and would remain the same under Alternative 2.

Visual Resources

Visual areas of influence for the project area include Magdalena Ridge, Water Canyon Road, and surrounding areas with views of the proposed construction areas, including US 60, Highway 107, forest roads, and trails in the vicinity. The Magdalena Mountains are one of the key visual elements in the landscape for the residents of the Village of Magdalena and the Town of Socorro, the Alamo Navajo tribe, local ranchers, highway travelers, and visitors to the area. The visual quality of the mountains has been altered to varying degrees from its original state by timber harvest, road construction, farming, vegetation manipulation, mineral exploration and production, and utility corridors.

To address the visual quality and aesthetics in the CNF, each Ranger District used the 1974 Visual Management System (VMS) to analyze the visual conditions of the CNF and to establish VQO ratings, based on the scenic quality of value of a given area. The VQO ratings define the degrees of acceptable alteration of the area.

A number of long standing structures and facilities exist within the Langmuir Research Site in the vicinity of the project area south of South Baldy Peak. The existing structures have limited visual impact on vantage points from surrounding areas. The existing facilities within the construction area were constructed prior to the implementation of the VMS. Notwithstanding, the area has a fairly restrictive classification of Partial Retention, which is inconsistent with actual conditions in the Langmuir Research Site. The existing Forest Plan does, however, make special allowances for structures required for research purposes as designated in the SUP.

Water Canyon Road and the existing utility corridors have a minimal visual impact on the area but are consistent with management direction for those areas.

VQOs would remain the same under all alternatives. Ridgetop facilities would be less visible under Alternatives 3 and 4 than under Alternative 1.

Recreation

Dispersed recreation accounts for the largest amount of recreation activity in the CNF and is projected to be the fastest growing segment in the future. Several types of dispersed recreation currently take place throughout the year in the Magdalena Mountains, which include the Langmuir Research Site and proposed project site. Recreational activities include hunting, camping, hiking, horseback riding, cross-county skiing, all-terrain vehicle use (ATV), picnicking, biking, auto touring, sightseeing, wildlife viewing, and gathering of forest products. Off-road vehicles are only permitted on existing roadways within the Langmuir Research Site boundary.

The primary recreation resources in and around the project area include the following: Water Canyon Road, Magdalena Ridge (including the existing laboratory facilities), Water Canyon Campground, various trails and trailheads leading through the numerous canyons, mountain tops and ridges, and supporting infrastructure including parking areas, signage, and interpretive displays. There are no WAs or Research Natural Areas (RNA) in the immediate vicinity of the project area.

Alternatives 1, 3, and 4 would have temporary limitations in access during construction. Alternative 2 would have no change in access.

Minerals

The project has no current mining activity although historically there has been mining activity in the area. Past mining districts in the general area include Water Canyon, Hop Canyon and Mill Canyon districts. Mining began in the 1890s, continuing sporadically until the 1930s. Mines produced gold, silver, copper, and lead. Water Canyon was the most active of the three, producing 1,161 tons of ore.

There is low to moderate potential for locatable minerals in the project area. Past mining activity in the general area indicates there may be favorable conditions for metallic mineral deposits. There is low potential for leasables (oil and gas), and no known geothermal potential. The area has an abundant supply of salable minerals (mostly sand and gravel). However, very poor access, similar materials widely available elsewhere, and great distances to markets indicate a very low potential for development of suitable minerals.

There would be no change in mineral access due to the proposed MRO under any of the alternatives.

Heritage and Cultural Resources

Human occupation of the region is known to date back at least 11,000 years, the earliest known inhabitants being small bands of mobile hunter-gatherers. By about 1,100 years ago, pueblo villages were developed and spread into previously unoccupied areas along major drainages. About 900 years ago, people started gathering in larger, planned communities and developing water-control devices. In the 1540s, the Spanish encountered traveling bands of hunter-gatherers and found occupied pueblos along the Rio Grande. More recently (in the 1880s), ranchers and miners settled the area. With the coming of the railhead, ores and cattle could be shipped to markets. The nearby town of Magdalena was a prosperous mining community from the 1880s until 1925.

Many tribal and pueblo groups in the area today can be traced within the history of the region, including the Zuni, Acoma, and Hopi pueblos and the Navajo and Mescalero Apache tribes. The CNF has been consulting with eight tribes and pueblos on this project who may have used or continue to use the MRD for traditional cultural or religious activities. The primary concerns of these groups are focused on South Baldy Peak, which is considered a sacred site or traditional cultural property by some groups. Others are interested in maintaining access for various traditional uses (such as gathering special plants) and other religious practices. Consultation with the interested tribes on this project by the Forest Service is ongoing.

Previous archaeological inventories of the project area and a recent survey have been completed, and only three recorded archaeological sites are identified with the project area. All three sites have been determined not eligible for the National Register of Historic Places. Compliance with Section 106 of the National Historic Preservation Act (NHPA), including the State Historic Preservation Office consultation, has been completed by the Forest Service.

There would be no impact to identified heritage and cultural resource sites under any of the alternatives. Access for traditional cultural or religious activities would be modified under Alternative 1, 3, and 4 during construction but not under Alternative 2.

Human Health and Safety

The existing Langmuir Laboratory supports current day-to-day operations of a scientific and general maintenance nature. Tasks and responsibilities are performed in accordance with federal and state occupational safety and health requirements. Small quantities of solvents and cleaners are stored and used at the facility. The site also operates under the management framework of the existing Langmuir Laboratory SUP and an Annual Operations and Maintenance Plan that describes planned actions for any given year.

Access to the site is by means of Water Canyon Road. The road is classified to serve high-clearance vehicles and is steep, narrow, winding in places, and native-surfaced for most of this distance. Remoteness contributes to concerns about fire and emergency response. From 1975 to 1994, there have been 131 fires in the CNF within the Magdalena Mountains, mostly small in extent. However, by most accounts, the current fuel loads and drought conditions increase the risk of wildfires.

Communications from the ridgetop are by radio. There are some communication “dead spots” in the area, which is a concern for fire and other safety issues. In emergencies, NMIMT security police are contacted (a connection that is generally reliable) and they dispatch whatever services are needed. Travel time from Socorro is at least 45 minutes.

Abandoned mine shafts are a local safety risk in the surrounding forest. Also, health concerns in the area involve the potential presence of bloodborne pathogens, plague, and Hanta Virus. No cases of plague have been identified in the project area.

Construction activities would slightly increase safety risks under Alternative 1, 3, and 4. There would be no increase in safety risks under Alternative 2. Maintenance and repair on Water Canyon Road would decrease safety risks under all alternatives.

Socioeconomics

The geographic area most directly affected by the proposed MRO action is encompassed within Socorro County, New Mexico. The affected region can be characterized as rural in nature. The communities most impacted by the alternatives are the Village of Magdalena and the City of Socorro. Economic effects may extend to a wider region of Socorro County. Since it is difficult to predict where materials and services for the construction would be purchased, the State of New Mexico is the broadest area considered.

The City of Socorro (population 8,986 in the year 2000) and the Village of Magdalena (population 940 in the year 2000) grew at a much slower pace over the past decade (1990 to 2000) than the state and the county populations. In both towns, large Hispanic populations constitute the majority. The county population as a whole has a significant Native American component. Both towns also have high poverty rates when compared to the state level of 18 percent. The City of Socorro is at or above 30 percent while Village of Magdalena has a slightly lower rate of 25 percent.

The labor force for Socorro County has remained fairly stable over the past decade (1990 to 2000). The average unemployment rate for the 10-year period is 7.1 percent. The profile of employment by the major industrial sector from 1997 to 2000 indicates a heavy reliance on government employment in Socorro County. Public sector jobs account for over a third of total employment and lead the second largest sector, services, by two percentage points. Rounding out the top three industrial sectors is retail trade with 14 percent of total employment. The per capita income average for 2000 was $15,352.

Alternative 1, 3, and 4 would potentially increase local job opportunities. There would be no change under Alternative 2.

Environmental Justice

Census tract analysis of the project area and surrounding census tracts (within Socorro County) reveals several locations of high minority concentration and high poverty levels. The minority population includes a high portion of Native Americans and Hispanics.

None of the alternatives would create disproportionately high or adverse human health of environmental impacts on minority and low-income populations.

Comparison of Alternatives

Table S-5 compares the key features of the alternatives. **Table S-6** summarizes and compares the environmental impacts among the four alternatives. **Table S-7** lists identified mitigation measures and any associated monitoring.

Implementation monitoring would be employed to ensure that the mitigation measure was completed. Effectiveness monitoring would be used to assess whether the measure was effective in achieving the desired result. Validation monitoring would be used to determine whether the Forest Service practices, requirements standards, or guidelines are appropriate or should be modified.

Table S-5. Comparison of Alternatives

Identified Activities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Facility Locations [1]				
7.9-ft (2.4-m) Telescope	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak	Not applicable	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak
7.9-ft (2.4-m) Telescope Support Building	Not applicable	Not applicable	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak
Interferometer Array	Majority on west side of Water Canyon Road 4,637 ft (1,414 m) south of South Baldy Peak	Not applicable	Majority on west side of Water Canyon Road 4,637 ft (1,414 m) south of South Baldy Peak	Majority on west side of Water Canyon Road 4,637 ft (1,414 m) south of South Baldy Peak
Interferometer Support Facility	4,136 ft (1,261 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	Not applicable	4,136 ft (1,261 m) west side of Water Canyon Road, south of South Baldy Peak
Beam Combining and Delay Building	4,834 ft (1,447 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,834 ft (1,447 m) west side of Water Canyon Road, south of South Baldy Peak	4,834 ft (1,447 m) west side of Water Canyon Road, south of South Baldy Peak
Large Telescope Pair	4,195 ft (1,279 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,195 ft (1,279 m) west side of Water Canyon Road, south of South Baldy Peak	4,195 ft (1,279 m) west side of Water Canyon Road, south of South Baldy Peak
Operation Center	2,214 ft (675 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,598 ft (1,097 m) east side of Water Canyon Road, south of South Baldy Peak	1,548 ft (472 m) east side of Water Canyon Road, south of South Baldy Peak
Site Characterization Facility	4,641 ft (1,415 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,641 ft (1,415 m) west side of Water Canyon Road, south of South Baldy Peak	4,641 ft (1,415 m) west side of Water Canyon Road, south of South Baldy Peak
Electric Sub Station	2,483 ft (757 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,834 ft (1,169 m) east side of Water Canyon Road, south of South Baldy Peak	1,909 ft (582 m) east side of Water Canyon Road, south of South Baldy Peak

Identified Activities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Storage Facility	4,251 ft (1,296 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,251 ft (1296 m) west side of Water Canyon Road, south of South Baldy Peak	4,251 ft (1,296 m) west side of Water Canyon Road, south of South Baldy Peak
Temporary Structure	1,997 ft (609 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,398 ft (1,036 m) west side of Water Canyon Road, south of South Baldy Peak	1,817 ft (554 m) west side of Water Canyon Road, south of South Baldy Peak
Water Storage Tanks	1,938 ft (591 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,460 ft (1,055 m) west side of Water Canyon Road, south of South Baldy Peak	2,000 ft (610 m) east side of Water Canyon Road, south of South Baldy Peak
Electrical Backup Buildings (Liquid Fuel Bld., Water Pump Bld. and Generator Bld.)	2,483 ft (757 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,834 ft (1,169 m) east side of Water Canyon Road, south of South Baldy Peak	1,909 ft (582 m) east side of Water Canyon Road, south of South Baldy Peak
Avalanche Winch and Cable	924 ft (282 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	924 ft (282 m) west side of Water Canyon Road, south of South Baldy Peak	924 ft (282 m) west side of Water Canyon Road, south of South Baldy Peak
Utilities				
Alignment Option 1	X	Not applicable	X	X
Alignment Option 2	X	Not applicable	X	X
Alignment Option 3	X	Not applicable	X	X
Roads				
Road Maintenance and Repair	Ongoing as identified in the existing Langmuir Laboratory SUP	Ongoing as identified in the existing Langmuir Laboratory SUP	Ongoing as identified in the existing Langmuir Laboratory SUP	Ongoing as identified in the existing Langmuir Laboratory SUP
Road Realignment	1 mile (1.6 km)	0 miles (0 km)	1 mile (1.6 km)	1 mile (1.6 km)

Identified Activities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Significant Issues				
Issue 1 – Ground Disturbance **Units of Measure** – Acres of ground disturbance	47.41 acres	24 acres	47.14 acres	47.18 acres
Issue 2 – Changes in Visual Quality **Units of Measure** – Change in VQO percentages	Partial (75% of the area) Modified (25% of the area)	Partial (75% of the area) Modified (25% of the area	Partial (75% of the area) Modified (25% of the area)	Partial (75% of the area) Modified (25% of the area)

Notes: (1) All distances are approximate
SUP = Special Use Permit
km = kilometers
ft = feet
m = meters
VQO = Visual Quality Objective

Table S-6. Comparison of Environmental Impacts by Alternative

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Geology and Soils				
Direct Impacts				
Ridgetop	Estimated 23.41 acres of ground disturbance, including utilities. Erosion would be minimal.	No additional ground disturbance.	Estimated 23.14 acres of ground disturbance, including utilities. Erosion would be minimal.	Estimated 23.18 acres of ground disturbance, including utilities. Erosion would be minimal.
Utility Options	Options 2 and 3 require less trenching than Option 1.	No trenching.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Maintenance and repair will continue to decrease erosion.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Minimal potential for sedimentation.	No additional sedimentation.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Cumulative impacts would be minimal.	No cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Resources				
Direct Impacts				
Ridgetop	Water quality impacts from proposed MRO construction expected to be insignificant.	No impacts from proposed MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Option 1 would increase water use from Hardy Spring. Under Options 2 and 3, any water demand beyond the state authorize use of 84,375 gpy from East Sawmill Canyon Creek would be met by hauling water to the site.	No increase in water use.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Maintenance and repair will have minimal impact on drainage.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Minimal impacts on vegetation, riparian areas, and other water users.	No change to vegetation, riparian areas, or other water users with respect to water quality and quantity.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumulative Impacts	Cumulative impacts would be minimized with implementation of mitigation measures.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Air Quality				
Direct Impacts				
Ridgetop	Air emissions during construction would be temporary and cease with completion of construction activities. As a high estimate, construction-related emissions in the first year are estimated to be 24.6 tons of carbon monixide (CO), 5.0 tons of organic compounds (VOC), 52.0 tons of nitrogen oxides (NO_x), less than a ton of sulfur oxides (SO_x), and 10.2 tons of PM_{10}. When fully operational, operation emissions are estimated to be 4.9 TPY of CO, 3.6 TPY of VOCs, 0.5 TPY of $NO_{x,}$ and less than 0.1 TPY of SO_x and $PM_{10.}$	No increase in air pollutant emissions due to the proposed MRO.	Construction-related air emissions would be slightly less than under Alternative 1. Operations emissions would be the same as under Alternative 1.	Construction-related air emissions would be slightly less than under Alternative 1 and marginally greater than Alternative 3. Operations emissions would be the same as under Alternative 1.
Utility Options	There would be no air pollutant emissions associated with the utility options.	No air pollutant emissions due to the proposed MRO.	There would be no air pollutant emissions associated with the utility options.	There would be no air pollutant emissions associated with the utility options.
Water Canyon Road	Maintenance and construction of Water Canyon Road would generate 0.2 TPY of VOCs and NO_x and less than 0.1 TPY of CO, SO_x, and PM_{10}.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	The increase in visitors to Magdalena Ridge would result in an estimated increase of 0.3 TPY of CO and less than 0.1 TPY of other pollutants	No increase in indirect air emissions due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumulative Impacts	Minor increase in fire risk from additional traffic could result in temporary decrease in air quality and visibility from fire.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Noise				
Direct Impacts				
Ridgetop	Facility construction is estimated to generate 8-hour L_{eq} of about 60 dBA at a distance of 100 feet (30 meters) from the construction location.	No additional noise generated by MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Minimal, short-term elevated noise levels would occur during installation of the utility lines.	No additional noise generated by utility line construction.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Vehicular traffic during construction would generate a 24-hour L_{eq} of about 41 dBA and 1-hour L_{eq} of about 55 dBA at a distance of 100 feet (30 meters) from the road. Noise levels from road maintenance and repair would have a 24-hour L_{eq} of 60 dBA and peak 1-hour L_{eq} of about 73-74 dBA at a distance of 100 feet (30 meters) from the road.	No construction related noise due to the proposed MRO. Noise levels from road maintenance and repair would be the same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Noise generated by MRO could indirectly affect wildlife and recreationists.	No additional impact from the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Noise events associated with MRO activities would contribute to cumulative impacts from other noise events such as periodic and intermittent blasting at NMIMT's Energetic Materials Research and Testing Center.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Fire Management				
Direct Impacts				
Ridgetop	A construction phase fire plan tiered to the CNF fire restrictions would minimize increased fire risk from construction.	No increased fire risk from proposed MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	None of the utility options would affect fire management.	No impact due to the proposed MRO.	No impact due to MRO.	No impact due to MRO.
Water Canyon Road	Additional traffic and repair and maintenance activities have the potential to increase the risk of human-caused fires.	No increase in traffic due to the proposed MRO. Repair and maintenance activities have the potential to increase the risk of human-caused fires.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Increase in fire risk could indirectly affect vegetation and wildlife resources.	No indirect impacts from the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Combined increases in traffic and human activity would generally increase the potential for human-caused fires.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Transportation				
Direct Impacts				
Ridgetop	About 1 mile (1.6 km) of new access road and new parking lots would be constructed. Construction is not expected to disrupt existing operations or significantly impact recreation access. Stage I construction is estimated to generate 12,800 additional round trips. Operational phase expected to generate fewer than 5 additional trips per day.	No change in transportation due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	Utility corridor would not alter road transportation or vehicle access.	No change due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Road maintenance and repair will allow for safer and more efficient use of the road.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO may attract additional visitors and increase traffic to Magdalena Ridge.	No change due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO improvements would add to benefit of expanded parking planned at Trailhead 8.	No new cumulative impact due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Vegetation				
Direct Impacts				
Ridgetop	About 23.41 acres of mountain meadow and San Mateo beardtongue habitat would be disturbed by construction and approximately 7 acres would be permanently lost to development.	No disturbance or loss of grasslands and San Mateo beardtongue habitat due to the proposed MRO.	About 23.14 acres of mountain meadow and San Mateo beardtongue habitat would be disturbed by construction. Land permanently lost to development would be about 3,200 sf less than Alternative 1.	About 23.18 acres of mountain meadow and San Mateo beardtongue habitat would be disturbed by construction. Land permanently lost to development would be about 1,500 sf less than Alternative 1.
Utility Options	Little to no disturbance of vegetation from Options 2 and 3. Option 1 trenching would disturb less than half an acre.	No additional disturbance of vegetation due to the proposed MRO.	Same as Alternative 1	Same as Alternative 1
Water Canyon Road	Up to 12 acres of vegetation could be disturbed by road maintenance and repair.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Indirect Impacts	Fires started by construction equipment could spread and affect the San Mateo beardtongue, a Forest Service Sensitive and state Rare species.	No additional fire risk associated with the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumulative Impacts	MRO development would add to combined long- and short-term loss of 8.8 percent of the subalpine plant community on the top of Magdalena Mountain.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1	Same as Alternative 1
Wildlife				
Direct Impacts				
Ridgetop	Minor impacts to neotropical migratory birds, other bird species of concern, MIS, and special status species, including the threatened MSO due to ground disturbance. No direct loss of MSO PAC. There would be a small reduction in elk habitat. Mountain meadow habitat would be reduced by 7 acres.	No change due to the proposed MRO.	Impacts from ground disturbance slightly less than Alternative 1.	Impacts from ground disturbance slightly less than Alternative 1 and marginally greater than Alternative 3.
Utility Options	Implementation of any Utility Option would have minimal impact to neotropical migratory birds, other bird species of concern, MIS, and special status species. Option 2 would cross the Baldy Spring MSO PAC, but surface laying of pipes is not expected disturb MSO habitat.	No change due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Potential loss of 12 acres of forested land along Water Canyon Road due to maintenance and repair would have minimal impact on neotropical migratory birds, other bird species of concern, and MIS. Impacts to the MSO in the Timber Peak PAC from maintenance and repair of Water Canyon Road would be mitigated by avoiding sensitive times and breeding months for the MSO.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	No indirect loss of wildlife habitat is expected. Noise from construction equipment and activities could result in bird movement and/or reduced breeding success within 100 feet of construction sites and Water Canyon Road. Noise associated with ridgetop construction would likely reduce elk use during daylight hours. MSO use of areas within 100-125 feet (30-38 meters) of Water Canyon Road may be temporarily reduced along a 2,000-foot (600 meter) stretch of the road.	No change in habitat or noise effects due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO development in combination with existing development on Magdalena Ridge would result in loss of about 10 acres of mountain meadow in the project area, a reduction of less than 2 percent.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Rangelands				
Direct Impacts				
Ridgetop	MRO development would result in a short-term reduction of 24 acres of grazing allotment, equivalent to 3 AUMs, and long-term loss of 13 acres, equivalent to less than 2 AUMs.	No change in grazing allotment or AUMs due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Utility Options would have no effect on rangelands.	No effect on rangelands from the proposed MRO.	Utility Options would have no effect on rangelands.	Utility Options would have no effect on rangelands.
Water Canyon Road	Road maintenance and repair could result in long-termreduction of 6 acres of grazing allotment.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	Road closures during maintenance and repair of Water Canyon Road could temporarily inconvenience grazing permitees.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO development would contribute minimally to cumulative decreases in available rangeland habitat.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Lands and Realty				
Direct Impacts				
Ridgetop	MRO development would convert approximately 13 acres of undeveloped land to development.	No conversion of undeveloped land due to the proposed MRO.	Conversion of undeveloped land would be slightly less than Alternative 1.	Conversion of undeveloped land would be slightly less than Alternative 1 and marginally more than Alternative 3.
Utility Options	Options 1 and 3 would be located in existing utility corridors. Option 2 would change approximately half an acre to utility easement.	No change in land use or realty due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	The Forest Service will seek to obtain a right-of-way for the portion of Water Canyon Road that passes through private land.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO development is not expected to have any indirect impact on land use or realty.	No indirect impact due to the proposed MRO.	MRO development is not expected to have any indirect impact on land use or realty.	MRO development is not expected to have any indirect impact on land use or realty.
Cumulative Impacts	MRO development would not contribute to cumulative land and realty impacts.	No new cumulative impacts due to the proposed MRO.	MRO development would not contribute to cumulative land and realty impacts.	MRO development would not contribute to cumulative land and realty impacts.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Visual Resources				
Direct Impacts				
Ridgetop	MRO development would not change VQOs.	No change in visual resources due to the proposed MRO.	MRO development would not change VQOs. Ridgetop facilities would be less visible than under Alternative 1.	MRO development would not change VQOs. Ridgetop facilities would be less visible than under Alternative 1.
Utility Options	Utility Options would have minimal effect on visual resources.	No change in visual quality due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Maintenance and repair work would be noticeable to travelers along the road but would not be out of context.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Increased risk of human-caused fires could result in alteration in the landscape.	No increase in potential for changes in landscape caused by fire due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO development would contribute to an overall change in the landscape of the region caused by increased development.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Recreation				
Direct Impacts				
Ridgetop	Construction activities would detract from the recreational experience of ridgetop visitors. Approximately 19 acres of undeveloped land would be removed from potential open space recreational use. Recreation Opportunity Spectrum designations would not change.	No change in recreational opportunities or experience due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	Option 1 would affect the quality of the recreational experience along portions of Trails 19, 21, and 22 to an insignificant degree. Option 2 would have a similar effect on Trail 93. There are no trails in the vicinity of Option 3.	No impact on recreational use of trails from the proposed MRO utilities.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Road closures during MRO construction would intermittently and temporarily limit access to recreation areas above Water Canyon Campground. Road maintenance and repair would also temporarily limit access above the campground.	No limits in access due to the proposed MRO construction. Road maintenance and repair would temporarily limit access above the campground.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Recreational use of Magdalena Ridge could increase due to improved access along Water Canyon Road.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	The attraction of MRO, in combination with improved parking at Trailhead 8, relocation of the visitor's kiosk, and improved access along Water Canyon Road, could increase visitors to Magdalena Ridge and reduce recreational experiences that are more conducive to quiet or naturalness.	MRO attraction would not add to visitor use of Magdalena Ridge.	Same as Alternative 1.	Same as Alternative 1.
Minerals				
Direct Impacts				
Ridgetop	MRO development would have no impact on mining or minerals.	No impact due to the proposed MRO.	MRO development would have no impact on mining or minerals.	MRO development would have no impact on mining or minerals.
Utility Options	None of the Utility Options would affect mining or minerals.	No impact due to the proposed MRO.	None of the Utility Options would affect mining or minerals.	None of the Utility Options would affect mining or minerals.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Water Canyon Road	Construction traffic could impede access to and removal of material from mining claims on private land off Water Canyon Road, although there are currently no active claims and a low probability of the claims becoming active.	No impact due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO development would have no indirect impacts on minerals.	No impact due to the proposed MRO.	MRO development would have no indirect impacts on minerals.	MRO development would have no indirect impacts on minerals.
Cumulative Impacts	MRO would not contribute to any cumulative impacts on minerals.	No new cumulative impacts due to the proposed MRO.	MRO would not contribute to any cumulative impacts on minerals.	MRO would not contribute to any cumulative impacts on minerals.
Heritage and Cultural Resources				
Direct Impacts				
Ridgetop	MRO construction and operations are not expected to affect heritage and cultural resources.	No impacts due to the proposed MRO.	MRO construction and operations are not expected to affect heritage resources.	MRO construction and operations are not expected to affect heritage resources.
Utility Options	None of the Utility Options would affect heritage and cultural resources.	No impacts due to the proposed MRO.	None of the Utility Options would affect heritage and cultural resources.	None of the Utility Options would affect heritage and cultural resources.
Water Canyon Road	Road maintenance and repair are not expected to affect heritage and cultural resources.	Road maintenance and repair are not expected to affect heritage and cultural resources.	Road maintenance and repair are not expected to affect heritage and cultural resources.	Road maintenance and repair are not expected to affect heritage and cultural resources.
Indirect Impacts	Road closures during construction and road maintenance and repair could change access for traditional resource use.	Road maintenance and repair could change access for traditional resource use. There would be no road closures due to the proposed MRO construction.	Road closures during construction and road maintenance and repair could change access for traditional resource use.	Road closures during construction and road maintenance and repair could change access for traditional resource use.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumulative Impacts	MRO development is not expected to contribute to cumulative impacts on heritage and cultural resources.	No new cumulative impacts due to the proposed MRO.	MRO development is not expected to contribute to cumulative impacts on heritage and cultural resources.	MRO development is not expected to contribute to cumulative impacts on heritage and cultural resources.
Human Health and Safety				
Direct Impacts				
Ridgetop	Safety hazards during construction will be minimized through development and implementation of a Transportation and Safety Plan.	No increase in health and safety hazards due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	None of the Utility Options would have health or safety impacts.	No increase in health and safety hazards due to the proposed MRO.	None of the Utility Options would have health or safety impacts	None of the Utility Options would have health or safety impacts
Water Canyon Road	Construction and maintenance vehicles and equipment would be equipped with spark arresters and catalytic converters would not be allowed off road in areas where grasses or other fuels could come in contact with the catalytic converter, in order to minimize fire risks.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Improved access along Water Canyon Road due to road maintenance and repair would benefit fire suppression capability.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Increased activity associated with MRO, in combination with other activities in the Magdalena Mountains, could increase risk of fire.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Socioeconomics				
Direct Impacts				
Ridgetop	MRO construction would potentially increase employment opportunities in the local areas by an average of 50 and a peak of 100 jobs.	No new employment opportunities due to the proposed MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	None of the Utility Options would affect socioeconomics.	No impacts due to the proposed MRO.	None of the Utility Options would affect socioeconomics.	None of the Utility Options would affect socioeconomics.
Water Canyon Road	Road maintenance and repair would provide minimal potential employment opportunities.	Same as Alternative 1	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO development is not expected to stimulate population inmigration to any measurable degree.	No impact due to the proposed MRO.	MRO development is not expected to stimulate population inmigration to any measurable degree.	MRO development is not expected to stimulate population inmigration to any measurable degree.
Cumulative Impacts	The MRO could attract a small number of additional tourists to the area.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Environmental Justice				
Direct Impacts				
Ridgetop	Ridgetop construction would be removed from any population centers and would not affect local populations, including minority and low-income populations. The availability of construction jobs may provide a small benefit for minorities and people whose income is currently affected by the lack of job opportunities.	No impact due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	None of the Utility Options would affect minority or low-income populations.	No impact due to the proposed MRO.	None of the Utility Options would affect minority or low-income populations.	None of the Utility Options would affect minority or low-income populations.
Water Canyon Road	See Heritage and Cultural Resources.	See Heritage and Cultural Resources.	See Heritage and Cultural Resources.	See Heritage and Cultural Resources.
Indirect Impacts	The MRO would have no disproportionately high or adverse indirect human health or environmental impacts on minority or low-income populations.	No impacts due to the proposed MRO.	The MRO would have no disproportionately high or adverse indirect human health or environmental impacts on minority or low-income populations.	The MRO would have no disproportionately high or adverse indirect human health or environmental impacts on minority or low-income populations.
Cumulative Impacts	The MRO's potential to contribute to increased recreation and tourism could benefit small businesses and generate service industry jobs, which could benefit local minority and low-income populations.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Table S-7. Mitigation Measures and Monitoring Requirements

Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Geology & Soils	Limit equipment and vehicle use on steep slopes (construction) (25.17[1]).				1, 3, 4
	Use mechanical and vegetative surface stabilization measures to prevent on-site soil loss from exposed cut slopes, fill slopes, and disposal areas (construction) (41.12[1]).	✓			1, 3, 4
	Develop and implement a Revegetation Plan coordinating with the Forest Service. All disturbed areas would be reseeded with appropriate native vegetation seed mixes. The plan would also address long-term post construction monitoring to ensure success of the revegetation effort (pre-construction, construction, post-construction) (25.18[1]).	✓	✓		1, 3, 4
	Develop an Erosion Control Plan using a combination of appropriate specification and practices (pre-construction) (41.12[1]).	✓	✓		1, 3, 4
	After heavy thunderstorms, erosion control devices should be checked to make sure they are functioning and appropriate action taken to repair or revise (construction).				1, 3, 4
	Establish sediment basins and sediment filters to filter surface runoff where such runoff may enter streams; build diversion ditches or berms to divert surface runoff around bare areas (construction) (41.5[1]).	✓			1, 3, 4
	Provide subsurface drainage to avoid moisture saturation and subsequent slope failure. Dispersion of collected water should be in an area capable of withstanding increased flows (construction) (41.13[1]).				1, 3, 4
	Provide methods of soil erosion reduction such as properly placed culverts, cross drains, water bars, dips, energy dissipaters, aprons, downspouts, gabions, and/or debris racks, and armoring of ditches and drain inlets and outlets (construction) (41.15[1]).				1, 3, 4
	Provide method of dispersal runoff such as rolling the grade, insloping, outsloping, crowning, installations of water spraying ditches, contour trenching, or overside drains (construction) (41.14[1]).				1, 3, 4
	Install sediment filters, settling ponds, and contour trenches to reduce sediment loads (construction) (41.14[1]).				1, 3, 4

Notes: (1) *FSH 2509.22 – Soil and Water Conservation Practices Handbook.* 1990. USDA Forest Service, Region 3.
(2) I = Implementation
E = Effectiveness
V = Validation

<table>
<tr><th rowspan="2">Resource</th><th rowspan="2">Mitigation Measure</th><th colspan="3">Monitoring[2]</th><th rowspan="2">Alternatives</th></tr>
<tr><th>I</th><th>E</th><th>V</th></tr>
<tr><td rowspan="10">Geology & Soils</td><td>Apply protective measures to all areas of disturbed, erosion-prone, unprotected ground that is not to be further disturbed in the present year by (construction):
▪ Removing water-controlling devices that will not carry anticipated seasonal water runoffs.
▪ Installing temporary devices that will carry anticipated seasonal water runoffs.
▪ Removing debris, obstructions, and spoil material.
▪ Grass seeding, planting deep-rooted vegetation, and/or mulching (41.15[1]).</td><td>✓</td><td></td><td></td><td>1, 3, 4</td></tr>
<tr><td>Locate waste areas where excess material can be deposited and stabilized. Loose, unconsolidated sidecast material should not be permitted to enter streamside management zones (pre-construction) (41.17[1]).</td><td>✓</td><td></td><td></td><td>1, 3, 4</td></tr>
<tr><td>Prevent spoil material from obstructing the streamcourse (including natural floodplain) associated structures by (construction):
▪ Keeping excavated materials out of stream courses (including ephemeral and intermittent).
▪ Removal of materials stacked or stockpiled on floodplains prior to high water.
▪ Diversion of flowing water around work sites.
▪ Importation of fill material for better soil compaction (41.21[1]).</td><td>✓</td><td></td><td></td><td>1, 3, 4</td></tr>
<tr><td>Plow road under SUP Snow Plowing provisions (construction, post-construction).</td><td></td><td></td><td></td><td>1, 2, 3, 4</td></tr>
<tr><td>Prescribe road surface treatments based on traffic levels, road design standards, soils and geology (pre-construction (construction) (41.26[1]).</td><td></td><td></td><td></td><td>1, 2, 3, 4</td></tr>
<tr><td>Perform annual inspections and maintenance scheduling to determine what work is needed to keep drainage functional and the road stable (post-construction) (41.25[1]).</td><td></td><td></td><td></td><td>1, 2, 3, 4</td></tr>
<tr><td>Place drain holes so that surface drainage occurs on non-erodable fill (construction).</td><td></td><td></td><td></td><td>1, 3, 4</td></tr>
<tr><td>Use guidance for snow removal to prevent erosion damage to roads, streams and other Forest values and that protects roads and appurtenances (post-construction).</td><td>✓</td><td>✓</td><td></td><td>1, 2, 3, 4</td></tr>
<tr><td>Use equipment specifically for the removal of snow (post-construction).</td><td></td><td></td><td></td><td>1, 2, 3, 4</td></tr>
<tr><td>Submit a written request for Forest Service approval of ice control; approval will contain information about ice control materials, application rates, and any specific requirements of use (post-construction).</td><td></td><td></td><td></td><td>1, 2, 3, 4</td></tr>
</table>

Notes: (1) *FSH 2509.22 – Soil and Water Conservation Practices Handbook.* 1990. USDA Forest Service, Region 3.
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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Geology & Soils	Develop a Spill Prevention Plan and Surface Water Pollution Prevention Plan to be on-site during construction (pre-construction) (25.13[1]).				1, 3, 4
Water Resources	Perform regular servicing and maintenance of fleet vehicles and daily inspection of construction vehicles for signs of oil or gasoline leaks (construction).				1, 3, 4
	Designate location, size and allowable uses of service and refueling areas away from wet areas and surface water. Berms should be placed around areas to contain spills (construction) (41.18[1]).				1, 3, 4
	Develop project constraints and mitigative measures and include in Erosion Control Plan (pre-construction) (41.1[1]).				1, 3, 4
	Develop and use proper slope ratio designs to promote stable embankments (pre-construction) (41.16[1]).				1, 3, 4
	When flow in stream courses diverted, restore such diverted flow to natural stream course as soon as practicable and prior to major storm season (construction) (41.19[1]).				1, 3, 4
	Incorporate mitigating measures into project plans and designs to maintain the hydrologic and biologic function of the wetlands (25.12[1]).	✓	✓		1, 3, 4
	Design and construct roadways with adequate strength to support the pavement structure, shoulders, and traffic to eliminate failure and subsequent water quality degredation (41.16[1]).				1, 3, 4
	Monitor water use in East Fork of Sawmill Canyon Creek.	✓		✓	1, 3, 4
Air Quality	Develop a Dust Abatement Plan to include (construction): ▪ Spraying exposed and disturbed areas with water as a means of controlling blowing dust and soil. ▪ Using a terrain trimmer to resurface Water Canyon Road to reduce the time for resurfacing, eliminate the need for blasting, and minimize grinding and dust-generating activities. ▪ Applying a dust-control skirt on the terrain trimmer. ▪ Following equipment with a fire engine to provide water for dust abatement.	✓			1, 3, 4
	Avoid long periods of engine idling; implement a phased construction schedule to minimize number of units operating simultaneously; perform regular engine maintenance (construction).				1, 3, 4

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Resource	Mitigation Measure	Monitoring[2] I	E	V	Alternatives
Fire Management	Implement fire management actions to alleviate existing conditions in the surrounding forest that are susceptible to a large-scale fire under certain conditions (construction, post-construction.	✓			1, 2, 3, 4
	Require spark arrestors on powered equipment; do not allow operation of vehicles with catalytic converters in tall, bushy grasses; provide an on-site emergency water supply during and following construction; provide personnel trained in suppression of small fires on-site at all times during construction and operations (construction).				1, 2, 3, 4
	Develop a construction phase fire plan tiered to the CNF fire restrictions and closures (pre-construction).				1, 3, 4
Transportation	Remove all slash from project area to a site approved by the Forest Service.				1, 3, 4
	Limit all personnel and visitor vehicles to existing roads or parking areas.				1, 2, 3, 4
	Monitor visitor numbers and activities and implement controls (such as organized tours) if visitation is high (construction, post-construction).				1, 2, 3, 4
	Monitor traffic levels for long-term cumulative increases that may exceed safe road capacity levels (construction, post-construction).	✓		✓	1, 2, 3, 4
	Monitor the condition of Water Canyon Road between US 60 to Water Canyon Campground; NMIMT, the Forest Service, Bureau of Land Management, and Socorro County would negotiate any repairs that may be needed as a result of damage during construction (pre-construction, post-construction).	✓			1, 3, 4
Vegetation	Develop and implement a Noxious Weed Management Plan consistent with Forest Service guidance and standards (pre-construction).	✓			1, 3, 4
	Limit all personnel and visitor vehicles to existing roads or parking areas to be included in Annual Operations and Maintenance Plan (construction/post-construction).				1, 2, 3, 4
	When tree limbs are pruned, use of climbing spurs or other tree climbing equipment that affects the tree's cambium layer is prohibited.				1, 3, 4
Wildlife	Work during daylight hours only (construction, post construction).	✓			1, 2, 3, 4
	When possible, perform road repair and maintenance projects in PAC areas in less sensitive months (July through March) (construction, post-construction).	✓			1, 2, 3, 4

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V = Validation

Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Wildlife	Limit road maintenance and repair in PAC areas to hours between 2 hours after sunrise and 2 hours before sunset during the breeding and rearing season (March through August) (construction, post-construction).	✓			1, 2, 3, 4
	Install sound-insulating housing around new pump/motor at water source location (Sawmill Canyon option) (construction, post-construction).	✓			1, 3, 4
	Dig and excavate by hand in the Baldy Spring PAC (construction, post construction).	✓			1, 3, 4
	Install water line and pump in months outside the breeding season for owls (and use alternate temporary water supply sources until new source can be developed and utilized) (construction, post construction).	✓			1, 3, 4
	Minimize duration of road maintenance and repair work (construction/post-construction).				1, 2, 3, 4
	Limit or avoid using primary and secondary rock crushers and conventional ripping for roadwork (construction).	✓			1, 2, 3, 4
	Limit hauling of rock base material (construction).				1, 3, 4
	Avoid blasting or use of pneumatic charge drilling (construction).				1, 3, 4
	Monitor traffic levels on Water Canyon Road to estimate increases in noise levels along the road that may affect wildlife (particularly bird species) in the long term (construction, post-construction).				1, 3, 4
	Add provision in construction constracts requiring adherence to speed limits and no loose materials on truck beds to reduce noise levels from construction.				1, 3, 4
Rangeland	Forest Service will coordinate access during road closures with grazing permittee.	✓			1, 2, 3, 4
Visual Resources	Paint project structures in natural non-reflective colors. Apply non-reflective coatings to glazing that is visible beyond the project boundary (construction).	✓	✓		1, 3, 4
	Develop and implement a Revegetation Plan. All disturbed areas would be reseeded with appropriate native vegetation seed mixes. The plan would also address long-term post construction monitoring to ensure success of the revegetation effort (pre-construction, construction, post-construction).				1, 3, 4
	Crush rocks from excavated areas on the ridge and use on-site for reconstructing roads and constructing graveled parking areas. Use materials for resurfacing or mixing with concrete (construction).				1, 3, 4

Notes: (1) *FSH 2509.22 – Soil and Water Conservation Practices Handbook.* 1990. USDA Forest Service, Region 3.
(2) I = Implementation
E = Effectiveness
V = Validation

Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Visual Resources	Cut all stumps to 6 inches (0.15 m) or less with cuts facing away from roads and development (construction).	✓			1, 3, 4
Recreation	Forest Service to publicize road closures schedules in local media, the district office and on MRD website.				1, 2, 3, 4
Heritage and Cultural Resources	Educate construction workers and use management practices to minimize potential effects to off-site heritage resources (construction).	✓			1, 3, 4
	Forest Service to coordinate with Mescalero Apache Tribe and Alamo Navajo Chapter to ensure ongoing vehicular access to top of South Baldy Peak during and after construction.				1, 2, 3, 4
Human Health & Safety	Use only ladders or mechanized equipment platforms to access tree limbs to be pruned (construction/post-construction).				1, 2, 3, 4
	Develop a Transportation and Safety Plan to address all aspects of safety on the construction site or in transit to or from the site in accordance with applicable regulations. Plan would address emergency response and fire safety and response and would include (construction, post-construction) measures developed by the construction contractor to control circulation and access to protect workers and public during the construction phase. Measures may include speed limits, road closures, vehicle inspections, designated turn-around areas, and passing procedures.	✓			1, 3, 4
	Fence all construction and storage sites on the ridgetop during construction for safety and security.				1, 3, 4
	Monitor equipment storage areas for rodent feces and decontaminate and disinfect area if feces are detected to minimize the risk of exposure to Hanta Virus.	✓			1, 3, 4
	Update and expand the Existing NMIMT Safety Manual to include the proposed MRO.				1, 3, 4

Notes: (1) *FSH 2509.22 – Soil and Water Conservation Practices Handbook.* 1990. USDA Forest Service, Region 3.
(2) I = Implementation
E = Effectiveness
V = Validation

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CHAPTER 1. PROJECT SCOPE

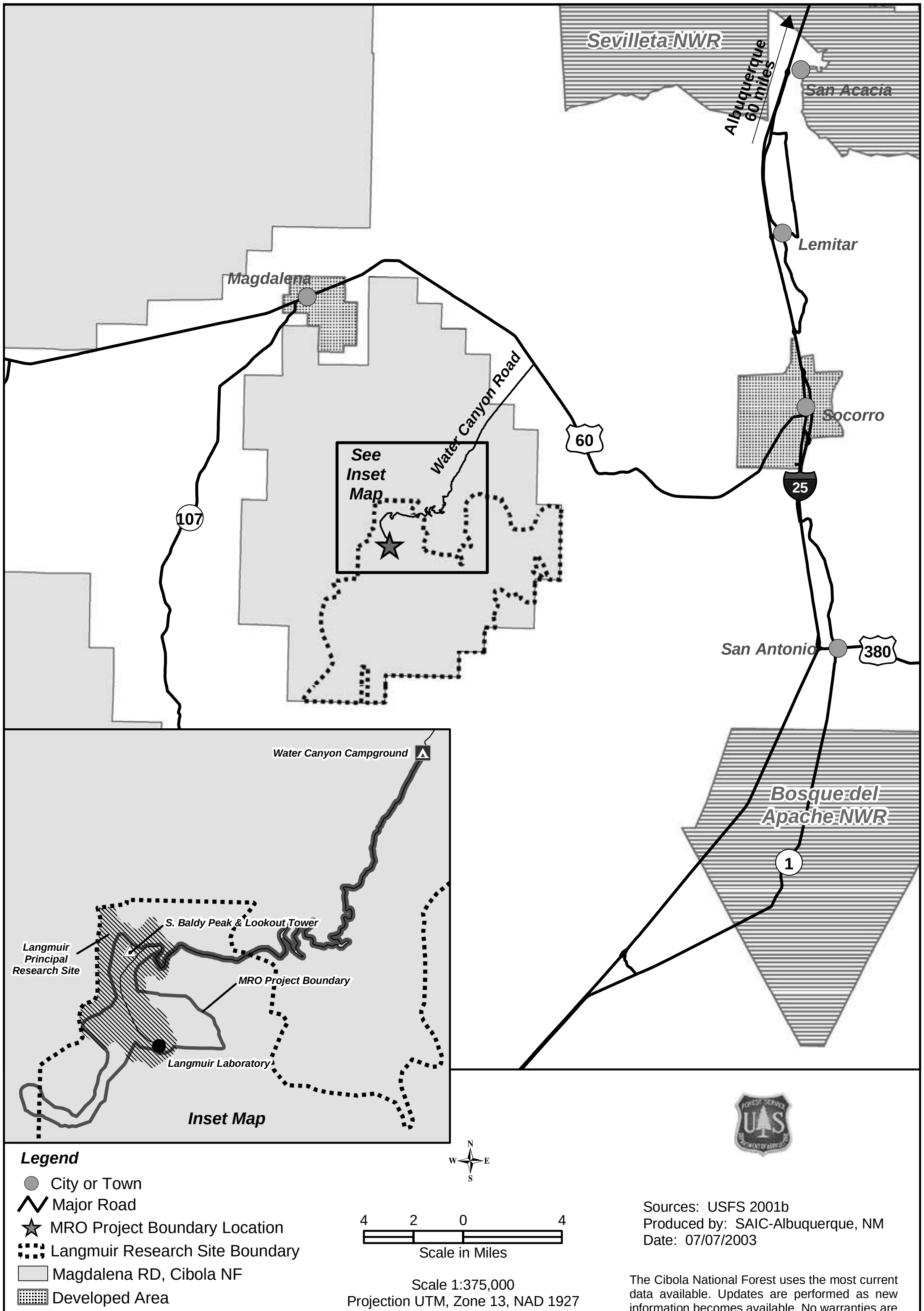
1.1 Introduction

This Final Environmental Impact Statement (EIS) was prepared by Science Applications International Corporation (SAIC) for the Forest Service in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. The Final EIS evaluates the potential impacts from a proposal by the New Mexico Institute of Mining and Technology (NMIMT) to construct and operate an observatory in the Magdalena Mountains in the Cibola National Forest (CNF) in central New Mexico. The proposed observatory is known as Magdalena Ridge Observatory (MRO). The general location of the project area is shown in **Map 1-1**.

1.2 Document Structure

To guide and direct the NEPA process and preparation of this Final EIS, the Forest Service has created an Interdisciplinary (ID) Team of Forest Service specialists. This Final EIS discloses the direct, indirect, and cumulative environmental impacts that would result from the Proposed Action and alternatives. The document is organized into seven chapters:

- *Chapter 1. Project Scope*: The chapter includes information on the history of the project proposal, the purpose of and need for the proposed project, and a brief description of the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, Including the Proposed Action*: This chapter provides a more detailed description of the agency's Proposed Action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation and monitoring measures. Finally, this section compares the alternatives in summary form and identifies mitigation measures to reduce impacts.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes existing conditions of the environment and the environmental effects of implementing the Proposed Action and other alternatives. This analysis is organized by resource topic. Resources evaluated include 1) Geology and Soils 2) Water Resources; 3) Air Quality; 4) Noise; 5) Fire Management; 6) Transportation; 7) Vegetation; 8) Wildlife; 9) Rangelands 10) Lands and Realty; 11) Visual Resources; 12) Recreation; 13) Minerals; 14) Heritage and Cultural Resources; 15) Human Health and Safety; 16) Socioeconomics; and 17) Environmental Justice. For each resource, the affected environment is described and the environmental consequences of implementing the Proposed Action or alternatives are evaluated.



Map 1-1
General Location of the Proposed MRO

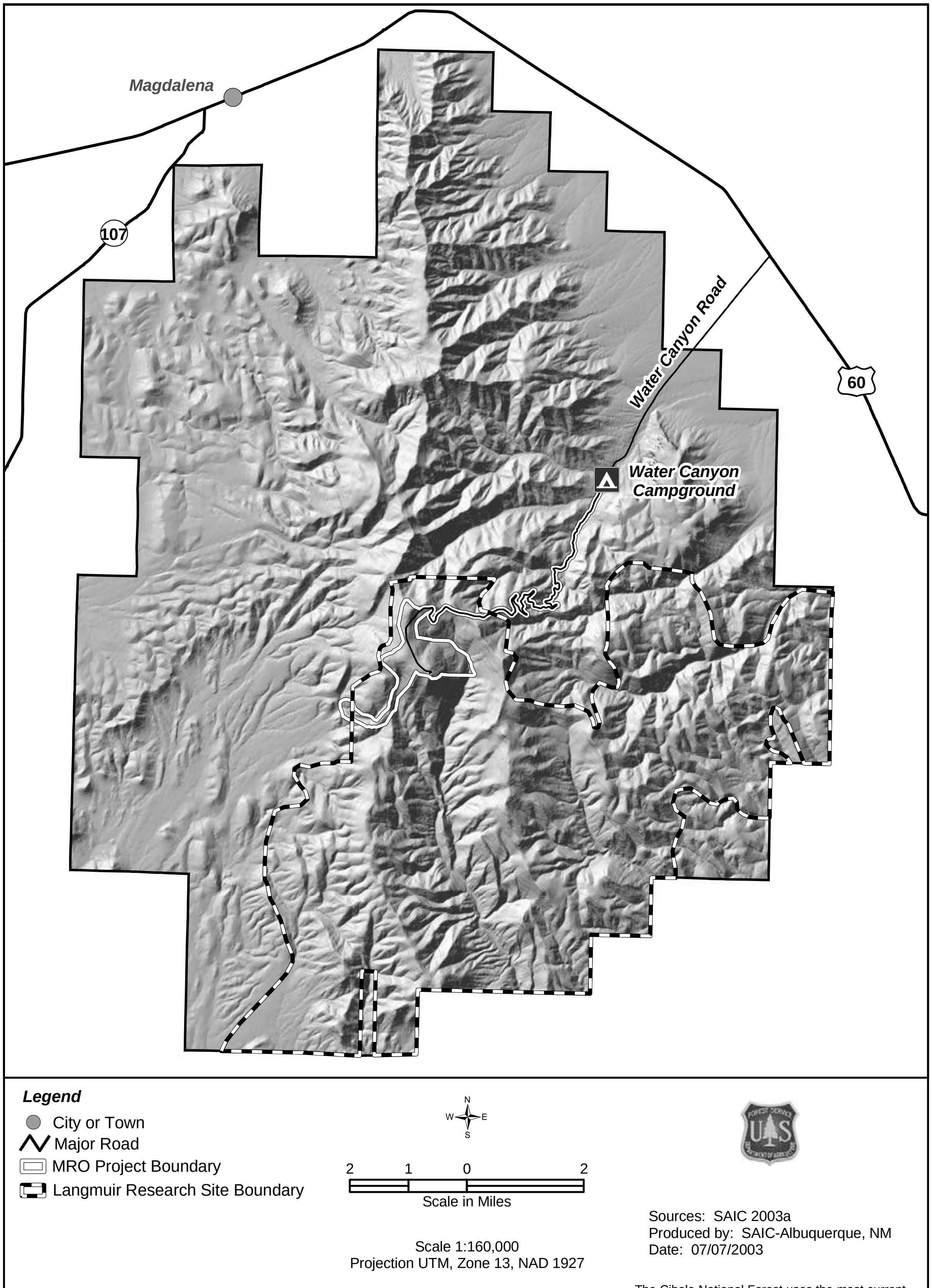
- *Chapter 4. Consultation and Coordination*: This chapter provides a list of preparers and agencies consulted during the development of the Draft and Final EIS, and includes agencies, organizations and individuals that were sent the Draft and Final EIS.
- *Chapter 5. References*: This chapter provides references for information cited in the Final EIS.
- *Chapter 6. Glossary*: This chapter provides definitions for terminology used in the Final EIS.
- *Chapter 7. Index*: The index provides page numbers by document topic.
- *Appendix A*: Appendix A provides more detailed information on scoping comments.
- *Appendix B*: Appendix B provides public comments received on the Draft EIS and responses to those comments.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record. The record is located at:

- USDA Forest Service, Cibola National Forest
  203 First Street
  Magdalena, NM 87825

1.3 Project Background

NMIMT is part of a consortium including several universities and the United States (U.S.) Navy, Naval Research Laboratory (NRL) that is proposing to develop the proposed MRO. The proposed site for the new proposed MRO facilities is within Langmuir Research Site, a 31,000-acre area set aside by Congress in 1980, under Public Law (P.L.) 96-550, within the CNF, New Mexico. Within the Langmuir Research Site is a 1,000-acre area designated by Congress as the “Principle Research Facility” (PRF). Langmuir Laboratory is located within the PRF. The major portion of the 980-acre proposed MRO project area, containing the proposed facilities, would also be located in the PRF. However, portions of the proposed MRO project area along Water Canyon Road and the utility corridor would be located outside the PRF. The Langmuir Research Site was established to encourage scientific research into atmospheric processes and astronomical phenomena. **Map 1-2** shows the location of the Langmuir Research Site and the proposed MRO project boundary on Magdalena Ridge below South Baldy Peak in the Magdalena Mountains. This is the project area within which most direct effects of activities for the proposal could occur. The proposed observatory would feature both a conventional telescope and an Interferometer Array of telescopes that function together to provide higher resolution than that which is available from a single telescope. This innovative technology has been pioneered by NRL at the Navy Prototype Optical Interferometer (NPOI) near Flagstaff, Arizona. Experience from developing NPOI would be applied to this proposed facility with further refinements that would improve capabilities for high-resolution observations.



Map 1-2
Langmuir Research Site and Proposed MRO Project Boundary

Currently, the Langmuir Laboratory operates under an existing Special Use Permit (SUP) from the Forest Service as a scientific research facility (USFS 1992; USFS 2002c). There are several existing facilities (**Map 1-3**) within the Langmuir Research Site, mostly on the ridgetop, within the (PRF). These include the primary atmospheric research laboratory and dormitories, a balloon hangar with balloon launch facilities, the Digital Astronomy Observatory, the Joint Observatory for Cometary Research (JOCR), and several truck trailers housing scientific equipment. The SUP requires the permit holder to prepare an Annual Operation and Maintenance Plan (USFS 1992; USFS 2002c) that list the activities and facilities (including equipment and utilities infrastructure) that support current operations. The Forest Service also has a communication site on the tip of the West Knoll.

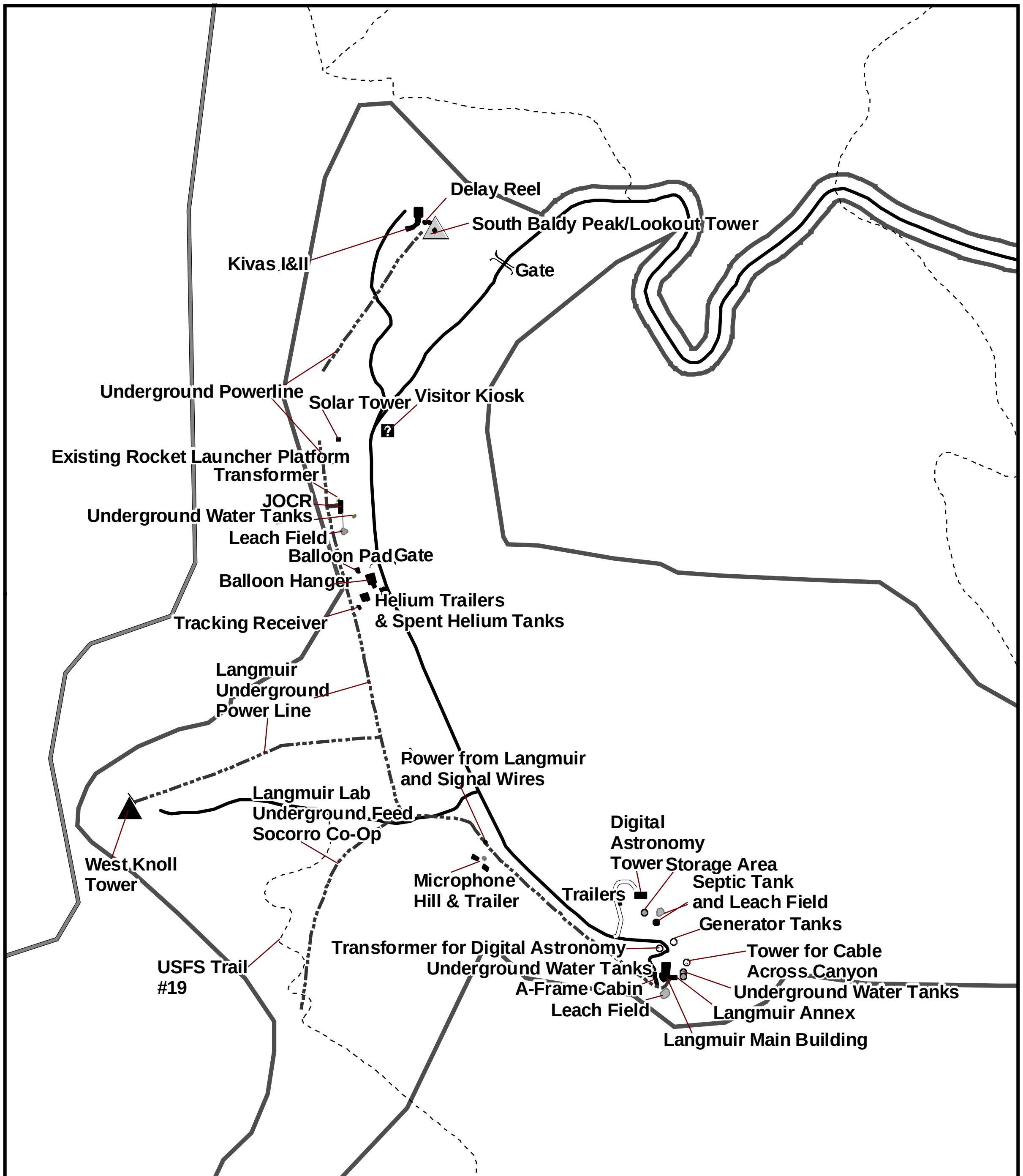
Water Canyon Road, a gravel road that is suitable for high clearance vehicles, provides access to the ridge and existing facilities (see Map 1-2). A locked gate restricts public vehicular access into the research site, although the area supports grazing and is accessible for non-motorized recreation.

The proposed MRO project started with initial discussions among potential collaborators in 1995. NMIMT and U.S. Army staff visited the site to determine its general feasibility. In 1996 and 1997, the U.S. Air Force, New Mexico State University, and the University of Puerto Rico joined the consortium, and atmospheric testing on the site was begun to determine if it was competitive with other southwestern sites. NMIMT received the 7.9-foot (2.4-meter [m]) mirror in 1998, and the mirror was transported to Socorro where it is in storage. The first formal consortium meeting was held at the University of Puerto Rico the same year. Late in the year, New Mexico Highlands University joined the consortium. Two consortium meetings were held in 1999, and a design and engineering firm was retained to develop a conceptual design of the facility. In 2001, sponsorship of the project was transferred to the U.S. Navy. Since then, the University of Cambridge joined the consortium in 2002. A conceptual layout of the facilities was developed in 2002.

1.4 Purpose and Need for the Proposed Action

The observatory's primary purpose would be astronomical and optical research and education by NMIMT and the consortium members. A secondary purpose would be to support White Sands Missile Range (WSMR) with passive observing techniques for identifying satellites and tracking missiles during tests. The facility would provide a location for state-of-the-art telescopes, cameras, spectrometers, and associated equipment. There is an acute need for high-tech education in New Mexico, where the economy is closely tied to science and engineering.

The proposed MRO would serve the academic research community by providing telescopes for research and development of research techniques. This is important and timely, and the need is great due to the ongoing closing of several research telescopes at other observatories that has handicapped the research community. The observatory would also provide public outreach, programs for K-12 students, courses for K-12 teachers, research experience for undergraduates, and support of research by graduate students.



Legend

- Langmuir Research Site Boundary
- MRO Project Boundary
- Road
- Trail

N W E S

0.25 0.125 0 0.25

Scale in Miles

Sources: Ackerly 2002; NMT 2003 b; SAIC 2002
Produced by: SAIC-Albuquerque, NM
Date: 07/07/2003

Scale 1:15,000
Projection: UTM, Zone 13, NAD1927

The Cibola National Forest uses the most current data available. Updates are preformed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 1-3
Location of the Existing Facilities at the Langmuir Research Site

Using the Interferometer Array, passive-observing techniques for identifying satellites could be developed. This would serve a national need to know how well satellites are performing and to improve satellite performance if they malfunction. A stand-alone, single telescope would be able to track missiles during tests at the WSMR. Also, this telescope could be used as a test bed for new instruments and sensors and could be used to develop new surveillance technologies, although none are proposed or known at this time.

1.5 Proposed Action

The action proposed by the Forest Service to meet the purpose and need is to issue an amended SUP to NMIMT. The proposed amendment, referred to as the proposed MRO project, would allow NMIMT to construct and operate a new observatory and its associated facilities within the existing PRF of the Langmuir Research Site located on Magdalena Ridge in the Magdalena Ranger District (MRD) of the CNF.

The observatory and its associated facilities would consist of two main parts: 1) the scientific equipment consisting of an Interferometer Array of 16 telescopes at full buildout and its associated infrastructure, including a Beam-Combining Facility, a single 7.9-foot (2.4-m) stand-alone telescope, and a telescope pair; 2) educational and research support facilities including an Operations Center, parking areas, utility provisions, and roadways. Construction would take place over 4 to 5 years. Additional information about the Proposed Action is provided in Chapter 2.

1.6 Decision to be Made

Given the purpose and need, the deciding Forest Service official reviews the Proposed Action, the other alternatives, and the environmental consequences in order to make the following decision:

- Whether or not to amend the existing SUP that currently allows NMIMT to operate the Langmuir Laboratory for Atmospheric Research to include the Proposed Action. The amended permit would allow construction and operation of the proposed observatory and associated facilities and infrastructure;
- Whether to select another alternative in response to identified issues;
- Whether to select a combination of alternatives; or
- Whether to take no action at this time.

The decision would be consistent with the 1985 CNF Land and Resource Management Plan (LRMP), as amended, and would not require a plan amendment.

1.7 Public Involvement

The CNF prepared a Public Information and Communication (PIC) Plan in September 2002, outlining tasks and strategies to involve the public during the NEPA process. Some of the chosen methods included, open houses, field trips, direct mailings, announcements and publications in local newspapers.

CNF Schedule of Proposed Actions (SOPA): The Proposed Action has been listed in the CNF SOPA every quarter of the year beginning in October 2000. This list is mailed to approximately 500 persons who have expressed an interest in management activities on the CNF.

Pre-Scoping: In October of 2002, a pre-scoping letter and general information packet were mailed to over 900 members of the public and tribes; to other federal, state, and local agencies; and to other interested parties on the CNF's established mailing list. Based on response from this mailing, about 160 entities expressed interest in receiving continued information and copies of the environmental document. Information, comments, and concerns expressed during this initial mailing assisted in the development of the formal Proposed Action presented to the public on November 8, 2002. In late October and early to mid-November 2002, several news releases were sent to local and statewide newspapers to notify the broader public of the Proposed Action and to invite participation. In late October 2002, NMIMT's MRO Education and Outreach Group began work with the local school districts, sharing information on the proposed MRO project.

Notice of Intent: In order to formally notify the public and other federal and state agencies of the Proposed Action, a Notice of Intent (NOI) to prepare a Draft EIS was published in the Federal Register on Thursday, October 3, 2002. The NOI asked for public comment on the proposal by November 29, 2002.

Project Scoping: On November 8, 2002, a scoping letter was sent to over 160 individuals and organizations that identified continued interest in being contacted. Recipients were asked to provide comments on the proposal. The CNF and NMIMT held public tours of the proposed observatory site early in November 2002 and again in late April 2003. During the tours, participants had the opportunity to talk with research scientists from NMIMT and with Forest Service ID Team members. Following the initial field tour, the Forest Service held three Open Houses in November providing an opportunity for the public to view detailed maps of the proposed project, and to discuss potential issues, concerns, and alternatives. Meetings were held in Magdalena (on November 13, 2002), Albuquerque (on November 19, 2002), and Socorro (on November 21, 2002), New Mexico. The Socorro meeting had the largest attendance, with 38 persons. Verbal and written comments received during the Open Houses supplemented scoping comments received by mail, e-mail, and telephone. Nineteen persons have submitted written comments. **Table 1-1** summarizes the public involvement activities for the NEPA process for this Final EIS. Comments received during scoping are summarized in **Appendix A**.

Draft EIS: The Draft EIS was distributed to the public for comment in September 2003. The Notice of Availability (NOA) was published in the Federal Register on Friday September 19, 2003. The 45-day public comment period on the Draft EIS ended November 3, 2003. The CNF received 9 public comments during the 45-day public comment. Comments were received via email (1), conventional mail (7), and hand

Table 1-1. Summary of Public Involvement Activities for the Proposed MRO Project

Activity	Date	Action Implemented
SOPA	Oct. 2000 to July 2003	Listing of Proposed Action.
Pre-Scoping Letter	Oct. 3, 2002	Over 900 letters and information packets mailed to individuals and organizations on the CNF's established mailing list.
Legal Notice	Oct. 3, 2002, Sept. 19, 2003	NOI to prepare a Draft EIS was published in the Federal Register. NOA for Draft EIS public comment period was published in the Federal Register.
News Releases	Oct. 24, 29, 30 Nov. 5, 14, 18, 2002; April 16, July 10, 2003	Articles placed in several local news papers requesting comments on the Proposed Action and information on activities.
Fact Sheets to other Forest Service offices	Oct. 28, 2002	Information distributed on the proposed MRO project, time lines, and activities to the CNF offices and posted on the CNF's web site.
Student Education	Oct. 28, 2002	MRO Education and Outreach Group began work with the local school districts, sharing information on the proposed MRO project.
Public Tours	Nov. 2, 2002, April 26, 2003, and Oct. 4, 2003	Public tours held of the proposed MRO site location with the general public, the CNF ID Team members, and NMIMT research scientists.
Scoping Letter	Nov. 8, 2002	Letter sent to over 160 individuals and organizations that identified continued interest in being contacted based on responses from the pre-scoping letter and the CNF's established mailing list.
Open Houses	Nov. 13, 19, and 21, 2002	Public Open Houses held to meet one-on-one with the public and solicit comments.
Draft EIS	Sept. 19, 2003 to Nov. 3, 2003	Draft EIS available to the public for 45 day comment period.

delivered (1). The comments were indexed by author and categorized by topic for response. The comment categories are defined in Appendix B, which contains the comments and responses to the comments. Most of the comments involved clarification of information in the Draft EIS.

Involvement of Other Agencies: In addition to involving the public, the Forest Service has consulted with other agencies for resource data and issue identification (40 Code of Federal Regulations [CFR] 1508.5). A list of agencies appears in Chapter 4 under "Agencies Consulted."

1.8 Issues

Scoping issues were divided into two groups: significant and non-significant issues. Significant issues are those with a large geographic extent, high intensity of effects, or the intensity of interest or resource conflict is high. Non-significant issues are those 1) outside the scope of the Proposed Action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Section 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Section 1506.3)…". Some issues were also non-significant in view of measures included in the Proposed Action and alternatives that would reduce impacts. A list of non-significant issues and reasons regarding their categorization as non-significant is documented in Appendix A, Scoping Comments and Responses.

As for significant issues, the Forest Service identified the following based on input during the scoping process:

- Issue 1. The amount of ground disturbance during construction of utility corridors, road repairs, and ridgetop development could lead to increases in erosion. The unit of measure for comparison of alternatives is acres of ground disturbance.
- Issue 2. Implementation of the project facilities and infrastructure may change the visual character of the area and reduce aesthetic quality. The unit of measure for comparison of alternatives is changes to visual quality objectives (VQO).

1.9 Changes Between the Draft and the Final EIS

In response to comments received on the Draft EIS, additional information and clarification was added to the Final EIS to provide the following:

- Clarify the sources of water for the proposed MRO project under Utility Options 2 and 3 (see Sections 2.2.1.2 and 3.2.2.2 and Table 2-5).
- Clarify the effects of proposed water use under Utility Options 2 and 3 on wildlife (see Section 3.3.2 and Table 2-5).
- Clarify habitat type and wildlife species occurrence in the project area (see Sections 3.3.1 and 3.3.2 and Table 2-5).

- Clarify agency coordination for maintenance of Water Canyon Road (see Section 3.2.6.2).
- Correct the information on the expected reduction in grazing acreage and Animal Unit Months due to the proposed project (see Sections 3.3.2.3 and 3.3.3).
- Incorporate additional mitigation measures (see Table 2-6).
- Add comments received on the Draft EIS and documented responses to those comments (see Appendix B).

Minor editorial clarifications, corrections, and additions were also made in other sections. A new appendix was added, Appendix B, containing the Draft EIS comments and responses.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

This chapter describes and compares the alternatives considered for the proposed Magdalena Ridge Observatory (MRO). It includes a description and map of each alternative analyzed in detail. It also briefly summarizes alternatives considered but eliminated from detailed study. This section presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. The information used to compare the alternatives is based upon variations in the design of the project (i.e., siting facilities, potential water supply sources) that may result in differing environmental, social, and economic effects of implementing each alternative (i.e., potential erosion or visibility from various locations for facilities).

2.2 Alternatives Considered in Detail

Four alternatives were developed for analysis including the No Action Alternative and the Proposed Action. Two of these alternatives were developed in response to issues raised by the public (see Section 1.8).

2.2.1 Alternative 1: Proposed Action

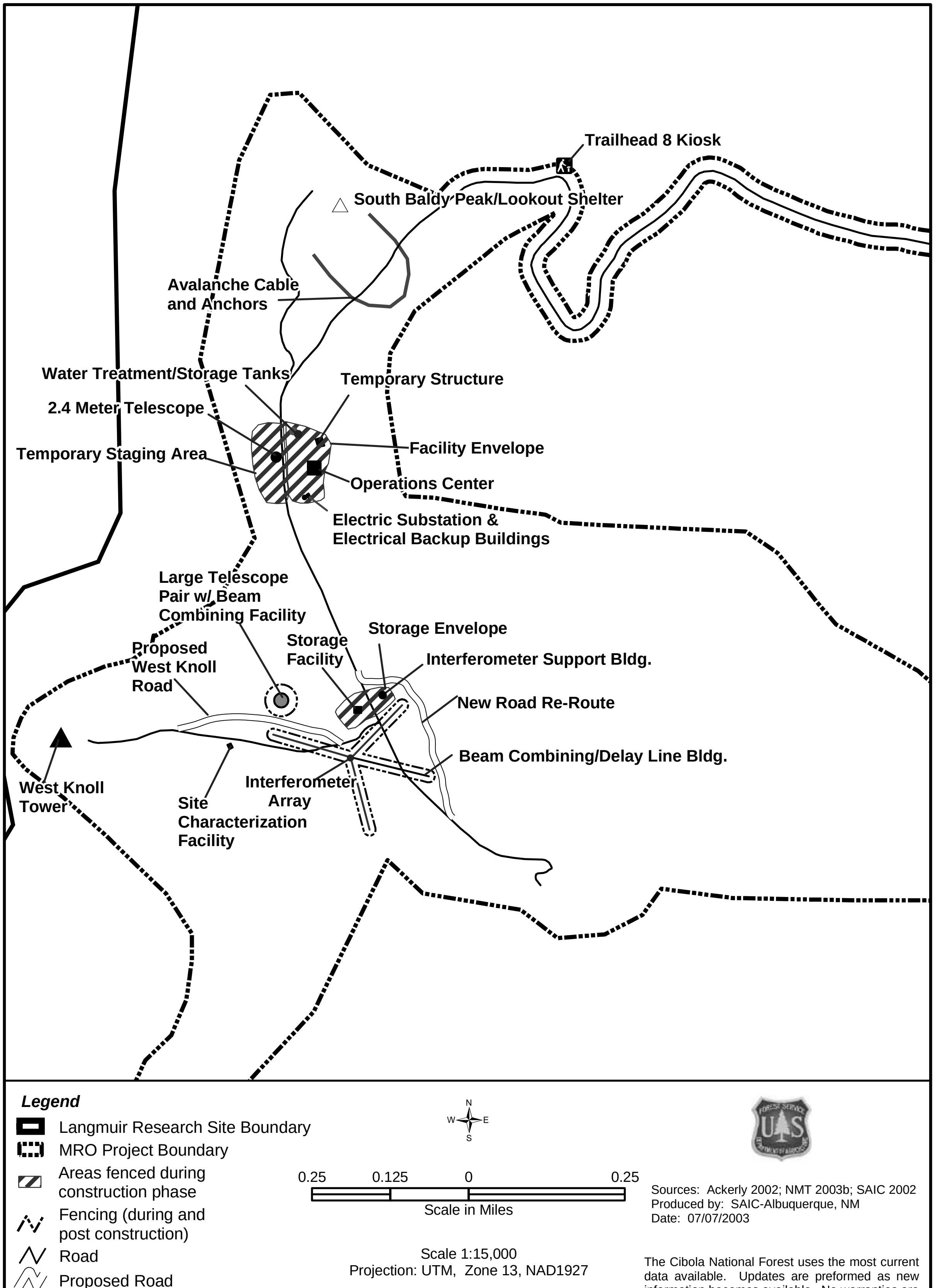
2.2.1.1 Project Overview

The new proposed MRO would be located near South Baldy Peak in the Magdalena Mountains of the Cibola National Forest (CNF) in central New Mexico. Developing the proposed MRO would include construction of new structures and infrastructure on the ridgetop near South Baldy Peak; rerouting of a portion of the access road around the new facilities; and expansion of utility services to the ridge to meet the needs of the new observatory. Construction would take place over a 4- to 5-year period.

2.2.1.2 Construction Phase

Proposed MRO Facility Development

New facilities would be sited on the ridge of the Magdalena Mountains between the main Langmuir Laboratory and South Baldy Peak (**Map 2-1**). Locations are approximate and could be altered to maximize operations or to minimize impacts. Development would have two main parts: 1) the scientific equipment consisting of an Interferometer Array and associated infrastructure; and 2) educational and research support facilities. **Table 2-1** lists all the proposed scientific equipment and associated infrastructure and the educational and research support facilities. Brief descriptions are provided below.



Map 2-1
Location of Facilities for the Proposed MRO
Proposed Action

Table 2-1. Proposed MRO Ridgetop Development

Facility	Description	Size (sf)
7.9-ft (2.4-m) Telescope	7.9-ft (2.4-m) mirror, 30-ft (9.1-m) diameter structure with dome roof, 38 ft (11.6 m) in height, with equipment room and lab.	600 (55.7 sm)
Interferometer Array	Sixteen telescopes at full buildout, each with a mirror about 4.9 ft (1.5 m) in diameter, arranged in a **Y** shape. Each arm would extend for 800 ft (244 m) from the center. The arms would radiate from the center at 120 degrees. Along each arm, there would be as many as 11 concrete pads with domes, each 12 ft by 12 ft (3.7 m by 3.7 m).	5,000 (464.5) sm
Beam-Combining/ Delay Line Building	The facility would be at least 600 ft (182.9 m) in length and about 30 ft (9.1 m) wide, with adjacent combiner room.	20,500 (1,904.5 sm)
Large Telescope Pair	Two 7.9-ft (2.4-m telescopes on circular track (165 ft [50.3 m] in diameter), with enclosures, beam-combining room, and parking “shed.”	6,600 (613.2 sm)
Operations Center	Operations Center with lab areas, dining and dormitories, bathrooms, office spaces, etc., 2 stories high.	18,600 (1,728.4 sm)
Interferometer Support Facility	An Interferometer Support Facility (about 1,500 sf [139.4 sm]) would be located close to the Beam-Combining Facility.	1,500 (139.4 sm)
Site Characterization Facility	Small domed building with telescope and associated equipment in vicinity.	100 (9.3 sm)
Electric Substation	The substation would also be located on the east slope, near the Operations Center.	2,500 (232.3 sm)
Storage Facility	This 5,000-sf (464.5 sm) storage facility would have indoor maintenance and shop areas, with compacted gravel surface for outdoor storage and parking areas (10,000 sf [929.0 sm]).	15,000 (1,393.5 sm)
Parking Areas	Gravel parking areas (about 2,000 sf [185.8 sm] each) located adjacent to Operations Center, 7.9-ft (2.4-m) telescope, and Interferometer Array for vehicle parking.	6,000 (557.4 sm)
Temporary Structure	A round temporary structure (about 40 ft [12.2 m] in diameter and 22 ft [6.7 m] in height) made of a white plastic fabric over an aluminum frame would be erected on an as-needed basis.	1,260 (117.1 sm)
Water Storage Tanks	One 120,000-gallon tank would be placed underground and would hold non-potable water for fire suppression. One or two underground tanks totaling 80,000 gallons would hold potable water for domestic water use. Alternatively, several smaller tanks could be used for potable water within the same area.	11,000 (1,021.9 sm)
Water Treatment Plant and Enclosure	A small potable water treatment ozonation facility would be located on-site.	100 (9.3 sm)

Facility	Description	Size (sf)
Wastewater System	Local septic tanks and fields would handle wastewater septic flows from the various occupied sites.	2,600 (241.6 sm)
Liquid Fuel Storage Building	Liquid fuels storage tanks enclosed (as per applicable federal and state standards) for emergency generator and water pump.	100 (9.3 sm)
Emergency Water Pump Enclosure	Small concrete block enclosure for back-up water pump.	100 (9.3 sm)
Emergency Generator Enclosure	Small concrete block enclosure for emergency power generator.	100 (9.3 sm)
Avalanche Winch and Cable	Two concrete pads to anchor winch and cable.	50 (4.7 sm)
New Roads	A total of about 1 mile (1.6 km) of new gravel roadway. Includes rerouted ridge road around east arm of array, and new road to West Knoll.	1 mile (1.6 km)

Notes: sf = square feet
ft = feet
m = meters
sm = square meters
km = kilometers

Scientific Equipment and Support Facilities

2.4-Meter Telescope

A telescope with a 7.9-foot (2.4-meter [m]) diameter mirror would be located on the site of the existing JOCR. This would be enclosed in a concrete block structure (about 30 feet [9.1 m] in diameter) with a domed roof, giving the observatory a total height of about 38 feet (11.6 m). The dome would be painted a color that would minimize glare and visual impact.

Interferometer Array

Sixteen telescopes (each with a mirror about 4.9 feet ([1.5 m] in diameter) would be arranged in a **Y** shape on three arms radiating from a central point. Each arm would extend for 800 feet (244 m) from the center. The arms would be separated from each other by 120 degrees. Along each arm there would be as many as 11 concrete pads (12 feet by 12 feet [3.7 m by 3.7 m]). One telescope would be located at the "hub" and five others along each arm in various formations using 34 concrete pads. Most of the pads would be concentrated toward the center of the **Y** with a gang of three pads adjacent to each other on each arm. A mobile crane would be used to move the telescopes from one pad to another. Alternatively, an overhead crane would operate on a rail track integrated with the structure for the telescope roof structure.

The footings for each pad would comprise three 20-foot (6.1-m) deep tubes or, alternatively, a massive conventional foundation. Each telescope would be covered by a simple framed structure or dome, which would be wheeled to the side or slide back on an overhead rail when the telescope is in use. Initially there would be seven to ten telescopes installed; additional telescopes would be installed when funding becomes available.

Five pipes, each less than 1 foot (0.3 m) in diameter, would run along the side of each arm of the array (above-ground) to convey the gathered light to a central combining facility. Gravel access roads would run along the array arms to facilitate equipment access. Conduits containing electronic cables would link the telescopes in the array to a computer terminal. To the extent possible, the conduits would be placed underground.

Beam-Combining and Delay Line Building

This facility would be constructed inside the science area near the center of the array. The facility would be at least 600 feet (182.9 m) in length and about 30 feet (9.1 m) wide. It has to be at least half as long as the maximum telescope separation. This building would be slightly sunken into the ridgetop and the cut material would be bermed around exterior walls to a depth of 1 to 2 feet (0.3 to 0.6 m) to provide passive temperature control for the facility. A beam-combining room (about 2,500 sf [232.3 sm]) housing computers and an optical table would be located in the building.

Large Telescope Pair

The large telescope pair would consist of two telescopes of approximately 7.9-foot (2.4-m) aperture sitting on a circular track, similar to a railroad track, of 165-foot (50.3-m) diameter. The tops of the telescopes would be approximately 25 feet (7.6 m) high. The footprint of each telescope would be a square approximately 16 feet (4.9 m) on each side.

At the center of the track there would be a single-story building for combining the telescope beams. Pipes approximately 8 inches (20.3 centimeters [cm]) in diameter would link the telescopes to the building. The pipes would move with the telescopes as they move on the track. The building is likely to be circular with an 82-foot (25-m) diameter.

A shed would cover the northernmost part of the circular track. It would be tall enough to house the telescopes, approximately 30 feet (9.1 m) in height, and its footprint would be large enough to house both telescopes simultaneously, approximately 20 feet by 40 feet (6.1 m by 12.2 m).

Educational and Research Support Facilities

Operations Center

Offset from the ridgeline to the east, an 18,600-sf (1,728-sm) Operations Center would be built. This facility would house the science control room, offices, the laboratory, resting quarters, a machine shop, an emergency medical treatment area, study areas, a dining area, and other living support areas. This two-story structure would be located just off the ridgetop to avoid wind turbulence. Glass window panels would be coated to lessen potential for glint and glare.

Interferometer Support Facility

An Interferometer Support Facility (about 1,500 sf [139.4 sm]) would be located close to the Beam-Combining Facility in order to provide emergency sleeping space, a break room, a computer lab, and tools for repairs.

Site Characterization Facility

This facility (about 100 sf [9.3 sm]) would have a small telescope, a domed roof, and a nearby weather station.

Electric Substation

The substation (2,500 sf [232.5 sm]) would also be located on the east slope near the Operations Center. It would house new step-down transformers. When fully operational and occupied, peak power demand for the facility would be on the order of 0.5 megawatt, not including power requirements for telescope operation.

Storage Facility

A 5,000-sf (464.5 sm) Storage Facility would have both indoor maintenance and shop areas as well as an outdoor yard for storing equipment and vehicles used in the operation and maintenance of the observatory. This building would be metal construction. Outdoor storage would have a compacted gravel yard (about 10,000 sf [929 sm]).

Temporary Structure

A round temporary structure (about 40 feet [12.2 m] in diameter and 22 feet [6.7 m high) made of a white polyvinyl fabric over an aluminum frame would be erected on an as-needed basis for activities such as student gatherings. During construction it would be used for storing and staging materials.

Water Storage Tanks and Treatment Facility

On the west side of the ridge, two or three water storage tanks would be placed partially underground to minimize wind disturbance and to prevent freezing. A 120,000-gallon tank would hold non-potable water for fire suppression. One or two tanks totaling 80,000 gallons would hold potable water for domestic water use. Alternatively, several smaller tanks linked together could be installed in the same area. A small potable water treatment ozonation facility would be located on-site.

Wastewater System

Local septic tanks and fields would handle wastewater flows from the Operations Center, the 7.9-foot (2.4-m) telescope, and the Interferometer Array site. Each of the three systems would be sized to treat the discharges from associated facilities in accordance with applicable building codes.

Electrical Backup Buildings (Liquid Fuel Storage Building, Emergency Water Pump Enclosure, and Emergency Generator Enclosure)

These three small concrete enclosures (each about 100 sf [9.3 sm]) would be located close to the electric substation. Storage would be designed to meet applicable federal and state Occupational Safety and Health Administration (OSHA) standards and regulations, which would be enforced by the Forest Service.

Avalanche Winch and Cable

An avalanche winch would be mounted on two concrete pads on the east side of the ridge, above the existing visitor kiosk.

Roads and Parking Areas

On the ridgetop, a small portion of Water Canyon Road would be rerouted around the east arm of the proposed Interferometer Array (Map 2-1), and a small section of the West Knoll Road would be rerouted around the west arm of the array. These two changes would total 1 mile (1.6 kilometers [km]) of new roadway constructed. All new road segments would be native-surfaced (with gravel as needed) and classified and built as Level 2 forest roads (FR).

In addition to the large gravel area adjacent to the Storage Facility (10,000 sf [930 sm]), there would be about three smaller gravel parking areas (each about 2,000 sf [186 sm]) next to the Operations Center, the Interferometer Array, and the 7.9-foot (2.4-m) telescope for personnel and researcher vehicles.

A temporary staging area (about 3.4 acres) (Map 2-1) would be cleared, leveled, and native-surfaced, and then used for the duration of the construction phase. After construction is complete, gravel would be removed and reused on Water Canyon Road, and the area would be reseeded in accordance with a Revegetation Plan.

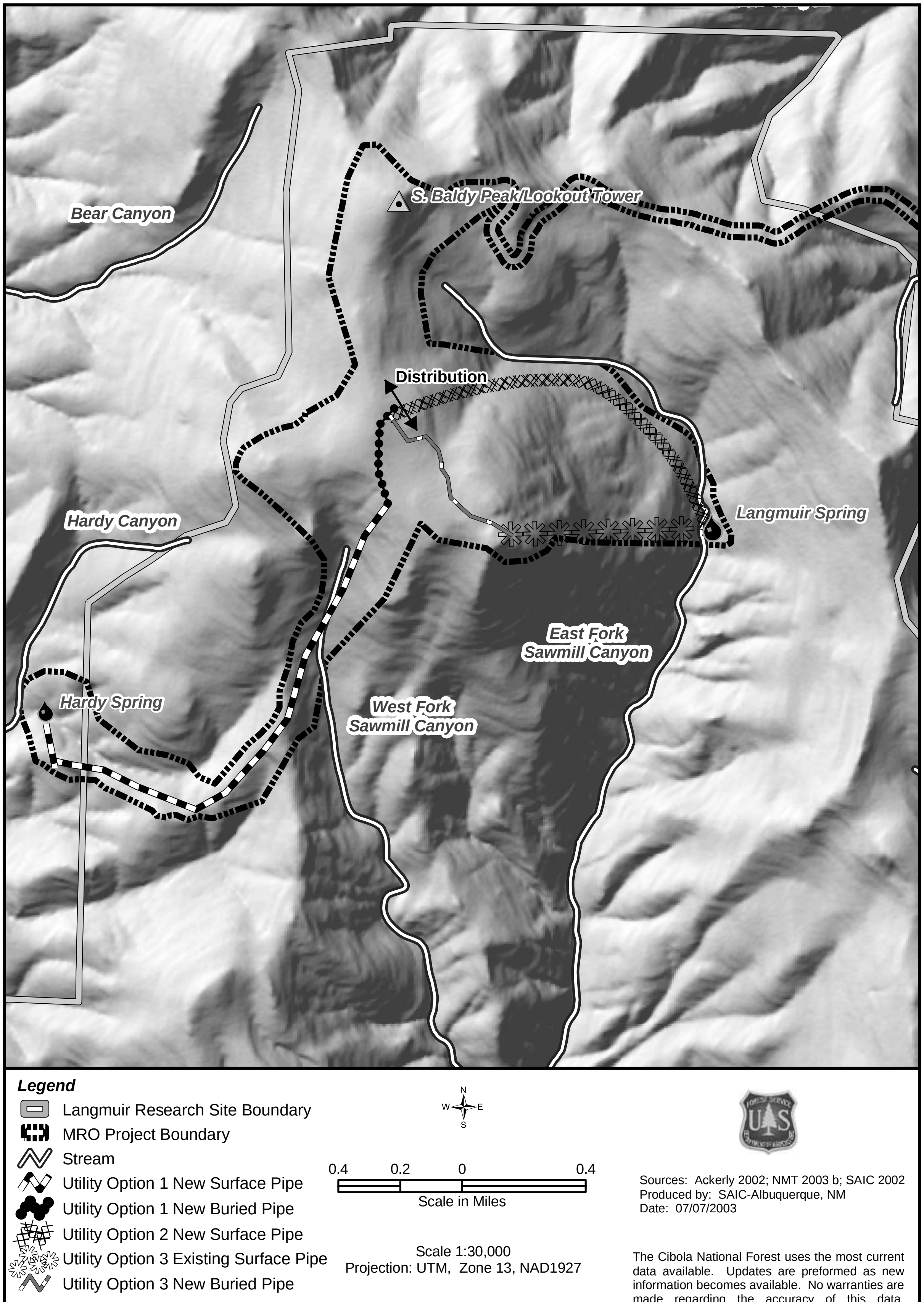
Utility Provision

Three options are being considered for providing utilities. They differ primarily in the method in which water would be provided for the proposed MRO.

Option 1

In Option 1, utilities for the proposed MRO would be brought to the ridgetop along an existing corridor from Hardy Spring (**Map 2-2**). They were originally planned to be buried along the entire length of the corridor, but in response to public concerns about ground disturbance and visual impacts (see Section 1.8), the plan was modified to provide for aboveground utilities up to the ridge.

The existing power supply to the ridge would be upgraded to three-phase 14,000 volts. No additional wiring is anticipated, but if needed, it would be added to the existing power poles. The power supply would be connected to the new electric substation building. Communications would be enhanced with a new fiber optics line and with a copper wire line for conventional telephone service. These would also use the existing power poles. At the point where the power line reaches the ridge, it would be buried. The line would connect with the West Knoll Road, then connect with Water Canyon Road, and be installed within the roadbeds. It would be buried in a 1-foot (0.3-m) wide trench at a depth of 4 feet (1.2 m). The total length of the trench is estimated at about 1,700 feet (518.2 m).



Map 2-2
Proposed Utility Provisions at the Proposed MRO

The estimated annual potable water demand is 150,000 gallons. Potable water would be treated on-site using ozonation and replenished at the rate of demand. Peak use would generally occur during the fall, winter and early spring when the nights are longest and astronomical research most active. Daily demands could be as high as about 2,000 gallons per day (gpd) for short periods. The highest demands generally would occur in non-summer months. Water saving fixtures and measures would be used to reduce consumption.

Under Option 1, the existing power supply corridor would also be used to convey water to the ridgetop storage facilities. A new well would be drilled at Hardy Spring (see Map 2-2). A new pump would be installed, and water would be pumped to the ridge in a 1.5-inch (3.8-cm) diameter surface pipe at a maximum rate of 2 gallons per minute (gpm), as needed, to replenish storage on the ridge. The pump would use electricity from the existing Socorro electric line. No additional pump stations would be needed to bring the water to the storage facilities.

At the point where the water supply pipeline reaches the ridge, the water pipeline would be buried. The line would connect with the West Knoll Road, then connect with Water Canyon Road, and be installed within the roadbeds. The pipe would be buried in a 1-foot (0.3 m) wide trench at a depth of 4 feet (1.2 m). The total length of the trench is estimated at about 2,200 feet (671 m).

During winter, the line would be drained. Potable water would be stored in one or two new underground tanks on the ridge, totaling 80,000 gallons. Alternatively, a tank farm of smaller underground tanks would be installed to provide the 80,000-gallon storage capacity. The smaller tanks could be delivered to the site without requiring assemblage on-site. If necessary, additional water could be hauled to the site during both the construction and the operation phases of the project. Non-potable water for fire suppression would be collected from rainwater collected off the Beam-Combining Building roof and stored in a 120,000-gallon underground tank. This water supply would only be replenished when, and if, used. Potable water would be distributed from the water storage tanks to the Operations Center, the 7.9-foot (2.4-m) telescope, the Interferometer Array, and the support buildings. The distribution lines would be placed underground within the existing roadbed to the extent possible with short feeder lines to facilities. The distribution lines would total about 4,000 feet (1,220 m) in length. Water would be hauled in to augment the local source, if needed.

The wastewater system would use a standard septic and leach field system. Leach fields would be placed on the downhill side of the Operations Center, the 7.9-foot (2.4-m) telescope and the Interferometer Array site. Household wastes would be collected in bear-proof dumpsters and hauled off-site as needed.

Option 2

Utility provisions would be the same as Option 1 with the exception of the source of water supply. Water would be provided from the existing surface water impoundment in the East Fork of Sawmill Canyon that currently supplies Langmuir Laboratory. The existing water supply system is undergoing comprehensive maintenance and many components are being replaced. As part of the maintenance, the area behind the existing impoundment would be scooped out and lined with rocks. Once the water supply system is restored to full operating condition, it would also supply water for the proposed MRO. Water would be drawn from this source up to 84,375 gallons per year as provided for in the existing state permit. Any water needs above this amount would be met by hauling water to the site.

Under this option, a pipe may be installed with water gravity-fed to a new water pump near the impoundment. The new pump would be placed on a concrete pad. The pump would be enclosed in soundproofing materials to achieve noise levels that are no greater than the current pump. Water would be pumped in a 1.25- or 1.5-inch (3.2- or 3.8-cm) diameter pipe (location shown in Map 2-2) to the water storage and treatment plant (see Table 2-1) on the ridge (shown in Map 2-1). To avoid ground disturbance, the pipe would be placed on the surface. Power to the new pump could also use the same alignment. Electrical cable would be contained in an 80-gauge steel conduit and also laid on the surface. Because the site is not accessible by road, the pump would be small and capable of being disassembled and carried from the ridge down to the spring without use of a motorized vehicle.

Water would be stored, treated, and distributed as described in Option 1, and the wastewater system would also be the same.

Option 3

All aspects of this option are the same as Option 2 except that a new water line would be extended to the MRO from the existing water line on the ridge next to the laboratory. A distribution pipe would be buried within the existing Water Canyon Road roadbed. It would deliver water to the water storage and treatment plant (shown in Map 2-1 and Map 2-2). The trench would be about 0.5 mile (0.8 km) in length.

Construction Process

Timeline

Construction would take place in two stages. Stage I would include all major infrastructure for the proposed MRO. Stage II involves installation of the remaining telescopes and the Large Telescope Pair. Stage II construction would be implemented when funds are available. Stage II may overlap with Stage I.

Stage I construction is projected to occur over a 4- to 5-year period. It is expected that construction work would begin in spring, 2004. During the first year, the new utility infrastructure would be developed. The existing JOCR facility would be demolished. Materials and equipment would be transported to the ridge for the major construction effort. Water for workers and mixing concrete would be hauled to the site prior to development of the new water supply and storage tanks, supplemented by the existing Langmuir water supply. Portable sanitation facilities would be placed on the site, and debris would be collected in standard construction dumpsters. Both would be serviced or removed as necessary. Clearing, grading, and excavation would be undertaken. Cut material would be reused to the extent possible as fill for roadway improvements, berming around scientific buildings, and mix for concrete. Most of the concrete work would also be accomplished in the first year, including the foundations for the full array. Work accomplished in the first year would represent about 75 percent of the heavy construction in terms of traffic and jobs.

In the second year, buildings would be constructed and interiors finished. Ten of the 16 telescopes and scientific equipment would be installed during the third and fourth years. The remaining six telescopes (Stage II) would be installed as funding became available. During the fifth year, calibration of the scientific equipment would begin. Starting that year, two to three engineers/technicians would commute to the site every day for about two years. Construction and installation of the Large Telescope Pair would occur when funding became available.

The proposed construction schedule assumes that use of Water Canyon Road would be limited during winter months. Most work would take place during a standard 5-day workweek, although work might occur on weekends, particularly in the first year. NMIMT anticipates using mitigation measures to minimize impacts on the threatened Mexican spotted owl (MSO) during construction. Preliminary measures identified to minimize impacts on MSOs are listed in Section 2.5.

Water Canyon Road may be closed above Water Canyon Campground to protect public safety during some parts of the construction process. The construction contractor would coordinate with the Forest Service for approval of road closures. Closure times would be posted at the campground kiosk, in the district office, at Water Canyon Road and U.S. Highway 60 (US 60) intersection, in local newspapers, and on the Forest Service web site. The Forest Service would provide the closure schedule in advance to those tribes who have requested continued vehicular access to the mountain (Mescalero Apache and Alamo Navajo). Closures may be timed on a daily basis, particularly in the summer and fall of the first year of construction, to allow for trucks to make deliveries to the ridge in the morning and to return in the afternoon.

Staging Areas and Development Areas

There would be several discernible construction activity areas on the ridge. An area of about 3.4 acres would be cleared and graveled for use as a temporary staging area. Materials would be stored in this location, and trucks would park and turn around in this area. The Operations Center and several support structures would be clustered in a 4.4-acre area on the east side of the ridge (see Map 2-1), opposite the existing JOCR site. The Interferometer Array would occupy an 8.9-acre site. Nearby, the Storage complex would be developed in a 2-acre site. For safety purposes, all construction sites, about 19 acres, would be fenced. Following construction, only the Interferometer Array and the large telescope pair would be fenced to safeguard the scientific equipment from damage by cattle. An area of about 9 acres would be enclosed by three-wire barbed wire fence about 4 feet (1.2 m) in height for the Interferometer Array, and about 2 acres for the large telescope pair.

Ground Disturbance, Clearing and Revegetation

Under Alternative 1, an estimated 24 acres would be disturbed by construction at the proposed MRO site for staging, facility development, new roads, utilities, and parking areas (**Table 2-2**). Less than 0.1 acre would be disturbed at the spring location for developing a water supply. Under Utility Options 1 and 3, all estimates are approximate and assume that work would be accomplished with the minimum excavation and disturbance possible. Water Canyon Road is maintained and repaired as needed under the existing Langmuir Laboratory Special Use Permit (SUP). If additional maintenance and repair is needed during the course of proposed MRO construction, an additional 24 acres of ground disturbance could occur.

Table 2-2. Estimated Acres of Ground Disturbance and Revegetation

Project Activity/Location	Ground Disturbance (acres)	Revegetated (acres)
Ridgetop:	23.4	16.8
Temporary Staging Area	3.4	3.4
Operations Center complex	4.4	3.5
Interferometer Array	8.9	6.2
Storage Area	2.0	1.7
Additional utility trenches, roads, and driveways	2.9	2.0
Large telescope pair	1.8	0
Water Supply Development:		
Spring Area	<0.1	<0.1
Water Canyon Road Maintenance and Repair	24.0	6.0
Total (approximate)	**47.4**	**22.8**

On the ridgetop, slightly less than 24 acres would be graded and disturbed by construction activities. The temporary staging area would be surfaced in native material until completion of construction. On about 6 acres near the Interferometer Array and Operations Center complex, there would be deep excavation for footings, leach fields, and trenches. Removed soil would be used for backfill. Some soil would be used to berm around the Beam-Combining Facility. The remaining area would be disturbed primarily by operation of equipment and staging.

Areas that are not directly covered by building, road, or gravel would be revegetated with appropriate native plant species. The construction contractor would develop a Forest Service-approved revegetation and monitoring program. The Forest Service would advise on suitable seed mixtures for various locations. An estimated 17 acres would be revegetated on the ridge, and a small area (less than 0.1 acre) at the water supply location. If Water Canyon Road requires additional maintenance and repair, another 6 acres outside the roadbed could be revegetated along the road.

On a recent site visit by the Forest Timber Management Specialist to the project area, about 40 trees were tagged for removal. About 31 are located where the road would be rerouted around the east arm of the array (USFS 2003f). Dead, damaged, or diseased trees would also be removed along Water Canyon Road to allow for snow removal and safe passage of vehicles. As road projects have been further refined, additional trees have been identified for possible removal, with a new total of approximately 80 trees on the ridgetop and along Water Canyon Road combined. Trees would be removed from the project area and slash from removal would be hauled off-site or chipped and dispersed.

Vehicles and Personnel

During Stage I, about 12,800 vehicular round trips are estimated during the 5-year construction period. About 3,200 round trips would be heavy trucks and 9,600 round trips would be light trucks, pick-up trucks, and personal vehicles. Seventy-five percent of the vehicular activity and construction effort (about 200 person-years[1]) would take place in the first year.

During peak construction, up to 100 workers could be on-site, but the average number of workers would be closer to 50. Including truck traffic, there would be about 50 round trips along Water Canyon Road on an average day, with 60 round trips on a busy day.

Stage II would involve 5 percent of estimated trips and 10 percent of estimated person-years of Stage I vehicle trips and person-years. These could overlap with or follow Stage I for an additional year.

In Stage II, the remaining telescopes of the Interferometer Array and the Large Telescope Pair would be installed. The area around the pair, about 2 acres, would be fenced to preclude damage to the scientific equipment by livestock.

2.2.1.3 Operational Phase

Research and Science Activities

The proposed MRO would be used primarily for research and educational programs, but the 7.9-foot (2.4-m) telescope would also support tracking of missiles during tests at White Sands Missile Range (WSMR). There would also be an ongoing monitoring of weather, seismic activity, and other conditions at the observatory. The 7.9-foot (2.4-m) telescope may also be used to monitor and track space shuttle missions.

Road Access and Maintenance

The existing Water Canyon Road (see Map 1-2) would be used for access. The portion between US 60 and Water Canyon Campground is paved. The condition of this road would be monitored before and after construction, and any required repairs would be performed in accordance with an agreement developed among NMIMT, the Forest Service, and Socorro County.

Between Water Canyon Campground and the ridgetop, the existing native-surfaced road is currently and would continue to be maintained and repaired as needed in accordance with the Langmuir Laboratory SUP and the Annual Operations and Maintenance Plan.

[1] A person-year is a unit measuring the work of one person for a year, based on a standard number of 8-hour workdays per year. Typically, a person-year equals 2,008 hours.

The road would remain classified as a Level 2 FR, suitable for high clearance vehicles. Road maintenance and repair activities conducted under the SUP could include the following:

- Low water crossings;
- Recontouring of roadbed slope;
- Leveling and gravelling of rocky segments of the road;
- Removal of obstructions (for example, trees and rock outcroppings); and
- Addition of culverts and drainage features as needed.

A terrain trimmer could be used to resurface Water Canyon Road for ongoing and future maintenance and repair. Using this equipment would reduce the time for resurfacing, eliminate the need for blasting, and minimize grinding and dust-generating activities. The equipment would be followed by a water truck to provide water for dust abatement.

With access needed to the proposed MRO in the winter, standard contract provisions would be employed to avoid road rutting and sedimentation of drainages and streams (Marks 2003). There would continue to be a lockable gate on the road below the proposed MRO site in order to limit vehicular access. Access for permitted activities (e.g., grazing, hiking, and for America Indian traditional cultural and religious activities) would continue.

Site Users

Personnel

Initially, during telescope operational setup, there would be a 1- to 2-year period when only a small core of technical staff (about two or three engineers/technicians) would commute to the observatory on a daily basis. About two or three persons would reside at the site on a 24-hour basis. These would include a security/safety chief, an engineer, and a maintenance technician. Staff would use a vanpool. On average, about one or two round trips to the site would be expected per day, with occasional additional daily trips for special research projects. Once fully operational, there could be one or two extra trips a day to bring up researchers and students.

Researchers and Students

About 300 scientists per year would visit the proposed MRO. Scientists may stay for a few weeks, spending a few days at the proposed MRO and a couple of weeks in Socorro, on average. While the facility would have a capacity for up to 20 residents, this number would be expected occasionally for brief periods only. Typically, larger groups would be brought up daily, while smaller groups could stay overnight. Students could participate in day trips or longer research projects using the telescopes at the proposed MRO. The proposed MRO would be most active in winter when there is less cloud cover and longer hours of darkness. Except for calibration, maintenance, and reconfiguration functions, most scientific activity could take place at computer terminals at off-site locations. There may be an annual proposed MRO conference hosted by NMIMT that would attract up to 300 scientists to Socorro for a week.

Public

Information describing the proposed MRO purpose and function would be displayed at a Forest Service kiosk at Trailhead 8. The proposed MRO would be located within a National Forest, and the public would have access to the site either on foot, horseback, skis, or other non-vehicular means. The public would continue to have access to trails and the ridge for a variety of dispersed recreational activities. Except for the fenced array and Large Telescope Pair, the public would be able to walk around the outside of facilities. NMIMT would periodically sponsor public events and tours of the proposed MRO.

Maintenance Activities

Site Maintenance

Grounds maintenance, avalanche control, and road maintenance would be performed by NMIMT in accordance with an amended SUP and Annual Operations and Maintenance Plan. The SUP would require NMIMT to keep areas cleared of vegetation around facilities and equipment as needed, but clearing would be kept to a minimum. NMIMT and the Magdalena Ranger District (MRD) would coordinate efforts for minimizing fire hazard on the ridgetop. NMIMT would provide a new water supply of 120,000 gallons for defending facilities on the ridge.

Each year, water supply lines would be drained before winter, and pumps would be disassembled and taken to NMIMT for annual servicing. The use of smaller pumps would allow them to be carried out in sections in back packs, without requiring vehicular access.

Equipment stored and operated at the proposed MRO would include a pumper truck, a travel crane (for moving telescopes), a tractor with snowplow blades, a pick-up truck, a commuter van, and possibly a fire engine.

Emergency response capabilities would include one on-site person trained as an Emergency Medical Technician. A specially equipped vehicle or ambulance would also be kept at the site. This would augment the current system of notifying NMIMT campus police who dispatch appropriate service to all emergencies. If needed, this could include helicopter evacuation.

Household cleansers (including bleach and Clorox) would be used for general household cleaning. Solvents would be stored and used at the proposed MRO for cleaning electronic components. This is similar to the existing situation for Langmuir Laboratory, except that there would be an increase in the amounts needed for the expanded facilities. All materials would be stored, handled, used, and disposed of in accordance with applicable state and federal standards and regulations.

Equipment Maintenance

Minor cleaning of mirrors using carbon dioxide, deionized water, and ethyl alcohol would take place at the proposed MRO. Major cleaning of large telescopes (involving the use of potassium dichromate and a vacuum chamber) would continue to occur at NMIMT. Mirrors would be transported to Socorro in a standard pick-up truck, equipped with a suitable shock-absorbing system.

There would be a new emergency power generator for the proposed MRO (that may operate for short periods for testing and maintenance, averaging 16 hours per year). For infrequent emergencies, the generator could operate for about 40 or 50 hours. Also, an emergency water pump would be installed close to the other utility equipment on the ridgetop. Both back-up systems would operate on liquid fuel.

2.2.2 Alternative 2: No Action

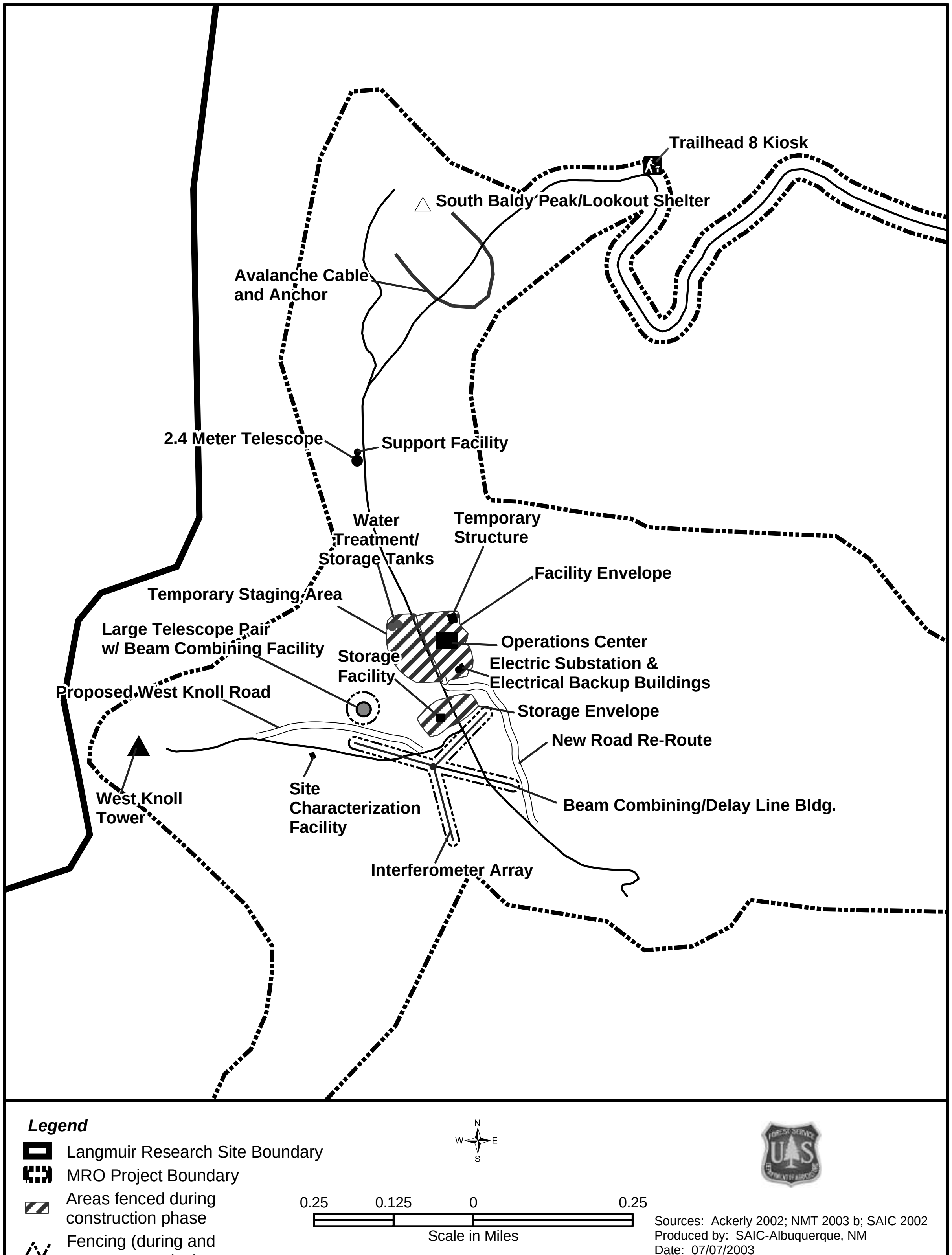
Under the No Action Alternative, current management plans would continue to guide management of the project area under the existing SUP and Annual Operations and Maintenance Plan. The activities associated with operation and maintenance of Langmuir Laboratory would continue, including continued use of water from East Fork Sawmill Canyon Creek under the existing state authorization. Water Canyon Road would continue to be maintained and repaired as needed in accordance with the existing Langmuir Laboratory Operations and Maintenance Plan to provide access for the Langmuir facility, recreation, and other permitted forest uses. Map 1-3 shows the location of the existing Langmuir Laboratory facilities.

2.2.3 Alternative 3: Preferred Alternative

Alternative 3 differs from the Proposed Action in the location of some of the facilities on the ridge. In response to issues concerning ground disturbance and reduction in aesthetic quality raised by the public during scoping (see Section 1.8), NMIMT identified a location for the Operations Center and main cluster of support facilities farther south on the ridge, closer to the Interferometer Array (**Map 2-3**). This alternate site is flatter and less visible from off-site locations. Construction in this location would also require less excavation, responding to public concern about ground disturbance. This location would also improve operational efficiency for the proposed MRO. Utility distribution trenches would be designed to minimize disturbance and would be placed in roadbeds to the extent possible. For these combined reasons, this is the Preferred Alternative.

The following additional differences from the Proposed Action would apply under this alternative:

- The Operations Center would be smaller in size (9,800 sf [910.5 sm]) and one story high.
- There would be no need for a separate Interferometer Support Facility because the Operations Center would be close by.
- The 7.9-foot (2.4-m) telescope would need a separate nearby support building (about 1,500 sf [139.4 sm]) for labs, offices, sleeping quarters, and equipment.
- The electric substation would be downsized to about 1,500 sf (139.4 sm).



Scale 1:15,000
Projection: UTM, Zone 13, NAD1927

Sources: Ackerly 2002; NMT 2003 b; SAIC 2002
Produced by: SAIC-Albuquerque, NM
Date: 07/07/2003

The Cibola National Forest uses the most current data available. Updates are preformed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 2-3
Location of Facilities for the Proposed MRO
Alternative 3

With slightly smaller building footprints, there would be a very slight reduction in ground disturbance compared to Alternative 1 (less than 1 acre on the ridgetop). All three utility options described for Alternative 1 would be considered (Map 2-2). While the location of some facilities would differ, the construction process and operational phase under this alternative would be the same as described for Alternative 1.

2.2.4 Alternative 4

Alternative 4 was also developed in response to public concerns about ground disturbance and changes in aesthetic character of the area. It differs from the Proposed Action in the location of the Operations Center and associated support buildings on the ridge. The Operations Center would be located farther north on the ridge near the existing visitor kiosk (**Map 2-4**). As with Alternative 3, this location is flatter requiring less excavation and soil disturbance and is less visible from off-site locations. The following differences from the Proposed Action would apply under this alternative:

- The Operations Center would be smaller in size (9,800 sf [910.5 sm]) and one story high.
- The 7.9-foot (2.4-m) telescope would need a separate nearby support building (about 1,500 sf [139.4]) for labs, offices, sleeping quarters, and equipment.
- The electric substation would be downsized to about 1,500 sf (139.4 sm).

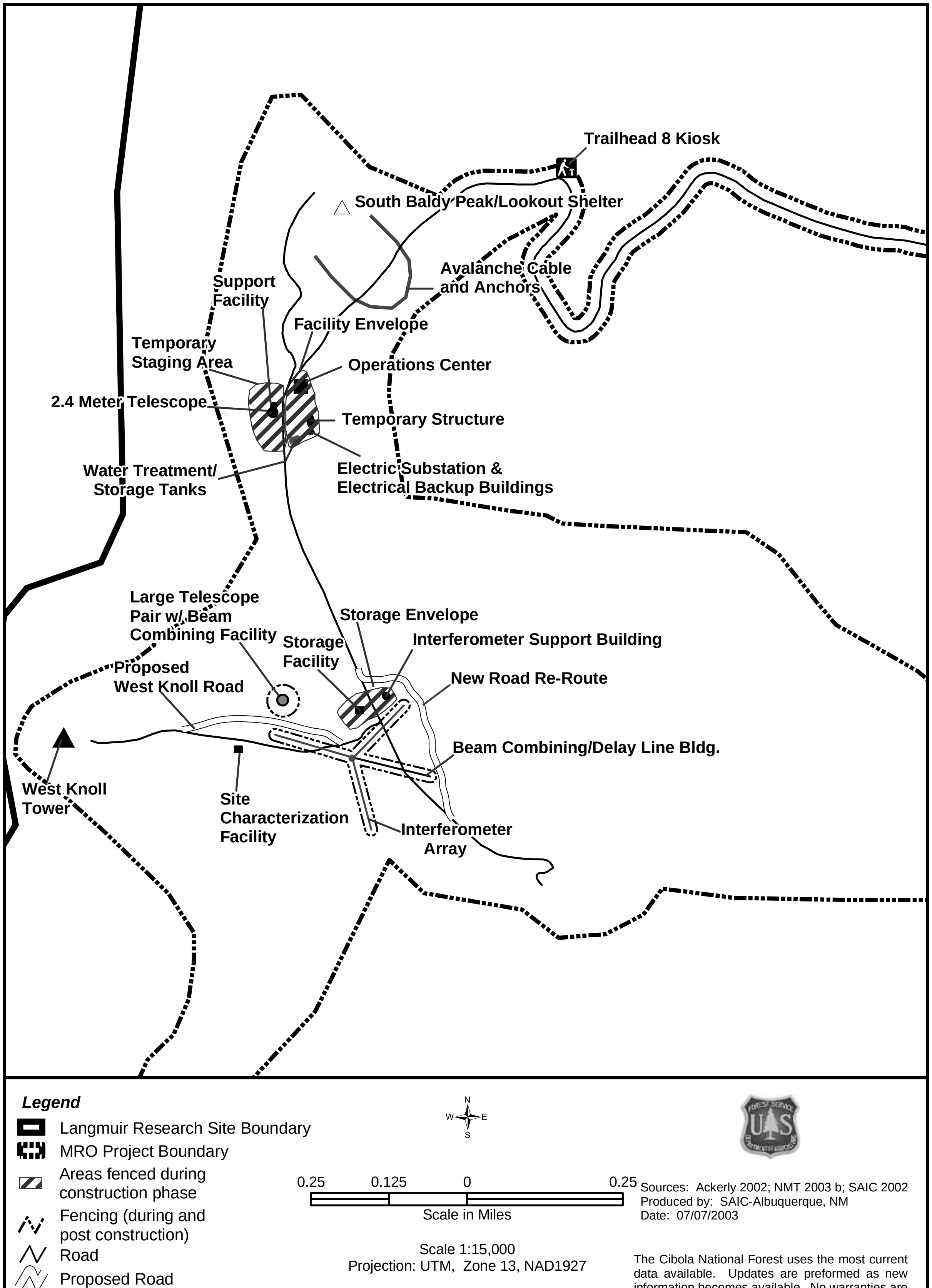
All three utility options described for Alternative 1 would be considered (Map 2-2). While the location of some facilities would differ, the construction process and operational phase under this alternative would be the same as described for Alternative 1.

2.2.5 Design Criteria to Reduce Environmental Impacts

The Proposed Action and Alternatives 3 and 4 incorporate several criteria to reduce potential impacts that may be associated with proposed MRO construction and operations as described below.

Rocks from excavated areas on the ridge would be crushed and used on-site for road maintenance and repair and constructing graveled parking areas. Materials would also be used for resurfacing or mixed with concrete in order to maintain as much of the natural color of the surrounding landscape as possible.

Several plans would be required and developed prior to construction to address specific methods to be used during construction to minimize environmental impact. These would include any plans required by the Forest Service or other regulatory agencies, including development of a Surface Water Pollution Prevention Plan (if needed, as part of the application for a National Pollutant Discharge and Elimination System [NPDES] permit), a Stormwater/Erosion Control Plan, a Noxious Weed Management Plan, a Revegetation Plan, a Dust Abatement Plan, and a Traffic and Safety Plan. These may be separate plans or combined, where practical, into a plan addressing different elements listed above.



Map 2-4
Location of Facilities for the Proposed MRO
Alternative 4

A construction phase fire plan would be developed tiered to the CNF fire restrictions and closures that regulate how, when, and where construction activities take place with regard to Forest and state fire closures or restrictions.

To reduce visual impacts, project structures and equipment would be painted in natural non-reflective colors, as needed. Non-reflective coatings would be applied to glazing that is visible beyond the project area boundary.

Specific measures to minimize impacts on the MSO, a federally threatened species in the project area, include the following:

- Work during daylight hours only;
- When possible, perform road projects in Protected Activity Centers (PAC)[2] outside the breeding and rearing season (July through February);
- Limit road maintenance and repair in PAC areas to hours between 2 hours after sunrise and 2 hours before sunset during the breeding and rearing season (March through August);
- Install sound-insulating housing around new pump/motor at water source location (Sawmill Canyon option);
- Digging and excavating would be done by hand in the Baldy Spring PAC;
- Install water line and pump during months outside the breeding season for owls (and use alternate temporary water supply sources until new source can be developed and utilized);
- Minimize duration of road maintenance and repair work;
- Limit or avoid using primary and secondary rock crushers and conventional ripping (which is louder and takes longer than the proposed process) for road work;
- Limit hauling of rock base material;
- Avoid blasting or use of pneumatic charge drilling.

See Section 2.5 for additional mitigation measures.

2.3 Alternative Sites Considered but Eliminated from Detailed Study

Federal agencies are required by National Environmental Policy Act (NEPA) to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 Code of Federal Regulations [CFR] 1502.14). Comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. A number of potential locations were considered (see **Table 2-3**), but those that did not accord with these needs were dismissed from detailed consideration.

[2] The U.S. Fish and Wildlife Service defined guidelines in *Recovery Plan for the Mexican Spotted Owl* (USFWS 1995) for agencies to delineate areas for the protection of the MSO. These areas, known as Protected Activity Centers, include an "activity center" with the best nesting and roosting habitat in the area surrounded by at least 600 acres.

The locations were evaluated for conformity with both scientific and operational criteria. The selection process considered the extent to which existing infrastructure would minimize the amount of new construction and thereby limit change to the environment. Locations in Wilderness Areas (WA) were not considered. The criteria used in the comparison and the potential locations are listed in Table 2-3. An "X" in a cell indicates that the site satisfies the criterion. Magdalena Ridge offers superior conditions for the scientific functions. It also provides the best opportunity to use existing physical infrastructure. Because no locations other than the Magdalena Ridge site satisfied all the criteria, others were not considered viable alternatives to the proposed site.

Table 2-3. Comparison of Location Options

Criteria	Site[1]							
	Mt. Withington	Nogal Peak	Sierra Blanca Peak	Manzano Peak	Ladrone Peak	Caballo Mountains	Polvadera Peak	Magdalena Ridge
Scientific Needs								
Known levels of wind-blown dust								X
Low levels of nighttime light pollution	X							X
Large number of clear nights per year				X	X			X
Above 7,500 feet (2,286 m)	X	X	X	X	X			X
Proven good astronomical seeing				X				X
Flat area[2]				X				X
Operational and Environmental Needs								
Previously developed site			X			X	X	X
Pre-existing environmental studies								X
Electricity available			X			X	X	X
Water available			X					X
Physically accessible by road	X		X			X	X	X
Reasonable distance from campus				X	X		X	X
Support facilities present							X	X
Uninterrupted view to Ft. Wingate area	X	X	X	X	X			X
Straight-line visibility to N. Oscura Peak, White Sands Missile Range	X	X	X	X	X			X
Criteria Satisfied	**5**	**3**	**7**	**7**	**5**	**3**	**5**	**15**

Note: (1) All sites are in New Mexico.
(2) Large enough for **Y**-shaped array with arms 787 feet (240 m) in length. This is represented by a 39-acre circular area.

The original pre-scoping proposal outlined methods for upgrading infrastructure to the selected site. The concepts involved placing a new "utility umbilical" with water, power, and communication lines in an underground trench. Two alignments for the trench were being considered. As a result of comments received during pre-scoping and scoping (see Appendix A) regarding concerns for visual impacts, erosion, and habitat changes, NMIMT reevaluated this utility concept. Subsequently, the underground utility umbilical concept was eliminated.

2.4 Comparison of Alternatives

This section compares the four alternatives analyzed in detail in order to define the issues and provide a clear basis of choice for the decisionmaker. **Table 2-4** compares the key features of the alternatives. **Table 2-5** summarizes and compares the environmental impacts among the four alternatives.

Table 2-4. Comparison of Alternatives

Identified Activities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Facility Locations [1]				
7.9-ft (2.4-m) Telescope	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak	Not applicable	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak
7.9-ft (2.4-m) Telescope Support Building	Not applicable	Not applicable	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak	On west side of Water Canyon Road 2,187 ft (667 m) south of South Baldy Peak
Interferometer Array	Majority on west side of Water Canyon Road 4,637 ft (1,414 m) south of South Baldy Peak	Not applicable	Majority on west side of Water Canyon Road 4,637 ft (1,414 m) south of South Baldy Peak	Majority on west side of Water Canyon Road 4,637 ft (1,414 m) south of South Baldy Peak
Interferometer Support Facility	4,136 ft (1,261 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	Not applicable	4,136 ft (1,261 m) west side of Water Canyon Road, south of South Baldy Peak
Beam Combining and Delay Building	4,834 ft (1,447 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,834 ft (1,447 m) west side of Water Canyon Road, south of South Baldy Peak	4,834 ft (1,447 m) west side of Water Canyon Road, south of South Baldy Peak
Large Telescope Pair	4,195 ft (1,279 m) west side of Water Canyon Road, south of South	Not applicable	4,195 ft (1,279 m) west side of Water Canyon Road, south of South	4,195 ft (1,279 m) west side of Water Canyon Road, south of South

Identified Activities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Baldy Peak		Baldy Peak	Baldy Peak
Operation Center	2,214 ft (675 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,598 ft (1,097 m) east side of Water Canyon Road, south of South Baldy Peak	1,548 ft (472 m) east side of Water Canyon Road, south of South Baldy Peak
Site Characterization Facility	4,641 ft (1,415 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,641 ft (1,415 m) west side of Water Canyon Road, south of South Baldy Peak	4,641 ft (1,415 m) west side of Water Canyon Road, south of South Baldy Peak
Electric Sub Station	2,483 ft (757 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,834 ft (1,169 m) east side of Water Canyon Road, south of South Baldy Peak	1,909 ft (582 m) east side of Water Canyon Road, south of South Baldy Peak
Storage Facility	4,251 ft (1,296 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	4,251 ft (1296 m) west side of Water Canyon Road, south of South Baldy Peak	4,251 ft (1,296 m) west side of Water Canyon Road, south of South Baldy Peak
Temporary Structure	1,997 ft (609 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,398 ft (1,036 m) west side of Water Canyon Road, south of South Baldy Peak	1,817 ft (554 m) west side of Water Canyon Road, south of South Baldy Peak
Water Storage Tanks	1,938 ft (591 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,460 ft (1,055 m) west side of Water Canyon Road, south of South Baldy Peak	2,000 ft (610 m) east side of Water Canyon Road, south of South Baldy Peak
Electrical Backup Buildings (Liquid Fuel Bld., Water Pump Bld. and Generator Bld.)	2,483 ft (757 m) east side of Water Canyon Road, south of South Baldy Peak	Not applicable	3,834 ft (1,169 m) east side of Water Canyon Road, south of South Baldy Peak	1,909 ft (582 m) east side of Water Canyon Road, south of South Baldy Peak
Avalanche Winch and Cable	924 ft (282 m) west side of Water Canyon Road, south of South Baldy Peak	Not applicable	924 ft (282 m) west side of Water Canyon Road, south of South Baldy Peak	924 ft (282 m) west side of Water Canyon Road, south of South Baldy Peak
Utilities				
Alignment Option 1	X	Not applicable	X	X
Alignment Option 2	X	Not applicable	X	X
Alignment Option 3	X	Not applicable	X	X

Identified Activities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Roads				
Road Maintenance and Repair	Ongoing as identified in the existing Langmuir Laboratory SUP	Ongoing as identified in the existing Langmuir Laboratory SUP	Ongoing as identified in the existing Langmuir Laboratory SUP	Ongoing as identified in the existing Langmuir Laboratory SUP
Road Realignment	1 mile (1.6 km)	0 miles (0 km)	1 mile (1.6 km)	1 mile (1.6 km)
Significant Issues				
Issue 1 – Ground Disturbance **Units of Measure** – Acres of ground disturbance	47.41 acres	24 acres	47.14 acres	47.18 acres
Issue 2 – Changes in Visual Quality **Units of Measure** – Change in VQO percentages	Partial (75% of the area) Modified (25% of the area)	Partial (75% of the area) Modified (25% of the area	Partial (75% of the area) Modified (25% of the area)	Partial (75% of the area) Modified (25% of the area)

Notes: (1) All distances are approximate.
SUP = Special Use Permit
km = kilometers
ft = feet
m = meters
VQO = Visual Quality Objective

Table 2-5. Comparison of Environmental Impacts by Alternative

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Geology and Soils				
Direct Impacts				
Ridgetop	Estimated 23.41 acres of ground disturbance, including utilities. Erosion would be minimal.	No additional ground disturbance.	Estimated 23.14 acres of ground disturbance, including utilities. Erosion would be minimal.	Estimated 23.18 acres of ground disturbance, including utilities. Erosion would be minimal.
Utility Options	Options 2 and 3 require less trenching than Option 1.	No trenching.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Maintenance and repair will continue to decrease erosion.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Minimal potential for sedimentation.	No additional sedimentation.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Cumulative impacts would be minimal.	No cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Resources				
Direct Impacts				
Ridgetop	Water quality impacts from proposed MRO construction expected to be insignificant.	No impacts from proposed MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Option 1 would increase water use from Hardy Spring. Under Options 2 and 3, any water demand beyond the state authorize use of 84,375 gpy from East Sawmill Canyon Creek would be met by hauling water to the site.	No increase in water use.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Maintenance and repair will have minimal impact on drainage.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	Minimal impacts on vegetation, riparian areas, and other water users.	No change to vegetation, riparian areas, or other water users with respect to water quality and quantity.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Cumulative impacts would be minimized with implementation of mitigation measures.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Air Quality				
Direct Impacts				
Ridgetop	Air emissions during construction would be temporary and cease with completion of construction activities. As a high estimate, construction-related emissions in the first year are estimated to be 24.6 tons of carbon monixide (CO), 5.0 tons of organic compounds (VOC), 52.0 tons of nitrogen oxides (NO_x), less than a ton of sulfur oxides (SO_x), and 10.2 tons of PM_{10}. When fully operational, operation emissions are estimated to be 4.9 TPY of CO, 3.6 TPY of VOCs, 0.5 TPY of NO_x, and less than 0.1 TPY of SO_x and PM_{10}.	No increase in air pollutant emissions due to the proposed MRO.	Construction-related air emissions would be slightly less than under Alternative 1. Operations emissions would be the same as under Alternative 1.	Construction-related air emissions would be slightly less than under Alternative 1 and marginally greater than Alternative 3. Operations emissions would be the same as under Alternative 1.
Utility Options	There would be no air pollutant emissions associated with the utility options.	No air pollutant emissions due to the proposed MRO.	There would be no air pollutant emissions associated with the utility options.	There would be no air pollutant emissions associated with the utility options.
Water Canyon Road	Maintenance and construction of Water Canyon Road would generate 0.2 TPY of VOCs and NO_x and less than 0.1 TPY of CO, SO_x, and PM_{10}.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	The increase in visitors to Magdalena Ridge would result in an estimated increase of 0.3 TPY of CO and less than 0.1 TPY of other pollutants	No increase in indirect air emissions due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Minor increase in fire risk from additional traffic could result in temporary decrease in air quality and visibility from fire.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Noise				
Direct Impacts				
Ridgetop	Facility construction is estimated to generate 8-hour L_{eq} of about 60 dBA at a distance of 100 feet (30 meters) from the construction location.	No additional noise generated by MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Minimal, short-term elevated noise levels would occur during installation of the utility lines.	No additional noise generated by utility line construction.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Vehicular traffic during construction would generate a 24-hour L_{eq} of about 41 dBA and 1-hour L_{eq} of about 55 dBA at a distance of 100 feet (30 meters) from the road. Noise levels from road maintenance and repair would have a 24-hour L_{eq} of 60 dBA and peak 1-hour L_{eq} of about 73-74 dBA at a distance of 100 feet (30 meters) from the road.	No construction related noise due to the proposed MRO. Noise levels from road maintenance and repair would be the same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	Noise generated by MRO could indirectly affect wildlife and recreationists.	No additional impact from the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Noise events associated with MRO activities would contribute to cumulative impacts from other noise events such as periodic and intermittent blasting at NMIMT's Energetic Materials Research and Testing Center.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Fire Management				
Direct Impacts				
Ridgetop	A construction phase fire plan tiered to the CNF fire restrictions would minimize increased fire risk from construction.	No increased fire risk from proposed MRO construction.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	None of the utility options would affect fire management.	No impact due to the proposed MRO.	No impact due to MRO.	No impact due to MRO.
Water Canyon Road	Additional traffic and repair and maintenance activities have the potential to increase the risk of human-caused fires.	No increase in traffic due to the proposed MRO. Repair and maintenance activities have the potential to increase the risk of human-caused fires.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Increase in fire risk could indirectly affect vegetation and wildlife resources.	No indirect impacts from the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Combined increases in traffic and human activity would generally increase the potential for human-caused fires.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Transportation				
Direct Impacts				
Ridgetop	About 1 mile (1.6 km) of new access road and new parking lots would be constructed. Construction is not expected to disrupt existing operations or significantly impact recreation access. Stage I construction is estimated to generate 12,800 additional round trips. Operational phase expected to generate fewer than 5 additional trips per day.	No change in transportation due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Utility corridor would not alter road transportation or vehicle access.	No change due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Road maintenance and repair will allow for safer and more efficient use of the road.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO may attract additional visitors and increase traffic to Magdalena Ridge.	No change due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO improvements would add to benefit of expanded parking planned at Trailhead 8.	No new cumulative impact due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Vegetation				
Direct Impacts				
Ridgetop	About 23.41 acres of mountain meadow and San Mateo beardtongue habitat would be disturbed by construction and approximately 7 acres would be permanently lost to development.	No disturbance or loss of grasslands and San Mateo beardtongue habitat due to the proposed MRO.	About 23.14 acres of mountain meadow and San Mateo beardtongue habitat would be disturbed by construction. Land permanently lost to development would be about 3,200 sf less than Alternative 1.	About 23.18 acres of mountain meadow and San Mateo beardtongue habitat would be disturbed by construction. Land permanently lost to development would be about 1,500 sf less than Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	Little to no disturbance of vegetation from Options 2 and 3. Option 1 trenching would disturb less than half an acre.	No additional disturbance of vegetation due to the proposed MRO.	Same as Alternative 1	Same as Alternative 1
Water Canyon Road	Up to 12 acres of vegetation could be disturbed by road maintenance and repair.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Indirect Impacts	Fires started by construction equipment could spread and affect the San Mateo beardtongue, a Forest Service Sensitive and state Rare species.	No additional fire risk associated with the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO development would add to combined long- and short-term loss of 8.8 percent of the subalpine plant community on the top of Magdalena Mountain.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1	Same as Alternative 1
Wildlife				
Direct Impacts				
Ridgetop	Minor impacts to neotropical migratory birds, other bird species of concern, MIS, and special status species, including the threatened MSO due to ground disturbance. No direct loss of MSO PAC. There would be a small reduction in elk habitat. Mountain meadow habitat would be reduced by 7 acres.	No change due to the proposed MRO.	Impacts from ground disturbance slightly less than Alternative 1.	Impacts from ground disturbance slightly less than Alternative 1 and marginally greater than Alternative 3.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	Implementation of any Utility Option would have minimal impact to neotropical migratory birds, other bird species of concern, MIS, and special status species. Option 2 would cross the Baldy Spring MSO PAC, but surface laying of pipes is not expected disturb MSO habitat.	No change due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Potential loss of 12 acres of forested land along Water Canyon Road due to maintenance and repair would have minimal impact on neotropical migratory birds, other bird species of concern, and MIS. Impacts to the MSO in the Timber Peak PAC from maintenance and repair of Water Canyon Road would be mitigated by avoiding sensitive times and breeding months for the MSO.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	No indirect loss of wildlife habitat is expected. Noise from construction equipment and activities could result in bird movement and/or reduced breeding success within 100 feet of construction sites and Water Canyon Road. Noise associated with ridgetop construction would likely reduce elk use during daylight hours. MSO use of areas within 100-125 feet (30-38 meters) of Water Canyon Road may be temporarily reduced along a 2,000-foot (600 meter) stretch of the road.	No change in habitat or noise effects due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumulative Impacts	MRO development in combination with existing development on Magdalena Ridge would result in loss of about 10 acres of mountain meadow habitat in the project area, a reduction of less than 2 percent.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Rangelands				
Direct Impacts				
Ridgetop	MRO development would result in a short-term reduction of 24 acres of grazing allotment, equivalent to 3 AUMs, and long-term loss of 13 acres, equivalent to less than 2 AUMs.	No change in grazing allotment or AUMs due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Utility Options would have no effect on rangelands.	No effect on rangelands from the proposed MRO.	Utility Options would have no effect on rangelands.	Utility Options would have no effect on rangelands.
Water Canyon Road	Road maintenance and repair could result in a long-term reduction of 6 acres of grazing allotment.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Road closures during maintenance and repair of Water Canyon Road could temporarily inconvenience grazing permitees.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO development would contribute minimally to cumulative decreases in available rangeland habitat.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Lands and Realty				
Direct Impacts				
Ridgetop	MRO development would convert approximately 13 acres of undeveloped land to development.	No conversion of undeveloped land due to the proposed MRO.	Conversion of undeveloped land would be slightly less than Alternative 1.	Conversion of undeveloped land would be slightly less than Alternative 1 and marginally more than Alternative 3.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	Options 1 and 3 would be located in existing utility corridors. Option 2 would change approximately half an acre to utility easement.	No change in land use or realty due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	The Forest Service will seek to obtain a right-of-way for the portion of Water Canyon Road that passes through private land.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO development is not expected to have any indirect impact on land use or realty.	No indirect impact due to the proposed MRO.	MRO development is not expected to have any indirect impact on land use or realty.	MRO development is not expected to have any indirect impact on land use or realty.
Cumulative Impacts	MRO development would not contribute to cumulative land and realty impacts.	No new cumulative impacts due to the proposed MRO.	MRO development would not contribute to cumulative land and realty impacts.	MRO development would not contribute to cumulative land and realty impacts.
Visual Resources				
Direct Impacts				
Ridgetop	MRO development would not change VQOs.	No change in visual resources due to the proposed MRO.	MRO development would not change VQOs. Ridgetop facilities would be less visible than under Alternative 1.	MRO development would not change VQOs. Ridgetop facilities would be less visible than under Alternative 1.
Utility Options	Utility Options would have minimal effect on visual resources.	No change in visual quality due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Maintenance and repair work would be noticeable to travelers along the road but would not be out of context.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	Increased risk of human-caused fires could result in alteration in the landscape.	No increase in potential for changes in landscape caused by fire due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	MRO development would contribute to an overall change in the landscape of the region caused by increased development.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Recreation				
Direct Impacts				
Ridgetop	Construction activities would detract from the recreational experience of ridgetop visitors. Approximately 19 acres of undeveloped land would be removed from potential open space recreational use. Recreation Opportunity Spectrum designations would not change.	No change in recreational opportunities or experience due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	Option 1 would affect the quality of the recreational experience along portions of Trails 19, 21, and 22 to an insignificant degree. Option 2 would have a similar effect on Trail 93. There are no trails in the vicinity of Option 3.	No impact on recreational use of trails from the proposed MRO utilities.	Same as Alternative 1.	Same as Alternative 1.
Water Canyon Road	Road closures during MRO construction would intermittently and temporarily limit access to recreation areas above Water Canyon Campground. Road maintenance and repair would also temporarily limit access above the campground.	No limits in access due to the proposed MRO construction. Road maintenance and repair would temporarily limit access above the campground.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	Recreational use of Magdalena Ridge could increase due to improved access along Water Canyon Road.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	The attraction of MRO, in combination with improved parking at Trailhead 8, relocation of the visitor's kiosk, and improved access along Water Canyon Road, could increase visitors to Magdalena Ridge and reduce recreational experiences that are more conducive to quiet or naturalness.	MRO attraction would not add to visitor use of Magdalena Ridge.	Same as Alternative 1.	Same as Alternative 1.
Minerals				
Direct Impacts				
Ridgetop	MRO development would have no impact on mining or minerals.	No impact due to the proposed MRO.	MRO development would have no impact on mining or minerals.	MRO development would have no impact on mining or minerals.
Utility Options	None of the Utility Options would affect mining or minerals.	No impact due to the proposed MRO.	None of the Utility Options would affect mining or minerals.	None of the Utility Options would affect mining or minerals.
Water Canyon Road	Construction traffic could impede access to and removal of material from mining claims on private land off Water Canyon Road, although there are currently no active claims and a low probability of the claims becoming active.	No impact due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	MRO development would have no indirect impacts on minerals.	No impact due to the proposed MRO.	MRO development would have no indirect impacts on minerals.	MRO development would have no indirect impacts on minerals.
Cumulative Impacts	MRO would not contribute to any cumulative impacts on minerals.	No new cumulative impacts due to the proposed MRO.	MRO would not contribute to any cumulative impacts on minerals.	MRO would not contribute to any cumulative impacts on minerals.
Heritage and Cultural Resources				
Direct Impacts				
Ridgetop	MRO construction and operations are not expected to affect heritage and cultural resources.	No impacts due to the proposed MRO.	MRO construction and operations are not expected to affect heritage resources.	MRO construction and operations are not expected to affect heritage resources.
Utility Options	None of the Utility Options would affect heritage and cultural resources.	No impacts due to the proposed MRO.	None of the Utility Options would affect heritage and cultural resources.	None of the Utility Options would affect heritage and cultural resources.
Water Canyon Road	Road maintenance and repair are not expected to affect heritage and cultural resources.	Road maintenance and repair are not expected to affect heritage and cultural resources.	Road maintenance and repair are not expected to affect heritage and cultural resources.	Road maintenance and repair are not expected to affect heritage and cultural resources.
Indirect Impacts	Road closures during construction and road maintenance and repair could change access for traditional resource use.	Road maintenance and repair could change access for traditional resource use. There would be no road closures due to the proposed MRO construction.	Road closures during construction and road maintenance and repair could change access for traditional resource use.	Road closures during construction and road maintenance and repair could change access for traditional resource use.
Cumulative Impacts	MRO development is not expected to contribute to cumulative impacts on heritage and cultural resources.	No new cumulative impacts due to the proposed MRO.	MRO development is not expected to contribute to cumulative impacts on heritage and cultural resources.	MRO development is not expected to contribute to cumulative impacts on heritage and cultural resources.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Human Health and Safety				
Direct Impacts				
Ridgetop	Safety hazards during construction will be minimized through development and implementation of a Transportation and Safety Plan.	No increase in health and safety hazards due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	None of the Utility Options would have health or safety impacts.	No increase in health and safety hazards due to the proposed MRO.	None of the Utility Options would have health or safety impacts	None of the Utility Options would have health or safety impacts
Water Canyon Road	Construction and maintenance vehicles and equipment would be equipped with spark arresters and catalytic converters would not be allowed off road in areas where grasses or other fuels could come in contact with the catalytic converter, in order to minimize fire risks.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	Improved access along Water Canyon Road due to road maintenance and repair would benefit fire suppression capability.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cumulative Impacts	Increased activity associated with MRO, in combination with other activities in the Magdalena Mountains, could increase risk of fire.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Socioeconomics				
Direct Impacts				
Ridgetop	MRO construction would potentially increase employment opportunities in the local areas by an average of 50 and a peak of 100 jobs.	No new employment opportunities due to the proposed MRO construction.	Same as Alternative 1.	Same as Alternative 1.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Utility Options	None of the Utility Options would affect socioeconomics.	No impacts due to the proposed MRO.	None of the Utility Options would affect socioeconomics.	None of the Utility Options would affect socioeconomics.
Water Canyon Road	Road maintenance and repair would provide minimal potential employment opportunities.	Same as Alternative 1	Same as Alternative 1.	Same as Alternative 1.
Indirect Impacts	MRO development is not expected to stimulate population inmigration to any measurable degree.	No impact due to the proposed MRO.	MRO development is not expected to stimulate population inmigration to any measurable degree.	MRO development is not expected to stimulate population inmigration to any measurable degree.
Cumulative Impacts	The MRO could attract a small number of additional tourists to the area.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Environmental Justice				
Direct Impacts				
Ridgetop	Ridgetop construction would be removed from any population centers and would not affect local populations, including minority and low-income populations. The availability of construction jobs may provide a small benefit for minorities and people whose income is currently affected by the lack of job opportunities.	No impact due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.
Utility Options	None of the Utility Options would affect minority or low-income populations.	No impact due to the proposed MRO.	None of the Utility Options would affect minority or low-income populations.	None of the Utility Options would affect minority or low-income populations.
Water Canyon Road	See Heritage and Cultural Resources.	See Heritage and Cultural Resources.	See Heritage and Cultural Resources.	See Heritage and Cultural Resources.

Project Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indirect Impacts	The MRO would have no disproportionately high or adverse indirect human health or environmental impacts on minority or low-income populations.	No impacts due to the proposed MRO.	The MRO would have no disproportionately high or adverse indirect human health or environmental impacts on minority or low-income populations.	The MRO would have no disproportionately high or adverse indirect human health or environmental impacts on minority or low-income populations.
Cumulative Impacts	The MRO's potential to contribute to increased recreation and tourism could benefit small businesses and generate service industry jobs, which could benefit local minority and low-income populations.	No new cumulative impacts due to the proposed MRO.	Same as Alternative 1.	Same as Alternative 1.

2.5 Mitigations and Monitoring

As Section 2.2.5 indicates, several design criteria and other mitigation measures have been incorporated into Alternatives 1, 3, and 4 to reduce potential environmental impacts. With these measures, no significant adverse impacts were identified in the impact analysis. **Table 2-6** lists identified mitigation measures and indicates any monitoring that would be performed to determine whether the objectives of these measures have been met, determine the need for additional action, and assist in the design of future projects.

Implementation monitoring would be employed to ensure that the mitigation measure was completed. Effectiveness monitoring would be used to assess whether the measure was effective in achieving the desired result. Validation monitoring would be used to determine whether the Forest Service practices, requirements standards, or guidelines are appropriate or should be modified.

Table 2-6. Mitigation Measures and Monitoring Requirements

Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Geology & Soils	Limit equipment and vehicle use on steep slopes (construction) (25.17[1]).				1, 3, 4
	Use mechanical and vegetative surface stabilization measures to prevent on-site soil loss from exposed cut slopes, fill slopes, and disposal areas (construction) (41.12[1]).	✓			1, 3, 4
	Develop and implement a Revegetation Plan coordinating with the Forest Service. All disturbed areas would be reseeded with appropriate native vegetation seed mixes. The plan would also address long-term post construction monitoring to ensure success of the revegetation effort (pre-construction, construction, post-construction) (25.18[1]).	✓	✓		1, 3, 4
	Develop an Erosion Control Plan using a combination of appropriate specification and practices (pre-construction) (41.12[1]).	✓	✓		1, 3, 4
	After heavy thunderstorms, erosion control devices should be checked to make sure they are functioning and appropriate action taken to repair or revise (construction).				1, 3, 4
	Establish sediment basins and sediment filters to filter surface runoff where such runoff may enter streams; build diversion ditches or berms to divert surface runoff around bare areas (construction) (41.5[1]).	✓			1, 3, 4

Notes: (1) *FSH 2509.22 – Soil and Water Conservation Practices Handbook.* 1990. USDA Forest Service, Region 3.
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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Geology & Soils	Provide subsurface drainage to avoid moisture saturation and subsequent slope failure. Dispersion of collected water should be in an area capable of withstanding increased flows (construction) (41.13[1]).				1, 3, 4
	Provide methods of soil erosion reduction such as properly placed culverts, cross drains, water bars, dips, energy dissipaters, aprons, downspouts, gabions, and/or debris racks, and armoring of ditches and drain inlets and outlets (construction) (41.15[1]).				1, 3, 4
	Provide method of dispersal runoff such as rolling the grade, insloping, outsloping, crowning, installations of water spraying ditches, contour trenching, or overside drains (construction) (41.14[1]).				1, 3, 4
	Install sediment filters, settling ponds, and contour trenches to reduce sediment loads (construction) (41.14[1]).				1, 3, 4
	Apply protective measures to all areas of disturbed, erosion-prone, unprotected ground that is not to be further disturbed in the present year by (construction): ▪ Removing water-controlling devices that will not carry anticipated seasonal water runoffs. ▪ Installing temporary devices that will carry anticipated seasonal water runoffs. ▪ Removing debris, obstructions, and spoil material. ▪ Grass seeding, planting deep-rooted vegetation, and/or mulching (41.15[1]).	✓			1, 3, 4
	Locate waste areas where excess material can be deposited and stabilized. Loose, unconsolidated sidecast material should not be permitted to enter streamside management zones (pre-construction) (41.17[1]).	✓			1, 3, 4
	Prevent spoil material from obstructing the streamcourse (including natural floodplain) associated structures by (construction): ▪ Keeping excavated materials out of stream courses (including ephemeral and intermittent). ▪ Removal of materials stacked or stockpiled on floodplains prior to high water. ▪ Diversion of flowing water around work sites. ▪ Importation of fill material for better soil compaction (41.21[1]).	✓			1, 3, 4
	Plow road under SUP Snow Plowing provisions (construction, post-construction).				1, 2, 3, 4
	Prescribe road surface treatments based on traffic levels, road design standards, soils and geology (pre-construction (construction) (41.26[1]).				1, 2, 3, 4

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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Geology & Soils	Perform annual inspections and maintenance scheduling to determine what work is needed to keep drainage functional and the road stable (post-construction) (41.25[1]).				1, 2, 3, 4
	Place drain holes so that surface drainage occurs on non-erodable fill (construction).				1, 3, 4
	Use guidance for snow removal to prevent erosion damage to roads, streams and other Forest values and that protects roads and appurtenances (post-construction).	✓	✓		1, 2, 3, 4
	Use equipment specifically for the removal of snow (post-construction).				1, 2, 3, 4
	Submit a written request for Forest Service approval of ice control; approval will contain information about ice control materials, application rates, and any specific requirements of use (post-construction).				1, 2, 3, 4
	Develop a Spill Prevention Plan and Surface Water Pollution Prevention Plan to be on-site during construction (pre-construction) (25.13[1]).				1, 3, 4
Water Resources	Perform regular servicing and maintenance of fleet vehicles and daily inspection of construction vehicles for signs of oil or gasoline leaks (construction).				1, 3, 4
	Designate location, size and allowable uses of service and refueling areas away from wet areas and surface water. Berms should be placed around areas to contain spills (construction) (41.18[1]).				1, 3, 4
	Develop project constraints and mitigative measures and include in Erosion Control Plan (pre-construction) (41.1[1]).				1, 3, 4
	Develop and use proper slope ratio designs to promote stable embankments (pre-construction) (41.16[1]).				1, 3, 4
	When flow in stream courses diverted, restore such diverted flow to natural stream course as soon as practicable and prior to major storm season (construction) (41.19[1]).				1, 3, 4
	Incorporate mitigating measures into project plans and designs to maintain the hydrologic and biologic function of the wetlands (25.12[1]).	✓	✓		1, 3, 4
	Design and construct roadways with adequate strength to support the pavement structure, shoulders, and traffic to eliminate failure and subsequent water quality degredation (41.16[1]).				1, 3, 4
	Monitor water use in East Fork of Sawmill Canyon Creek.	✓		✓	1, 3, 4

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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Air Quality	Develop a Dust Abatement Plan to include (construction): ▪ Spraying exposed and disturbed areas with water as a means of controlling blowing dust and soil. ▪ Using a terrain trimmer to resurface Water Canyon Road to reduce the time for resurfacing, eliminate the need for blasting, and minimize grinding and dust-generating activities. ▪ Applying a dust-control skirt on the terrain trimmer. ▪ Following equipment with a fire engine to provide water for dust abatement.	✓			1, 3, 4
	Avoid long periods of engine idling; implement a phased construction schedule to minimize number of units operating simultaneously; perform regular engine maintenance (construction).				1, 3, 4
Fire Management	Implement fire management actions to alleviate existing conditions in the surrounding forest that are susceptible to a large-scale fire under certain conditions (construction, post-construction.	✓			1, 2, 3, 4
	Require spark arrestors on powered equipment; do not allow operation of vehicles with catalytic converters in tall, bushy grasses; provide an on-site emergency water supply during and following construction; provide personnel trained in suppression of small fires on-site at all times during construction and operations (construction).				1, 2, 3, 4
	Develop a construction phase fire plan tiered to the CNF fire restrictions and closures (pre-construction).				1, 3, 4
Transportation	Remove all slash from project area to a site approved by the Forest Service.				1, 3, 4
	Limit all personnel and visitor vehicles to existing roads or parking areas.				1, 2, 3, 4
	Monitor visitor numbers and activities and implement controls (such as organized tours) if visitation is high (construction, post-construction).				1, 2, 3, 4
	Monitor traffic levels for long-term cumulative increases that may exceed safe road capacity levels (construction, post-construction).	✓		✓	1, 2, 3, 4
	Monitor the condition of Water Canyon Road between US 60 to Water Canyon Campground; NMIMT, the Forest Service, Bureau of Land Management, and Socorro County would negotiate any repairs that may be needed as a result of damage during construction (pre-construction, post-construction).	✓			1, 3, 4

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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Vegetation	Develop and implement a Noxious Weed Management Plan consistent with Forest Service guidance and standards (pre-construction).	✓			1, 3, 4
	Limit all personnel and visitor vehicles to existing roads or parking areas to be included in Annual Operations and Maintenance Plan (construction/post-construction).				1, 2, 3, 4
	When tree limbs are pruned, use of climbing spurs or other tree climbing equipment that affects the tree's cambium layer is prohibited.				1, 3, 4
Wildlife	Work during daylight hours only (construction, post construction).	✓			1, 2, 3, 4
	When possible, perform road repair and maintenance projects in PAC areas in less sensitive months (July through March) (construction, post-construction).	✓			1, 2, 3, 4
	Limit road maintenance and repair in PAC areas to hours between 2 hours after sunrise and 2 hours before sunset during the breeding and rearing season (March through August) (construction, post-construction).	✓			1, 2, 3, 4
	Install sound-insulating housing around new pump/motor at water source location (Sawmill Canyon option) (construction, post-construction).	✓			1, 3, 4
	Dig and excavate by hand in the Baldy Spring PAC (construction, post construction).	✓			1, 3, 4
	Install water line and pump in months outside the breeding season for owls (and use alternate temporary water supply sources until new source can be developed and utilized) (construction, post construction).	✓			1, 3, 4
	Minimize duration of road maintenance and repair work (construction/post-construction).				1, 2, 3, 4
	Limit or avoid using primary and secondary rock crushers and conventional ripping for roadwork (construction).	✓			1, 2, 3, 4
	Limit hauling of rock base material (construction).				1, 3, 4
	Avoid blasting or use of pneumatic charge drilling (construction).				1, 3, 4
	Monitor traffic levels on Water Canyon Road to estimate increases in noise levels along the road that may affect wildlife (particularly bird species) in the long term (construction, post-construction).				1, 3, 4
	Add provision in construction constracts requiring adherence to speed limits and no loose materials on truck beds to reduce noise levels from construction.				1, 3, 4

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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
Rangeland	Forest Service will coordinate access during road closures with grazing permittee.	✓			1, 2, 3, 4
Visual Resources	Paint project structures in natural non-reflective colors. Apply non-reflective coatings to glazing that is visible beyond the project boundary (construction).	✓	✓		1, 3, 4
	Develop and implement a Revegetation Plan. All disturbed areas would be reseeded with appropriate native vegetation seed mixes. The plan would also address long-term post construction monitoring to ensure success of the revegetation effort (pre-construction, construction, post-construction).				1, 3, 4
	Crush rocks from excavated areas on the ridge and use on-site for reconstructing roads and constructing graveled parking areas. Use materials for resurfacing or mixing with concrete (construction).				1, 3, 4
	Cut all stumps to 6 inches (0.15 m) or less with cuts facing away from roads and development (construction).	✓			1, 3, 4
Recreation	Forest Service to publicize road closures schedules in local media, the district office and on MRD website.				1, 2, 3, 4
Heritage and Cultural Resources	Educate construction workers and use management practices to minimize potential effects to off-site heritage resources (construction).	✓			1, 3, 4
	Forest Service to coordinate with Mescalero Apache Tribe and Alamo Navajo Chapter to ensure ongoing vehicular access to top of South Baldy Peak during and after construction.				1, 2, 3, 4
Human Health & Safety	Use only ladders or mechanized equipment platforms to access tree limbs to be pruned (construction/post-construction).				1, 2, 3, 4
	Develop a Transportation and Safety Plan to address all aspects of safety on the construction site or in transit to or from the site in accordance with applicable regulations. Plan would address emergency response and fire safety and response and would include (construction, post-construction) measures developed by the construction contractor to control circulation and access to protect workers and public during the construction phase. Measures may include speed limits, road closures, vehicle inspections, designated turn-around areas, and passing procedures.	✓			1, 3, 4
	Fence all construction and storage sites on the ridgetop during construction for safety and security.				1, 3, 4

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Resource	Mitigation Measure	Monitoring[2]			Alternatives
		I	E	V	
	Monitor equipment storage areas for rodent feces and decontaminate and disinfect area if feces are detected to minimize the risk of exposure to Hanta Virus.	✓			1, 3, 4
	Update and expand the Existing NMIMT Safety Manual to include the proposed MRO.				1, 3, 4

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CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This Chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

The Cibola National Forest (CNF) Land and Resource Management Plan (LRMP) provides overall direction for all activities conducted on the Forest. In addition, applicable legal and regulatory requirements must be met. These guidelines and requirements are discussed in this introduction to provide a framework for the description of the affected environment and environmental consequences. In addition, relevant past, present, and reasonably foreseeable future actions are described to provide context for the cumulative impacts analysis.

3.1.1 Forest Plan Direction

Management of the CNF is guided by the CNF LRMP, July 1985, as amended, which provides forest-wide resource goals and objectives. The LRMP divides the CNF into 18 distinct Management Areas, each having a unique set of management objectives, standards, and guidelines (USFS 1985). The MRO project area passes through lands in Management Areas 7, 12, 13, and 16.

Management Area 7 covers the entire Langmuir Research Site, which is roughly coincident with the Ryan Hill Roadless Area, and contains the proposed construction site. Overall Management Plan direction for this area is as follows (USFS 1985):

> Protection of clear atmospheric conditions is emphasized to meet research objectives of Langmuir Laboratory. Dispersed recreation is also featured. Livestock grazing, timber and firewood harvest is permitted within atmospheric objectives.

Management Area 12 includes a portion of Water Canyon Road. Overall Management Plan direction for Management Area 12 is as follows (USFS 1985):

> Maintain the forest and watershed health, vigor, and productivity. Provide and maintain wildlife habitat diversity and old growth. Slash from harvest activities will be made available to the public for personal use firewood.

> Developed site capacity will increase through construction/maintenance and repair of recreational facilities. Trail maintenance is planned.
>
> Grazing use will be balanced with grazing capacity.

Overall Management Plan direction for Management Area 13, which includes portions of Water Canyon Road and the utility corridor, is as follows (USFS 1985):

> The primary emphasis is on wildlife management activities. Wildlife habitat carrying capacity will increase through structural and nonstructural improvements. Firewood will be provided as a result of wildlife management practices.
>
> Existing developed recreation sites will be maintained.

Overall Management Plan direction for Management Area 16, which includes portions of the utility corridors, is as follows (USFS 1985):

> The primary emphasis is on range and wildlife management activities that will increase both grazing capacity and wildlife habitat carrying capacity. Firewood management will be coordinated with range and wildlife needs.
>
> Maintenance and protection of sensitive soils are important to management goals.
>
> Existing developed sites will be maintained. Planned trail maintenance and new trailheads will benefit dispersed recreation and wilderness.

Most of the MRO development would occur in Management Area 7, Analysis Area 6. Specific direction for Analysis Area 6 is summarized below. The primary management emphasis for this area is to preserve conditions necessary to meet the research needs of Langmuir Laboratory.

Direction	**Resource Areas**
Manage rangelands at or above the following intensity levels in Period 1: Level A 3,910 acres Level B 22,889 acres Level X 3,755 acres Manage rangelands so as to achieve the following intensity levels by Period 5: Level A 3,910 acres Level B 26,644 acres Livestock grazing permitted on full and potential capacity range with permitted use balanced with grazing capacity.	Rangelands
Treat full capacity rangelands in unsatisfactory condition through structural range improvements and modification of stocking levels	Rangelands
Manage full capacity rangelands to achieve the following by: Condition / Period 2 / Period 5 Satisfactory / 3,662 acres / 4,051 acres Unsatisfactory / 1,255 acres / 866 acres	Rangelands

Direction	Resource Areas
Maintain structural improvements on a planned basis until replacement is scheduled. Replace structural improvements after 20-30 years for water and 40 years for fences. Wildlife habitat and species diversity maintained for federal and state listed species. Harvest activities coordinated with wildlife habitat needs. Slash from timber harvests made available to the public as personal use firewood. Timber activities managed to minimize disturbance to Langmuir Laboratory.	Vegetation Wildlife
Construct or replace structural range improvements at the following rates per period in Periods 1-4: 7 miles (11.2 km) of fence 2 waters 2 storage-drinkers 1 mile (1.6 km) of pipeline	Wildlife Water Resources Geology and Soils Rangelands
File for water rights for one water development per period	Water Resources
Manage for the following acreages of Recreational Opportunity Spectrum: 27,348 acres semi-primitive non-motorized 3,258 acres semi-primitive motorized Provide for dispersed recreation opportunities, especially for hiking.	Transportation Recreation
Manage for the following acreages of Visual Quality Objectives: 22,138 acres Partial Retention 8,468 acres Modification	Visual Resources
Paint buildings with colors specified by Forest Landscape Architect except where different color needed for scientific research. Remove temporary installations by season following termination of use.	Visual Resources
Close entire Langmuir Research Site (30,606 acres) to Off-road Recreational Vehicles. Restrict (sign and regulate) motorized vehicular travel to designated roads.	Transportation Recreation
Maintain the following miles of trails in each period for Periods 1-5: Level 1 — Levels 2-5 17 miles (27.4 km) — 4 miles (6.4 km)	Recreation
Identify (and publicize annually) periods and locations where public use is restricted because of research activities.	Recreation
Offer timber sales in accordance with silvicultural prescriptions and environmental analyses. Coordinate sale planning with Langmuir Lab to avoid conflict with research activities. Minimum harvest volume = 800 board feet/acre.	Vegetation Socioeconomics
On all treatment areas, leave existing snags (with the objective of 2 snags/acre) and sufficient live hulks with a minimum 12-inch (30.5 cm) diameter at breast height (dbh) and 15-foot (4.6-meter) height for replacement. Leave known and potential turkey roost trees (objective one group per 640 acres within 0.5 mile (0.8 km) of water). Maintain 2 Abert’s squirrel sites per 100 acres, except maintain 1 site per 100 acres where basal area over 8 inches (20.3 cm) dbh is between 150 and 200 square feet (sf) (13.9 and 18.6 sm) per acre. Abert’s squirrel sites consist of at least 6 trees, 11 to 16 inches (28 to 40.6 cm) dbh in 1 1/20 acre group.	Vegetation Wildlife

Direction	Resource Areas
Apply primarily uneven-aged management. Where even-aged management is applied, use a shelterwood system according to following guidelines: 1. No precommercial thinning 2. Intermediate commercial harvest at 20-year intervals to control for appropriate growing season length 3. First preparatory cut removes 50% of overstory volume 20 years before rotation age 4. Seed cut at rotation age to remove 65% of remaining volume 5. Final removal of all remaining overstory before regeneration reaches age 20	Vegetation
Remove overstories infected with dwarf mistletoe as soon as regeneration is accomplished. Thin understories to maximize fiber production using yield simulation models as guides. Eliminate mistletoe by clearcutting, and regenerate artificially when yield simulation models indicate stands will not reach maturity because of mistletoe.	Vegetation
Suppress Western spruce budworm, using insecticides when necessary, to prevent or minimize stand damage. Prioritize in areas where harvesting is focused or accelerated.	Vegetation
Create even-aged stands of Douglas fir, ponderosa pine, and aspen in budworm-susceptible areas by: Patch cutting, site preparation, broadcast burning, and planting a mixture of ponderosa pine and Douglas fir. Regeneration cutting to retain a uniformly spaced overstory composed principally of Douglas fir. Regeneration cutting to retain a mixture of species in the overstory.	Vegetation
Construct or reconstruct 20 miles of timber purchaser road per period in Periods 2 through 5.	Vegetation Wildlife Water Resources Geology and Soils Transportation
Maintain Forest System roads at Levels 3, 4, and 5 at 120 miles (193 km) per period.	Water Resources Geology and Soils Transportation
Consult with special interest groups in managing Langmuir Research Site to achieve research objectives.	Socioeconomics

3.1.2 Applicable Legal and Regulatory Requirements

Following are federal and state statutes, regulations, and Executive Orders (EO) that could apply to the Proposed Action and alternatives:

Air

- Clean Air Act (CAA) of 1970 (Public Law [P.L.] 95-95), as amended in 1977 and 1990 (P.L. 91-604) 40 Code of Federal Regulations (CFR) 52-99
- Air Pollution, N.M. Stat. Ann. § 74-2; Air Quality (Statewide), 20.2.1-99 New Mexico Administrative Code (NMAC)

Noise

- Noise Control Act of 1972 (P.L. 92-574) and Amendments of 1978 (P.L. 95-609) 40 CFR 201-211

Water

- Federal Water Pollution Control Act (FWPCA) of 1972 (P.L. 92-500) and Amendments: Clean Water Act (CWA) of 1977 (P.L. 95-217), 40 CFR 100-140 and Water Quality Act of 1987 (P.L. 100-4), 40 CFR 401-471
- Safe Drinking Water Act of 1972 (P.L. 95-523) 40 CFR 141-149 and Amendments of 1996 (P.L. 104-182)
- Water Rights in General, N.M. Stat. Ann. § 72-1; Administration and Use of Water – General Provisions, 19.25.1-9 NMAC
- Surface Water, N.M. Stat. Ann. § 72-5; 19.26.1-11 NMAC
- Underground Water, N.M. Stat. Ann. § 72-12; 19.27.1-62 NMAC
- Water Quality, 20.6.1-4 NMAC
- Groundwater Protection, N.M. Stat. Ann. § 74-6B
- Wastewater and Water Supply Facilities, 20.7.1-11 NMAC
- Water Quality, N.M. Stat. Ann. §74-6; 20.6.1-4 NMAC
- National Pollutant Discharge Elimination System (NPDES) General Construction Permit for Stormwater Discharge from Construction Activities (63 *Federal Register* 7857)

Land

- Federal Land Policy and Management Act of 1076 (P.L. 94-579)
- Engle Act of 1958 (43 U.S.C. 155)
- Wilderness Act of 1964 (P.L. 88-577)
- National Forest Management Act of 1976 (P.L. 940588)
- United States Lands, N.M. Stat. Ann. § 19-2

Rangelands

- Public Rangelands Improvement Act of 1978
- Taylor Grazing Act (43 CFR 315)

Biological Resources

- Migratory Bird Treaty Act of 1918
- Bald and Golden Eagle Protection Act of 1940
- Fish and Wildlife Coordination Act of 1958 (P.L. 83-654)

- Sikes Act of 1960 (P.L. 86-797), 1974 (P.L. 93-452) and Amendments 1986 (P.L. 99-561), 1997 (P.L. 105-85) Title XXIX
- EO 13112, Invasive Species
- Endangered Species Act of 1973 (P.L. 93-205) and Amendments 1988 (P.L. 100-478)
- Fish and Wildlife Conservation Act of 1980 (P.L. 96-366)
- Lacey Act Amendments of 1981 (P.L. 97-79)
- Forest Conservation, N.M. Stat. Ann. § 68-2; Forest Management, 19.20.1-4 NMAC
- Endangered Plants, N.M. Stat. Ann. § 75-6; 19.21.1-2 NMAC
- Wildlife Administration, 19.30.1-9 NMAC
- Habitat Protection, N.M. Stat. Ann. § 17-6; Wildlife Habitat and Land, 19.34.1-6 NMAC

Wetlands and Floodplains

- Section 401 and 404 of FWPCA of 1982 (P.L. 92-500), 40 CFR 100-149
- EO 11988, Floodplain Management – 1977
- EO 11990, Protection of Wetlands – 1977
- Emergency Wetlands Resources Act of 1986 (P.L. 99-645)
- North American Wetlands Conservation Act of 1989 (P.L. 101-233)
- Wetlands Area Restoration, N.M. Stat. Ann. § 75-8

Cultural Resources

- National Historic Preservation Act (NHPA) of 1966 (P.L. 89-665) and Amendments of 1980 (P.L. 96-515) and 1992 (P.L. 102-575)
- EO 11593, Protection and Enhancement of the Cultural Environment – 1971
- EO 13007, Indian Sacred Sites – 1996
- Archaeological and Historic Preservation Act of 1974 (P.L. 86-253)
- American Indian Religious Freedom Act of 1978 (P.L. 95-341)
- Antiquities Act of 1906
- Archaeological Resources Protection Act of 1979 (P.L. 96-95)
- Native American Graves Protection and Repatriation Act of 1990 (P.L. 101-601)
- Cultural Properties, N.M. Stat. Ann. § 18-6
- Cultural Properties Protection, N.M. Stat. Ann. § 18-6A
- Cultural Resources, 4.10.1-13 NMAC

Solid/Hazardous Materials and Wastes

- Resource Conservation and Recovery Act of 1976 (P.L. 94-5800) as Amended (P.L. 100-582), 40 CFR 240-280
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510) as Amended by the Superfund Amendments and Reauthorization Act of 1986 (P.L. 99-499), 40 CFR 300-399
- Toxic Substances Control Act, 40 CFR 702-799
- Federal Insecticide, Fungicide, and Rodenticide Act, 40 CFR 162-180
- Emergency Planning and Community Right-to-Know Act, 40 CFR 300-399
- Occupational Safety and Health Act (OSHA) of 1970 (P.L. 91-596)
- Hazardous Waste, N.M. Stat. Ann. § 74-4; 20.3.1-4 NMAC
- Solid Waste Act, N.M. Stat. Ann. § 74-9; Solid Waste, 20.9.1-4 NMAC
- Occupational Health and Safety, N.M. Stat. Ann. § 50-9

Environmental Justice

- EO 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 13045, Protection of Children from Environmental Risks and Safety Risks

Socioeconomics

- Americans with Disabilities Act of 1990 (P.L. 101-336)

Construction

- 1977 Building Codes, 14.7.2.1-62 NMAC
- National Electric Code, 2002
- Uniform Building Code, 1997, and updates

3.1.3 Description of Relevant Past, Present, and Reasonably Foreseeable Future Actions Not Part of the Proposed Action or Alternatives

The analysis of cumulative impacts focuses on the extent to which impacts from each alternative could combine with impacts from past, present, and reasonably foreseeable future actions to create a significant adverse impact in the project area or wider region of influence. Past and present impacts are reflected in existing conditions. Analysis of reasonably foreseeable future impacts includes consideration of other efforts described below. This analysis is more general than the analysis of direct and indirect impacts because decisions about the future actions have yet to be made, and the location, timing, magnitude and specifics of these actions are not well known. Also, a wider area of potential effects may be considered over a longer time span. The combination of project activities is evaluated against future conditions that are understood as trends. Other actions identified in the regions potentially affected by the proposed Magdalena Ridge Observatory (MRO) are described below.

The primary research undertaken at Langmuir Laboratory is in cloud processes that produce lightning. Consequently, the busiest season for Langmuir is summer when the occurrence of lightning is highest. Small groups of students and researchers frequently stay in primitive dormitories for several days. Activity during the rest of the year is sporadic and infrequent. Typically, there has been little activity in winter because conditions do not favor lightning research, and road conditions are more hazardous. The JOCR has been operated year-round when important comets are visible.

During the construction phase for the MRO, the CNF proposes to move the existing forest kiosk to Trailhead 8 as part of their trailhead improvement program. The roadway would be expanded near the trailhead to accommodate additional visitor parking. New Mexico Institute of Mining and Technology (NMIMT) would provide interpretive information about the MRO for the kiosk.

Repairs and maintenance of Water Canyon Road are being performed during the fall of 2003 in accordance with Langmuir Laboratory's responsibilities under the existing Special Use Permit (SUP) (USFS 1992). Repairs and maintenance can include building up the surface in locations where the road is outsloped, widening some of the tight hairpin curves near the top of the mountain, adding fill and cutting back rock outcroppings, and installing adequate water drainage structures.

MRO, as presently conformed, would use lasers within buildings to calibrate equipment. However, there are adaptive optical techniques being developed that utilize "laser guide stars." It is conceivable that such technology could be used at the MRO facility in the future. Lasers used in these systems would be beamed upward from the site. They would require about 100 watts of power and operate with exceptionally low sidescatter.

The Forest Service recently recommended to the Bureau of Land Management (BLM) that approximately 852 acres at the Langmuir Principle Research Site be withdrawn from mineral entry for 20 years in order to protect scientific equipment. The lands are currently being protected by a 2-year segregation from location and entry under the United States (U.S.) mining laws pending issuance of a Public Land Order, which would withdraw the lands for a period of 20 years. The environmental assessment of this action was completed and a decision notice was issued on January 31, 2003, which found that no significant impacts would result from the action (USFS 2003c).

Langmuir Laboratory currently uses water from a surface source in the East Fork of Sawmill Canyon. A small impoundment was constructed in the 1960s and became full of sediment shortly thereafter. The entire system needs repair and is deficient in some areas. Work is taking place in the summer and fall of 2003 to replace equipment and supply lines, add containment features, and excavate and remove soil that has absorbed small spills over time, as required under the existing SUP (USFS 1992).

3.2 Physical Resources

3.2.1 Geology and Soils

3.2.1.1 Affected Environment

Region of Influence

The region of influence (ROI) for soils is the project area described in Chapter 1 and shown in Map 1-2, the area that may be affected by construction for the MRO, access roads, and utilities required to serve the facilities. Streams or drainageways that may receive sedimentation from erosion caused by surface disturbance will be discussed under Water Resources. This section includes a general description of the geology underlying the project area, the soil types within the project area, soil characteristics that may affect construction design and planning, and identification of suitability ratings of Terrestrial Ecosystem Survey (TES) map units for uses proposed under the Action Alternatives.

Existing Conditions

Geology

The project area is located near South Baldy Peak in the Magdalena Mountains within the Datil-Mogollon Volcanic physiographic province. It is located within the historic Kelly Mining District. The area is mostly over 10,000 feet (3,048 m) in elevation, within a cluster of five large overlapping calderas formed from Oligocene-age (32 to 24 million years ago during the Tertiary Period) volcanoes that emitted great quantities of ash, then collapsed (Chronic 1987). Bedrock geology consists primarily of rhyolite (volcanic rock with high silica content) and multiple volcanic flows of densely welded ash. Intracaldera successions of rhyolite ash-flow tuff (porous rock, usually stratified, consisting of accumulations of scoria and ash), several thousand feet thick, underlie the crest of the range at South Baldy. Timber Peak rhyolite is the youngest volcanic rock in the central Magdalena Mountains, small knobs of which are exposed in lower Hardy Canyon. Slopes of the mountain to the east and south consist of Quaternary talus formed from slides of the Timber Peak rhyolite (USFS 2000b).

Locally derived alluvial gravels and sandstones (Popotosa Formation) shed from the tilted volcanic strata then filled in structural depressions above the evolving fault blocks. As many as 1,475 feet (450 m) of conglomerates and sandstones underlie the Muleshoe Ranch area, where it is preserved on the western down-thrown side of a large and steep fault zone that is exposed about 1.25 miles (2.0 kilometers [km]) east of the Ranch. The Popotosa conglomerates contain rhyolite lava flows and ash beds that were erupted onto the aggrading alluvial fans.

In the late Oligocene and Miocene epoch, the calderas were stretched and broken into fault blocks that were tilted, rotated, and fractured. Alluvial gravels and sandstone of the Popotosa Formation filled in some of the structural depressions left by the movement of the fault blocks. Rhyolite lava flows and ash beds erupted, covered the fault blocks, and formed lava flows and domes between Magdalena Peak and Squaw Peak to the west of the project area (Chamberlin and Johnson 2002).

A tight cluster of earthquake activity in the Rio Grande valley near Socorro, concentrated north and northeast of South Baldy Peak, serves as the location for one of the seismographs maintained by NMIMT. This cluster is called the Socorro Seismic Anomaly, which accounts for 37 percent of the earthquakes of magnitude 2.0 or greater and 47 percent of those of magnitude 4.5 or greater documented between 1962 and 1998 in New Mexico (Sanford et al. 2000). It is likely that the project area would experience ground motion as a result of nearby earthquakes within the next 50 years.

The volcanic bedrock and the Popotosa Formation around South Baldy Peak form the primary aquifers that could provide water to the MRO facilities. The bedrock ranges from low to moderate permeability depending on the location and the amount of alteration by fractures, fault movement, and other alterations in the formations after deposition. Thin, saturated zones at the base of Quaternary gravels on the west side of the mountain (Chamberlin and Johnson 2002) and in the Sawmill canyon area (the location of the current water source for Langmuir Laboratory) could also provide water from existing springs.

Soils

The description of the soils within the project area is based on the Terrestrial Ecosystem Survey (TES) data that were mapped and compiled by the Southwest Region TES Survey Crew (USFS 2001f). The TES mapping is currently in progress, so some data are incomplete. TES units are mapped in the field based on soil, vegetation, and climatic properties, and are classified according to a standardized system. They are generalized units that include up to six components or soil types that may be distinctly different from others in the map unit but that cannot be delineated further at the scale of mapping used. The TES incorporates spatial data in Geographic Information System (GIS) that delineates the mapping units with a database that contains soil properties, ratings for the potential success of specific activities like revegetation, and interpretations that include limitations or hazards for a variety of land uses. The interpretations are presented in the form of ratings that assist planners in selecting appropriate sites and soils for designated uses and identifying potential hazards to be further investigated in the field before projects are finalized.

There are 13 TES units within the project area, each of which contains 3 to 6 components, for a total of 49 components. Most soils in the project area are very deep and well drained, and are formed from residual materials derived primarily from igneous rock. The soil map unit and component numbers, names, and some key characteristics derived from the TES database are listed in **Table 3-1**. **Map 3-1** displays the boundaries of each TES map unit within the project area.

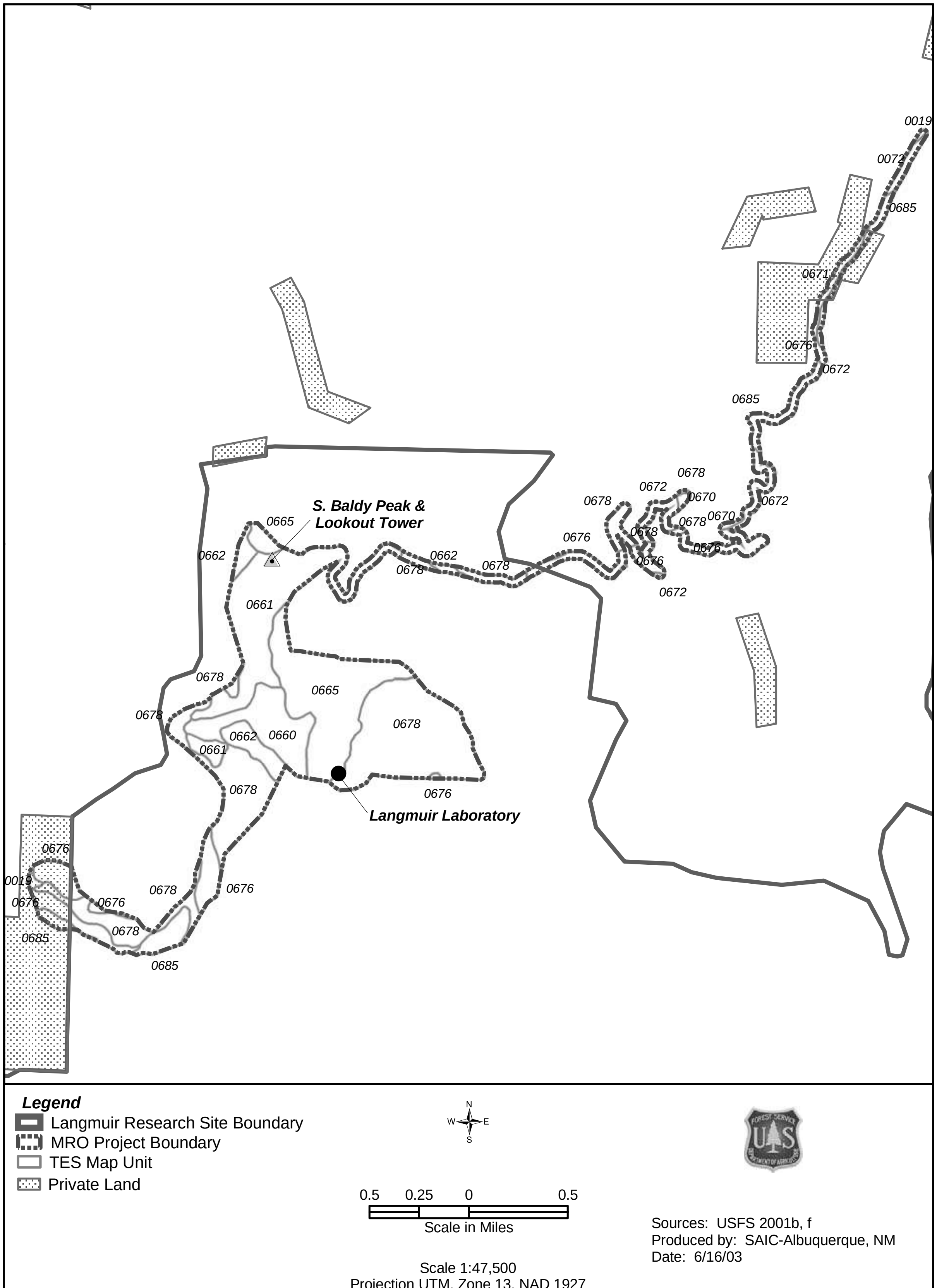
Table 3-1. TES Units within the Project Area

TES Map Unit	Component (soil type)	Amount in Project Area (acres)	Map Unit Component Classification	Slope Range (%)
19	0.1	2	Pachic Argiustolls, fine-loamy, very deep, gravelly, loams	0-15
19	0.2	<1	Pachic Argiustolls, coarse-loamy, very deep, gravelly, fine sandy loams	0-15
19	0.5	<1	Pachic Argiustolls, loamy-skeletal, very deep, gravelly, sandy loams	0-15
24	0.1	<1	Typic Hapludolls, loamy-skeletal, very deep, gravelly, loams	0-15
24	0.2	<1	Cumulic Endoaquolls, fine-loamy, very deep, sandy clay loams	0-15
24	0.5	<1	Pachic Argiudolls, loamy-skeletal, very deep, fine sandy loams	0-15
72	0.1	2	Typic Argiustolls, loamy-skeletal, deep, very gravelly, sandy loams	0-15
72	0.2	2	Typic Haplustalfs, clayey-skeletal, deep, extremely cobbly, sandy loams	0-15
72	0.3	2	Typic Haplustalfs, fine-loamy, deep, very gravelly, sandy loams	0-15
72	0.4	1	Typic Haplustalfs, loamy-skeletal, very deep, very gravelly, sandy loams	0-15
72	0.5	<1	Typic Argiustolls, loamy-skeletal, deep, very gravelly, sandy loams	0-15
72	0.6	<1	Typic Haplustalfs, fine, deep, very gravelly, sandy loams	0-15
660	0.1	52	Vitrandic Haplocryolls, loamy-skeletal, deep, gravelly, loams	0-15
660	0.5	11	Vitrandic Argicryolls, fine, deep, gravelly, sandy clay loams	0-15
660	0.6	11	Vitrandic Argicryolls, clayey-skeletal, deep, gravelly, loams	0-15
661	0.1	130	Vitrandic Haplocryolls, loamy-skeletal, deep, cobbly, loams	15-40
661	0.5	16	Vitrandic Haplocryalfs, loamy-skeletal, deep, very cobbly, loams	15-40
661	0.6	16	Vitrandic Argicryolls, clayey-skeletal, deep, cobbly, loams	15-40
662	0.1	25	Vitrandic Haplocryolls, loamy-skeletal, moderately deep, stony, sandy loams	40-80

TES Map Unit	Component (soil type)	Amount in Project Area (acres)	Map Unit Component Classification	Slope Range (%)
662	0.2	7	Rock Outcrop	40-120
662	0.5	4	Vitrandic Haplocryolls, sandy-skeletal, deep, very stony, sandy loams	40-80
665	0.1	123	Vitrandic Eutrocryepts, loamy-skeletal, deep, very gravelly, sandy loams	40-80
665	0.5	25	Vitrandic Haplocryolls, loamy-skeletal, deep, very gravelly, sandy loams	40-80
665	0.6	16	Rock Outcrop	40-120
670	0.1	2	Vitrandic Haplustepts, loamy-skeletal, moderately deep, extremely gravelly, sandy loams	40-80
670	0.2	1	Rock Outcrop	40-120
670	0.5	<1	Vitrandic Haplustolls, loamy-skeletal, moderately deep, extremely gravelly, sandy loams	40-80
670	0.6	<1	Lithic Haplustepts, loamy-skeletal, very gravelly, sandy loams	40-80
671	0.1	4	Vitrandic Haplustolls, loamy-skeletal, moderately deep, very gravelly, sandy loams	40-80
671	0.2	2	Rock Outcrop	40-120
671	0.5	1	Vitrandic Haplustepts, loamy-skeletal, moderately deep, extremely gravelly, sandy loams	40-80
671	0.6	1	Lithic Haplustolls, loamy-skeletal, extremely gravelly, coarse sandy loams	40-80
672	0.1	13	Vitrandic Haplustolls, loamy-skeletal, deep, extremely cobbly, sandy loams	40-80
672	0.2	8	Talus	40-80
672	0.5	3	Vitrandic Argiustolls, clayey-skeletal, deep, very cobbly, loams	40-80
672	0.6	3	Vitrandic Argiustolls, loamy-skeletal, deep, extremely cobbly, loams	40-80
676	0.1	44	Vitrandic Eutrudepts, loamy-skeletal, deep, very gravelly, sandy loams	40-80
676	0.2	28	Lithic Eutrudepts, loamy-skeletal, very gravelly, sandy loams	40-80
676	0.3	22	Rock Outcrop	40-120
676	0.4	11	Vitrandic Hapludalfs, clayey-skeletal, moderately deep, very gravelly, sandy loams	40-80
676	0.5	6	Vitrandic Hapludalfs, loamy-skeletal, moderately deep, very gravelly, sandy loams	40-80

TES Map Unit	Component (soil type)	Amount in Project Area (acres)	Map Unit Component Classification	Slope Range (%)
678	0.1	246	Vitrandic Eutrudepts, loamy-skeletal, moderately deep, extremely cobbly, sandy loams	40-80
678	0.2	66	Rubble land	40-80
678	0.5	16	Vitrandic Hapludalfs, clayey-skeletal, moderately deep, very stony, loams	40-80
685	0.1	20	Vitrandic Haplustalfs, clayey-skeletal, moderately deep, very gravelly, sandy loams	15-80
685	0.2	20	Vitrandic Haplustalfs, loamy-skeletal, moderately deep, very gravelly, sandy loams	15-80
685	0.4	6	Vitrandic Haplustepts, loamy-skeletal, moderately deep, extremely gravelly, sandy loams	15-80
685	0.5	6	Vitrandic Argiustolls, loamy-skeletal, moderately deep, very gravelly, sandy loams	15-80
685	0.6	6	Vitrandic Argiustolls, clayey-skeletal, moderately deep, very gravelly, sandy loams	15-80

Source: USFS 2001f.



Map 3-1
TES Map Units
within the Project Area

The soil characteristics, potential for erosion, and likelihood for success in revegetation are important to consider when planning for stabilization of disturbed areas. Based on the TES database information, there are no hydric soils in the project area. However, from recent field observations, it is likely that there are hydric soils in the riparian areas along the perennial stream in the East Fork of Sawmill Canyon. **Table 3-2** summarizes the important soil characteristics to be considered when analyzing surface-disturbing activities such as building and road construction and site revegetation. Where components are not rated in the database, the rating for the primary component (0.1) has been applied. The ratings included in Table 3-2 are further described below.

Table 3-2. Selected Characteristics and Use Ratings, Percentage of TES Map Units within the Project Area

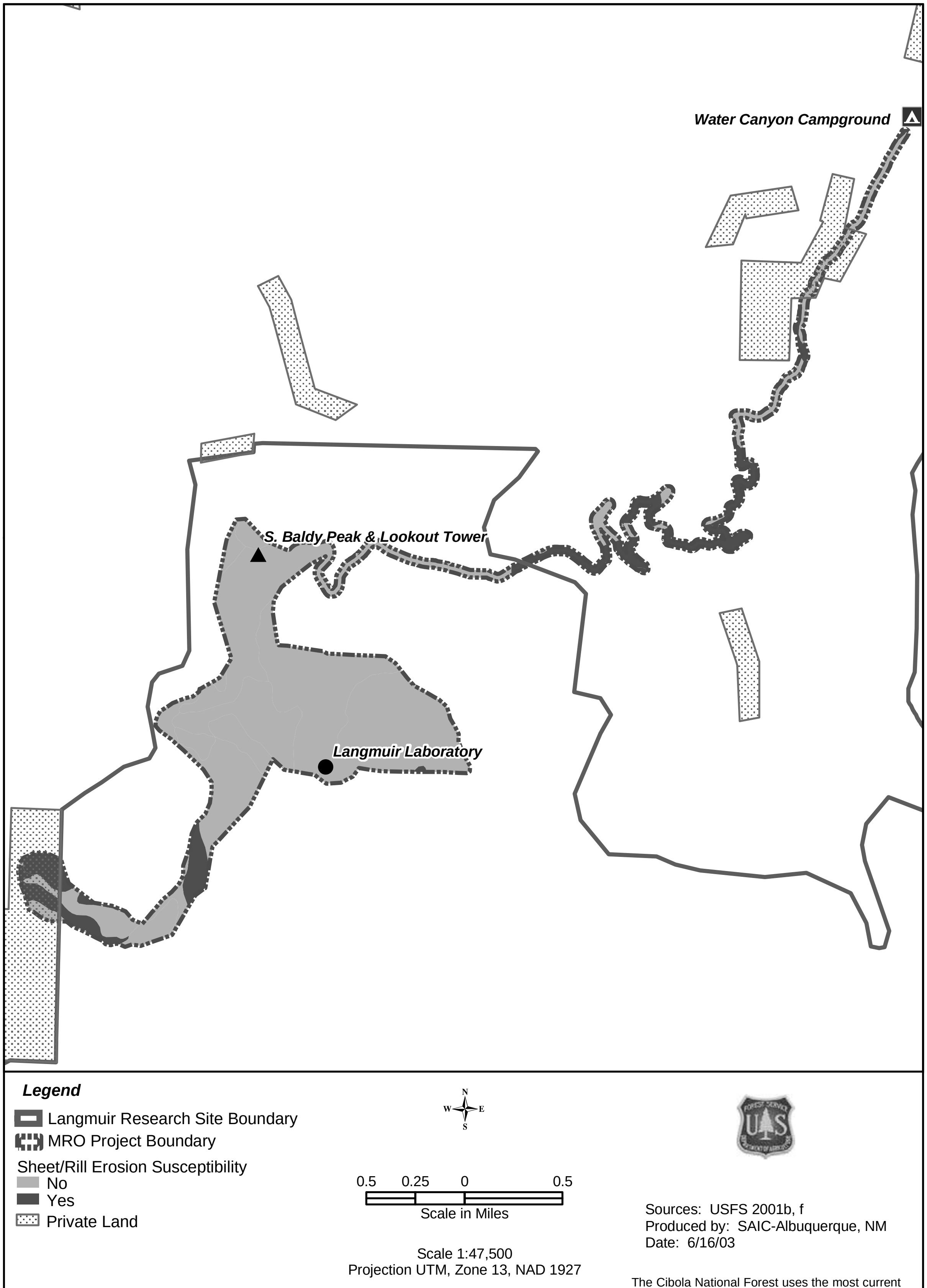
TES Map Unit	Component (soil type)	Sheet/Rill Erosion Likely	Mass Wasting Probability	Suitability Criteria			
				Unsurfaced Roads	Revegetation	Topsoil	Road Fill
19	0.1	Yes	Low	Moderate (low strength)	Moderate (too cobbly)	Fair (too clayey)	Fair (low strength)
19	0.2	No	Low	Moderate (too cobbly)	High	Poor (too cobbly)	Good
19	0.5	Yes	NR	NR	NR	NR	NR
24	0.1	No	NR	Slight	High	Fair (too cobbly)	Good
24	0.2	Yes	NR	Severe (poorly drained)	Low (too wet)	Good	Poor (too wet)
24	0.5	Yes	NR	NR	NR	NR	NR
72	0.1	No	Low	Moderate (too rocky)	High	NR	NR
72	0.2	No	Low	Severe (too rocky)	Low (too cobbly)	Poor (too clayey)	Poor (too rocky)
72	0.3	No	Low	Moderate (low strength)	High	Fair (too clayey)	Fair (low strength)
72	0.4	Yes	NR	NR	NR	NR	NR
72	0.5	Yes	NR	NR	NR	NR	NR
72	0.6	Yes	NR	NR	NR	NR	NR
660	0.1	No	Low	Slight	Moderate (too cobbly)	Poor (too cobbly)	Poor (too cobbly)
660	0.5	Yes	NR	NR	NR	NR	NR
660	0.6	Yes	NR	NR	NR	NR	NR

TES Map Unit	Component (soil type)	Sheet/Rill Erosion Likely	Mass Wasting Probability	Suitability Criteria			
				Unsurfaced Roads	Revegetation	Topsoil	Road Fill
661	0.1	No	Low	Moderate (slope)	Moderate (too steep)	Poor (too cobbly)	Fair (too steep)
661	0.5	Yes	NR	NR	NR	NR	NR
661	0.6	Yes	NR	NR	NR	NR	NR
662	0.1	No	Moderate	Severe (slope)	Low (too steep)	Poor (too steep)	Poor (too steep)
662	0.2	Yes	NR	NR	NR	NR	NR
662	0.5	Yes	NR	NR	NR	NR	NR
665	0.1	No	High	Severe (slope)	Low (too steep)	Poor (too steep)	Poor (too steep)
665	0.5	Yes	NR	NR	NR	NR	NR
665	0.6	Yes	NR	NR	NR	NR	NR
670	0.1	No	High (too steep)	Severe (too steep)	Low (too steep)	Poor (too steep)	Poor (too steep)
670	0.2	Yes	NR	NR	NR	NR	NR
670	0.5	Yes	NR	NR	NR	NR	NR
670	0.6	Yes	NR	NR	NR	NR	NR
671	0.1	No	Moderate (too steep)	Severe (too steep)	Low (too steep)	Poor (too steep)	Poor (too steep)
671	0.2	Yes	NR	NR	NR	NR	NR
671	0.5	Yes	NR	NR	NR	NR	NR
671	0.6	Yes	NR	NR	NR	NR	NR
672	0.1	No	High (too steep)	Severe (too steep)	Low (too steep)	Poor (too steep)	Poor (too steep)
672	0.2	Yes	NR	NR	NR	NR	NR
672	0.5	Yes	NR	NR	NR	NR	NR
672	0.6	Yes	NR	NR	NR	NR	NR
676	0.1	No	Moderate (too steep)	Severe (too steep)	Low (too steep)	Poor (too steep)	Poor (too steep)
676	0.2	No	Moderate (too steep)	Severe (too shallow)	Low (too steep)	Poor (too steep)	Poor (too shallow)
676	0.3	Yes	NR	NR	NR	NR	NR
676	0.4	Yes	NR	NR	NR	NR	NR

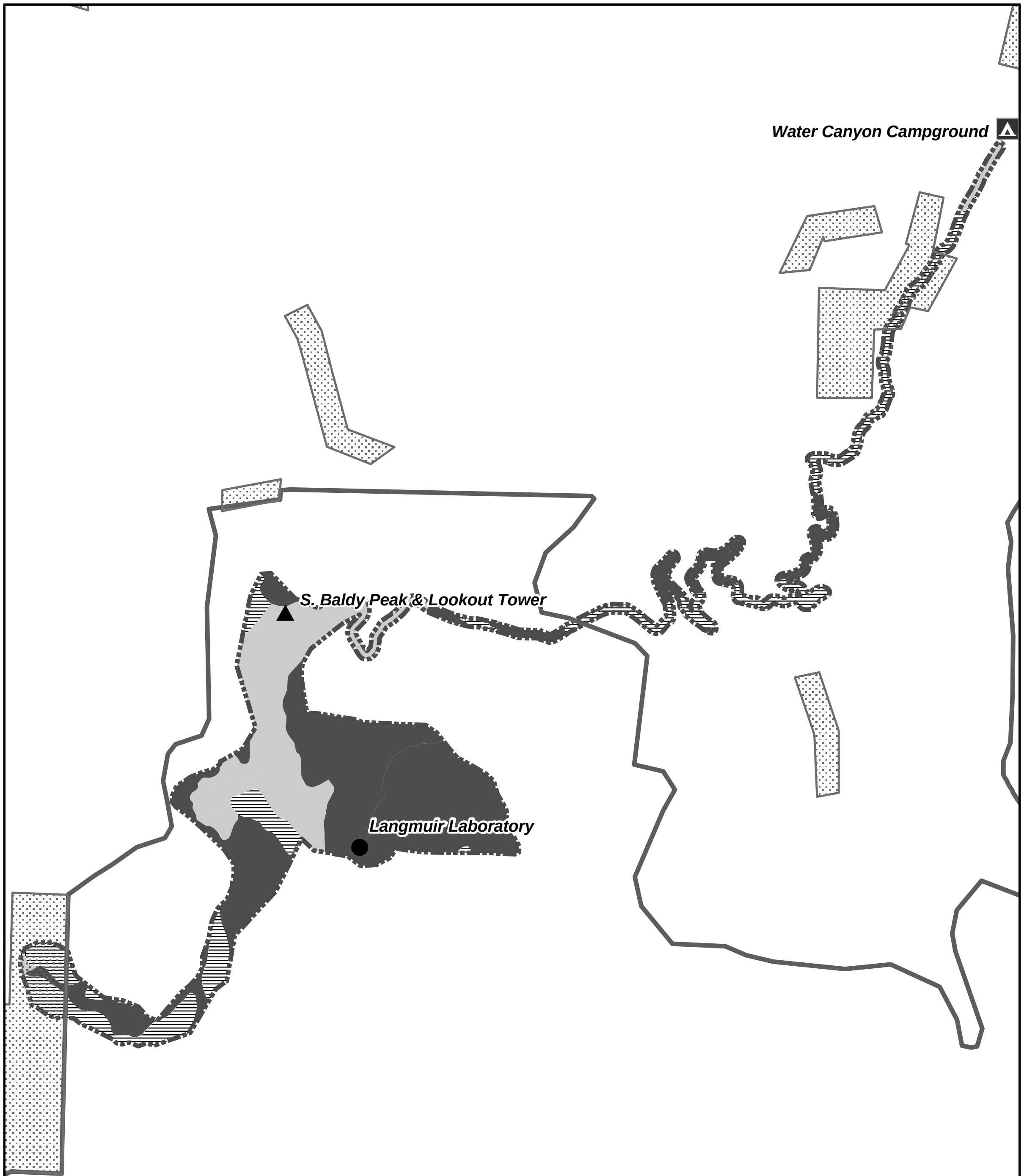
TES Map Unit	Component (soil type)	Sheet/Rill Erosion Likely	Mass Wasting Probability	Suitability Criteria			
				Unsurfaced Roads	Revegetation	Topsoil	Road Fill
676	0.5	Yes	NR	NR	NR	NR	NR
678	0.1	No	High (too steep)	Severe (too steep)	Low (too steep)	Poor (too steep)	Poor (too steep)
678	0.2	Yes	NR	NR	NR	NR	NR
678	0.5	Yes	NR	NR	NR	NR	NR
685	0.1	No	Moderate (too clayey)	Severe (too stony)	Moderate (too steep)	Poor (too stony)	Fair (too shallow)
685	0.2	No	Moderate (too clayey)	Moderate (too shallow)	Moderate (too steep)	Poor (too cobbly)	Fair (too shallow)
685	0.4	Yes	NR	NR	NR	NR	NR
685	0.5	Yes	NR	NR	NR	NR	NR
685	0.6	Yes	NR	NR	NR	NR	NR

Notes: NR = Not rated.
Source: USFS 2001f.

- **Sheet/Rill Erosion**: Soils that are the most subject to sheet and rill erosion (indicated by a “Yes” in the column) are those without any vegetation or litter covering the bare ground. These soils are considered highly erodible. These were selected because they have a K Factor in the TES database greater than 0.3. Approximately 27 percent of the project area contains soil components that are highly erodible if left bare. **Map 3-2** displays the distribution of soils susceptible to sheet and rill erosion based on the ratings of the primary components of each map unit.
- **Mass Wasting**: This describes a variety of processes that result in areas of soil moved as a mass by gravity from one place to another. If a TES unit is rated as prone to mass wasting, this is an indication that the soil would not be stable if road construction required removal of fill on a slope. In this case, extra measures are required to ensure slope stability. In some cases, the TES database includes the reason for the rating, which is listed in parentheses in the table. Approximately 25 percent of the project area has a low probability of mass wasting, 22 percent has a moderate probability, and 53 percent has a high probability. **Map 3-3** displays the location of the TES map units with their ratings for mass wasting.
- **Unsurfaced Road Suitability**: This describes the limitations that may cause problems for construction and maintenance of unsurfaced roads on the TES map unit identified. Moderate and severe limitations are followed by the reason for the rating in parentheses. Approximately 8 percent of the TES map units have few limitations for construction of unsurfaced roads (slight), 19 percent have moderate limitations, and 73 percent have severe limitations (**Map 3-4**).



Map 3-2
Distribution of Soils Susceptible to Sheet/Rill Erosion



Legend

Langmuir Research Site Boundary
MRO Project Boundary
Mass Wasting Rating
Low
Moderate
High
Private Land

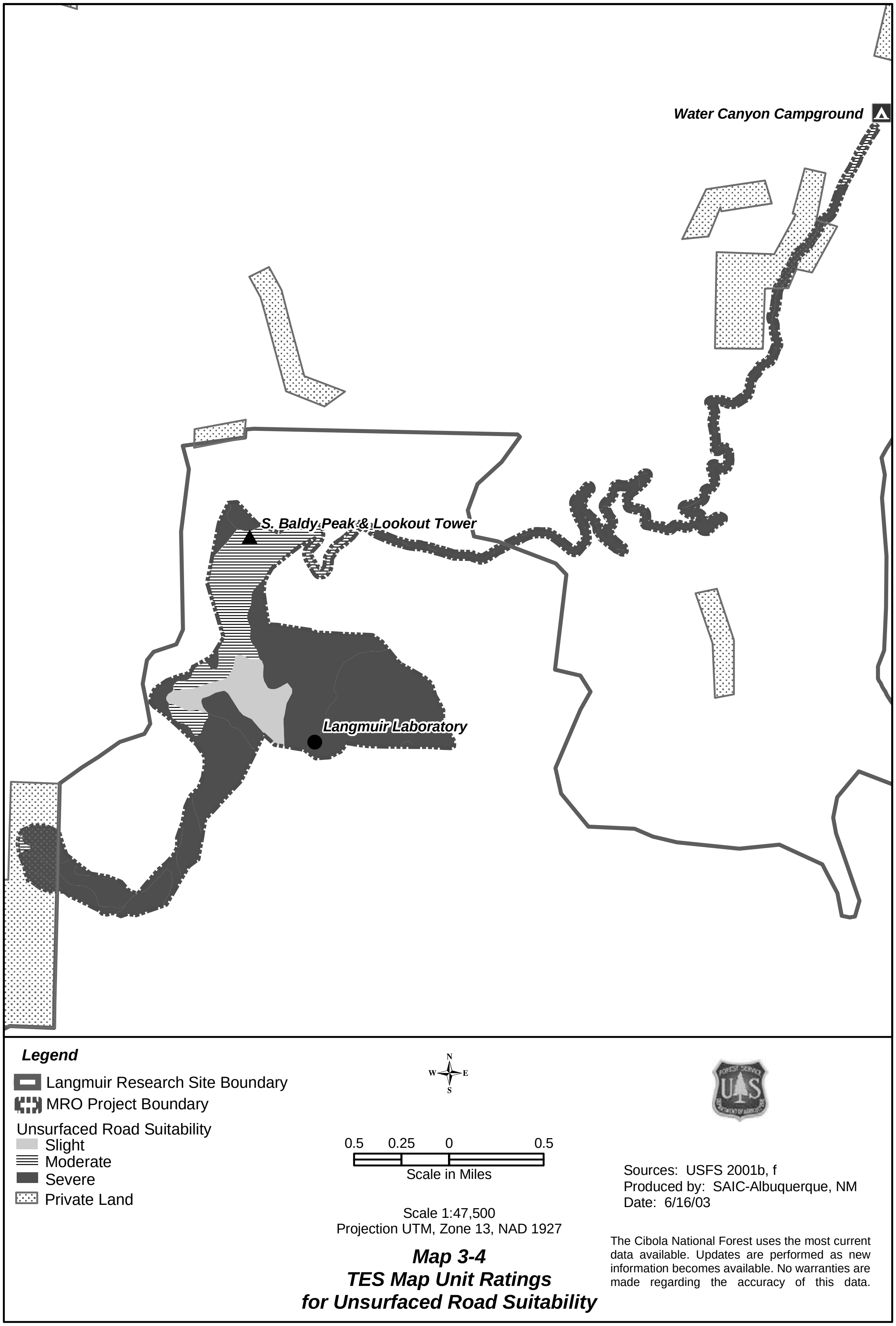
0.5 0.25 0 0.5
Scale in Miles

Scale 1:47,500
Projection UTM, Zone 13, NAD 1927

Sources: USFS 2001b, f
Produced by: SAIC-Albuquerque, NM
Date: 6/16/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-3
Location of TES Map Units
with Their Ratings for Mass Wasting



Map 3-4
TES Map Unit Ratings for Unsurfaced Road Suitability

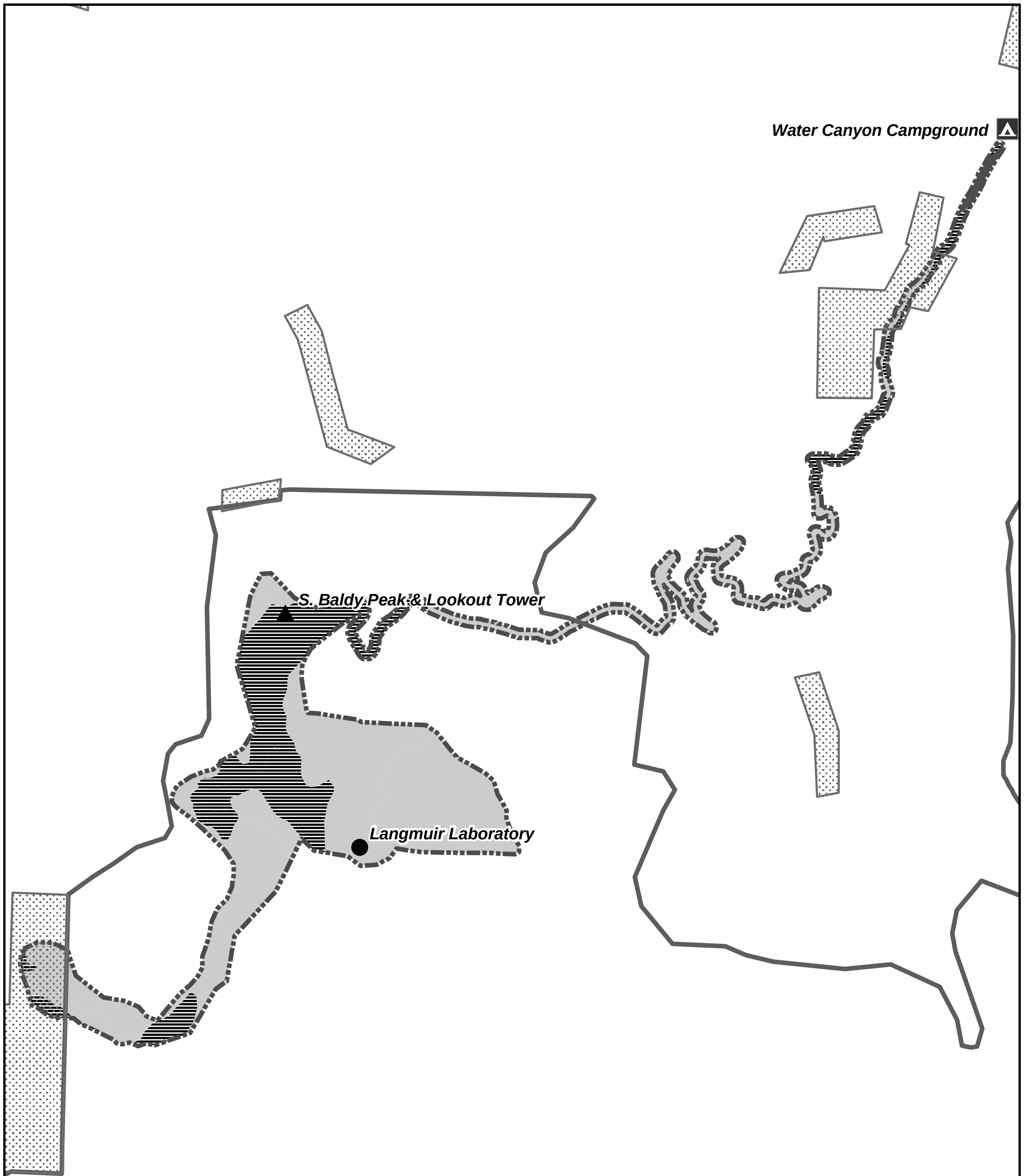
- **Revegetation potential** refers to the probable survival and ease of the establishment of seed mixtures based primarily on soil and topographic characteristics. Other factors such as timing and precipitation would affect revegetation success but are not considered in this rating. A high rating is the best for this category. Almost 70 percent of the soils in the project area are in the low category, 30 percent are in the moderate category, and less than 1 percent are in the high category. **Map 3-5** displays the distribution of TES map units with the ratings for revegetation potential associated with the primary component.
- **Topsoil** suitability ratings provide a measure of the quality of the topsoil in the project area that could be stripped from the site of roads, buildings, and parking lots to be used in areas where revegetation is planned. Due to the soil characteristics in the project area, less than 1 percent is rated as either fair or good (**Map 3-6**).
- **Road fill** ratings can be used to identify soil types that would be the most suitable for base material in case fill is needed during road construction. In the project area, approximately 77 percent of the soils would be poor road fill, almost 23 percent would be rated fair, and less than 1 percent would be rated good (**Map 3-7**).

3.2.1.2 Environmental Consequences

Method of Analysis

Impact evaluation is mainly qualitative and assumes that the majority of impacts to soils would be temporary during construction. Any soil characteristics that would require special treatment or pose problems with stability of roads and building are identified and generally located by TES map unit. No fieldwork was done to take samples or describe site-specific soil characteristics. The information from this analysis is used to assess impacts to surface water quality from potential sedimentation caused by erosion while soils are bare. Properly installed measures that meet Forest Service standards and guidelines are assumed so as to minimize most of the impacts to soil and water. These measures are provided in Table 2-6. Compliance with state and federal regulations requiring erosion and sediment controls is also assumed.

All impacts described above and the specific hazards to surface stability due to soil characteristics identified in Table 3-2 would be minimized (but not eliminated) through the implementation of the Best Management Practices (BMP) summarized in Table 2-6, which presents a collection of potential measures that would be appropriate to protect the resources identified. The effectiveness of BMPs in protecting soil and water resources associated with forest activities has been evaluated in many studies. The Black Hills National Forest recently developed a literature review entitled *Forest Plan Best Management Practices Evaluation* (USFS 2003d), in which they determined that most studies have clearly supported the assumption that BMPs are very effective in minimizing negative impacts to soil and water resources. In many cases, the effectiveness was rated at 75 percent or greater protection when compared to similar areas without the implementation of BMPs. A study of the effectiveness of BMPs to reduce impacts to water quality from timber harvesting operations in New York State (Schuler and Briggs 2000) is representative of many of the recent reports. This paper demonstrated a strong correlation between the implementation of BMPs and a reduction in sediment movement when the BMPs were properly installed and maintained.



Legend

Langmuir Research Site Boundary
MRO Project Boundary
Revegetation Potential
Low
Moderate
High
Private Land

N W E S

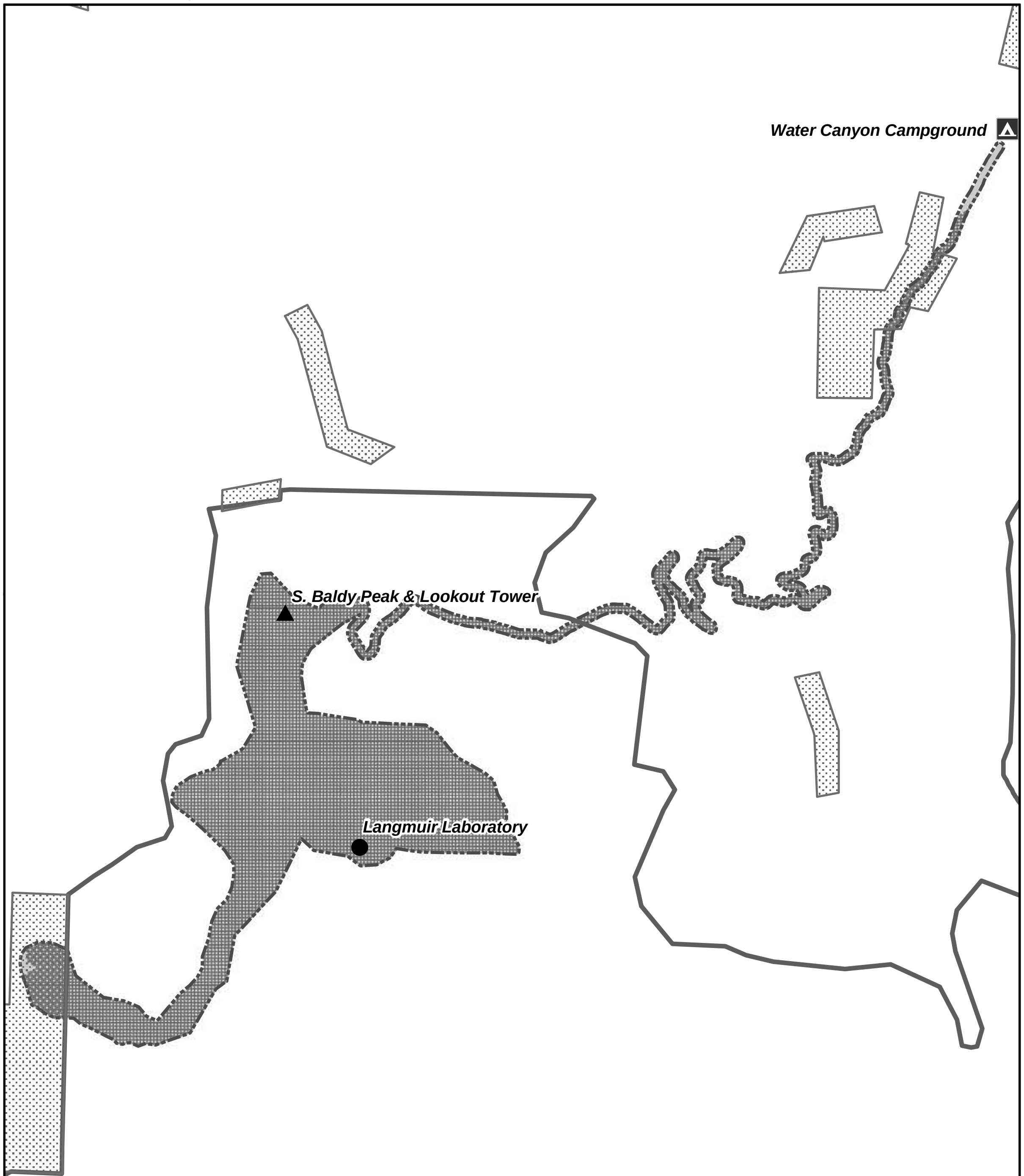
0.5 0.25 0 0.5
Scale in Miles

Scale 1:47,500
Projection UTM, Zone 13, NAD 1927

Sources: USFS 2001b, f
Produced by: SAIC-Albuquerque, NM
Date: 6/16/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-5
TES Map Unit Ratings for Revegetation Potential



Legend

- Langmuir Research Site Boundary
- MRO Project Boundary

Topsoil Rating
- Fair
- Poor

- Private Land

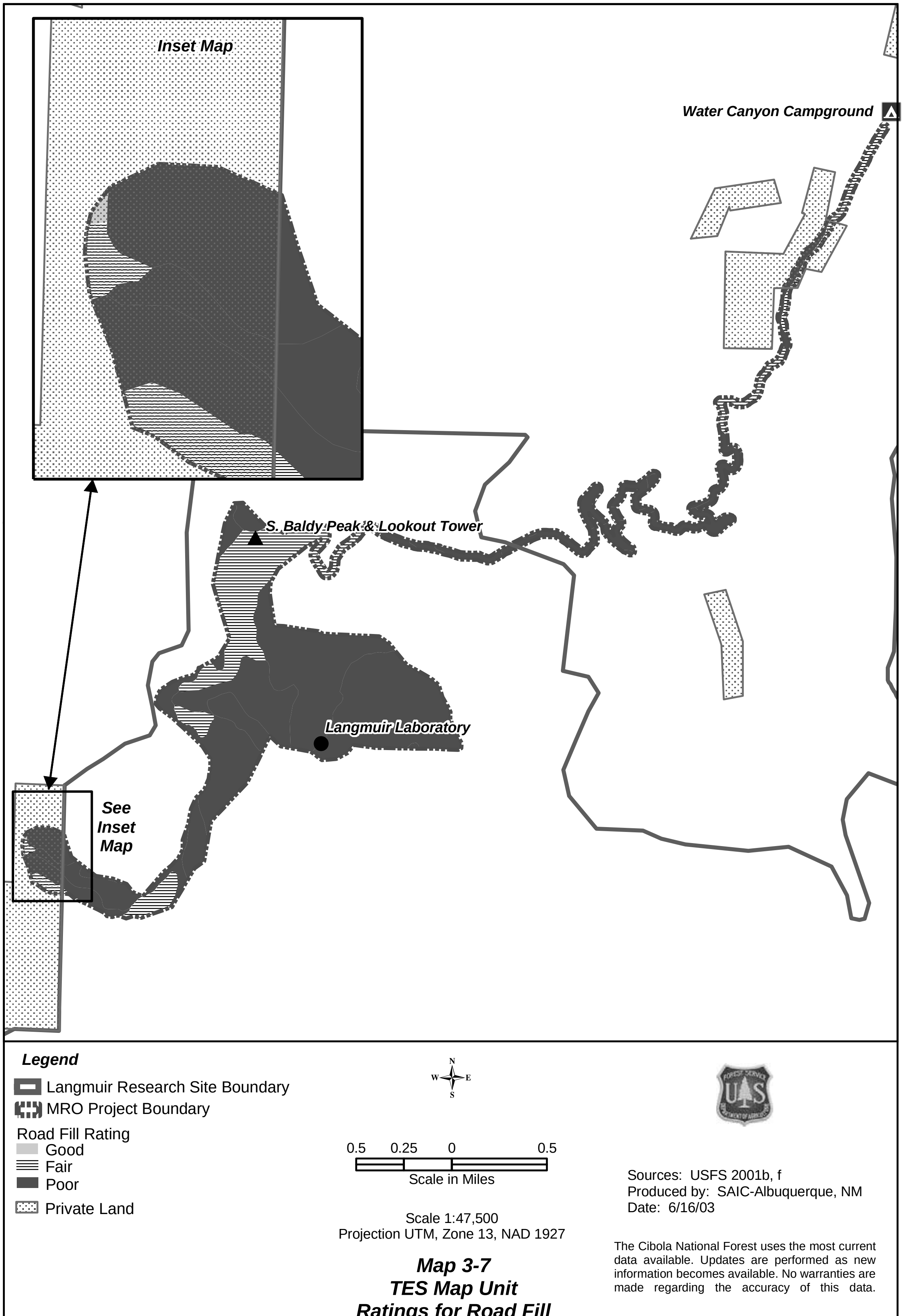
0.5 0.25 0 0.5
Scale in Miles

Scale 1:47,500
Projection UTM, Zone 13, NAD 1927

Map 3-6
TES Map Unit
Topsoil Rating

Sources: USFS 2001b, f
Produced by: SAIC-Albuquerque, NM
Date: 6/16/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.



Map 3-7
TES Map Unit Ratings for Road Fill

The selection of the BMPs to be used on the ground would be determined during the site design phase. Selection of specific BMPs would be based on their effectiveness in treating site characteristics including the proposed project, soil types, location on the landscape, slope steepness and gradient, climate, and nearness to sensitive areas or resources.

For all alternatives that involve surface-disturbing activities (Alternatives 1, 3, and 4), a general permit for construction activities must be obtained in compliance with the NPDES under the federal CWA. In New Mexico, the regulatory authority for this permit is the New Mexico Environment Department (NMED), Surface Water Quality Bureau (SWQB), under the guidance of the U.S. Environmental Protection Agency (USEPA). Part of the requirements for the permit include the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP) with appropriate BMPs to minimize the discharge of pollutants from the site.

The discussion of impacts under each alternative focuses on the areas where construction is proposed to occur, mainly the areas where buildings, parking areas, staging areas, and roads would be constructed. Because the acreage of narrow trenches that are likely to be installed to bury utilities on the mountaintop is minimal (less than 1 acre), it has been included in the amount of disturbance discussed below. As this disturbance would be short term and on relatively flat slopes, and BMPs would be installed to minimize offsite sedimentation, its contribution to impacts from the project would be negligible.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

Soils can be affected by any surface-disturbing activities. Soil properties should be considered when planning construction activities because they can affect the design and stability of structures such as roads, well pads, and water controls, as well as revegetation plans. Surface-disturbing activities such as road and building construction can directly affect soils at the construction sites primarily by accelerating erosion by removing protective vegetation. Stockpiling excavated soil increases soil compaction, which reduces surface water infiltration, increases surface water runoff, and increases associated loss of soil productivity on disturbed areas.

Ridgetop

Under Alternative 1, an estimated 23.41 acres would be distributed for construction on the mountaintop and for utilities.

Few problems with soil erosion (sheet/rill and mass wasting) are projected under this alternative because all soil map units on the ridgetop have a low rating for sheet/rill erosion and 98 percent is rated low likelihood of instability due to mass wasting. Topsoil quality is poor under all alternatives, mainly due to cobbles in the soil or steep slopes in a few areas. Revegetation potential is low for 98 percent of the soils, mainly due to cobbles in the soil profile that would hinder seeding equipment. Appropriate mitigation measures may be needed to successfully reseed the temporary staging area and other areas around buildings after completion of construction. Such measures include the use of mulch to hold moisture, a tackifier to cause the mulch and seed to stick together and thereby resist erosion, and watering of seedings until the vegetation is established. Native seed mixtures would be used to revegetate disturbed areas according to recommendations from the Forest Service. Most of the area would be stable for construction of unsurfaced road but would be poorly suited to use as road fill due to the cobbles in the soil.

Utility Options

The only direct impacts to soils would result from changing the natural soil profile through excavation. Because the acreage of the narrow trenches excavated to bury utilities on the mountaintop is small (less than 1 acre total disturbance), and would be short-term, on relatively flat slopes, with BMPs installed to minimize offsite sedimentation, their contribution to impacts from the project would be negligible under all options. The primary distribution pipelines would be placed underground within the existing roadbed. Options 2 and 3 have the slight benefit over Option 1 of not requiring a 2,200-foot (671-m) trench to be dug across the West Knoll.

Water Canyon Road

Approximately 154 acres along Water Canyon Road are located within the 148 feet (45 m) perpendicular to the centerline of the road for maintenance and repair. About 24 acres within this area (12 acres within the existing roadbed) may be affected by maintenance and repair activities. Soil characteristics that have a bearing on road construction and stability were evaluated within this area, and are summarized below as a percentage of the acreage within 74 feet (22.5 m) on either side of the road centerline.

- Likelihood of mass wasting—High 31 percent; Moderate 41 percent; Low 28 percent.
- Soil limitations for unsurfaced road construction—Severe 72 percent; Moderate 23 percent; Slight 5 percent.
- Soil limitations for road fill—Poor 62 percent; Fair 38 percent

These limitations would require careful selection and maintenance of BMPs required by Forest Service standards and guidelines, and compliance with the NPDES permit for construction, in order to minimize downstream impacts to waterways from sedimentation. Because the soils along this road are already disturbed from their natural state and downstream impacts would be controlled by the installation of BMPs, no negative impacts would occur from the maintenance and repair of Water Canyon Road. The installation of surface water control structures and the resurfacing project would be likely to make the road more stable, reducing erosion and downstream sedimentation as long as the road is properly maintained.

Operational Phase

Operation of the proposed MRO is not expected to have any effects on geology and soils, except for periodic maintenance and repair of Water Canyon Road, which is described above.

Indirect Impacts

Indirect effects to water quality may be caused by earthmoving, which results in sedimentation entering drainageways and then being transported to perennial water bodies. Also, disruption of topsoil can reduce the potential to successfully reseed disturbed areas, causing effects to vegetation.

The direct effects on soils from surface-disturbing activities include soil displacement, compaction, erosion, and loss of productivity. These can be assessed mainly in relation to the indirect effects on other resources. For example, surface-disturbing activities could cause erosion such that topsoil leaves the construction site and enters waterways that already have been identified as impaired due to high volumes of sediment, turbidity, and excessive stream bottom deposits. Even a small increase in sediment entering this water system could be significant. Use of BMPs is expected to prevent or minimize this condition. If removal or compaction of topsoil damages soil-protecting vegetative cover and limits the success of revegetation in stabilizing disturbed soils, accelerated erosion would result. This would reduce feed and cover for wildlife, forage for livestock, and downstream water quality.

Alternative 2: No Action

Under the No Action Alternative, no MRO construction would be undertaken. Ongoing use of the Langmuir Research Site would continue, as would Forest Service management activities and Forest uses such as recreation. Water Canyon Road would be maintained and repaired in accordance with the Langmuir Laboratory SUP and Annual Operations and Maintenance Plan. Use of BMPs would be employed during road maintenance and repair in accordance with Forest Service standards.

Alternative 3: Preferred Alternative

Under Alternative 3, an estimated 23.14 acres would be disturbed for ridgetop construction and utilities. The suitability of the soils for construction and stability of the 154 acres along Water Canyon Road would be the same as those described under Alternative 1. The soil erosion (sheet/rill and mass wasting) and topsoil characteristics of the soils that would be disturbed by construction on the mountaintop are the same as those described under Alternative 1. Most of the area would have few limitations for the construction of unsurfaced roads but would be poorly suited to use as road fill due to the cobbles in the soil.

Direct and indirect impacts would be as described for Alternative 1.

Alternative 4

Under Alternative 4, an estimated 23.18 acres would be disturbed for ridgetop construction and utilities. The suitability of the soils for construction and stability of Water Canyon Road would be as described under Alternative 1.

The soil erosion (sheet/rill and mass wasting) and topsoil characteristics of the soils that would be disturbed by construction on the mountaintop are the same as those described under Alternative 1. There would be few limitations for the construction of unsurfaced roads.

Direct and indirect impacts would be as described for Alternative 1.

3.2.1.3 Cumulative Impacts

The cumulative impact from the direct and indirect effects of Alternative 1, in combination with other planned activities and other possible developments that involve surface disturbance in the project area, such as moving the existing forest kiosk, maintenance and repair of Water Canyon Road, and removal of fuels from the surrounding forest would be minimal. Any cumulative adverse impacts would be minimized by implementation of appropriate BMPs and other mitigation measures identified in Table 2-6.

Alternative 2, the No Action Alternative, would not change existing conditions. Therefore, impacts to soil resources from the construction and operation of MRO facilities would be avoided. There would be no new cumulative impacts.

Cumulative impacts from implementation of Alternatives 3 or 4 would be the same as Alternative 1.

3.2.1.4 Mitigation

BMPs and other identified mitigation measures are listed in Section 2.2.5 and Table 2-6.

3.2.2 Water Resources

3.2.2.1 Affected Environment

Region of Influence

The direct and indirect areas of potential effects for water resources include the following:

- Magdalena Ridge and surrounding areas;
- Water supply source areas (canyons, creeks, springs, and groundwater);
- Drainages and stream crossings along and across Water Canyon Road;
- Utility corridor(s) including water supply lines;
- Wetlands and riparian areas at the bottom of the canyons; and
- Campgrounds and recreation sites, depending on the extent of increased runoff.

Map 3-8 shows the project boundary within which direct impacts could occur and a wider region that includes several canyon creeks in the project area that could be affected by the Proposed Action. These creeks include Water, Hardy, and Bear Creeks, and the East and West Forks of Sawmill Canyon Creek.

Existing Conditions

The description of the affected environment includes information about climate; watersheds; rivers, streams, and creeks; road/stream crossings; geologic and hydrogeologic setting; groundwater; springs; wetlands and riparian areas; water quality; and the existing water supply, demand, and storage facilities for Langmuir Laboratory. There is not a lot of water resources information available for the project area.

The project site is on Magdalena Ridge. The ridge forms the west side of Water Canyon. South Baldy Peak marks the northernmost point of Magdalena Ridge and has an elevation of 10,783 feet (3,287 m). Langmuir Laboratory is located in the southern area of the ridge with several structures located throughout the ridgetop area. The area where the proposed observatory would be located varies in elevation from approximately 10,400 to 10,600 feet (3,170 to 3,231 m).

The area is very rocky with numerous large cobbles present on the surface. The site has some moderately level ground, but most of the terrain undulates and is generally much steeper away from the top and down from the ridge. The site is above the timberline. However, timberline is relatively close and appears to stop at about 10,400 feet (3,170 m). There is moderate vegetation consisting of high altitude grasses, moss, and lichen (Sea West 2002).

Climate

The average annual precipitation is 18 inches (45.7 centimeters [cm]) or more on the mountain peaks. Mean annual precipitation at the summit of Mt. Baldy (approximately 11,000 feet [3,353 m]) is about 25 inches (63.5 cm). The rainiest months are July, August, and September when nearly half of the annual precipitation occurs (USFS 2000a). Annual precipitation in the Magdalena Mountains has ranged from 13.4 inches

Scale 1:55,500
Projection UTM, Zone 13, NAD 1927

Sources: USFS 2001b, e; SAIC 2003a
Produced by: SAIC-Albuquerque, NM
Date: 6/16/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-8
Canyons and Streams
in the Vicinity of the Project Area

(34.0 cm) at 7,000 feet (2,134 m) to 17.7 inches (45.0 cm) at 10,630 feet (3,240 m) at the Langmuir Laboratory. Precipitation for July, August, and September has ranged from 8.8 inches (22.4 cm) at 6,720 feet (2,048 m) to 11.9 inches (30.2 cm) at the Laboratory (NMSBM&MR 1972).

- Most of the warm season precipitation falls during brief but heavy thunderstorms. More than 70 percent of the annual precipitation is received from May through October. Snow generally falls in the mountains from October through April. Precipitation varies greatly from year to year and month to month (USFS 2000a). Drought and flood cycles typically occur in the region. These cycles can have a large effect on water supplies, watershed condition, and the range of vegetation species.

Regional Setting: The Middle Rio Grande Basin

The CNF is located within the Rio Grande Basin. The Rio Grande splits New Mexico down the middle for over 400 miles (644 km). Within New Mexico, the river has been divided into three sections for water quality management purposes (NMED 2001):

- Upper Rio Grande, which extends from the Colorado/New Mexico State Line to the Angostura Diversion Works;
- Middle Rio Grande, which extends from the Angostura Diversion Works to the headwaters of Elephant Butte Reservoir; and
- Lower Rio Grande, which extends from Elephant Butte Reservoir to the International Boundary.

The following discussion on the regional setting is summarized from a New Mexico Water Quality Control Commission (NMWQCC) report (NMED 2001). The Middle Rio Grande watershed covers nearly 12,000 square miles (mi^2) (31,080 square kilometers [km^2]) in parts of nine counties (Rio Arriba, Sandoval, McKinley, Valencia, Santa Fe, Bernalillo, Torrance, Catron, and Socorro). It is located along the main floodplain of the Rio Grande Valley. Principal tributaries are the Jemez River, the Rio Puerco/Rio San Jose, and the Rio Salado.

Most of the surface water in the Middle Rio Grande is supplied by runoff and stream flow from the Upper Rio Grande. Exceptions are perennial tributaries in the Jemez Mountains, which contribute to the Jemez River and its principal tributary, the Guadalupe River. The upper reaches of the Rio Puerco and its principal tributary, the Rio San Jose, also contribute to the Middle Rio Grande. Large amounts of groundwater are held in storage in the alluvial materials of the Rio Grande trough. Most water uses, primarily municipal and industrial, in the Rio Grande Basin are met with groundwater supplies; an exception is irrigated agriculture, which relies primarily upon surface water.

Wetland habitats within the Middle Rio Grande are either intermittent or perennial. Intermittent wetland areas receive water during spring runoff. As floods withdraw, remaining ponded backwaters dry up with the hot summer sun. Perennial wetland areas include the Rio Grande riverside drains and the low-flow conveyance channels and wetlands in the Belen, Bernardo, Casa Colorada, and La Joya State Waterfowl areas. Also included are the low-flow conveyance channels and wetlands in the Sevilleta and Bosque del Apache National Wildlife areas. Oxbow lakes formed from cut-off channels of the Rio Grande also provide wetlands habitats.

Surface Water

The project area is within the Rio Grande-Albuquerque Watershed (U.S. Geological Survey [USGS] Hydrologic Unit Code 13020203). Many arroyos drain the Magdalena Mountains but none contain permanent streamflow (NMSBM&MR 1972). There are several canyon creeks in the project area including Water Canyon Creek, Hardy Canyon Creek, Bear Canyon Creek, and the East and West Forks of Sawmill Canyon Creek. The creeks are tributary to the Rio Grande. The creeks are primarily ephemeral and flow mostly in response to snowmelt and storm runoff. Flash floods are common during and following summer thunderstorms. Some reaches of the creeks flow intermittently and are fed by geologically controlled springs.

There is little to no flow or water quality data available for the above mentioned creeks except for the East Fork of Sawmill Canyon Creek. All developed water sources are either springs or groundwater wells. In general, there is a lack of information on water availability with the Magdalena Ranger District (MRD). As part of the Forest Plan revision process, a compilation of existing surface and groundwater developments as well as the status of water rights for existing developments is underway (USFS 2000a).

The project site is surrounded by headwaters of several creeks such as Water Canyon Creek, Hardy Canyon Creek, Bear Canyon Creek, and the East and West Forks of Sawmill Canyon Creek. These creeks are intermittent in the vicinity of the ridge, carrying flows from surface runoff and springs. A range of water flows has been documented through field observations for the creeks mentioned above. No flowing water was observed in these creeks during a field trip on November 20, 2001[1], with the exception of flows observed at a weir in the East Fork of Sawmill Canyon Creek near a cable alignment. The flow was estimated to be approximately 2 gpm. According to information from NMIMT personnel on a recent field trip (SAIC 2003b), water flows in this creek all year long. Flow during the May 2003[1] field visit was estimated at 8 to 9 gpm. The East Fork of Sawmill Canyon Creek flows on the surface for about 2 more miles (3.2 km) downstream from the dam site through conifer forest. It then reaches more open piñon-juniper woodlands and the stream channel becomes braided and disappears underground. This creek is the source of a seasonal potable water supply for the facilities at Langmuir Laboratory.

One recent report concluded that, where water is diverted for Langmuir Laboratory at the location in the East Fork of Sawmill Canyon Creek, the surface water flow in the drainage is probably perennial due to spring discharge (Pawelek 2003). Water is pumped seasonally during the warm months for Langmuir Laboratory at the rate of approximately 1 gpm. The water is diverted from the creek at a location downstream from the spring. A dam was constructed in the early 1960s. It is located across a small perennial creek whose primary source is a spring about 2 miles (3.2 km) upstream; other springs provide the baseflow. The storage behind the dam silted in within a few years of its construction, and the outflow comes from a weir over the top of the stone dam and two pipes with inlets buried in the deposition. The creek flow has been reliable for Langmuir Laboratory for 32

[1] Water was estimated during one of the driest period of the year (WRCC 2003).

years (Winn 2003). Langmuir Laboratory does not divert flow all the time, even during the warm season. Under the existing Langmuir Laboratory water permit from the State of New Mexico (State Permitt 04848), 84,375 gallons of water per year are allowed from East Sawmill Creek. Water demands above this threshold would be meet through alternative means such as water hauling.

There are no designated or potential wild and scenic rivers in this geographic area (USFS 2000a). An assessment of the rivers on the MRD was conducted in 1997. No rivers or other flowing waters were found to be eligible for inclusion in the Wild and Scenic Rivers systems. Drainages that were assessed include Water Canyon, Sixmile Canyon, and the East Fork of Sawmill Creek.

There are no paved areas at Langmuir Laboratory. Langmuir has not changed the natural drainage system and has not installed storm drains that discharge to stream channels (Winn 2003). Therefore, storm drainage follows the natural drainage patterns.

Streams and Road Drainage Conditions

The access road to the research facilities at Langmuir Laboratory runs along Water Canyon. Many areas of the roadbed contain rock outcroppings, both adjacent to and as part of the roadbed. There are continual small flows and intermittent larger flows from the drainages that cross the access road from Water Canyon Campground to the top of the mountain. Proper drainage is necessary to prevent deterioration of the roadbed and to protect against erosion in the summer and freeze/thaw buckling in the winter. Road maintenance, including additional drainage and stream control measures, is needed in some sections of the access road where natural watercourses cross the roadbed. Drainage is necessary to prevent road failures, scouring, and gully erosion. Based on a review performed as part of the MRO Conceptual Design Report (Sea West 2002), there are numerous sections of the access road where water crossings present a particular problem for drainage and road maintenance. The following road/stream crossing section descriptions are examples of road and drainage conditions along Water Canyon Road.

Key Road/Stream Crossings

Water Crossing at Water Canyon Campground. Water Canyon creek crosses the road at the campground. The crossing is wide and undefined with seasonal flows. Scouring of the roadbed is most pronounced after peak flows. This is relatively flat land and is, therefore, an area of potential deposition of debris.

Water Crossing of Water Canyon Creek just above the Campground. Water Canyon creek again crosses the road a short distance above the campground. This crossing is wide and undefined with seasonal flows. Scouring of the roadbed is most pronounced after peak flows. This is relatively flat land and an area of potential deposition of debris.

Water Crossing of Roadway 1.1 Miles (1.7 Kilometers) Upstream from the Campground. An unnamed watercourse crosses the road. The crossing is more defined in this location with localized scouring of the roadbed. This crossing is subject to debris movement during peak flow conditions.

Narrow Road and Water Course Crossings between 2.0 and 2.3 Miles (3.2 to 3.7 Kilometers) Upstream. The road narrows in areas to roughly 14 feet (4.3 m) wide with rock outcroppings. The roadbed slopes toward the downhill side. This area also has several water courses crossing the roadbed, most of which are of little consequence to the serviceability of the road.

Rock Outcroppings and Road Slopes Severely to the Outside (Downslope) Edge 2.6 Miles (4.2 Kilometers) Upstream. The road in this area is encumbered roughly 2 feet (0.6 m) with jagged rock outcroppings, and the roadbed is sloped toward the downhill side. This area also has one location where a watercourse follows the upstream side of the road and eventually crosses the roadbed causing a localized washout.

Water Crossing of the Roadbed 2.8 Miles (4.5 Kilometers) Upstream. There is a water crossing of the roadbed with a seasonal washout on the south side of the road. This is a more defined watercourse that will flow with seasonal rains. Debris is expected in this area along with the seasonal flood flow of the water.

Water Crossing of Roadbed 3.6 Miles (5.8 Kilometers) Upstream. There is a water crossing of the roadbed with a seasonal washout on the south side of the road. This area is more of a problem with debris flow and seasonal scouring of the roadbed.

Rock Outcroppings and Road Slopes Adversely to the Outside (Downslope) Edge 4.2 Miles (6.8 Kilometers) Upstream. A slide area and a water crossing are in this area. The road is also encumbered with jagged rock outcroppings of the type similar to other locations. There is one area where a watercourse crosses the road in a sheet flow manner and has caused erosion on the south slope side of the road when it exits the roadbed.

Water Crossing of the Roadbed 4.4 Miles (7 Kilometers) Upstream. There is a water crossing of the roadbed with a seasonal washout on the south side of the road. This area is a problem with debris flow and seasonal scouring of the roadbed.

Groundwater

The state-declared groundwater basin for the Magdalena Mountains Geographic Area is the Rio Grande. There are six groundwater basins underlying the CNF (USFS 1985). All developed water sources on the MRD are either springs or groundwater wells. In general, there is a lack of information on water availability on the MRD. Basic information on groundwater, such as annual drawdown and water levels, and spring flow is generally not available. As part of the Forest Plan revision process, a compilation of existing surface and groundwater developments as well as the status of water rights for existing developments is underway (USFS 2000a).

The USGS conducted the most recent study of the groundwater resources of Socorro County (USGS 1991). Based on the 30 wells with records, the depth of wells ranged from 30 to 546 feet (9 to 166 m) with the majority of wells drilled more than 100 feet (30.5 m). The wells located in the mountains appear to be at least 300 to over 400 feet (90 to 122 m) deep. Yields of the wells ranged from less than 1 gpm to 350 gpm. Yields were not reported for most of the wells.

Geology and Hydrogeology

The project area is located within the Datil-Mogollon Volcanic physiographic province. The area is located within the historic Kelly Mining District. Structurally, the site lies along the western flank of the Rio Grande Rift formation. The Magdalena Mountains were formed by a series of block faulting, uplift, and volcanic intrusions and extrusions. Geologic deposits of the Magdalena Mountains are Precambrian argillite and granite; Paleozoic limestones, shales, and sandstones; Cenozoic rhyolite, andesite, quartz monzonite, ash flows, breccias, tuffs, and conglomerates; and Quaternary sediments found on talus slopes and alluvial fans (Sea West 2002).

The geology and hydrogeology of the project area have been evaluated by the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) (Chamberlin and Johnson 2002). Potential sites for water supply wells have also been evaluated. Relevant sections of the report are summarized in the following paragraphs (see Soils [Section 3.2.1] for more information).

Potential Aquifers

Potential aquifers in the project area consist of four types:

- Type 1: Moderate to low permeability fracture zones along faults in the volcanic strata;
- Type 2: Moderate to low permeability fracture zones in silicified Popotosa conglomerates and sandstones;
- Type 3: Moderate permeability but thin, saturated zones near the base of Quaternary gravels; and
- Type 4: Moderately permeable, unaltered beds in the Popotosa Formation.

The locations of north-trending fault zones are reasonably well known from map data, but the dip or angles of these faults are less certain. The geometry of Quaternary fan gravels can be inferred from gradient and drainage patterns. The distribution of altered zones in the Popotosa Formation has not been mapped. Thus, the location of "Type 4" permeable beds, if present in the area, is essentially unknown.

Five exploratory water well sites were evaluated in Hardy Canyon. One potential site for developing a supply for the proposed observatory in this valley is being assessed in the Final EIS. The most promising site for locating a water supply lies to the southwest of the ridge in the valley running from Hardy Spring down to Mill Place.

The geologic formation along the ridge in the vicinity of the project site is classified as Hells Mesa Tuff, a unit of densely welded, crystal and quartz-rich, feldspar rhyolite tuff. There is an east-west shear zone crossing the Magdalena Mountains located south of the observatory site. Because of its geologic conditions and its location on top of the ridge, the possibility of finding adequate groundwater in the fractured rocks, if any, appears to be very low (Sea West 2002).

The most promising groundwater basin is beneath the alluvial fan in Hardy Canyon located approximately 2.5 miles (4.0 km) southwest of the ridgetop site. The ground surface elevation of this alluvial fan ranges from 7,000 to 7,400 feet (2,134 to 2,256 m).

During a field trip conducted on November 20, 2001, a well was observed near Mill Place, which is located at the mouth of the Hardy Canyon. The well is equipped with a windmill, which may indicate a shallow depth of water. Local residents have estimated the well flow rate to be less than 10 gpm. A search of the records at the New Mexico Office of the State Engineer (OSE) indicates that a shallow well (Well Number RG 56199) was drilled in Hardy Canyon on November 30, 1992. The well is 160 feet (49 m) deep, and the depth to water during drilling was 70 feet (21 m) below ground surface (Sea West 2002).

It is possible that yields from properly drilled deep production wells in a groundwater basin such as this can exceed 50 gpm (Sea West 2002). This source may be capable of providing reliable flows year-round, even in dry years when surface water flows are typically very low or non-existent. Based on the known hydrogeologic and topographic conditions at the site, and on the estimated water demands for the MRO, groundwater in Hardy Canyon would be the most reliable source of water in the area (Sea West 2002). Based on findings, it is estimated that a new production well for the observatory could be drilled to a depth of approximately 200 to 600 feet (61 to 183 m) depending on the yields of test wells and is expected to yield up to 50 or 100 gpm in Hardy Canyon (Sea West 2002).

Water Quality

Surface Water Quality

The Rio Grande Basin has over 1,000 state-jurisdictional miles of assessed river reaches that only partially, or do not at all, support their designated or attainable uses. The specific pollutants in these reaches are turbidity, stream bottom deposits, metals, pH, total ammonia and total residual chlorine near the major municipal dischargers, temperature, total organic carbon, pathogens, plant nutrients, total phosphorus, nuisance algae, flow alteration, and overall watershed condition. The probable sources of this non- or partial-support are agriculture, recreation, hydromodification, road and highway maintenance, silviculture, resource extraction, municipal and domestic point sources, land disposal, road runoff, and natural and unknown sources. The most commonly found toxins in acute concentrations are aluminum, copper and zinc; the most commonly found toxins in chronic concentrations are aluminum, arsenic, cadmium, lead, mercury, nickel, selenium, and zinc (NMED 2001).

The Existing Condition Report for Magdalena Mountains stated that the CNF LRMP (USFS 1985) identified the three administrative watersheds in the CNF to be in unsatisfactory condition. A watershed condition assessment, riparian inventory/condition assessment, and water availability assessment are being conducted by the Forest Service but have not yet been completed (USFS 2000a). Surface, rill, and gully erosion occur on the MRD. Nonpoint source sediment pollution to surface water bodies is an ongoing concern. Livestock grazing, off-road vehicle (ORV) use, and poorly located and/or maintained roads are the primary sources contributing to nonpoint source pollution from soil erosion and sedimentation (USFS 1985). The NMED has not identified any surface water bodies with impaired water quality on the MRD (USFS 2000a).

The water quality of the Langmuir Laboratory water supply was analyzed in 2003. Results of the water analysis were (NMSBM&MR 2003):

- pH of 7.92;
- Hardness, 110 parts per million (ppm);
- Bicarbonate, 148 ppm;
- Chloride, 1.6 ppm;
- Sulfate, 7 ppm;
- Nitrate, <0.36 ppm;
- Fluoride, <0.1 ppm;
- Sodium, 5.2 ppm;
- Potassium, 0.96 ppm;
- Magnesium, 5 ppm; and
- Calcium, 36 ppm.

All microbiology analyses were negative (NMSLD 1992). No other water quality data are available for the East Fork of Sawmill Canyon Creek.

Groundwater Quality

Approximately 90 percent of the population of New Mexico depends on groundwater for its domestic water supply. In New Mexico, at least 1,235 groundwater contamination plumes emanating from point sources and numerous areas of widespread contamination from nonpoint sources have been identified from data acquired between 1927 and December 1999. This contamination has impacted at least 188 public and 1,719 private water supply wells (NMED 2001).

Over half of all cases of groundwater contamination in New Mexico have been shown to be caused by nonpoint sources, predominantly household septic tanks and cesspools, which together create the single largest known source of groundwater contamination in the state. It is estimated that there are over 170,000 household septic tanks or cesspools in the state discharging roughly 51 million gallons of wastewater every day. Other nonpoint sources that may impact groundwater include residual minerals from evapotranspiration, pesticides and fertilizers from agricultural and urban sources, and discharges from mine water and urban runoff. The following nonpoint source contaminants have been found to contribute to groundwater pollution in the Rio Grande Basin: iron, manganese, and sulfides; nitrate; pesticides; and total dissolved solids (TDS) (NMED 2001).

Point source contamination in the Rio Grande Basin is predominantly industrial in nature, involving refined petroleum in approximately half of the cases. Non-industrial point sources include centralized sewage-treatment works and landfills. Most of New Mexico's point source cases have resulted from either poor historical disposal practices or accidental, permitted, or non-permitted discharges. The following point sources have been found to contribute to groundwater pollution in the Rio Grande Valley: leaking underground storage tanks and refined petroleum products; landfills; radionuclides; halogenated aliphatic compounds; polychlorinated biphenyls (PCB); TDS; metals; and spills (NMED 2001).

The only potential source of groundwater quality impairment that may exist within the MRD is contamination resulting from mining activities. There are numerous abandoned mines scattered throughout the geographic area (USFS 2000a). To date, no assessment has been made regarding potential groundwater contamination from the active and inactive mining operations on the MRD. Results of one of the few sampling studies indicated that pH is about 6.7, TDS is less than 500 ppm, and calcium and bicarbonate are the dominant ions in groundwater in the Magdalena Mountains (NMSBM&MR 1972). This same study reported that yields of wells and springs are all less than 50 gpm, and few yields of more than 20 gpm have been measured.

Springs

There are 193 springs and 79 wells on the MRD, plus a small number of other manufactured water collectors (USFS 2000a). Springs are geologically controlled and occur at local permeability barriers in the canyons and arroyos of the Magdalena Mountains. Some of the springs are intermittent.

All developed water sources on the MRD are either springs or groundwater wells. In general, there is a lack of information on water availability (i.e., annual drawdown and water levels, and spring flow).

As part of the Forest Plan revision process, a compilation of existing surface and groundwater developments, as well as the status of water rights for existing developments, is underway (USFS 2000a). Water rights have become increasingly important and have become an issue on grazing allotments in the Magdalena Mountains. As of March 2000, filings for water rights had been made on 57 developments, mostly springs, on the MRD (USFS 2000a).

Physical characteristics of springs in Socorro County were compiled and tabulated by the USGS and the New Mexico OSE (USGS 1992). Several springs were inventoried in the Magdalena Mountains and the CNF. Data from 23 of the springs in the project area are summarized in this section. The springs are located on hillsides, in arroyos, and in canyons. Some have names (e.g., Baldy and Hardy Springs) while others do not. Several springs are located in Water Canyon. Elevations of the springs ranged from 6,800 to 9,920 feet (2,073 to 3,034 m) at Baldy Spring. Yields ranged from 1 to more than 40 gpm with most yields lower than 10 gpm. The springs in Water Canyon had the highest yields. Specific conductance of the springs ranged from 120 to 700 microsiemens.

A number of springs were sampled by the New Mexico State Bureau of Mines and Mineral Resources (NMSBM&MR) (NMSBM&MR 1972). All water tests indicated an alkaline (basic) pH. Field pH of the samples varied from 6.4 to 7.8 while laboratory pH ranged from 7.2 to 8.8. Analyses were performed for several water quality parameters including fluoride, nitrate, lithium, rubidium, strontium, barium, chromium, copper, zinc, iron and manganese. Most concentrations were near or at the detection limits except for fluoride and strontium. Calcium, bicarbonate, and TDS concentrations diminished with time. Results of the study indicate that TDS is less than 500 ppm, and calcium and bicarbonate are the dominant ions.

There are several springs located adjacent to the ridgetop. The closest spring is Baldy Spring located approximately 2,000 feet (610 m) from the ridge. Baldy Spring is located at approximately 9,900 feet (3,018 m), only 600 feet (183 m) lower than the elevation of the proposed MRO. This spring, however, is intermittent. No water was observed during the field trip on November 20, 2001. Based on this, Baldy Spring may not be a reliable year-round water source (Sea West 2002). However, Langmuir Laboratory has never been without an adequate supply for its uses, which occur mostly in the summer.

Three additional springs are located on the western flank of Magdalena Ridge. One of these springs is Hardy Spring. Hardy Spring was supplying water to the Arrowhead Tank at a rate of approximately 3 gpm during a field trip conducted on November 20, 2001. The flow, if any, from other springs is estimated to be less than the flow from Hardy Spring because the other springs are located at higher elevations (8,580 and 8,620 feet [2,615 to 2,627 m]) than Hardy Spring (8,040 feet [2,451 m]).

Wetland and Riparian Areas

A riparian area inventory and condition assessment are being conducted by the Forest Service for the Magdalena Mountains Geographic Area, but they are not yet completed. A forest-wide review of riparian areas was completed in 1998. Areas include Bear Springs/Bear Canyon, Sawmill Canyon, Smith Canyon, and Agua Fria. The riparian reaches of Bear Canyon and the East Fork of Sawmill Canyon are each approximately 2 miles (3.2 km) in length, and Water Canyon is about 1 mile (1.6 km) long with average widths from 10 to 20 feet (3 to 6 m). The existing condition was reported as unsatisfactory for the major riparian areas, Water Canyon and the East Fork of Sawmill Canyon. However, the many small riparian areas, which include stream reaches less than a mile long, springs and seeps, and wet meadows, are important for vegetation and wildlife. Scattered throughout the CNF, their total area is equal to or greater than the few larger wetland and riparian areas (USFS 2000a).

A recent site survey of the land proposed for mineral withdrawal at the Langmuir Laboratory Site in October 2002 (USFS 2002b) found no significant floodplains or wetlands in the 1,000-acre Principle Research Facility (PRF) at Langmuir.

A wetland determination in the bottom of the East Fork of Sawmill Canyon in the vicinity of the existing diversion for Langmuir Laboratory was conducted in May 2003. The wetland determination followed U.S. Army Corps of Engineers (USACE) wetland delineation procedures. The area (see Surface Water above), about 30 feet (9.1 m) wide and extending 20 feet (6.1 m) upstream from the Langmuir water source, supports a dense growth of vegetation. However, the species of plants in this riparian strip did not meet the USACE criteria for hydrophytic vegetation for a wetland, which requires that 50 percent or more of the plants be species that occur at least one half the time (USACE 1987).

During the site visit, the soil was wet but not saturated. There were some mottles in the soil that may indicate the presence of periodic reducing soil conditions. It was determined that the soils in the deposition behind the dam can be considered hydric (borderline), with a matrix of low chroma and some bright mottles. The hydrology exists that is required for a determination of a wetland, but no hydrophytic plants are present. There appear to be small areas of wetlands along the riparian areas even though hydrophytic plants are not present (SAIC 2003b).

Water Demand, Supply and Storage

Current authorized water demand from the Langmuir Laboratory is 84,375 gallons per year, as per the water permit application with the State of New Mexico. Existing water storage tanks at the Laboratory can hold 80,000 gallons for both potable and fire suppression purposes. Water is treated with chlorine prior to use as potable water at Langmuir Laboratory. The Laboratory uses a septic tank and leach field system for wastewater and sewage treatment (Winn 2003).

Historically, reliable water sources have been in short supply in the upper reaches of the Magdalena Mountains. Science facilities that have occupied these ridges and peaks south of South Baldy for the past 4 or 5 decades have relied upon local intermittent streams and upper slope runoff to supply their potable water needs. The seasonal characteristics of these sources have frequently required occupants and observers to bring their own water to the mountain and curtail the use of water for toilets or cleaning (Sea West 2002).

3.2.2.2 Environmental Consequences

Method of Analysis

Existing and planned water use, supply, and quality information were evaluated and compared. Professional judgment and experience, along with consultation with local experts, were used to make qualitative comparisons and evaluations. For the most part, quantitative data are lacking for water resources in this area. It was assumed for the analysis that BMPs, as required by the Forest Service, would be utilized for the project. The Forest Service Soil and Water Conservation Practices Handbook was used to identify BMPs as appropriate. Because design of site-specific mitigation measures for stormwater, erosion, and sediment control would be required, it was assumed that they would be included as part of the project plans.

Alternative 1: Proposed Action

Direct Impacts

This section describes direct impacts from construction and operation of the proposed MRO facilities. Construction activities include construction of new structures and infrastructure on Magdalena Ridge and expansion and installation of utility services. Maintenance and repair of Water Canyon Road could also be performed under the existing Langmuir Laboratory SUP. Water resource impacts could occur at the following:

- Water supply source areas (canyons, creeks, springs, and groundwater);
- Drainages and stream crossings along and across Water Canyon Road;
- Utility corridor(s) including water supply lines;
- Wetlands and riparian areas at the bottom of the canyons; and
- Campgrounds and recreation sites, depending on the extent of increased runoff.

There are several canyon creeks in the project area that could be affected by the Proposed Action. These creeks are shown in Map 3-8 and include Water, Hardy, and Bear Creeks, and the East and West Forks of Sawmill Canyon Creek.

Construction Phase

Direct impacts from construction activities may include increased runoff, soil erosion, and potentially impaired water quality from sedimentation due to transport of topsoil to streams.

Design of site-specific plans for water, erosion, and sediment control would be developed and implemented for all construction activities. A number of BMPs for control of storm runoff, erosion, and sedimentation are presented in the Soil and Water Conservation Practices Handbook, Forest Service Handbook (FSH) 2509.22 (USFS 1990). These BMPs are summarized in Table 2-6. These types of soil and water control measures would be adapted and designed for specific construction activities at specific locations prior to constructing the proposed MRO facilities. The BMPs used for construction would include the use of water trucks to spray water prior to and during construction activities to minimize blowing dust, and the installation of temporary water control structures and silt fences around construction sites.

As described in Section 3.2.1.2, a general construction permit would be required under Stage II regulations of the NPDES Program, authorized by the CWA, for any proposed MRO construction activities that disturb more than 1 acre of land. This would include developing an SWPPP addressing general and specific measures for all construction activities for the project.

Ridgetop

Development on the ridge would disturb an estimated 23.41 acres. The largest areas would be the temporary staging area (about 3.4 acres in size) and about 2.5 acres for new native-surfaced road. Other locations would be distributed throughout the site and would involve smaller non-contiguous areas (less than 1 acre in size). Once areas are cleared of vegetation and graded, they would be most prone to erosion, soil loss, and resulting sedimentation. During and after construction, larger areas would be subject to ponding and stormwater runoff, especially during heavy thunderstorms. Table 2-6 includes measures and BMPs to minimize temporary impacts during construction.

Provisions for adequate drainage including conveyance to the natural watercourses would be incorporated into the design of the facility. Design of site-specific plans for water, erosion, and sediment control would be developed and implemented for construction activities.

The 600-foot (182.9-meter) long Beam-Combining Facility may require specific design measures to provide positive drainage around the structure. Similarly, the two-story Operations Center would be constructed on the east side of the ridge. Site design would again include measures for proper drainage and retention features for excavated and recontoured areas around this building. The three septic tank and leach fields would be sized and constructed to handle projected demands of the facilities. A Groundwater

Discharge Permit Application submitted to the NMED for approval prior to construction would include design details for the system that respond to the specific soils of the sites.

Creeks that could be impacted by construction of the proposed MRO facilities on Magdalena Ridge include Bear Canyon and Hardy Canyon Creeks, the West Fork of Sawmill Canyon Creek, and potentially the East Fork of Sawmill Canyon Creek, if construction activities extend to the east side of the Ridge. The primary concern is that sediment may enter the surface water system. However, only a small amount of the ridge (about 7 acres) would be wholly or partially impervious. About 17 acres (of 24 acres disturbed) would be revegetated to restore natural water retention functions. Given the relatively small size of the areas to be disturbed and the fact that there would be several small areas of disturbance and not one large disturbed area, as well as the fact that construction activities would mostly take place on the ridge and not on the slopes or directly adjacent to the creeks, and that BMPs would be in place, the impacts are expected to be insignificant.

<u>Utility Options</u>

Option 1

Under this option, a new well would be drilled near Hardy Spring, on the western side of Magdalena Ridge, and water would be pumped to the proposed MRO via a 1.5-inch (3.8 cm) diameter surface pipe at a maximum rate of 2 gpm, as needed, to replenish the water storage tanks (see Map 2-2). The water line upslope, from the well to the ridge, would be placed along the surface to avoid ground disturbance and possibly gully erosion. On the ridge, the water pipeline would be buried in a 1-foot (0.3 m) wide trench at a depth of 3 to 4 feet (0.9 to 1.2 m) for a distance of less than 0.5 mile (0.8 km). Water distribution lines would be placed underground within the existing roadbed, to the extent possible, with short feeder lines to the buildings.

All of the test well sites for this option are hydrologically downslope of the spring. Therefore, none would interfere with spring flow. Most of the subsurface rock is fractured in that area (Pawelek 2003). A test well or a water supply well may or may not intercept a fracture or fault zone. If a well does intercept a fracture or fault zone, it may be able to produce an adequate water supply for the proposed MRO. A test well drilling application would need to be submitted and approved by the New Mexico OSE prior to drilling.

Under Option 1, the existing forest road may need to be improved to enable access for drilling equipment. Similar impacts as those described for Water Canyon Road may result but would be minimized by use of BMPs and design of site-specific water, erosion, and sediment controls.

A water supply well drilled in Hardy Canyon could be between 100 and 600 feet (30 to 183 m) deep in order to reach a productive water-bearing zone (Sea West 2002). There should not be any wetlands or riparian impacts from a deep, low-yielding well drilled into a fracture or fault zone. Drilling and transmission pipeline costs at this site would be considerable.

Option 2

Water would be provided from the existing surface water impoundment in the East Fork of Sawmill Canyon Creek (see Map 2-2). That is the same water source used by Langmuir Laboratory. Planned improvements to the Langmuir diversion system may be adequate to supply the additional needs of the proposed MRO. These improvements include a new pipe and pump installed on a concrete pad. Alternatively, the area behind the existing impoundment would be scooped out and lined with rocks, and a pipe and new water pump installed.

Water distribution pipes would be aboveground. Very little ground disturbance (less than 0.1 acre) could result from developing this source, thereby causing minimal impacts to water resources. The Forest Service would amend the existing SUP to provide for any new pipeline across Forest Service land.

Option 3

Option 3 would involve trenching within the existing roadbed from Langmuir Laboratory to the proposed MRO water storage and treatment area. Using BMPs and conservation measures, additional erosion, gullying, and sedimentation would be minimal, with no appreciable effect on water resources.

The current water source (East Fork of Sawmill canyon Creek) for operational usage at the existing Langmuir Laboratory has been used for greater than four decades. The existing state authorization allows 84,375 gpy to be pumped from this source. Any additional water needs would be met by hauling water. Pumping would occur only about 6 months out of the year. No pumping would occur in the winter months. The majority of the pumping is anticipated to occur between May through October when most of the warm season precipitation occurs.

Water Canyon Road

Maintenance and repair may be performed along Water Canyon Creek. BMPs would be installed prior to these activities. Repairs to Water Canyon Road could include sloping the roadbed toward the mountain. To avoid gullying, particularly on the inside of the slope, water would be channeled to control and promote drainage. Suitable methods (such as culverts or rock-lined swales or ditches) would be used to minimize erosion. Where culverts discharge, methods such as rock piles would be used to dissipate the impact of the flowing water.

There are continual small flows and intermittent larger flows from the drainages that cross the access road from Water Canyon Campground to the top of the mountain. Some locations along the road may need specific treatments to provide drainage necessary to minimize erosion, to prevent road failures, landslides, scouring and gully erosion, and to protect against freeze/thaw buckling in the winter. Using measures listed in Table 2-6, drainage of the road would be stabilized and improved. Because of the influence of seasons, there is potential for construction activities to be interrupted, leaving some areas disturbed and prone to erosion before completion of drainage features. Special measures to prevent deterioration during interludes are provided in Table 2-6. Any temporary erosion or soil loss during one season would be small, and drainage features would be put in place as soon as feasible in the following spring.

The increase in traffic on the road during construction would be temporary. Any potential for increased water contamination from oil and fuel leaks from the construction vehicles themselves would be prevented by regular servicing and maintenance of the vehicles. This would involve daily inspection of the construction vehicles for oil or gasoline leaks or spills prior to use.

Operational Phase

Ridgetop

The estimated annual potable water demand is 150,000 gallons. Daily demands could be as high as 2,000 gallons for short periods with the highest demands in the non-summer months. Peak use would generally occur during fall, winter, and early spring. Potable water would be treated on-site and the water storage tanks would be refilled as needed. The non-potable water would only be replenished if used for fire suppression.

Based on projected water use, no more than 2,000 gallons of wastewater would need to be disposed of each day. The disposal rate is based on a 100 gallon per day per person wastewater load for up to 20 people.

Potential impacts from operation of the wastewater treatment systems include odors, wastewater ponding, runoff, and impaired water quality if wastewater runoff is permitted to reach natural watercourses. Each system would be adequately designed to treat the volume of wastewater expected from each facility in accordance with applicable building and state codes. Standards are designed to allow adequate percolation and filtration of water into groundwater. The diameter and slope of wastewater pipelines would be designed to be self-cleaning and to prevent erosion of the piping. Septic tanks must be maintained and cleaned out on a regular schedule in order to prevent waste buildup, and wastewater effluent and water quality problems. Assuming routine maintenance would be performed, impacts from these systems would be minimal.

Based on information on site location, land area, elevation, soil and groundwater characteristics, and anticipated wastewater effluent, septic tank and leach field systems would satisfy state requirements (Sea West 2002).

The roads and parking areas would be partially permeable. Nevertheless, these areas would be subject to ponding, stormwater runoff, and sediment transport during heavy thunderstorms. Provisions for adequate drainage and erosion control, including conveyance of stormwater to the natural watercourses, would have to be incorporated into the design of the road and parking/staging areas.

Utility Options

Option 1

A well developed near Hardy Spring (at a depth of between 100 and 600 feet [30 to 183m]) would not need to produce 2 gpm continuously since the water would only be pumped as necessary to refill the water storage tanks. In order to lessen potential groundwater impacts, the water should be pumped during the spring and summer months when water levels may be higher than during the winter. The pipeline would be drained for the winter to avoid freezing.

There would not likely be any wetlands or riparian impacts, or impacts on streamflow, from a deep, low-yielding well drilled into a fracture or fault zone. There would not likely be any impact on water resources used by local residents and ranchers. Water rights for the proposed MRO would not likely be an issue given the small quantity of water to be supplied. The projected annual demand is about the same as an average household for domestic uses. As stated previously, a permit would have to be submitted and approved by the New Mexico OSE prior to drilling a well and withdrawing groundwater for the proposed MRO water supply.

Option 2

As in Option 1, water would be pumped in a 1.5-inch diameter pipe to the water storage tanks on the ridge. Water would be stored, treated, and distributed as in Option 1. The wastewater treatment systems would also be the same as in Option 1.

Water would be supplied from the existing impoundment dam in Sawmill Canyon, located across a small perennial stream. The primary source of streamflow is a spring about 2 miles (3.2 km) upstream plus other local springs. A few miles downstream from the dam, the surface flow goes underground, so it is not directly connected to the Rio Grande, its ultimate outlet. The outflow comes from a weir over the top of a stone dam and 2 pipes with inlets buried in the deposition. Under Option 2, water would be diverted from the existing outflow pipe, or a new pipe would be buried in the deposition behind the weir. The water would be diverted to a new pump that would pump water, as needed, to refill the water storage tanks on the ridge. Water would be diverted intermittently as provided for in the existing state permit and would not cut off downstream flow. Water requirements above the permitted amount would be hauled to the ridge as needed to augment supplies.

The area was evaluated for floodplains and wetlands, and no significant floodplains or wetlands were found (USFS 2002b). However, there are many small riparian areas. At the Langmuir Laboratory diversion, the area of vegetation is about 30 feet (9 m) wide along the dam and extends about 20 feet (6 m) upstream from the dam. Based on the lack of hydrophytic plants and clear evidence of wetland soils and hydrology that meet the USACE criteria, it was determined that this area is not a USACE jurisdictional wetland. However, there are small areas that look similar to "wetlands" along the riparian areas even though they do not meet the USACE criteria. It is possible that these areas could be reduced in size or even dry up completely when additional water is diverted from the stream under Option 2.

There would not likely be any impact on water resources used by local residents and ranchers from additional water supplied from this location. Water rights for Langmuir Laboratory and the proposed MRO would not likely be an issue given the small quantity of water required.

Under Option 2, an Application for a Permit to Appropriate the Public Surface Waters of the State of New Mexico would have to be submitted to the OSE. Also, a joint 401/404 permit application would need to be submitted to the USACE and to the SWQB. These permits would have to be approved prior to diverting additional water from this location for the proposed MRO use. The amount to be diverted would be equivalent to domestic demand for a standard household.

Option 3

Impacts during the Operational Phase would be the same as for Option 2.

Water Canyon Road

Impacts from continued maintenance and repair of Water Canyon Road during the operational phase would be as described for the construction phase.

Indirect Impacts

Changes in water quality could indirectly affect vegetation and habitats in riparian areas along the creeks around Magdalena Ridge. However, with use of BMPs, conservation measures, and specific designs for water drainage and wastewater treatment, there would be little change in water quality.

Indirect impacts could result if the proposed MRO water use depleted sources used by local ranchers. However, projected demands are very small. In times of drought, water for the proposed MRO would be supplemented by hauling in water, thus minimizing potential impacts to other users.

Alternative 2: No Action

Alternative 2 would not change existing conditions. Impacts to water resources from the construction and operation of the proposed MRO facilities would not occur. Ongoing water use to support Langmuir Laboratory and Forest Service management activities would continue. Maintenance and repair of Water Canyon Road would continue to be performed as needed to increase safety and reduce erosion; the direct and indirect impacts would be as described for Alternative 1.

Alternative 3: Preferred Alternative

Direct and indirect impacts under Alternative 3 would be similar to those under Alternative 1. As under Alternative 1, measures would be used to address site-specific conditions for the alternate location of the Operations Center complex. The location for this complex provides benefits over Alternative 1 since the site is flatter and would therefore require less excavation and site work to achieve proper drainage.

Alternative 4

Direct and indirect impacts under Alternative 4 would be similar to those under Alternative 1. As with Alternative 3, the Operations Center site is slightly easier to develop than under Alternative 1 and therefore more compatible with natural drainage.

3.2.2.3 Cumulative Impacts

The identified direct and indirect impacts from implementation of Alternative 1, in combination with other past, present, and reasonably foreseeable future activities, could result in the following cumulative impacts: increased stormwater runoff; impaired water quality due to sedimentation of eroded topsoil transported to streams; and odors, wastewater ponding, runoff, and impaired water quality if wastewater runoff is permitted to reach natural watercourses. It is also possible that vegetation and wildlife habitat associated with the watercourses and along the road and utilities alignments could be disturbed. Any adverse effects to water resources would be minimized by use of appropriate BMPs and conservation measures to be used for the proposed MRO development and activities. Issues of water quality, primarily from runoff and sedimentation within the watershed, would ultimately be most affected by broader watershed management actions.

Alternative 2 would not change existing conditions. Therefore, impacts to water resources from the construction and operation of the proposed MRO facilities would be avoided. There would be no new cumulative impacts.

Cumulative impacts from implementation of Alternatives 3 or 4 would be the same as Alternative 1.

3.2.2.4 Mitigation

The above analysis assumes use and implementation of measures listed in Table 2-6.These include provisions for developing several plans prior to construction. Soil and water control measures would be adapted and designed for specific construction activities at specific locations prior to initiating road improvements on Water Canyon Road and prior to construction and operation of the proposed MRO facilities. The draft plans would be reviewed by the Forest Service and revised if necessary before the final plans are issued and implemented. The plans would need to include sections on monitoring and maintenance of the installed mitigation measures to verify their effectiveness.

3.2.3 Air Quality

3.2.3.1 Affected Environment

Region of Influence

The ROI for the air quality analysis is the Southwestern Mountains-Augustine Plains Intrastate Air Quality Control Region and adjacent areas where air pollutant emissions from the proposed MRO could affect air quality.

Existing Conditions

Federal Air Quality Standards

Air quality is determined by the type and concentration of pollutants in the atmosphere, the size and topography of the air basin, and local and regional meteorological influences. The significance of a pollutant concentration in a region or geographical area is determined by comparing it to federal and/or state ambient air quality standards (AAQS). The CAA established two types of National Ambient Air Quality Standards (NAAQS): primary standards and secondary standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and against damage to animals, crops, vegetation, and buildings. Under the authority of the CAA, the USEPA has developed NAAQS, which represent the maximum allowable atmospheric concentrations for six "criteria" pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), lead (Pb), and respirable particulate matter less than 10 micrometers in diameter (PM_{10}) (USEPA 2002c).

The USEPA designates areas of the U.S. as having air quality equal to or better than the NAAQS. These areas are considered in attainment for the NAAQS. If areas are not meeting NAAQS, they are designated as nonattainment. Areas previously designated nonattainment are redesignated as maintenance areas for a period of 10 or more years once achieving attainment. Areas are designated as unclassifiable for a pollutant when there is insufficient ambient air quality data for the USEPA to form a basis of attainment status. For the purpose of applying air quality regulations, unclassifiable areas are treated the same as areas that are in attainment of the NAAQS.

The NAAQS are defined in terms of concentration (i.e., ppm or micrograms per cubic meter [$\mu g/m^3$]) determined over various periods of time (averaging periods). Short-term standards (1-hour, 8-hour, or 24-hour periods) were established for pollutants with acute health effects and may not be exceeded more than once a year. Long-term standards (annual periods) were established for pollutants with chronic health effects and may never be exceeded.

In 1997, the USEPA promulgated two new standards: a new 8-hour O_3 standard, which will eventually replace the existing 1-hour O_3 standard; and a standard for particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$). In addition, the USEPA revised the existing PM_{10} standard. The two new standards are scheduled for implementation over the next few years, as monitoring data becomes available to determine the attainment status of areas in the U.S. Meanwhile, the USEPA will enforce the existing 1-hour O_3 standard for areas that are still in nonattainment of that standard.

State Air Quality Standards

Under the CAA, state and local agencies may establish AAQS and regulations of their own, provided these are at least as stringent as the federal requirements. For selected criteria pollutants, the State of New Mexico has established its state AAQS, which are somewhat more stringent than the federal standards for CO, NO_2, and SO_2 (NMED 2002). New Mexico does not have state standards for PM_{10}, O_3, and Pb. In addition, New Mexico regulates emissions of total suspended particulates, hydrogen sulfide (H_2S), and total reduced sulfur, three pollutants for which there are no federal standards. A summary of the federal and state AAQS that apply to the project area is presented in **Table 3-3**.

State Implementation Plan

The CAA of 1977 set provisions for the attainment and maintenance of the NAAQS. The Clean Air Act Amendments (CAAA) of 1990 established new federal nonattainment classifications, new emission control requirements, and new compliance dates for nonattainment areas. The requirements and compliance dates are based on the severity of nonattainment classification.

For nonattainment regions, the states are required to establish a State Implementation Plan (SIP) designed to eliminate or reduce the severity and number of NAAQS violations. The underlying goals are to bring state air quality conditions into compliance with the NAAQS by specific deadlines and to maintain compliance. This plan is to be prepared by local agencies and incorporated into the overall SIP of each state. Attainment status for New Mexico is described below under Existing Conditions – Attainment Status.

General Conformity

CAA Section 176(c), General Conformity, established certain statutory requirements for federal agencies with proposed federal activities to demonstrate conformity of the proposed activities with each state's SIP for attainment of the NAAQS. In 1993, the USEPA issued the final rules for determining air quality conformity. Federal activities must not do any of the following:

- Cause or contribute to any new violation;
- Increase the frequency or severity of any existing violation;
- Delay timely attainment of any standard interim emission reductions or milestones in conformity to a SIP's purpose of eliminating or reducing the severity and number of NAAQS violations, or delay achieving attainment of NAAQS.

General conformity applies only to nonattainment and maintenance areas. If the emissions from a federal action proposed in a nonattainment area exceed annual thresholds identified in the rule, a conformity determination is required of that action. The thresholds become more restrictive as the severity of the nonattainment status of the region increases. The State of New Mexico Environmental Improvement Board (NMEIB) has implemented the federal general conformity regulations in Title 20, Chapter 2, Part 98 of the state's Air Quality Regulations.

Table 3-3. Federal and State Ambient Air Quality Standards

Air Pollutant	Averaging Time	New Mexico AAQS	Federal (NAAQS)	
			Primary	Secondary
Carbon Monoxide (CO)	8-hour 1-hour	8.7 ppm 13.1 ppm	9 ppm 35 ppm	— —
Nitrogen Dioxide (NO_2)	AAM 24-hour	0.05 ppm 0.10 ppm	0.053 ppm —	0.053 ppm —
Sulfur Dioxide (SO_2)	AAM 24-hour 3-hour	0.02 ppm 0.10 ppm —	0.030 ppm 0.14 ppm —	— — 0.50 ppm
Particulate Matter (PM_{10})	AAM 24-hr	— —	50 $\mu g/m^3$ 150 $\mu g/m^3$	50 $\mu g/m^3$ 150 $\mu g/m^3$
Particulate Matter ($PM_{2.5}$)[a]	AAM 24-hour	— —	15 $\mu g/m^3$ 65 $\mu g/m^3$	15 $\mu g/m^3$ 65 $\mu g/m^3$
Total Suspended Particulates (TSP)	AGM 30-day 7-day 24-hr	60 $\mu g/m^3$ 90 $\mu g/m^3$ 110 $\mu g/m^3$ 150 $\mu g/m^3$	— — — —	— — — —
Hydrogen sulfide (H_2S)	1-hr[d] ½-hr[e] ½-hr[f]	0.010 ppm 0.100 ppm 0.030 ppm	— — —	— — —
Total Reduced Sulfur[b]	½-hr[d] ½-hr[e] ½-hr[f]	0.003 ppm 0.010 ppm 0.003 ppm	— — —	— — —
Ozone (O_3)[c]	1-hour 8-hour	— —	0.12 ppm 0.08 ppm	0.12 ppm 0.08 ppm

Sources: 40 CFR 50; NMAC 20.2.3.

Notes: AAM = Annual Arithmetic Mean; AGM = Annual Geometric Mean; ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter.

(a) The $PM_{2.5}$ standard (particulate matter with a 2.5-micron diameter) was promulgated in 1997, and will be implemented over an extended period. Areas will not be designated as in attainment or nonattainment of the PM 2.5 standard until the 2003-2005 period.

(b) Total reduced sulfur does not include H_2S.

(c) The 8-hour Ozone standard was promulgated in 1997, and will eventually replace the 1-hour standard. The USEPA plans to implement this standard beginning in 2004. During the interim, the 1-hour ozone standard will continue to apply.

(d) Entire state except for the Pecos-Permian Air Basin (AQCR 155), which includes De Baca, Chaves, Curry, Quay, and Roosevelt counties.

(e) Within the Pecos-Permian Air Basin.

(f) Within corporate limits of municipalities in the Pecos-Permian Air Basin, or within 5 miles of the corporate limits of municipalities having a population greater than 20,000 and within the Pecos-Permian Air Basin.

Stationary Sources Operating Permits

In New Mexico, the New Mexico Air Quality Bureau (NMAQB) Permitting Section processes permit applications for industries that emit pollutants to the air. The Permitting Section consists of two groups: a) New Source Review (NSR), and b) Title V. NSR is responsible for issuing construction permits, technical and administrative revisions or modifications to existing permits, Notices of Intent (NOI) for smaller industrial operations, and No Permit Required (NPR) determinations. Construction Permits (under NSR) are required for all sources with the potential emission rate greater than 10 pounds per hour, or 25 tons per year (TPY), of criteria pollutants (such as nitrogen oxides and carbon monoxide). Air quality permits must be obtained for new or modified sources. Title V of the CAA Amendments of 1990 requires states to issue Federal Operating Permits for major stationary sources. A major stationary source in an attainment or maintenance area is a facility (i.e., plant, base, or activity) that emits more than 100 TPY of any one criterion air pollutant, 10 TPY of a hazardous air pollutant (HAP), or 25 TPY of any combination of HAPs. The purpose of the permitting rule is to establish regulatory control over large, industrial activities and to monitor their impact upon air quality (NMAQB 2003).

Prevention of Significant Deterioration

Section 162 of the CAA further established the goal of prevention of significant deterioration (PSD) of air quality in mandatory Class I areas, while all other attainment or unclassifiable areas were defined as Class II areas. Under CAA Section 164, states or tribal nations, in addition to the federal government, have the authority to redesignate certain areas as nonmandatory Class I areas (i.e., a National Park or WA established after August 7, 1977, which exceeds 6,000 acres). The PSD requirements affect construction of new major stationary sources in all areas and are a pre-construction permitting system.

Visibility

CAA Section 169A established the additional goal of prevention of further visibility impairment in Class I areas. Visibility impairment is defined as atmospheric discoloration and reduction in the visual range. Determination of the significance of an activity on visibility in a Class I area is typically associated with evaluation of stationary source contributions. The USEPA is implementing a Regional Haze rule for Class I areas that will also address contributions from mobile sources and pollution transported from other states or regions. Emission levels are used to qualitatively assess potential impairment to visibility in Class I areas. Decreased visibility may potentially result from elevated concentrations of PM_{10} and SO_2 in the lower atmosphere.

Regional Climate

The regional climate of central New Mexico is continental, ranging from arid in the Rio Grande Valley east of Magdalena to semi-arid in the uplands and mountains. The mean annual precipitation ranges from 8 inches (20 cm) in the valley to 14 inches (36 cm) in the uplands and mountains to 25 inches (64 cm) at the summit of South Baldy. Between 8,000 and 11,000 feet (2,438 to 3,353 m), precipitation increases by 3 to 4 inches (8 to 10 cm) for each 1,000-foot (305-m) increase in elevation. Between 5,000 and 8,000 feet (1,524 to 2,438 m), the increase is 2 to 3 inches (5 to 8 cm) per 1,000 feet (305 m). The rainiest months are July through September, during which the main source of moisture is air from the Gulf of Mexico. During the summer, the general circulation within the Bermuda high-pressure area shifts westward, causing the air to flow from the southeast into New Mexico. Most of the warm-season precipitation falls during thunderstorms, which are brief and sometimes heavy. During winter, much of New Mexico's weather originates from eastward-moving Pacific Ocean storms, which lose much of their moisture in the mountains to the west of the state. Annual snowfall ranges from 5 inches (13 cm) in the valley to 25 inches (64 cm) or more in the mountains, where snow may fall from October through April (USFS 2000a).

Mean annual temperatures range from a high of 59 degrees Fahrenheit (º F) in the Rio Grande Valley to a low of 48º F in the higher elevations to the west. Temperatures are even cooler on the mountain peaks. The average number of days with temperature over 90º F ranges from 111 days at Bosque del Apache to 21 days in the mountains. In areas above 6,500 feet (1,981 m), usually fewer than 30 days per year experience temperatures over 90º F. The sun shines an average of 75 percent of the time. Average annual relative humidity is 45 percent, ranging from 60 percent in winter to 30 percent in summer.

Winds in the valley are predominantly northerly in the winter and southerly in the summer. Northerly winds are more common in the morning and southerly in the afternoon. On the mesas and mountains, the prevailing winds are more westerly. Average annual wind speed is 9 miles per hour (mph) (15 kilometers per hour [kmph]). Wind speed is highest in spring (12 mph [19 kmph]) and lowest in fall and winter (8 mph [15 kmph]). The strongest winds come from the southwest.

Average annual evaporation from a Class A pan ranges from 105 inches (267 cm) in the southern part of the valley to 95 inches (241 cm) at the higher elevations. About 70 percent of the annual evaporation occurs during May through October (USFS 2000a).

Local Climate

Magdalena, New Mexico is about 2,000 feet (610 m) higher than and 27 miles (45 km) west of Socorro along US 60 at an elevation of 6,548 feet (1,996 m). Average precipitation is 12 inches (30 cm) per year. Wettest months are July and August. Average summer and winter temperatures are 77º F and 33º F, respectively (Magdalena COC 2003b). The existing Langmuir site is at an elevation of 10,600 feet (3,231 m), about 36 miles (58 km) (southwest of Socorro by road, near the summit of the 10,783-foot [3,287-m] South Baldy (NMIMT 2003a). **Table 3-4** shows the average monthly rainfall, temperatures, wind speeds, and wind directions recorded at Magdalena during the 30-year period from 1961-1990 (Buttle and Tuttle, LTD 2003; NMIMT 2003a). Temperatures are generally about 5.4º F lower for every 1,000-foot increase in altitude. Therefore, they would be about 22º F lower on the ridgetop than in Magdalena. Rainfall, especially during summer months, is somewhat higher than on the surrounding plain (where the Village of Magdalena is located) due to localized updrafts of warm air and formation of convective clouds over elevated regions (NMIMT 1979).

Table 3-4. Average Monthly and Annual Weather Data for Magdalena, New Mexico

Month	J	F	M	A	M	J	J	A	S	O	N	D	Annual Average
Rainfall (inches)	0.5	0.5	0.4	0.3	0.6	0.6	2.6	2.6	2.1	1.1	0.4	0.5	**12.3**
Temperature (º F)	33.8	38.7	44.2	51.8	60.3	69.1	71.8	69.3	63.7	54.0	43.5	36.0	**53.1**
Minimum Temperature (º F)	19.0	23.5	28.4	35.2	43.5	51.8	56.7	54.5	48.6	37.9	28.4	21.6	**37.4**
Maximum Temperature (º F)	48.6	54.0	60.4	68.4	77.0	86.2	87.1	84.0	78.6	70.2	58.8	50.7	**68.5**
Wind Speed (mph)	9.0	12.0	14.0	11.0	7.5	7.0	5.5	5.8	5.2	7.2	10.0	10.5	**8.6**
Wind Direction (degrees)[1]	273	284	282	259	248	240	199	188	225	221	249	267	**245**

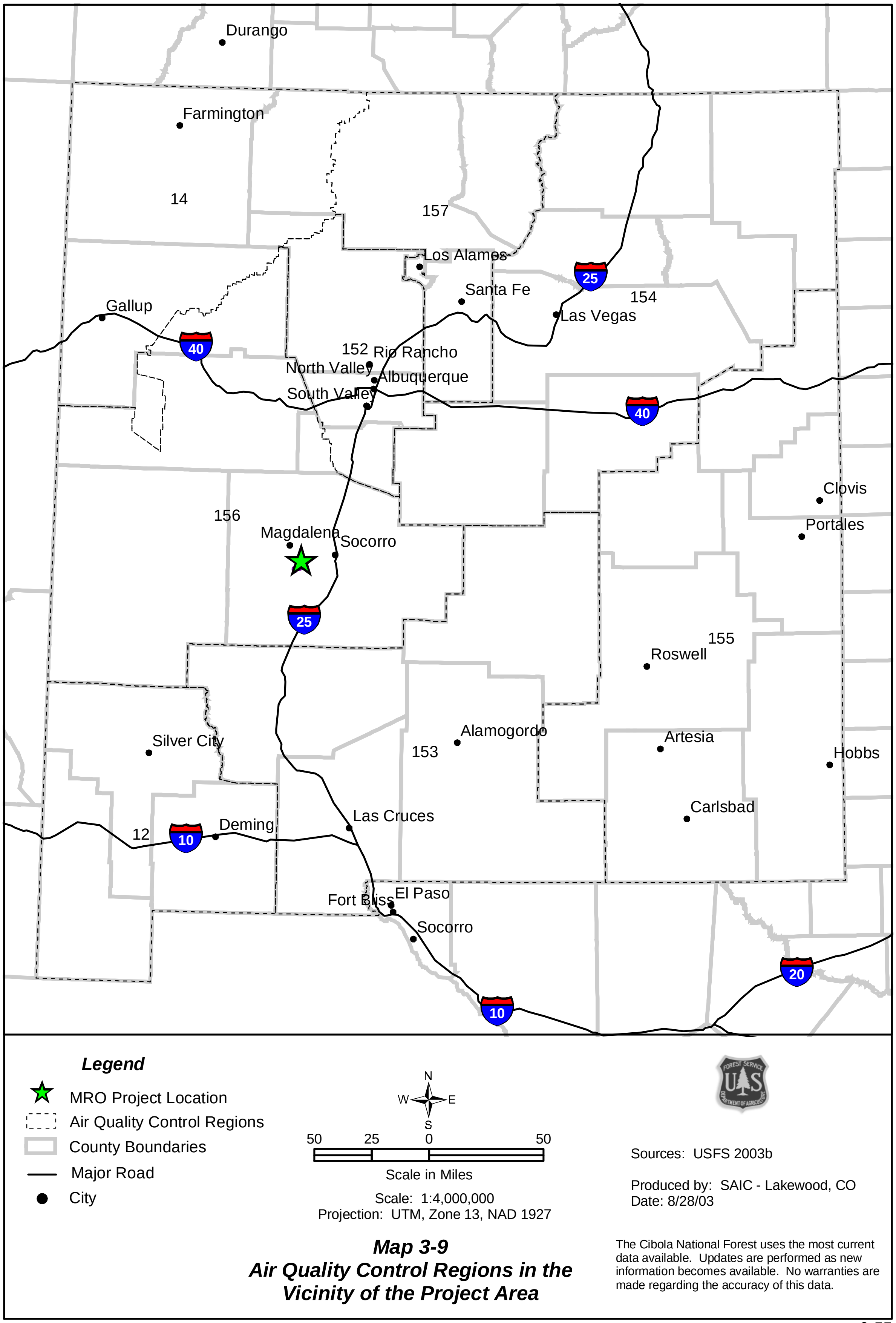
Sources: Buttle and Tuttle, LTD 2003; NMIMT 2003a.

Note: (1) Wind direction is expressed as degrees clockwise from true north and refers to the direction from which the wind is blowing.

Air Basins

Federal regulations at 40 CFR 81 define certain Air Quality Control Regions (AQCR), which were originally designated based on population and topographic criteria closely approximating each air basin. Typically, the potential effects on air quality are considered to be confined to the air basin in which the emissions occur. The proposed MRO boundary lies entirely within AQCR 156. AQCRs in the southwest are listed below and shown in **Map 3-9**:

- AQCR 156, the Southwestern Mountains-Augustine Plains Intrastate AQCR, covers 20,256 mi^2 (52,463 km^2) entirely within New Mexico. It includes Catron, Cibola, and Socorro counties, and portions of McKinley and Valencia counties.
- AQCR 12, which includes Grant, Hidalgo, and Luna counties in New Mexico, is more than 31 miles (50 km) south of the proposed MRO boundary.
- AQCR 153, which includes Doña Ana, Lincoln, Otero, and Sierra counties in New Mexico and El Paso County in Texas, is more than 15.5 miles (25 km) south of the proposed MRO boundary.
- AQCR 154, which includes Guadalupe and Torrance counties in New Mexico, is more than 19 miles (30 km) west of the proposed MRO boundary.
- ACQR 152, which includes portions of Sandoval and Valencia Counties, and Bernalillo County in its entirety, is approximately 50 miles (80 km) northeast of the proposed MRO boundary.



Map 3-9
Air Quality Control Regions in the Vicinity of the Project Area

Transport of Air Pollutants

The majority of air pollution affecting the CNF originates from other areas, primarily metropolitan areas and, to a lesser extent, unpaved roads and farming operations. Some temporary and localized pollution results from prescribed burning and wildfires in the CNF and surrounding private and state lands (USFS 1985). The project site is over 190 miles (300 km) from the Mexico border and well over 190 miles (300 km) from Ciudad Juarez, the closest source of air pollution from Mexico. Due to the distances, typical air flow patterns, and temperatures, the potential for pollutants from the proposed MRO site to impact those areas in Mexico already experiencing high levels of air pollution is minimal. For similar reasons, it is not likely that air pollutants from Mexico would impact the proposed MRO project.

Global Warming

Although global warming is a worldwide concern, it is outside the scope of this project level analysis. The level of analysis more suited for this topic would be at the national or international level and not at this site-specific project level. Typical industrial sources of pollutants that contribute to global warming include any sources that involve the combustion of fossil fuels, including natural gas, propane, gasoline, and diesel fuel.

Although the proposed project does include some of the combustion sources, it is not felt that they alone will contribute greatly to the global warming issue.

Attainment Status

A review of the federally published attainment status for New Mexico in 40 CFR 81.332 indicates that Socorro County is designated as in attainment. Based on monitoring data collected since 1997, the USEPA projects that the entire State of New Mexico will be in attainment of the new 8-hour ozone and $PM_{2.5}$ NAAQS when designations are made in 2004 or 2005 (USEPA 2002b), with the possible exception of San Juan County in the northwest corner of the state, approximately 249 miles (400 km) northwest of the proposed MRO site.

The nonattainment areas (shown in **Figure 3-1)** for each pollutant nearest to the proposed MRO boundary are as follows:

- PM_{10}: A 1.4-mi^2 (3.6 km^2)area encompassing most of the town of Anthony in the southern portion of Doña Ana County, approximately 156 miles (250 km) south-southwest of the proposed MRO site, is classified as moderate nonattainment for PM_{10}. The primary contributing source is from windblown soil and industrial activities in El Paso, Texas and Juarez, Mexico (Trujillo 2003). No PM_{10} maintenance areas exist within 156 miles (250 km) of the proposed MRO site (USEPA 2003b).

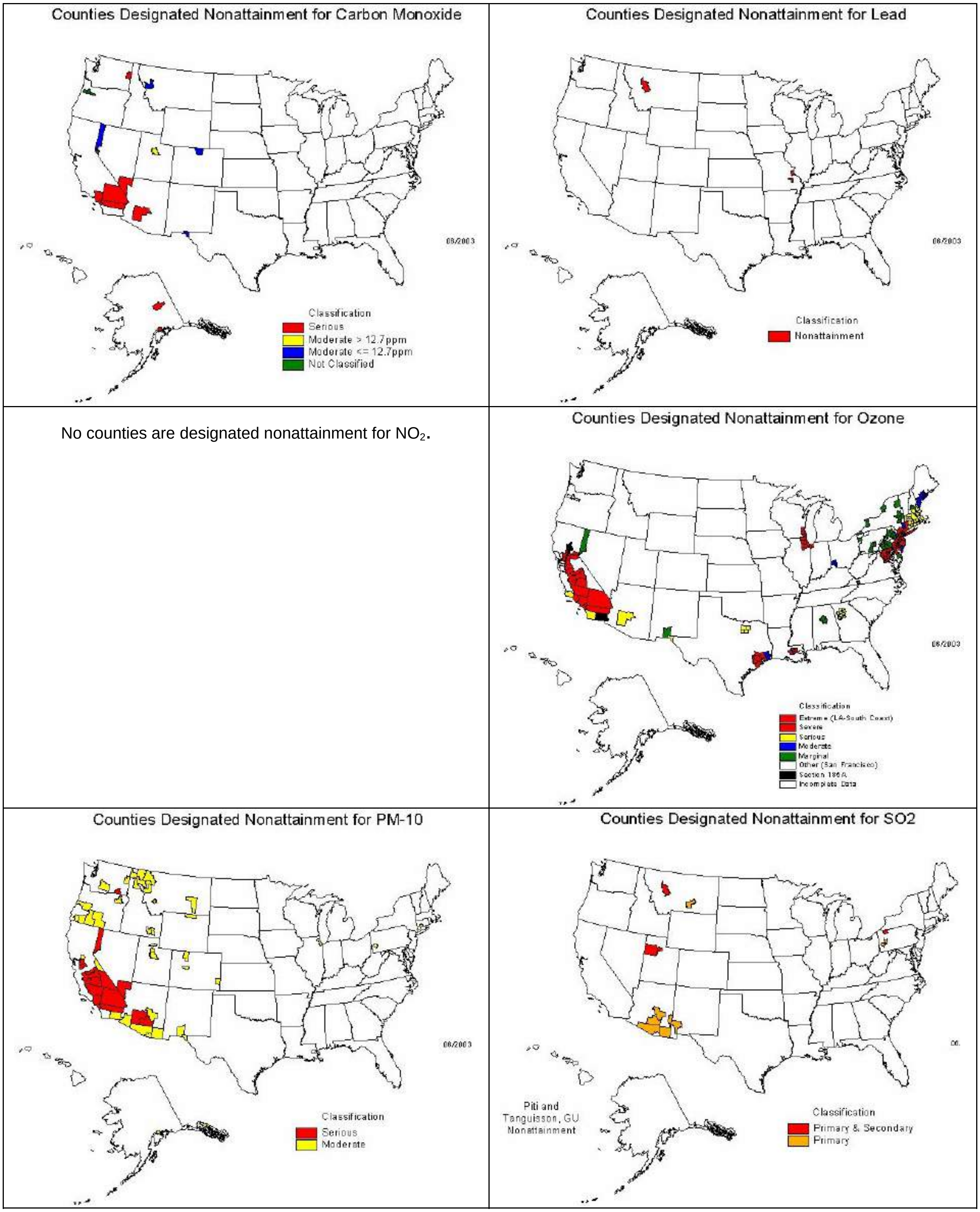


Figure 3-1. Counties Designated Nonattainment for the Six Criteria Pollutants

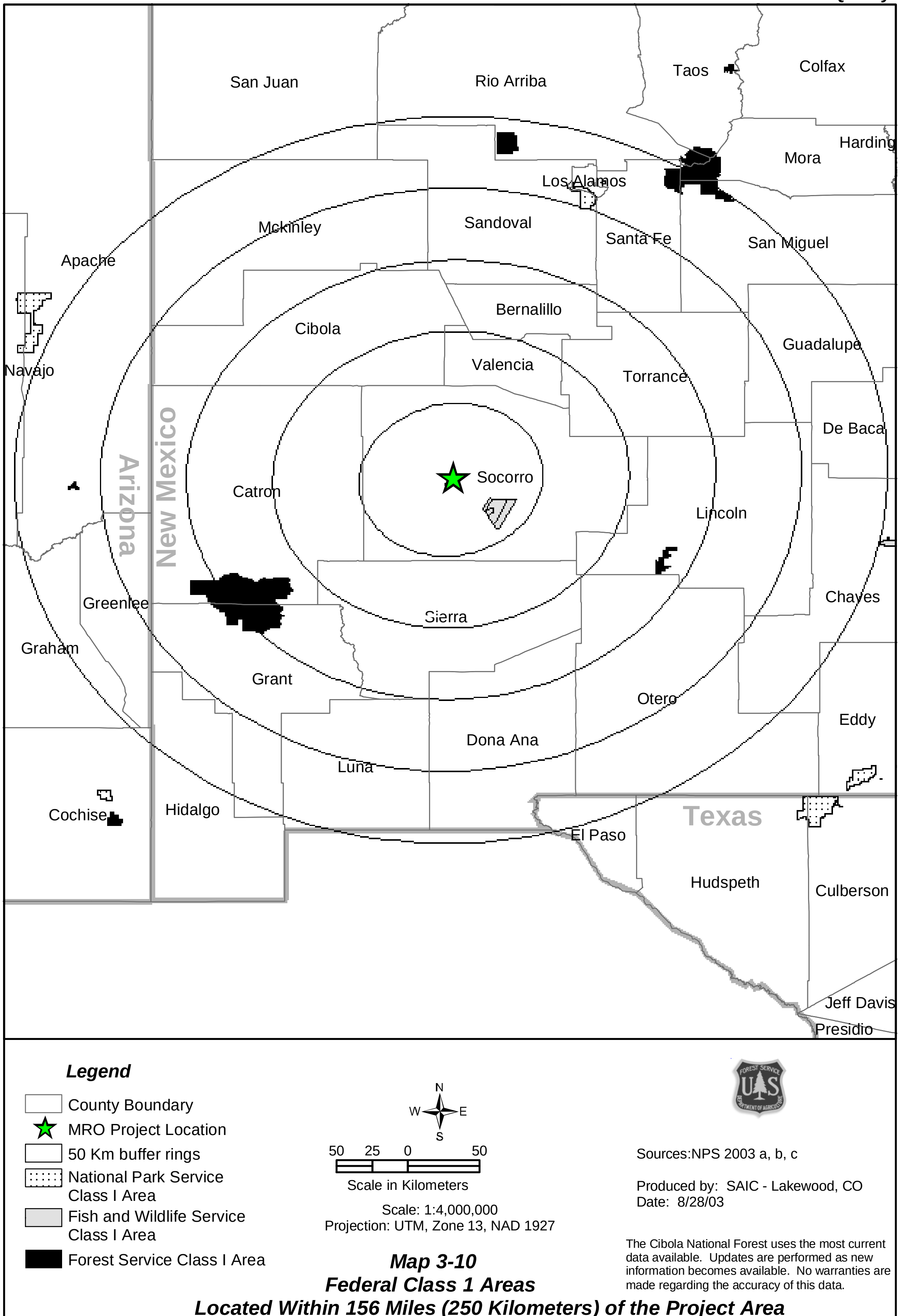
Source: USEPA 2003c.

- Ozone (1-hour standard): One nonattainment area for the 1-hour ozone NAAQS occurs within 156 miles (250 km) of the proposed MRO site, in Sunland Park in the southern portion of Doña Ana County, New Mexico. The nonattainment portion of the county is a 42-mi^2 (109 km^2) area classified as marginal nonattainment for O_3 on the New Mexico border near El Paso, Texas. Reportedly, much of the ozone present in this area is transported from El Paso, Texas and Juarez, Mexico (Trujillo 2003). No O_3 maintenance areas are within 156 miles (250 km) of the proposed MRO (USEPA 2003b).
- SO_2: Two SO_2 nonattainment areas are within 250 km of the proposed MRO—Greenlee County, Arizona, and Grant County, New Mexico. The Grant County nonattainment area, within a 3.5-mile (5.6-km) radius of the Phelps Dodge Chino Copper Smelter, between Hurley and Bayard, and more than 93 miles (150 km) southwest of the proposed MRO site, is in nonattainment of the secondary NAAQS for SO_2. This nonattainment status is a direct result of the copper smelter process emissions prior to the installation of control equipment in the 1970s. The region has not had an exceedance of the SO_2 standard in more than 20 years and has recently submitted a redesignation request to the USEPA (Trujillo 2003). The Morenci nonattainment area in the western portion of Greenlee County, AZ, more than 124 miles (200 km) west of the proposed MRO site, was designated as a nonattainment area for SO_2 in 1975. The primary source in Morenci was the Phelps Dodge Morenci copper smelter, which was dismantled in 1995. The Arizona Department of Environmental Quality in developing a maintenance plan submitted a request for redesignation to attainment in summer 2002 (ADEQ 2003). Currently, no SO_2 maintenance areas occur within 155 miles (250 km) of the proposed MRO site (USEPA 2003b).
- CO: No CO nonattainment areas exist within 155 miles (250 km) of the proposed MRO (USEPA 2003b). One CO maintenance area, Albuquerque, Bernalillo County, New Mexico, is approximately 81 miles (130 km) northeast of the proposed MRO site. The region was formerly designated as Moderate (≤2.7 ppm), primarily due to carbon monoxide emissions from vehicular traffic. Albuquerque was redesignated as attainment of the carbon monoxide NAAQS in 1996 (USEPA 1996a).
- Lead: No nonattainment or maintenance areas for the lead NAAQS occur in New Mexico. The closest nonattainment areas for this pollutant are in the states of Montana and Missouri (USEPA 2003c).
- NO2: No nonattainment areas for the nitrogen dioxide standard exist in the U.S. The only NO2 maintenance area is the South Coast air basin in California (Los Angeles region) (USEPA 2003c).

Class I Areas

Mandatory Class I federal areas for the State of New Mexico are listed under 40 CFR 81.421. There are seven Class I areas located within 156 miles (250 km) of the project boundary, shown in **Map 3-10** and listed below (USEPA 2002b).

- Bosque del Apache National Wildlife Refuge, located in Socorro County, New Mexico, approximately 19 miles (30 km) southeast of the proposed MRO boundary. This 80,850-acre WA, managed by the USFWS, is located in the Rio Grande Valley and is the winter home of thousands of sandhill cranes and Canada geese.



Map 3-10
Federal Class 1 Areas
Located Within 156 Miles (250 Kilometers) of the Project Area

- Gila Wilderness, located in Catron and Grant Counties, New Mexico, approximately 72 miles (115 km) southwest of the proposed MRO boundary. This 433,690-acre region in the Gila National Forest is managed by the Forest Service, Southwest Region (Region 3).
- White Mountain Wilderness, located in Lincoln County, New Mexico, approximately 81 miles (130 km) east-southeast of the proposed MRO boundary. This 31,171-acre region in the Lincoln National Forest is managed by the Forest Service, Southwest Region (Region 3).
- Bandelier National Monument, located in Sandoval and Los Alamos Counties, New Mexico, approximately 124 miles (200 km) north-northeast of the proposed MRO boundary. This 23,267-acre WA is managed by the National Park Service.
- Mount Baldy Wilderness, located in Apache County, Arizona, approximately 137 miles (220 km) west of the proposed MRO boundary. This 6,975-acre region in the Apache-Sitgreaves National Forest is managed by the Forest Service, Southwest Region (Region 3).
- San Pedro Parks Wilderness, located in Rio Arriba County, New Mexico, approximately 143 miles (230 km) north of the proposed MRO boundary. This 41,132-acre region in the Santa Fe National Forest is managed by the Forest Service, Southwest Region (Region 3).
- Pecos Wilderness, located in Santa Fe, Rio Arriba, Mora, and San Miguel Counties, New Mexico, approximately 143 miles (230 km) northeast of the proposed MRO project boundary. This 167,416-acre region in the Carson and Santa Fe National Forests is managed by the Forest Service, Southwest Region (Region 3).

The closest American Indian nonmandatory Class I area is the Yavapai-Apache Reservation, which is approximately 305 miles (490 km) west of the project area in central Arizona (USEPA 1998).

Monitoring

The NMAQB does not monitor ambient pollutant concentrations in Socorro County. The nearest routine air quality monitoring occurs near the border between Valencia and Bernalillo Counties, more than 62 miles (100 km) to the north-northeast of the proposed MRO site. Two monitors operate in this general location. A State and Local Air Monitoring Station (SLAMS) ozone monitor in the village of Bosque Farms in Valencia

County has measured no exceedances of the ozone standard since it began operation in 1998. A $PM_{2.5}$ monitor at Building 79 on Tribal Road 40 in Bernalillo County has recorded no exceedances since it began operation in the year 2000. To the south, a PM_{10} monitor at La Luz Elementary School in Otero County, approximately 124 miles (200 km) southeast of the proposed MRO facility, has recorded no exceedances since it began operation in 1995. This lack of exceedances in the vicinity of the proposed MRO indicates generally good air quality in the region.

In April 2000, the USFWS began an air quality program at the Bosque del Apache National Wildlife Refuge, the mandatory federal Class I area 19 miles (30 km) southwest of the proposed MRO site. The monitoring program includes an Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring station and a scene-monitoring camera, which began operation in November 2002. The IMPROVE sampler monitors PM_{10}, $PM_{2.5}$, and various other non-criteria pollutants that are components of the particulate matter (Davies 2003; Savig 2003). The sampler has not recorded an exceedance of either particulate matter NAAQS since it began operation (IMPROVE 2003).

Regional Emissions

Major emission sources within 62 miles (100 km) of the proposed MRO site are relatively few. The closest major sources, and the only major sources in Socorro County, are the Dicaperl/Socorro Perlite Plant, 3.5 miles (5.6 km) west of Socorro on US 60, and the National Radio Astronomy Observatory (NRAO), 20 miles (32 km) west of Magdalena. The El Paso Natural Gas facility in Belen (Valencia County), the Transwestern Pipeline facility in Mountainair (Torrance County), the St. Cloud Mining (zeolite crusher) facility in Chloride (Sierra County), and two facilities operated by Bartoo Sand and Gravel in Truth or Consequences (Sierra County) are the only other major sources located within 62 miles (100 km) of the proposed MRO site. **Table 3-5** shows the most recent emissions data for these major sources and for the entire State of New Mexico (USEPA 2003a). The table illustrates that sources in the project area account for less than 2 percent of emissions in any criteria pollutant in the state.

Current Emissions

Baseline emissions at the existing Langmuir facilities are from vehicular traffic and other routine activities, including stationary sources (e.g., propane heaters and ranges, diesel generators), rocket launches, personal vehicle traffic (e.g., scientists, collaborators, and unannounced sightseers), and mobile heavy equipment (e.g., cranes, dozers, graders, heavy trucks, and forklifts). **Table 3-6** provides current annual emissions estimates for the activities and equipment described below.

Propane Heaters and Ranges

The existing Langmuir facilities include various propane-fueled external combustion devices (heaters and ranges). These devices operate for a total of 300 hours per calendar year, using approximately 500 gallons of propane per year. Emissions from these external combustion devices were calculated using emission factors from the USEPA (USEPA 1996c). Annual baseline emissions from the combustion of 500 gallons of propane in the heaters and ranges are expected to be less than 0.1 TPY for each criteria pollutant.

Diesel Generators

The existing Langmuir facilities include two 150-kilowatt (kW) diesel generators in Quonset bunkers, each of which operates 20 hours per year. Emissions from these external combustion devices were calculated using emission factors from the USEPA (USEPA 1996b). These generators are each assumed to have a capacity of 100 horsepower (HP). Annual baseline emissions from the operation of two diesel generators are expected to be less than 0.1 TPY for each criteria pollutant (USFS 2002c).

Table 3-5. Major Source Criteria Pollutant Emissions (Tons per Year) within 100 Kilometers of Proposed MRO Site

Facility	Distance from Proposed MRO (km)	VOC	NO_2	CO	SO_2	PM_{10}	$PM_{2.5}$
New Mexico Totals	—	14,794	163,897	40,195	144,550	12,300	Unavailable at this time
Dicaperl/Socorro Perlite Plant	40	0.04	9.1	2.4	42	40	2.8
National Radio Astronomy Observatory	40	3.6	108	13	4.1	1.2	1.2
El Paso Natural Gas	70	6.0	349	72	—	—	—
Transwestern Pipeline	100	137	2,340	256	25	0.10	0.10
St. Cloud Mining (zeolite crusher)	100	0.5	31	4.0	—	16	16
Bartoo Sand and Gravel (crusher)	100	—	15	3.3	1.1	14	14
Bartoo Sand and Gravel (asphalt)	100	5.0	22	12	21	1.3	0.010

Source: USEPA 2003b.

Table 3-6. Baseline Emissions at Magdalena Ridge

Activity	Emissions (tons/year)				
	CO	VOC	NO_x	SO_x	PM_{10}
Propane Heaters & Ranges	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Diesel Generators	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Rockets	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Personal Vehicles	0.1	< 0.1	< 0.1	< 0.1	< 0.1
Mobile Equipment	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Totals	**0.1**	**< 0.1**	**< 0.1**	**< 0.1**	**< 0.1**

Source: Derived by SAIC.

Rockets

Twenty solid rockets, each with a capacity of 5 pounds, are currently used annually at the Langmuir facility. Combustion of the entire 100 pounds of rocket fuel would be expected to generate emissions of less than 100 pounds of any pollutant. Therefore, the annual baseline emissions from these rockets are expected to be less than 0.1 TPY for each criteria pollutant.

Personal Vehicles

Current passenger vehicle and pick-up truck traffic includes 10 vehicles driven by collaborating scientists and 80 trips by unannounced sightseers, traveling a total of 150 hours and 40 hours per week, respectively, to and from the Langmuir facilities. Emissions from these personally-owned vehicles were calculated from the USEPA's modeled emission factors (Jagielski and O'Brien 1994), assuming an average model year of 1995 for all vehicles. These personal vehicles were assumed to travel an average of 30 mph (48 kmph) during the trip to and from Langmuir. Annual baseline emissions from all personally-owned vehicles traveling to and from the Langmuir facility are expected to be 0.1 TPY for CO, and less than 0.1 TPY for all other criteria pollutants.

Mobile Equipment

Mobile equipment currently being used at the Langmuir facility includes one crane, one grader, one dozer, one heavy truck, and one forklift, all of which use diesel fuel. The baseline usage of these vehicles has been estimated at 10 hours per year for the crane, grader, heavy truck, and forklift, and two hours per year for the dozer. The grader, heavy truck, forklift, and dozer are assumed to travel an average of 5 mph (8 kmph) while they are operating. The crane is assumed to stay in one place while operating. Emissions from these devices were calculated using the USEPA emission factors compiled by the South Coast Air Quality Management District (SCAQMD 1993). The total annual baseline emissions from the operation of the crane, grader, dozer, heavy truck, and forklift are expected to be less than 0.1 TPY for each criteria pollutant.

3.2.3.2 Environmental Consequences

Method of Analysis

Air emissions resulting from the Proposed Action and alternatives were evaluated in accordance with federal, state, and local air pollution standards and regulations. Air quality impacts from a proposed activity or action would be significant if they:

- Increase ambient air pollution concentrations above any NAAQS;
- Contribute to an existing violation of any NAAQS;
- Interfere with or delay timely attainment of NAAQS; and/or
- Impair visibility within any federally mandated PSD Class I area.

The approach to the air quality analysis was to estimate the increase in emission levels due to the Proposed Action, and to evaluate the emissions against applicable thresholds.

The nearest mandatory federal Class I area is the Bosque del Apache Wildlife Refuge approximately 19 miles (30 km) southeast of the proposed MRO boundary. Because the Proposed Action would not include the addition or modification of major stationary sources, PSD and Title V permitting requirements would not apply. According to the NMAQB, the Proposed Action, including impacts to visibility, would not be covered under state or federal PSD regulations because it includes primarily fugitive dust and mobile source emissions (NMAQB 2003).

According to the USEPA's General Conformity Rule in 40 CFR Part 51, Subpart W, any proposed federal action that has the potential to cause violations, as described above, in a nonattainment or maintenance area must undergo a conformity analysis. A conformity analysis is not required in an attainment area. Since Socorro County is designated as attainment for all criteria pollutants, a conformity determination is not required.

Alternative 1: Proposed Action

Direct Impacts

Air quality impacts during construction activities related to Alternative 1 would occur from 1) particulate emissions (i.e., fugitive dust) from ground clearing, road construction and improvement, vehicle travel, and excavation activities, and 2) products of combustion from the construction equipment.

Construction Phase

Air emissions during the construction phase of the proposed project would be temporary and would cease upon completion of the construction activities. While the proposed construction schedule is planned to extend over 5 or more years, including Stage I and Stage II, the estimated emissions shown below were calculated based on the overly conservative assumption that all construction occurs during a single year. (A "conservative" assumption, in terms of emissions estimates, is one that results in higher emissions than would actually be expected to occur. This creates a protective margin when evaluating potential impacts.) If the total construction emissions were determined to have an insignificant impact over a 1-year period, then it would be expected that the lower actual emission totals, which would be spread over a longer period of time, would also be insignificant.

Ridgetop

Ground-Disturbing Activities

Under Alternative 1, an estimated 24 acres would be disturbed by construction over the duration of the project. These 24 acres include development along the ridgetop and development of a small area at the spring for a water supply. Most of the disturbance would occur during the first year of construction. In addition, potential maintenance and repair of Water Canyon Road could disturb another estimated 24 acres. Therefore, as a conservative approach (to yield an emissions estimate that probably would be higher than what would actually occur), all ground disturbance is assumed to occur over a 1-year period. Particulate emissions were evaluated for the clearing and grading of a total of 48 acres, based on USEPA emission factors compiled in the California Environmental Quality Act Air Quality Handbook (SCAQMD 1993). For the grading emission calculation, it was assumed that 2 acres would be disturbed per day, and that two graders, one backhoe, one trencher, one bulldozer, one scraper, and one roller would operate for 8 hours per day for 120 days, and that a work crew of 20 people would commute for 36 miles (58 km) each way per day. Total emissions from ground disturbance are estimated to be 5.5 tons for CO, 1.1 tons for volatile organic compounds (VOC), 8.9 tons for NOx, 0.9 ton for SOx, and 7.1 tons for PM_{10}. These emissions are compiled in

Table 3-7 and assumed to occur over 1 year. Using efficient grading practices and avoiding long periods where engines are running at idle may reduce combustion emissions from construction equipment. Potential impacts from fuel combustion equipment could be further minimized through the implementation of a phased construction schedule to reduce the number of units operating simultaneously, and the performance of regular engine maintenance programs. There are no clear criteria for measuring emissions from mobile sources. However, when project emissions are compared to PSD criteria for stationary sources of 100 TPY, they are well below threshold levels of concern.

Table 3-7. Construction Emissions Resulting from Alternative 1

Activity	Emissions (TPY)				
	CO	VOCs	NO_x	SO_x	PM_{10}
Ground Disturbance	5.5	1.1	8.9	0.9	7.1
Facility Construction	9.0	2.8	41.4	<0.1	2.9
Vehicle Trips (Light vehicles)	8.0	0.6	0.5	<0.1	<0.1
Vehicle Trips (Heavy vehicles)	2.1	0.5	1.2	<0.1	0.2
Terrain Trimmer	<0.1	0.2	0.2	<0.1	<0.1
Totals	**24.6**	**5.2**	**52.0**	**0.9**	**10.2**

Source: Derived by SAIC.

Building Construction

Construction of new facilities along the ridge, including scientific equipment, educational facilities, and research support facilities, would occur during the first 4 to 5 years. After ground clearing and concrete work during the first year, most of the buildings would be constructed during the second year, with the scientific equipment being installed during the third and fourth years. The fifth year would be devoted to calibration of the scientific equipment. In all, during Stage I, a total of 101,710 square feet (sf) (9,449 square meters [sm]) of new facilities would be constructed. Another 2,000-sf (186 sm) facility would be added during Stage II. Emissions of VOCs, NOx, CO, and PM_{10} from construction activities were calculated using emission factors from the California Environmental Quality Act Air Quality Handbook (SCAQMD 1993). The emission factors included contributions from engine exhaust emissions (i.e., on-site construction equipment, material handling, and workers' travel) and fugitive dust emissions. Emissions, assuming all of the building and facility construction occurs within a single year to yield the most conservative estimates, would be 9.0 tons of CO, 2.8 tons of VOCs, 41.4 tons of NOx, 2.9 tons of PM_{10}, and less than 0.1 ton of SOx. These emissions are compiled in Table 3-7 and conservatively assumed to occur over a single year.

Vehicle Travel

Approximately 12,800 vehicular round trips are estimated during Stage I of construction for the first year. Stage II construction would account for a 5 percent increase over Stage I (or 640 additional round trips) for a total of 13,440 round trips during the first year of construction. Heavy trucks would comprise 25 percent of the total trips, with the remaining trips being made by light trucks, pick-up trucks, and personal vehicles. Estimated emissions from vehicular trips during the construction period were calculated using emission factors from Calculation Methods for Criteria Pollutant Emission Inventories (Jagielski and O'Brien 1994), for high altitude conditions, with 1995 as the average vehicle model year. For calculation purposes, the heavy trucks were assumed to be heavy-duty diesel-powered vehicles with a gross vehicle weight exceeding 8,500 pounds; the light trucks, pick-up trucks, and personal vehicles were conservatively assumed to be light-duty gasoline-fueled trucks with a gross vehicle weight of 6,001 to 8,500 pounds. As a conservative assumption, to yield the highest calculated emissions estimate, the calculations assumed all vehicle trips for Stages I and II would occur during a single year. Total emissions from vehicle trips during the construction period were estimated to be 10.0 tons for CO, 1.1 tons for VOCs, 1.7 tons for NOx, 0.2 tons for PM_{10}, and less than 0.1 ton for SOx. These emissions are compiled separately for light- and heavy-duty vehicles in Table 3-7 and assumed to occur over 1 year.

Although construction related impacts on air quality may have a temporary impact on the local air quality, depending on the timing, wind conditions, and dust suppression methods used, they are short-term, temporary effects. In practice, the emissions could be significantly less due to the implementation of control measures in accordance with standard construction procedures. For instance, spraying of water on exposed soil during construction and prompt replacement of ground cover (grass and landscaping) are standard procedures that could be used to minimize the amount of dust generated during construction. Periodic inspections would be performed to check the long-term effectiveness of revegetation and erosion control measures. Consequently, the temporary emissions from construction activities are expected to be considerably smaller than shown in Table 3-7. In addition, the construction schedule for Stages I and II is spread over 5 or more years, so annual emissions would likely be a fraction (e.g., 75 percent construction activity occurring during the first year) of the emission totals shown in Table 3-7, depending on the implementation schedule. Therefore, the construction related impact on air quality is not expected to have a significant effect on the local air quality or visibility.

Utility Options

From an air quality perspective, the differences between the utility options would be virtually negligible, with no appreciable emissions from implementing any of them.

Water Canyon Road

Water Canyon Road is periodically maintained and repaired under the existing Langmuir Laboratory SUP. If road maintenance and repair are needed during proposed MRO construction, a terrain trimmer (also known as a track trencher) could be used. Assuming a track width of 12 feet (3.7 m), depth of 24 inches (61 cm), and travel speed of 0.5 mph for two passes over the road, the 600-HP vehicle would operate for 34 hours to accomplish the resurfacing task. The emissions from this vehicle were calculated using emission factors for excavators, trenchers, and graders, compiled in Air Emission Inventory Guidance Document for Mobile Sources at Air Force Installations (USAF 2002). Emissions from this equipment are estimated to be 0.2 ton for VOCs and

NOx, and less than 0.1 ton for CO, SOx, and PM_{10}. These emissions are compiled in Table 3-7.

Operational Phase

Operational emissions are defined as those emissions that would continue beyond the construction period as a result of operation of the proposed facility. These include operation of combustion equipment such as heaters and generators; equipment and site maintenance; and vehicle travel by personal vehicles, commuter vans, heavy vehicles, and non-road mobile equipment. Annual emissions estimates for the Operational Phase are compiled in **Table 3-8**. In addition, maintenance and repair of Water Canyon Road, as described above, would occur as needed.

Table 3-8. Operational Emissions Resulting from Alternative 1

Activity	Emissions (TPY)				
	CO	VOCs	NO_x	SO_x	PM_{10}
Vehicle Travel (sightseers)	0.3	<0.1	<0.1	<0.1	<0.1
Vehicle Travel (privately owned vehicles, van)	4.6	0.3	0.3	<0.1	<0.1
Mobile Equipment	<0.1	<0.1	<0.1	<0.1	<0.1
Equipment Maintenance	<0.1	3.3	<0.1	<0.1	<0.1
Emergency Power	<0.1	<0.1	0.2	<0.1	<0.1
Totals	**4.9**	**3.6**	**0.5**	**<0.1**	**<0.1**

Source: Derived by SAIC.

Propane Heaters and Ranges

Usage of propane heaters and ranges is not expected to increase over the baseline conditions. Therefore, emissions from usage of propane-fueled equipment would not increase as a result of the Proposed Action.

Rockets

Usage of solid rockets is not expected to increase over the baseline conditions. Therefore, emissions from usage of solid rockets would not increase as a result of the Proposed Action.

Because the baseline air emissions are 0.1 TPY or less, the estimated emissions shown in Table 3-8 represent increases in annual emissions as a result of the Proposed Action, as well as the estimated annual emissions from the proposed MRO facility, on a year-to-year basis, after the construction project is complete. These emissions are relatively minor. Therefore, impacts from operational emissions under Alternative 1 are not expected to have a significant effect on local air quality or visibility.

Vehicle Travel

Under Alternative 1, vehicle emissions from sightseers and the proposed MRO users represent the major portion of annual emissions for all pollutants, but levels are much lower (at least 20 percent lower in all categories) than during construction. These levels would be insignificant and below levels of concern for the region, given its current attainment status (see Affected Environment [Section 3.2.3.1]). These emissions are compiled in Table 3-8.

Mobile Equipment

Equipment stored and operated at the proposed MRO would include a pumper truck, travel crane (for moving telescopes), tractor with snowplow blades, pick-up truck, commuter van, possibly a fire engine, and an ambulance. Estimated usage of this equipment is approximately 100 miles per year (mpy) (160 kilometers per year [kmpy]). It is assumed that the additional equipment included in the baseline equipment inventory (including one forklift, one heavy truck, one grader, one dozer, and one crane) would remain at the site and that the usage for the existing equipment would not change from baseline conditions. The total annual emissions from the operation of the existing crane, grader, dozer, heavy truck, and forklift, plus the new pumper truck, travel crane, tractor, pick-up truck, commuter van, fire engine, and ambulance would be less than 0.1 TPY for each criteria pollutant. These emissions are compiled in Table 3-8.

Equipment Maintenance

A small amount of ethyl alcohol, a VOC, would be used, along with other nonvolatile chemicals, for cleaning purposes on a routine basis. It is assumed that any ethyl alcohol that is used would be emitted directly to the atmosphere upon evaporation. At a density of approximately 7 pounds per gallon, the usage of 1 gallon of pure ethanol would result in 7 pounds of emissions. As a conservative assumption, it is assumed that a total of 1,000 gallons of ethanol would be used during one year of routine maintenance activity once all of the telescopes are in place. This would result in approximately 3.3 tons of VOCs being emitted to the atmosphere per year from equipment maintenance activities. No emissions of other criteria pollutants would be expected to occur from these activities. These emissions are compiled in Table 3-8.

Emergency Power

An emergency power generator and an emergency water pump engine would be installed under Alternative 1. It is assumed that these internal combustion engines with a capacity of 100 HP would power generators and that they would each operate an average of 16 hours for testing and maintenance and up to 100 total hours, allowing for additional usage during unexpected power outages. Total estimated emissions from both generators, each running 100 hours per year, would be 0.2 TPY of NOx and less than 0.1 TPY of the other criteria pollutants. These emissions are compiled in Table 3-8.

Indirect Impacts

Indirect impacts of the Proposed Action would include increased sightseer traffic between Socorro and Magdalena Ridge. While the magnitude of the increase is difficult to project, one may estimate the increase in air pollution from the additional vehicle miles being traveled between the Socorro and the proposed MRO. For example, if sightseer traffic increased to 10 times the baseline conditions, the total increase in annual emissions would be 0.3 TPY of CO and less than 0.1 TPY (see Table 3-8) for the other criteria pollutants. These are insignificant emissions and would have negligible impact on air quality.

Alternative 2: No Action

Air emissions under Alternative 2 would be identical to those under baseline conditions, as described in Section 3.2.3.1. No increase in emissions or additional impact to the surrounding air quality from the proposed MRO would be expected to occur from this alternative. Air pollutant emissions would continue to be generated from maintenance and repair on Water Canyon Road and from vehicles used by employees and visitors at the Langmuir Research Site, Forest Service personnel, and recreation and other visitors to the Forest.

Alternative 3: Preferred Alternative

Direct Impacts

Air quality impacts during construction activities related to Alternative 3 would occur from 1) particulate emissions (i.e., fugitive dust) from ground clearing, road construction and improvement, vehicle travel, and excavation activities; 2) products of combustion from the construction equipment; and 3) vehicle miles traveled by the construction workers.

Construction Phase

Construction emissions under Alternative 3 would be virtually identical to those estimated for Alternative 1, with the exception of the facility construction emissions, which would be slightly less than those under Alternative 1, due to the fact that the total area of new facilities is slightly less under Alternative 3. Therefore, the construction related impact on air quality is not expected to have a significant effect on the local air quality or visibility.

Operational Phase

Operational emissions under Alternative 3 would be identical to those estimated for Alternative 1. Impacts from operational emissions under Alternative 3 are not expected to have a significant effect on local air quality or visibility.

Indirect Impacts

Indirect impacts to air quality under Alternative 3 would be identical to the estimated indirect impacts under Alternative 1.

Alternative 4

Direct Impacts

Air quality impacts during construction activities related to Alternative 4 would occur from 1) particulate emissions (i.e., fugitive dust) from ground clearing, road construction and improvement, vehicle travel, and excavation activities; 2) products of combustion from the construction equipment; and 3) vehicle miles traveled by the construction workers.

Construction Phase

Construction emissions under Alternative 4 would be virtually identical to those estimated for Alternative 1, with the exception of the facility construction emissions, which would be slightly less than those under Alternative 1, due to the fact that the total area of new facilities is less under Alternative 4. Therefore, the construction related impact on air quality is not expected to have a significant effect on the local air quality or visibility.

Operational Phase

Operational emissions under Alternative 4 would be identical to those estimated for Alternative 1. Impacts from operational emissions under Alternative 4 are not expected to have a significant effect on local air quality or visibility.

Indirect Impacts

Indirect impacts to air quality under Alternative 4 would be identical to the estimated indirect impacts under Alternative 1.

3.2.3.3 Cumulative Impacts

Cumulative impacts from Alternatives 1, 3, and 4 are expected to be relatively minor. It is possible that the additional traffic on Water Canyon Road, the campground, hiking trails, and the ridgetop could increase the chance of fires in the area. The smoke from forest fires poses temporary air quality and visibility problems for the surrounding region. There would be no new cumulative impact under Alternative 2.

3.2.3.4 Mitigation

With use of measures included in Table 2-6 for controlling air pollutants, no additional mitigations are identified for air quality.

3.2.4 Noise

3.2.4.1 Affected Environment

Region of Influence

The ROI for the noise analysis is the proposed MRO project area.

Existing Conditions

Noise is considered to be unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment (FICON 1992). It may be intermittent or continuous, steady or impulsive. It may be stationary or transient. Stationary sources are normally related to specific land uses, e.g., housing tracts or construction sites. Transient noise sources move through the environment either along established paths (e.g., highways and railroads) or randomly (e.g., a road grader preparing a construction site).

There is wide diversity in responses to noise that not only varies according to the type of noise and the characteristics of the sound source, but also according to the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source (e.g., a vehicle) and the receptor (e.g., a person or animal) (USEPA 1974).

The physical characteristics of noise or sound include intensity, frequency, and duration (USEPA 1974). Acoustic energy produces minute pressure waves that travel through the air and are sensed by the eardrum as sound. As the acoustic energy increases, the intensity or amplitude of these pressure waves increases, and the ear senses louder noise (USEPA 1974).

The frequency of sound is measured in cycles per second, or Hertz (Hz). This measurement reflects the number of times per second the air vibrates from the acoustic energy. Low frequency sounds are heard as rumbles or roars, and high frequency sounds are heard as screeches. Sound measurement is further refined through the use of “A-weighting.” The normal human ear can detect sounds that range in frequency from about 20 Hz to 15,000 Hz. However, all sounds throughout this range are not heard equally well. Therefore, through internal electronic circuitry, some sound meters are calibrated to emphasize frequencies in the 1,000- to 4,000-Hz range. The human ear is most sensitive to frequencies in this range, and sounds measured with these instruments are termed “A-weighted,” and are shown in terms of A-weighted decibels (dBA) (USEPA 1974).

The duration of a noise event and the number of times noise events occur are also important considerations in assessing noise impacts.

Measurements Used to Describe the Noise Environment

The description and assessment of noise involves the use of several descriptors. Each is unique and provides a quantitative means to describe both existing and project-induced noise. These various descriptors are explained in more detail below, along with a discussion of their use in quantifying various aspects of the acoustic environment.

The word "metric" is used to describe a standard of measurement. As used in environmental noise analysis, there are many different types of noise metrics. Each metric has a different physical meaning or interpretation, and each metric was developed by researchers attempting to represent the effects of environmental noise.

Current noise levels, as well as noise levels expected to be associated with the proposals assessed in this document, are described in terms of single event and time-averaged metrics.

Single Event Noise Metrics

The highest sound level measured during a single noise event is the Maximum Sound Level (L_{max}). This is the sound level actually sensed by the ear. L_{max} is important in judging how significantly a noise event interferes with conversation, sleep, or other common activities. However, L_{max} alone may not represent how intrusive a noise event is because it does not consider the length of time that the noise persists (ANSI 1980, 1988).

The Sound Exposure Level (SEL) metric combines both the intensity and duration of a noise event into a single measure. SEL does not directly represent the sound level heard at any given time. However, it does provide a measure of the total exposure of the entire event. Its value represents all of the acoustic energy associated with the event as though it was present for one second. Therefore, for sound events that last longer than one second, the SEL value will be higher than the L_{max} value. The SEL value is important because it is the value used to calculate other time-averaged cumulative noise metrics (ANSI 1980, ANSI 1988).

Time-Averaged Cumulative Noise Metrics

The number of times noise events occur during given periods is also an important consideration in assessing noise impacts. "Cumulative" noise metrics support the analysis of multiple, time-varying noise events. The most common are the Equivalent Sound Level (L_{eq}) and the Day-Night Average Sound Level (L_{dn}) (USEPA 1974).

The L_{eq} metric reflects average continuous sound. It considers variations in sound magnitude over periods of time and reflects, in a single value, the acoustic energy present during the total time period. Common time periods for averaging are 1-, 8-, and 24-hour periods ($L_{eq[1]}$, $L_{eq[8]}$, and $L_{eq[24]}$) (USEPA 1974). Each time period may be considered in this assessment as applicable.

The L_{dn} sums all individual noise events and averages the resulting level over a specified length of time. Normally, this is a 24-hour period. Thus, like L_{eq}, it is a composite metric representing the maximum noise levels, the duration of the events, and the number of events that occur. However, this metric also considers the time of day during which they occur. This metric adds 10 decibels to those events that occur between 10:00 PM and 7:00 AM to account for the increased intrusiveness of noise events that occur at night when ambient noise levels are normally lower than during the day (USEPA 1974).

It should be noted that for the assessments performed for this project, since no project-related noise events are anticipated to occur between 10:00 PM and 7:00 AM, the value calculated for L_{dn} will be identical to that calculated for a 24-hour equivalent noise level ($L_{eq[24]}$). This cumulative metric does not represent the variations in the sound level heard. Nevertheless, it does provide an excellent measure for comparing environmental noise exposures when there are multiple noise events to be considered.

In this document, sound levels associated with vehicular traffic are discussed in terms of $L_{eq(1)}$, $L_{eq(24)}$, and L_{dn} (if applicable). Those associated with construction activities are discussed in terms of $L_{eq(8)}$ and $L_{eq(24)}$. Average Sound Level metrics are the preferred noise metrics of the U.S. Department of Housing and Urban Development (HUD), the U.S. Department of Transportation (USDOT), the Federal Aviation Administration (FAA), the USEPA, and the Department of Veterans Affairs (VA) (FICON 1992). Scientific studies and social surveys have found that Average Sound Level metrics are the best measure to assess levels of community annoyance associated with all types of environmental noise. Therefore, their use is endorsed by the scientific community and governmental agencies (ANSI 1980, 1988; USEPA 1974; FICUN 1980; FICON 1992).

Noise Calculations

The USDOT, U.S. Federal Highway Administration (FHA) assesses traffic noise using the computer program "STAMINA." The program calculates noise based on 1-hour traffic loads and provides noise levels at specified receptor locations in terms of $L_{eq(1)}$. These calculated levels can then be normalized to the $L_{eq(24)}$ metric to provide daily average noise levels.

For other project-related noise such as construction activities, hypothetical scenarios will be developed that will reflect use of heavy vehicles, earthmovers, and other construction equipment in project areas. Using measured noise levels as a basis and estimated equipment operating times and use, calculations will be made indicating noise levels expected to emanate from the construction or activity site to points at specific distances from the site. Data will be reported in terms of $L_{eq(8)}$ and $L_{eq(24)}$ metrics.

For noise considerations, the land areas exposed to elevated noise levels resulting from project activities constitute the affected environment. This area generally falls within the project boundary, depending on terrain and vegetation (see Map 1-2).

Existing Noise Levels

Current noise levels in the project area result from human presence and ambient background noise. In assessing environmental noise, values are not normally assigned to background noise. There are two reasons for this. First, ambient background noise, even in WAs, varies widely depending on location and other conditions. For example, studies conducted in an open pine forest in the Sierra National Forest in California have measured up to a 10 dBA variance in sound levels simply due to an increase in wind velocity (Harrison 1973). Therefore, assigning a value to background noise would be arbitrary. Second, due to the relatively remote location of the project area, it is reasonable to assume that ambient background noise would have little or no effect on calculated project-related noise levels. In calculating noise levels, louder sounds dominate the calculations, and overall, noise from human presence and activity would be expected to be the dominant noise source characterizing the acoustic conditions in the ROI in the project area.

Under current conditions, the greatest source of intrusive noise probably results from vehicular traffic and other human activity (USFS 2000a). There is little mining in the area and limited woodcutting. The area supports recreational use such as hunting, gathering, camping, hiking, and other activities. Campers at Water Canyon Campground regularly ride all-terrain vehicles (ATV) through the area. The road between Water Canyon and the Langmuir Laboratory is used by laboratory staff for access and tourists for sightseeing (USFS 2000a). Staff at the laboratory also create noise from their day-to-day activities.

On average, it is estimated that approximately 20 vehicle round trips occur daily on Water Canyon Road (Aldridge 2003). It should be noted that this is only an estimate as traffic counts for the use of the road have not been completed to date.

To ensure a conservative estimate, it was assumed that ½ of the daily trips occurred during a 1-hour period in the morning (8:00 AM to 9:00 AM), with the remainder spread throughout a 14-hour period. No trips occurred at night. The USDOT's computer program STAMINA was used to model this level of use. These calculated levels were then normalized to the $L_{eq(24)}$ metric to provide daily average noise levels resulting from vehicular traffic. Calculated noise levels at four receptor locations at varying distances from the edge of the road are shown in **Table 3-9**.

Table 3-9. Current Traffic Noise on Water Canyon Road

Receptor Distance from Roadway (feet)	$L_{eq(1)}$ (dBA) [a]	$L_{eq(24)}$ (dBA) [a]
100 (30.5 m)	49.1	35.2
200 (61 m)	44.6	<35.0
300 (91.5 m)	41.9	<35.0
344[b] (105 m)	40.9	<35.0

Source: FHA 1982.

Notes: (a) Calculated values less than 35.0 not shown. These values are well below ambient noise, and would have no influence on the regional acoustic character.

(b) This distance is used because it represents the closest Protected Activity Center (PAC) location to any noise source. PACs designate areas with critical habitat supporting Mexican Spotted Owl (MSO) populations. See Biological Resources (Section 3.3) for additional details.

Daily activities at the Langmuir Laboratory also contribute localized noise to the region. Vehicle traffic noise resulting from the laboratory staff commuting to and from work was included in the traffic noise assessment above. However, diesel generators, support equipment, and other heavy earth moving equipment also operate on the laboratory site on a limited basis (Winn 2002). Noise resulting from the use of this equipment is addressed below.

Table 3-10 shows SELs associated with typical equipment currently operated on the laboratory site in varying operating regimes considered in the analysis. These SEL values formed the basis for the subsequent calculation of time-averaged noise levels.

Table 3-10. Typical Equipment Sound Levels at Langmuir Facilities

Equipment	Sound Level (dBA) Under Indicated Operational Mode[a]		
	Idle Power	Full Power	Moving Under Load
Forklift	63	69	91
Crane	66	83	87
Dozer	63	74	81
Grader	63	68	78
Diesel Generator	—	76	—

Source: USAF 1998.

Note: (a) Noise levels recorded at 125 feet from source. Used as basis to calculate noise levels at other distances.

For the assessment of the equipment noise, a 360,000-sf (33,445 sm) hypothetical "activity area[3]" was designated (a square area 600 feet by 600 feet [183 m by 183 m]). This represents an estimation of the approximate area that would contain most of the equipment operation.

The first step in the assessment was to calculate the total acoustic energy that would be generated in the area based on specific equipment, operating mode, and operating time in that mode (Winn 2002). These data also provided information concerning the relative contribution of individual pieces of equipment to the total amount of acoustic energy generated on the site. Next, individual equipment was spatially distributed throughout the activity area. This yielded an equipment-weighted contribution to total site acoustic energy at different points throughout the site. With this spatial distribution, it was then possible to calculate a mean and standard deviation for the distribution along an axis running through the site (Wuest 2003).

These data were then used to normally distribute the total site energy throughout the site. Finally, the normally distributed energy from multiple source points throughout the site was aggregated at a range of points at varying distances from the site edge. This allowed a determination at those points of the total acoustic energy that had emanated off-site from all noise sources (Wuest 2003). **Table 3-11** shows time-averaged noise levels at a range of distances from the edge of the activity area.

It should be noted that this assessment is conservative. Noise is attenuated (reduced) as it spreads from its source. Distance, atmospheric conditions (temperature and humidity), vegetation, and topography all contribute to the level of attenuation actually occurring (USEPA 1974). However, depending on specific circumstances, some conditions could

[3] The activity area includes the area encompassing the dispersed locations of facilities and equipment used by Langmuir Laboratory.

counteract others. For example, sloping ground and foliage generally increase the level of attenuation over given distances. However, if the ground is extremely hard and rock-covered, a reflective surface is formed, and the amount of attenuation actually achieved is reduced. Due to the complex and situation-specific interactions of all of these influencing factors, not all were considered.

Table 3-11. Current Noise Levels Associated with Langmuir Laboratory Operation

Distance from Site Edge (feet)	$L_{eq(8)}$ (dBA)	$L_{eq(24)}$ (dBA)
100	59.5	54.8
200	55.7	50.9
300	53.4	48.6
400	51.7	46.9
500	50.3	45.6

Source: Wuest 2003.

The attenuation mechanism considered in the calculations is spherical spreading. This results in an approximate 6-dBA decrease in sound for every doubling of distance from the sound source. Other data on attenuation mechanisms indicate that under ideal conditions, atmospheric attenuation could reduce sound levels by up to 2 dBA for every 100 feet (30.5 km) of spread. Dense-leafed foliage or grass growing in soft ground could also decrease levels by approximately 2 dBA per 100 feet (30.5 km). However, since the distances involved in the construction noise assessments are relatively small, and other conditions exist in and around the project area that could offset the attenuation levels described, it is reasonable to assume that the assessments presented are not significantly skewed by limiting calculations to spherical spreading. Nevertheless, due to the conservative nature of the scenario, actual sound levels emanating off-site would be expected to be lower than those shown.

3.2.4.2 Environmental Consequences

Method of Analysis

Noise associated with construction activities from the Proposed Action and other alternatives were considered and compared with current conditions to assess impacts. Data developed during this process also supports analyses in other resource areas (e.g., wildlife).

To assess noise around construction sites (e.g., the Operations Center), a hypothetical "construction area" of 200,000 sf (18,600 sm) was designated spatially in the model program. This would encompass a square area approximately 450 feet (137 m) on a side.

The first step in the analysis was to calculate the total acoustic energy that would be generated on the site. These data also provided information on the relative contribution of each individual piece of equipment to the total amount of acoustic energy generated on the site. Next, individual equipment was spatially distributed throughout the construction zone considering "most likely" areas of operation. This yielded an equipment-weighted contribution to total site acoustic energy at different points throughout the site. With this spatial distribution, it was then possible to calculate a mean and standard deviation for the distribution along an axis running through the site.

These data were then used to normally distribute the total site energy throughout the site. Finally, the normally distributed energy from multiple source points throughout the site was aggregated at a range of points at varying distances from the site edge. This allowed a determination at those points of the total acoustic energy that had emanated off-site.

To assess the noise exposure resulting from road maintenance and repair, a use-scenario was developed that would represent typical operation of the terrain trimmer equipment. The assessment is based on a hypothetical 600-foot (183-m) road section over which the equipment operates at an average speed of 50 feet (15 m) per minute. Based on the physical dimensions of the equipment, it was further assumed that two passes along the road segment would be required (Vermeer 2003). Noise data associated with use of the terrain trimmer was obtained from product technical engineers at the Vermeer product development factory. Based on those data, it was determined to use an SEL of 86 dBA when operating and 69 dBA when sitting at idle, when normalized to a distance of 100 feet (30.5 m) (Ryerson 2003).

The noise resulting from the operation of this equipment was then normally distributed along the road segment. Then, the normally distributed energy from multiple source points along and across the road segment was aggregated at a range of points at varying distances from the segment edges. This allowed a determination at those points of the total acoustic energy that had emanated off-site.

Alternative 1: Proposed Action

Direct Impacts

Alternative 1 involves developing the proposed MRO on South Baldy Peak in the Magdalena Mountains. Development of the facility would occur in two major stages: 1) a construction phase and 2) an operations phase. The construction phase would involve construction of new structures and infrastructure on the ridgetop and an expansion of utility services to support operation of the facility. In the operations phase, the facility would provide services as an observatory. Associated activities would include road maintenance, site maintenance, and minor equipment maintenance. During all proposed activities, vehicles would provide access to workers and transportation of equipment and supplies. All of these aspects of the proposal have the potential to create elevated noise in the environment.

Construction Phase

Ridgetop

Facility construction would occur over a multi-year period. Several facility sites would be under construction at the same time. Noise at specific facility construction sites would be intermittent and of limited duration. A hypothetical scenario was developed to assess potential noise associated with construction activities on a facility site. Primary noise sources during such activity would be expected to be heavy vehicles and earth moving equipment. **Table 3-12** shows sound levels associated with typical heavy construction equipment under varying modes of operation.

Table 3-12. Typical Equipment Sound Levels from Proposed MRO During Construction and Operational Phases

Equipment	Sound Level (in dBA) under Indicated Operational Mode[a]		
	Idle Power	Full Power	Moving under Load
Forklift	63	69	91
Crane	66	83	87
Dozer	63	74	81
Front-End Loader	60	62	68
Dump Truck	70	71	74

Source: USAF 1998.

Note: (a) Noise levels recorded at 125 feet (200 km) from source. These were used as a basis to calculate noise levels at other distances.

Table 3-13 reflects the aggregated noise levels at a typical facility construction area at varying distances from the edge of the construction area.

Table 3-13. Noise Levels Associated with Facility Construction

Receptor Distance from Site Edge (feet)	$L_{eq(8)}$ (dBA)	$L_{eq(24)}$ (dBA)
100	69.4	64.6
200	65.5	60.7
300	63.2	58.5
400	61.5	56.8
500	60.2	55.4

Source: Derived by SAIC using STAMINA noise model.

Since overall construction activity is expected to span many years, it should be noted that, as the “construction area” would move from specific location to specific location on the ridge, the land areas exposed to these noise levels would also shift to different locations. During the first year, several “construction areas” may be active on any given workday. The actual exposure of any one specific point to elevated noise would be expected to be relatively brief and limited to the time that any one specific facility is being built.

During the construction phase, workers would be exposed to noise levels presented in Tables 3-10 through 3-13. Workers would wear protection (such as ear plugs), as required under applicable occupational regulations, reducing exposure levels to those that have been determined as safe and protective of human health and safety. Work areas would be fenced, and the public would not have direct access onto construction sites. Therefore, noise exposure would not affect human activities. Noise effects on wildlife are discussed in Section 3.3.2.2.

Utility Options

Expansion of services in the utility corridors also involves human activity. In these areas, too, some localized elevated noise levels would be expected. However, noise at any one point along the corridor would be expected to be minimal and have very limited duration.

Water Canyon Road

Maintenance and repair of Water Canyon Road could be supported by motorized equipment (a terrain trimmer) that would limit the extent of exposure to elevated noise levels. While the equipment produces elevated noise levels when it is grading, smoothing, and compacting the improved roadway, it accomplishes all earthwork in a single pass. This limits the extent of time the equipment operates in any single area. Furthermore, the use of this equipment eliminates the need for blasting and minimizes the requirement for grinding.

For the assessment, it was assumed that the road segment was oriented in a west-to-east direction. To determine the levels of noise, assessment points were designated at specific distances north and south of the road segment and east and west of the extreme points of the segment. Resultant noise levels at these points are shown in terms of 1- and 24-hour L_{eq} measurements in **Table 3-14**.

Table 3-14. Noise Associated with Maintenance and Repair of Water Canyon Road

Distance from Noise Source (feet)	North/South Axis		East/West Axis	
	$L_{eq(1)}$ (dBA)	$L_{eq(24)}$ (dBA)	$L_{eq(1)}$ (dBA)	$L_{eq(24)}$ (dBA)
100	72.9	59.1	73.7	59.9
200	70.2	56.4	69.9	56.1
300	68.2	54.3	67.6	53.8
400	66.5	52.7	65.9	52.1
500	65.1	51.3	64.5	50.7

Source: Derived by SAIC using STAMINA noise model.

As shown, during equipment operation on a specific segment of the road, noise levels are elevated in close proximity to the roadway. However, it should be noted that under the conditions specified for the evaluation scenario, the specific road segment being evaluated would only experience equipment operation for approximately 30 minutes. The noise identified would be transitory and have limited duration.

During Stage I of construction, it is estimated that 50 to 60 vehicle round trips to and from the site could occur on a busy day. To form a conservative estimate of noise resulting from vehicle traffic, it was assumed that a maximum of 25 one-way trips would occur during a 1-hour period. During Stage II of construction, it is estimated that vehicle trips could increase by up to 5 percent of Stage I. The USDOT's computer program "STAMINA" was used to model these levels of use. The calculations provided by the program yield $L_{eq(1)}$ at receptors placed at designated distances from the roadway. These values were then normalized to $L_{eq(24)}$ values. These project-related values are compared with baseline (current) conditions in **Table 3-15**. Noise levels at 100 feet (30.5 m) from the roadway and beyond would be at $L_{eq(24)}$ 41.2 dBA or lower—levels that are likely to annoy very few people (Finegold et al. 1994). However, noise can be perceived differently in natural settings depending on the range of expectations of each person's experience.

Table 3-15. Noise Levels Associated with Vehicular Traffic

Receptor Distance (feet)	$L_{eq(1)}$ (dBA[a])			$L_{eq(24)}$ (dBA[a])		
	Baseline	Stage I Construction	Stage I and II Construction	Baseline	Stage I Construction	Stage I and II Construction
100	49.1	54.8	55.0	35.2	41.0	41.2
200	44.6	50.4	50.6	<35.0	36.6	36.8
300	41.9	47.6	47.8	<35.0	<35.0	<35.0
344[b]	40.9	46.6	46.8	<35.0	<35.0	<35.0

Source: FHA 1982.

Notes: (a) Calculated values less than 35.0 not shown. These values are well below ambient noise, and would have no influence on the regional acoustic character.

(b) This distance is used because it represents the closest PAC location to any noise source. PACs designate areas with critical habitat supporting MSO populations. See Biological Resources (Section 3.3) for additional details.

Operational Phase

During the Operational Phase of the proposed MRO, noise would result from traffic, general human presence, and the minor maintenance that would be necessary to maintain the operability of the observatory complex. Noise from these sources would be expected to be significantly less than the noise created during the construction phase. In actuality, since the activities associated with the operation of the proposed MRO would be similar to those associated with the current operation of Langmuir Laboratories, noise levels would generally be expected to return to those that exist under current conditions.

Water Canyon Road would be maintained and repaired as needed during operations. The noise effects would be as described above.

Indirect Impacts

Maintenance and repair of Water Canyon Road from Water Canyon Campground to the ridgetop could make its use more attractive to normal recreational users of the National Forest. Increased human presence in some areas and increased vehicle trips would create noise greater than that experienced under current conditions. However, there are no data available to quantify the scope of these possible increased uses. Therefore, no specific assessment is provided.

Noise generated by project activities can affect a variety of receptors, both human and wildlife. The effects of noise on wildlife and recreational activities are addressed in Wildlife (Section 3.3.2.2) and Recreation (Section 3.4.3.2), respectively.

Alternative 2: No Action

Under Alternative 2, the proposed MRO facility would not be developed. Operation of the Langmuir Laboratory would continue as under current conditions. Noise associated with this alternative would remain as described in Section 3.2.4.1.

Maintenance and repair of Water Canyon Road would continue to occur under this alternative. The noise effects would be as described for Alternative 1.

Alternative 3: Preferred Alternative

Alternative 3 differs from Alternative 1 only in the siting of the proposed facilities on the ridge. Overall, although the size of some facilities would be reduced, noise generated as a result of implementing this alternative would be similar to the noise identified and described under Alternative 1. Noise generated in any given construction area would be the same as reported in Table 3-15, although the duration may be somewhat shorter under this alternative because total new facility footprint would be slightly less than for Alternative 1. This difference overall would be very small. No difference in vehicle levels is expected, so noise from vehicles would be the same as shown in Table 3-13.

Direct and indirect impacts would be as described for Alternative 1.

Alternative 4

Alternative 4, like Alternative 3, differs from Alternative 1 only in the siting of the Operations Center and associated support buildings on the ridge. Overall, although the size of some facilities would be reduced, noise generated as a result of implementing this alternative would be similar to the noise identified and described under Alternative 1.

Direct and indirect impacts would be as described for Alternative 1.

3.2.4.3 Cumulative Impacts

As the full capabilities of the proposed MRO mature through the operational phase, other entities may propose specific enhancements (such as Trailhead 8 improvements). These proposals could entail the need for some additional facility construction and use of equipment. Noise from the proposed MRO construction and ongoing maintenance would be localized and temporary and cumulative to other localized and temporary noise sources such as periodic and intermittent blasting done in the Socorro Mountains at NMIMT’s Energetic Materials Research and Testing Center. Other specific projects or proposals are not presently quantified, but it is believed that they would be relatively small in scope. Such construction would create localized, short-term increases in noise.

3.2.4.4 Mitigation

No mitigation measures are identified for attenuating noise. Noise concerns are addressed under the resources affected by noise (e.g., Wildlife).

3.2.5 Fire Management

3.2.5.1 Affected Environment

Region of Influence

The ROI considered for fire includes the Magdalena Mountains (**Map 3-11**), particularly the east side of the mountain range that could most likely be affected by fires originating along Water Canyon Road and the ridgetop, depending on a variety of factors (i.e., wind direction and speed, vegetation and fuel loading, and moisture). The project area (Map 1-2) defines the area within which a fire could originate from project activities.

Existing Conditions

The forest types within the project area are shown in **Map 3-12** and include 1) subalpine conifer forest; 2) mixed conifer forest; and 3) ponderosa pine forest. These types are described in Vegetation (Section 3.3.1).

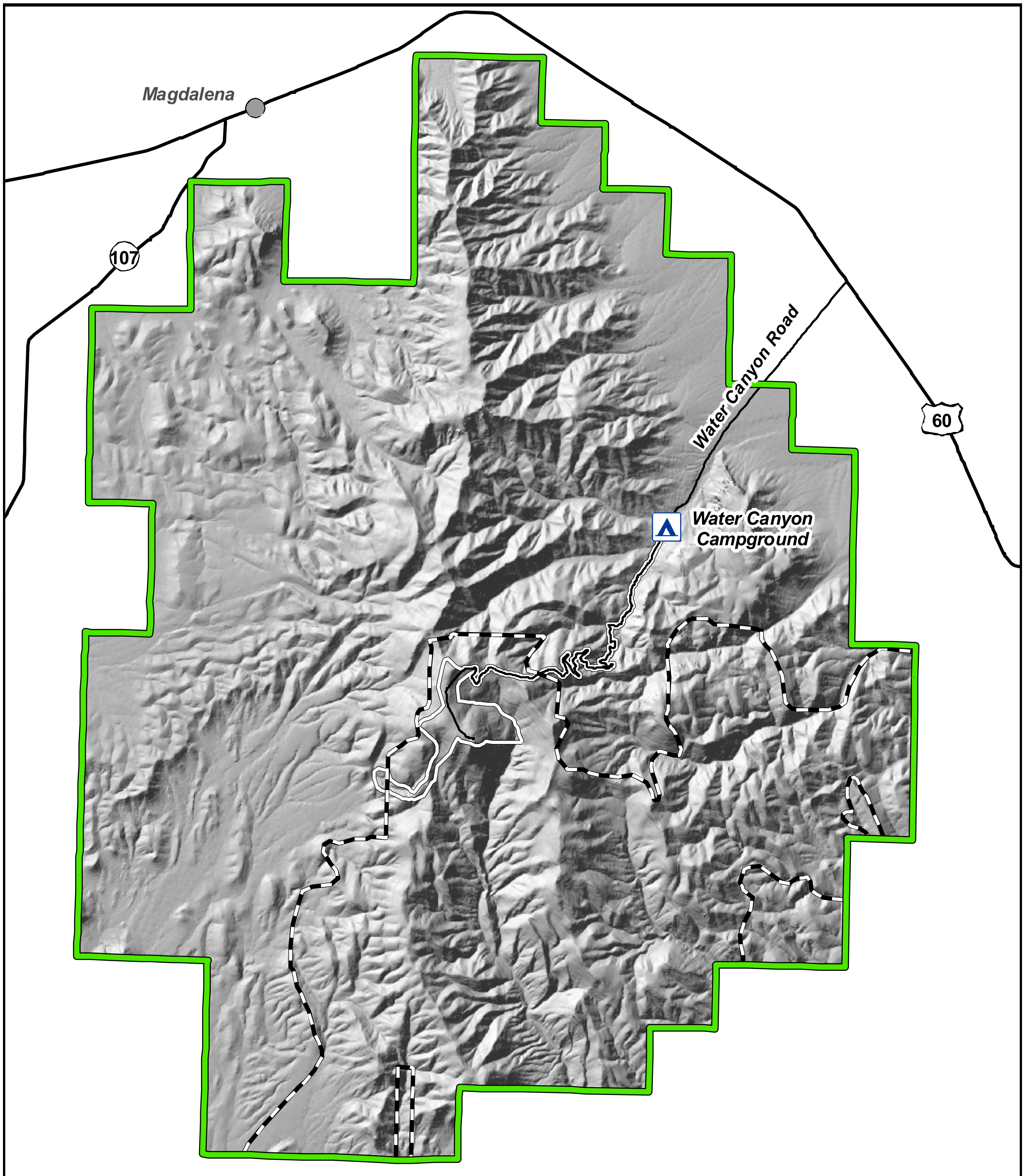
Typical of conditions throughout the MRD, the stands of trees within the project area are much more dense than they were before European settlement. **Table 3-16** shows that resettlement fires occurred on a regular basis in all forest types (USFS 1993). These regular fires maintained more open stands, kept insect and disease levels in check, and favored the regeneration of more shade intolerant species such as ponderosa pine and quaking aspen.

Table 3-16. Presettlement Fire Frequency by Vegetation Type

Species	Frequency (years)
Ponderosa Pine	2-10
Mixed Conifer	5-25
Piñon-Juniper	10-30
Spruce-Fir	150+

Source: USFS 1993.

Heavy cattle grazing at the turn of the century combined with fire suppression have increased the average number of trees per acre in ponderosa pine forests from as few as 23 trees per acre to as many as 851 trees per acre today. Because of these densely stocked conditions, present day forests are more susceptible to fire, insects, and diseases. As a result of these dense conditions and lack of fire, many stands within the analysis area have very little vegetation in the understory. Shrubs, grasses, and forbs are generally lacking in many stands. Litter and duff layers are thick, and fuel loading is very high in many stands. Increased tree density, fuel loading, and crown fire occurrence are common consequences of fire exclusion throughout ponderosa pine forests. Simulation studies indicate that this phenomenon may occur not only in pure ponderosa pine forests, but also in ponderosa pine/Douglas fir and mixed conifer forests as well (Covington and Moore 1992).



Legend

- City or Town
- Major Road
- MRO Project Boundary
- Langmuir Research Site Boundary
- ROI

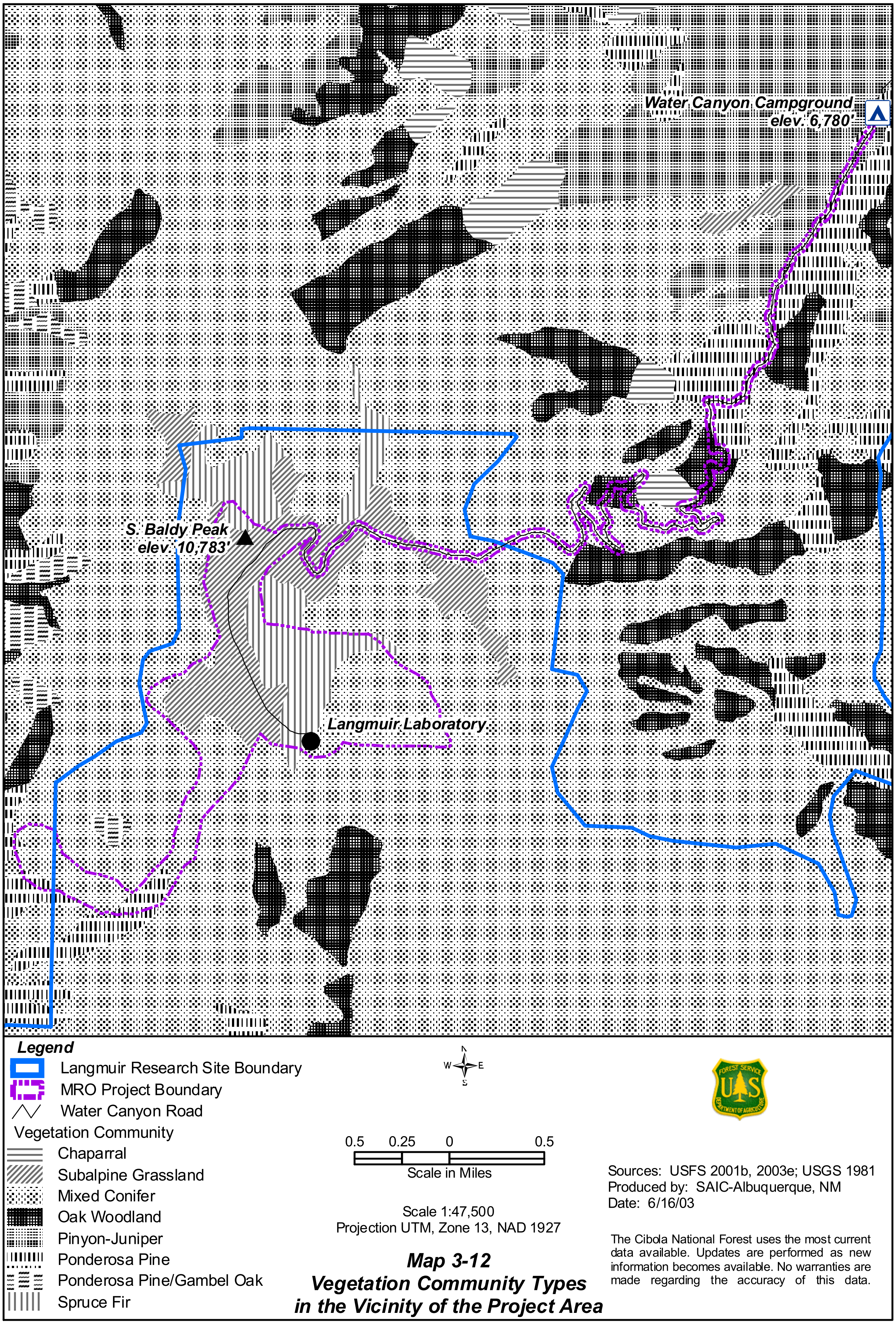
2 1 0 2
Scale in Miles

Scale 1:160,000
Projection UTM, Zone 13, NAD 1927

Sources: SAIC 2003a
Produced by: SAIC-Albuquerque, NM
Date: 07/07/2003

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-11
Region of Influence
for Fire Management



Map 3-12
Vegetation Community Types in the Vicinity of the Project Area

Lightning-caused wildfires in the Southwest are growing larger and larger over time, with some fires involving 10,000 to 20,000 acres, in contrast to the 3,000-acre surface fires of presettlement times (Barrows 1978; Swetnam and Dieteriech 1985; Swetnam 1990). This represents a three- to sixfold increase in average fire size (Covington and Moore 1992). The average fire size and the average acres burned in Arizona and New Mexico national forests have increased during the past 5 decades (Johnson 1996). **Table 3-17** quantifies these changes by showing the numbers of acres burned per decade and the average annual fire size since 1950.

Table 3-17. Acres Burned Per Decade and Annual Average Fire Size for National Forest Lands in Arizona and New Mexico, 1950-1996

Decade	Total Acres Burned	Average Annual Acres Burned	Average Fire Size (acres)
1950-1959	349,277	34,928	18.5
1960-1969	238,955	23,896	11.5
1970-1979	472,434	47,243	17.6
1980-1989	329,296	32,927	15.9
1990-1996	729,529	104,218	51.1

Source: Johnson 1996.

The 1990s included drought years, as did the 1950s and 1970s. Therefore, the recent high average fire size and acreage burned per year cannot be explained by lack of precipitation. Firefighting technology, road access, and suppression efforts have gradually improved in the decades since 1950. Major factors being about the same, a gradual decrease in average fire size would be expected. Increasing vegetation density and the resulting fuel laddering appear to be primary reasons for the opposite trend.

Under the existing SUP, Langmuir Laboratory is responsible for preventing and suppressing fires around their occupied facilities. However, ultimately, the Forest Service provides fire suppression support since the facilities are located on the MRD. The current Fire Management Plan for the MRD is in the process of being revised. Controlled burns and prescribed fires have occurred on the MRD. Prescribed fires were done in the Magdalena Mountains during the 1990s. The 3,300-acre Sargent Prescribed Burn in the San Mateo Range occurred in April 2003. Thinning, piling, and burning have occurred in the Hop Canyon urban interface in the Magdalena Mountain range in 2002 and 2003. About 12,000 acres are planned in the East Magdalena Prescribed Burn in 2004. With the current drought throughout the southwest and vegetative conditions as described above, the project area and surrounding areas have a high risk for fire under the right circumstances (i.e., an ignition source, wind, or low moisture content).

3.2.5.2 Environmental Consequences

Method of Analysis

Analysis of the fire hazard is qualitative, based on fire history, current climate, weather, and forest conditions. Increased levels of human activity and the introduction of non-natural ignition sources into the environment are reviewed. Increased probability of fire hazards is based on available information provided by the Forest Service. Measures to minimize impacts such as use of spark suppressors on powered equipment and restricting travel by vehicles with catalytic converters in areas with tall, bushy grasses will be identified.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

During the first year, up to 120 one-way trips (60 round trips) on the road each day by construction workers represent an increase of sixfold over the general average-day estimate. However, workers would operate under the direction of a Safety Plan that addresses fire risk and appropriate worker practices. The construction personnel would attempt to minimize risk of fire by providing a 3,000-gallon water truck, which would be on-site during all construction activities. The water truck would not eliminate the possibility of a fire being started, but would allow for immediate response to any fire that may occur. Also, there would be personnel trained in suppression of small fires at construction sites at all times. Immediate response would be important to the control and final suppression of any fires. A construction phase fire plan would be tiered to the CNF fire restrictions and closures. The plan would specifically regulate how, when, and where construction activities take place with regard to Forest and state fire closures or restrictions.

The Forest Service is requiring that all trees that are felled on the ridgetop be removed in consideration of the high fuel content of the CNF. Slash will be hauled off Forest Service land or, for smaller items, chipped and dispersed. Therefore, tree cutting would not increase fire hazard potential. Also, all new equipment and infrastructure (including generators, fuel tanks, and electric wiring or cables) would be housed and installed in accordance with all applicable codes.

Requiring spark arrestors on all powered equipment and not operating vehicles with catalytic converters in grassy areas would further lower the risk of starting a fire during the construction phase. The probability of a project-caused fire is low, given the measures to be used to safeguard against inadvertent ignitions.

Maintenance and repair of Water Canyon Road may increase the potential for human-caused fires started by construction equipment or construction personnel.

Operational Phase

The same measures would be in place during the operational phase so as to limit the possibility of a proposed MRO user or activity igniting a fire. However, the amount of proposed MRO-generated traffic would greatly decline to about 25 percent over general annual estimates after construction is complete, lowering the risk of a project-caused fire. During operations, the proposed MRO use may represent an increase of about 25 percent over general estimates of current use of the road. The water storage supply on the ridgetop and addition of a pumper truck would provide limited capabilities to defend new structures against small on-site fires. Water Canyon Road would continue to be maintained and repaired as needed during operations. During these activities, there could be an increased potential for human-caused fires. However, the positive consequence of improved access along Water Canyon Road would allow for easier access during the district’s fire suppression and fuel reduction activities.

Indirect Impacts

The direct effects of fire on the environment (loss of vegetation, mortality of animals) can indirectly affect vegetation and wildlife resources, as described in their respective sections.

Alternative 2: No Action

The district would continue with their current fire management plan and objectives. Because of prescribed fires and controlled burns on the MRD, conditions in treated and adjoining areas are expected to reduce the fire hazard. Ongoing maintenance and repair of Water Canyon Road would continue to create potential hazards during construction activity, but ultimately improve access for fire management and response.

Alternative 3: Preferred Alternative

The direct and indirect impacts of Alternative 3 would be the same as under Alternative 1.

Alternative 4

The direct and indirect impacts of Alternative 4 would be the same as under Alternative 1.

3.2.5.3 Cumulative Impacts

The combined increases in traffic and human activity from Langmuir Laboratory, recreation use, and the proposed MRO would generally increase the potential for a human-caused fire. With current conditions of drought and the high fuel content of surrounding forest, the possibility of fire (natural or human-caused) remains high on the MRD. Even though the likelihood of a project-caused fire is low, during times of extreme fire hazard, any added risk is not desirable and is a potential impact.

3.2.5.4 Mitigation

Several measures to minimize fire risks from project-related activities are listed in Table 2-6 and include proactive fire management actions such as forest thinning or prescribed burns.

In times of extreme fire hazard, access for construction may be prohibited or restricted, depending on the location and the equipment to be used. This would be decided by the Forest Service on a real-time basis. Other contingency measures may be included in a construction phase fire plan (tiered to the CNF fire restrictions) to address times of extreme fire hazard, such as additional on-site personnel trained in fire suppression (see Table 2-6).

3.2.6 Transportation

3.2.6.1 Affected Environment

Region of Influence

The primary access route to the project site involves two interchanges in Socorro with Interstate 25 (I-25), a short portion of Highway 85 in Socorro, Highway 1 in Socorro (locally known as California Street), and US 60 from Socorro to Water Canyon Road. These facilities and the Water Canyon Road (FR 235) corridor define the project's primary ROI for transportation and access issues.

Existing Conditions

Regional Roadway Network and Conditions

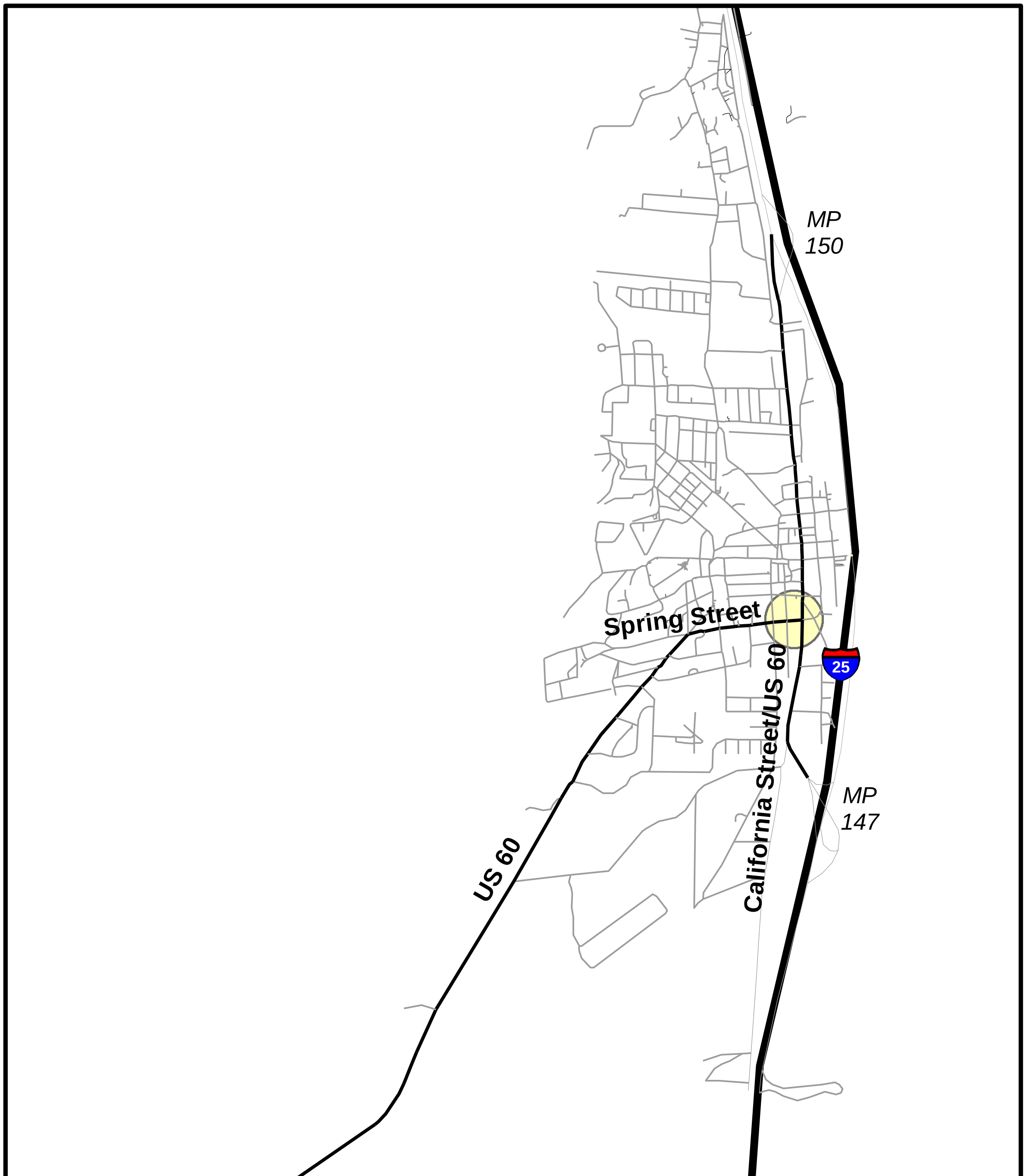
The regional transportation network serving the MRD within the CNF includes the following primary facilities: I-25, US 60, Highway 85, Highway 1, State Road 107, State Road 52 and State Road 163 (see Map 1-1). Primary access from I-25 through Socorro to the intersection of US 60 and Water Canyon Road is discussed below.

Interstate 25 Interchanges and Routes through Socorro

The Town of Socorro, New Mexico is served by two I-25 interchanges. The northern interchange, located at Milepost 150, connects I-25 to US 60 (west of the interstate). US 60 is designated as California Street within Socorro, and a portion of US 60 is also coincident with Highway 1. US 60/California Street/Highway 1 intersects Spring Street approximately 2 miles (3.2 km) south of the I-25 interchange, where traffic is controlled by a four-way traffic signal. The interchange design and the Socorro street network is shown in **Map 3-13.**

The southern interchange, located at Milepost 147, connects I-25 to Highway 85 (see Map 3-13), which merges with US 60/California Street/Highway 1 south of the Spring Street interchange. The railroad crossing located south of the US 60/Spring Street intersection is controlled by signal lights and bells only. This track is a low-volume spur and is not considered a traffic hazard. Generally, motorists bound for US 60 who are traveling on I-25 in either direction use the southern interchange rather than the northern interchange to save time. This route choice relates to the number of traffic lights north of the US 60/Spring Street intersection.

US 60 turns 90 degrees at the Spring Street intersection and proceeds west (as US 60/Spring Street) approximately a half-mile where it meets a skewed intersection from which Spring Street continues west and US 60 veers to the south. This intersection, controlled by a four-way stop, is relatively new and is considered an interim solution.



Legend

Interstate

US Highway

Local Road/Route

N
W E
S

0.5 0.25 0 0.5

Scale in Miles

Scale: 1:47,500
Projection: UTM, Zone 13, NAD 1927

Sources: USFS 2002, NMT 2003
Produced by: SAIC - Lakewood, CO
Date: 8/28/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-13
I-25 Interchange and Socorro Road Network

The local high school and hospital are located on the east side of US 60 at, and beyond, High School Road, respectively. New striping at both intersections provides a left-turn lane from US 60 westbound as well as right-turn acceleration and deceleration lanes. The striping required for these lanes used the entire shoulder of the road, so no shoulder space currently exists in these locations. Only signal lights and bells control the railroad crossing to the north. The track is the same low-volume spur described previously and is not considered a traffic hazard.

US 60 West of Socorro

US 60 proceeds west out of Socorro toward the MRD. US 60 is a two-lane, asphalt Highway with intermittent passing lanes and 5-foot shoulders. Approximately 16 miles (26 km) west of town, US 60 intersects Water Canyon Road (FR 235), the only access road to the project site. The US 60/Water Canyon Road intersection is stop sign controlled on Water Canyon Road. Currently, there are no deceleration/acceleration or passing lanes on US 60 nor is there a left-turn lane onto Water Canyon Road. Vehicles traveling along US 60, therefore, are required to wait if there are motorists turning onto Water Canyon Road. No substantial vertical or horizontal curves exist near the intersection. Although there have been accidents reported in the vicinity, they have not been attributed to engineering or traffic issues.

Long-Term Improvement Plans: Jurisdiction and Maintenance

State highways fall under the jurisdiction of the New Mexico State Highway and Transportation Department (NMSHTD). The project area is within District 1. The Department maintains a Statewide Transportation Improvement Program (STIP) for long-range capital investment planning. The current STIP does not include proposed improvements in the area other than a milling and overlay project along US 60 near Highway 52. There have been no substantial highway improvements in the area within the last 5 years. US 60 is maintained by the State of New Mexico for passenger car traffic (Levels 3 to 5). Definitions of maintenance levels are as follows:

- Level 1: Basic Custodial Care (closed);
- Level 2: High Clearance Vehicles;
- Level 3: Suitable for Passenger Cars;
- Level 4: Moderate Degree of Comfort; and
- Level 5: High Degree of User Comfort

Traffic Patterns, Volumes, and Levels of Service

Average annual daily traffic numbers (AADT) for 2001 as well as projected future AADTs are listed for the affected roads in **Table 3-18** below.

Levels of service (indicating the general condition or traffic flow) for these roadways are not available.

Table 3-18. Average Annual Daily and Projected Future Traffic Numbers

Intersection	2001 AADT	Future AADT (2023)
South Socorro interchange I-25	6,628	8,699
North Socorro interchange I-25	10,064	13,210
Junction US 60	15,283	20,059
Junction FR 235 (Water Canyon Road)	2,324	3,440
US 60 Junction Spring Street	5,680	7,456

Source: NMSHTD 2003.

Accident Rates

The NMSHTD provided accident history along the project's primary routes of influence from 1997 through 2001 (NMSHTD 2003). Accident rates along given stretches of road are summarized in **Table 3-19** below.

Table 3-19. Accident Rates along Given Stretches of Road

Stretch	Accidents/Injuries/Fatalities				
	1997	1998	1999	2000	2001
I-25, 5 miles north of Socorro	11/5/0	10/4/0	10/1/0	9/6/0	11/10/3
I-25, 5 miles south of Socorro	6/7/0	8/6/0	5/2/0	8/3/1	6/2/0
I-25, ramps for north and south interchanges	1/1/0	4/0/0	0	1/0/0	0
US 60, FR 235 to California Street	14/11/0	9/3/3	7/3/2	7/1/0	5/7/0
California Street	69/32/0	70/21/0	53/19/0	48/25/0	41/5/0
US 60, Spring Street through Socorro	13/8/0	13/3/0	9/8/0	8/3/0	6/3/0

Source: NMSHTD 2003.

In summary, a total of 462 accidents were reported along the listed routes over a 5-year period (January 1, 1997 to December 31, 2001) resulting in 199 injuries and 9 fatalities.

Local Roadways and Conditions

The local roadway network is composed of various paved and unpaved roads. The primary access road serving the project site, Water Canyon Road (FR 235), and associated access issues are discussed in detail below.

Water Canyon Road (FR 235)

Water Canyon Road begins at US 60 and extends up the valley plain to the entrance to Water Canyon and then follows the ridgeline up to the northeast face of South Baldy Peak and to Langmuir Laboratory. The road has relatively high volumes of traffic in the summer, coincident with peak periods for recreation and research activity (Aldridge 2003).

The lower portion of the road, from the US 60 interchange to the campground, is paved and is generally in fair condition up to the first main stream crossing at Water Canyon Campground. This portion of the road is maintained by Socorro County for passenger car access (Level 3).

The upper portion of the road, extending southeast to the ridgeline, is a bladed dirt road from the campground to the project site. This is currently an operational maintenance Level 2 road passable by high clearance and four-wheel drive vehicles and is maintained by NMIMT per the SUP for Langmuir Laboratory. This stretch of road varies in width and condition. Many areas of the roadbed have persistent outcroppings of hard rock both encroaching from the mountain face and within the roadbed itself, making some segments of the road difficult to navigate. The road is intersected by a number of water crossings resulting in seasonal washout and scouring. Improper drainage at these water crossings, erosion, and effects from freeze/thaw in the winter have accelerated the deterioration of the roadbed. Several hairpin turns in switchback conditions exist along the road, where it ascends steep mountain grades.

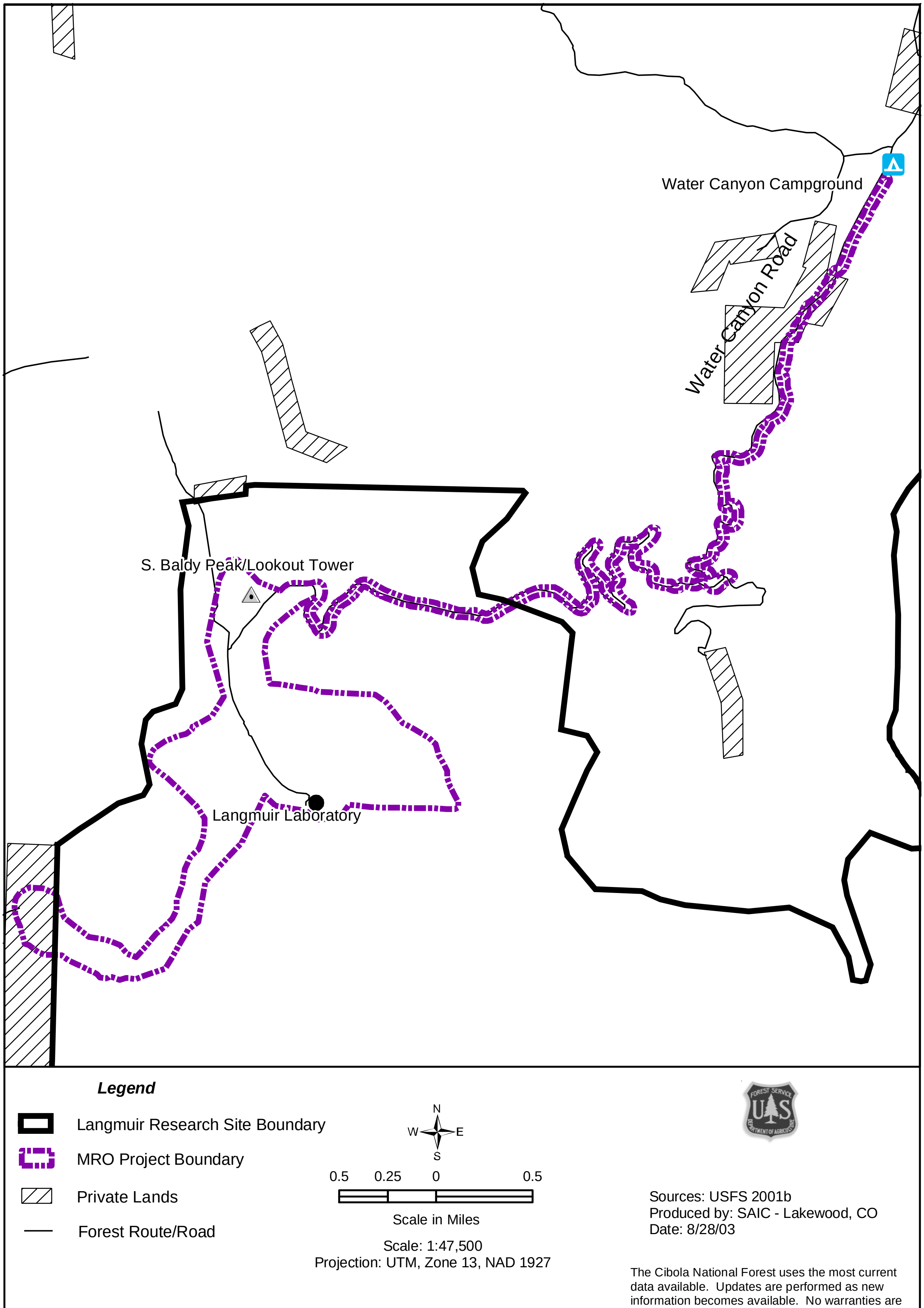
Adverse road conditions, steep road grades, miscellaneous obstructions and snow in the winter combine for a loss of traction and slide potential in a number of areas. Travel speeds are limited, and travel by some passenger vehicles and large trucks is precluded.

Adequate parking does not exist for the various trailheads along Water Canyon Road resulting in recreational users parking along the roadway, which is prohibited. Given the narrow condition of the road itself, this activity makes passage by other vehicles difficult to impossible depending on the location of the parked vehicle.

The Forest Service requires that this route remain the sole vehicular access route to South Baldy Peak and that the roadway remain a “primitive” corridor, with improvements limited to those necessary for construction material and equipment access, and those improvements considered necessary to provide a reasonable level of “life safety” (USFS 2000a). Current input of the governing agencies clearly suggests the desire to maintain a low impact policy when considering site and road improvements.

Private Property Access

Water Canyon Road provides access to private property at various locations from US 60 to the campground and on the upper reaches of the road (**Map 3-14**).



Map 3-14
Private Lands in the Vicinity of the Project Area

Traffic Patterns, Volumes and Levels of Service

Recreation traffic on Water Canyon Road can be characterized as seasonal. Seasonal use is highest between late May and late August and begins to decline in the fall, reaching the lowest levels in the winter months. Other traffic from residents, scientists, laboratory visitors, and construction and maintenance crews follows a similar, but perhaps flatter, distribution pattern. Specific volumes or levels of service are not available, but from observations of Forest Service staff, it is roughly estimated that the road may have an average of 20 vehicle round trips per day. This daily average is higher in summer, much higher during holidays, and low in winter (Aldridge 2003).

Accident Rates

A total of seven accidents have been reported along Water Canyon Road for the 18-year period from January 1, 1984, to December 31, 2001 (NMSHTD 2003). None of the accidents were attributed to road conditions.

Parking

Parking is provided only at Water Canyon Campground, the upper trailhead for South Baldy Trail (11), and beyond the entry gate to the site near primary laboratory facilities. There is no parking or turnaround space at the existing access gate to the Langmuir Laboratory and ridgetop. Parking along the road is prohibited due to the road condition although occasionally vehicles do park at the various trailheads. In some instances, parking at these trailheads can block travel along Water Canyon Road.

Trails

An extensive trail network exists on the MRD and is covered in detail in Recreation (Section 3.4.4).

3.2.6.2 Environmental Consequences

Method of Analysis

Traffic engineering details and related assumptions were taken from studies produced by Sea West Enterprises for NMIMT (Sea West 2002), communications with the Forest Service (USFS 2000a), and information from state and local transportation officials (NMSHTD 2003). Potential road capacity and safety issues are identified based on anticipated trip distributions, consultation and coordination with local public works officials, and communications with Forest Service transportation specialists. Additionally, a Road Analysis of Water Canyon Road (FR 235) was conducted and is available from the Forest Service.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

The following discussions provide specific descriptions of direct impacts from ridgetop construction installation of the utility corridor improvements, and possible maintenance and repair of Water Canyon Road. A discussion of construction and post-construction trip generation and related impacts follows.

Ridgetop

Construction for the ridgetop proposes approximately 1 mile (1.6 km) of new access road, four facility parking lots, and obliteration, grading, and revegetation of approximately 0.5 mile (0.8 km) of abandoned road segment (see Map 2-1). The proposed road would be resurfaced (using native material and gravel) from the ridgetop access gate to Langmuir Laboratory along its existing route, improving drivability. A small portion of Water Canyon Road would be rerouted around the east arm of the proposed Interferometer Array. A small portion of the West Knoll Road, which leads from Water Canyon Road to the West Knoll, would be rerouted around the west arm of the Interferometer Array. A temporary staging area would allow for vehicles to load and unload materials and workers and to turn around in a controlled area. The ridgetop construction process is not expected to disrupt existing site operations or significantly impact recreation access (see Recreation [Section 3.4.3]).

Construction Phase Trip Generation and Related Impacts

Proposed construction, as described in Chapter 2 of this EIS, would require transportation of construction materials, equipment, and personnel to Magdalena Ridge. Many of these trips would involve the use of I-25 and the interchanges in Socorro. All of the trips would require the use of Route 60 and Water Canyon Road.

Stage I construction is expected to generate 25,600 one-way trips (12,800 round trips). Approximately 75 percent of these trips would occur within the first year of construction if Stage II ridgetop construction occurs later than Stage I ridgetop construction. In subsequent years, the trip generation is expected to be far lower than during the first year. Heavy trucks would account for a total of 3,200 of the 12,800 round trips. The remaining 9,600 round trips would be made by light duty trucks and privately owned vehicles. If the Stage II construction were conducted simultaneously with Stage I construction, the 25,600 one-way trips would increase by approximately 5 percent to 26,880 one-way trips.

Construction is scheduled to occur during normal working hours on weekdays with occasional construction activity on weekends. Peak hour construction-related volumes are expected to be approximately 30 one-way vehicle trips per hour. This calculation is based on the following assumptions:

- Stage II construction would be made simultaneously with Stage I construction (26,880 trips);
- A total of 75 percent of those trips would occur in the first year (20,160 trips);
- The total number of annual trips in the first year would occur over a period of approximately 200 days (100 one-way or 50 round trips, on an average, per day);
- A busy day during the first year may have about 120 trips (60 round trips);
- A total of 25 percent of the daily trips would occur during each of the 2 peak hours, with up to 30 trips per peak hour (up to one vehicle per 2 minutes); and
- A total of 25 percent of these trips would be made by heavy trucks (seven or eight heavy trucks per hour, up to one heavy truck every 8 minutes).

The anticipated volume of trucks is not expected to create impacts on I-25 or the I-25 interchanges. However, the movement of this number of vehicles, especially heavy trucks, through intersections in Socorro would incrementally increase traffic volumes, reduce levels of service, and increase the potential for accidents. Coordination with the local officials in Socorro indicates that these temporary impacts would not be considered significant and would not require local personnel to facilitate traffic flow or maintain safety during the worst case traffic scenarios, when construction-related traffic volumes would be expected to be at their highest (NMSHTD 2003).

Impacts on US 60 between the developed areas of Socorro and the US 60/Water Canyon Road intersection would involve increased traffic volumes, but the incremental increases would not be considered significant because sufficient capacity is available. The potential would exist for increased wear and related maintenance requirements, but this impact would not be considered significant based on the condition and design of US 60. Heavy truck use could also impact the portion of Water Canyon Road maintained by the county. This road has not been designed and constructed to handle high volumes of trucks with heavy loads. Deterioration of the road surface over time may require increased maintenance and related maintenance costs. Portions of Water Canyon Road pass through lands administered by BLM (T. 3 S., R. 2 W., section 7, Lots 1 and 2). The road is authorized to Socorro County under RS 2477 (right-of-way case file NMNM 82589). Maintenance required on the roadway would require coordination among NMIMT, the U.S. Forest Service, Socorro County, and the BLM.

The ongoing maintenance and repair of Water Canyon Road and subsequent maintenance to be managed by NMIMT is designed to address the anticipated construction traffic, related wear on the road, and winter access requirements. However, the ultimate capacity of the road is inadequate to handle construction and other kinds of traffic. Consequently, intermittent closures of Water Canyon Road, in addition to those associated with reconstruction of the road, would be anticipated. These intermittent closures would be needed throughout the construction process (but mostly in the first year and during peak hours) to protect public safety. The construction contractor would determine the timing of the construction traffic closures. The anticipated closures could be timed to allow for morning deliveries to the ridgetop and afternoon return trips, particularly during the summer and fall of the first year of construction when trip generation is anticipated to be highest. Closure times would be posted in advance at the campground kiosk, district office, in local newspapers, and on the Forest Service web site. It is recommended that construction be avoided on holidays to allow for uninterrupted public access, and avoided on weekends to the extent possible. During winter months, the road may be plowed and cleared to provide access to the proposed MRO as needed. However, as under current management, the road may be closed to public access during most of the winter, depending on snowfall.

Utility Options

The utility corridor would not alter road transportation or vehicle access because construction access requirements would be met by using the existing utility corridor, roads, and trails. Impacts on recreation resources and opportunities are discussed in Recreation (Section 3.4.3).

Water Canyon Road

Maintenance and repair currently ongoing along Water Canyon Road, as identified in the existing Langmuir Laboratory Annual Operations and Maintenance Plan, will make the road more safe and efficient for passage of construction traffic for the proposed MRO construction. The repairs will also allow for safer and more efficient use by visitors to the area. However, the road surface conditions will remain in a condition classified as a Forest Service Maintenance Level 2 road. This classification is "suitable for high clearance vehicles."

Operational Phase

After construction is completed, there would be a minor and insignificant increase in trip generation from new personnel at the ridgetop and related increases in visitors. The actual net increase is likely to be fewer than five trips per day.

Indirect Impacts

Maintenance and repair of Water Canyon Road will make it safer and easier to use for the public. The area currently receives low use compared to other forests, with some surges on holidays. It is difficult to predict how much new public use would be stimulated by improved condition. The MRD receives fairly low use compared to other forests (with surges on holidays and hunting season), so any new use is not expected to amount to appreciable levels of traffic in combination with existing use. However, future levels are not known and should be monitored.

Deterioration of the county portion of Water Canyon Road resulting from project construction traffic would be monitored. If repairs are needed, NMIMT, the Forest Service, Socorro County and BLM would negotiate an agreement for making the repairs.

The proposed MRO facility may attract some number of visitors each year. For comparison, the NRAO, located directly off US 60, receives an estimated 40,000 to 50,000 visitors annually (Finley 2003). This level of visitation is not expected for the proposed MRO because of its remote location, the service level of the road, and the need to walk several hundred yards from the gate to the ridgetop. It is not known if induced new traffic on the road would exceed the safe design capacity of the road in the future.

In addition to some short-term interruption to access resulting from the project, all state and CNF fire restrictions would be followed, including possible closure of Forest Service lands as applicable.

Alternative 2: No Action

Under Alternative 2, the proposed MRO-related traffic increases would not occur. Ongoing traffic related to use of Langmuir Research Site, Forest Service management, and recreation would continue. Ongoing maintenance and repair of Water Canyon Road would improve safety and access.

Alternative 3: Preferred Alternative

Direct and indirect impacts under Alternative 3 would be identical to those under Alternative 1.

Alternative 4

Direct and indirect impacts under Alternative 4 would be identical to those under Alternative 1.

3.2.6.3 Cumulative Impacts

To address existing parking demand, the Forest Service plans to expand parking capacity at Trailhead 8. Expanded parking would allow for a maximum of 8 to 10 vehicles to park outside of the ridgetop gate (Carter 2003). This would complement the proposal by alleviating some of the existing parking problems of hikers and incidental visitors to Langmuir Laboratory, and any increased needs from additional public use stimulated by the proposed MRO, improved roads, and planned Forest Service projects.

Overall, ongoing maintenance and repair of Water Canyon Road and parking should benefit access and safety for multiple purposes, but traffic levels should be monitored for long-term increases that may eventually exceed safe road capacity levels.

3.2.6.4 Mitigation

It is recommended that traffic levels and visitor activities be monitored upon completion of construction. This information can be used to assist in future management decisions for Water Canyon Road as part of the CNF transportation system. The proposed MRO could implement tours and/or shuttle service to control some proposed MRO-generated interest and related traffic demands.

3.3 Biological Resources

The Magdalena Mountains in central New Mexico, ascending rapidly from the surrounding grasslands, provide the regional setting for biological resources in the EIS (see Map 3-11). The steep elevation gradient results in rapid changes in plant community types from piñon (*Pinus edulis*)- juniper (*Juniperus spp.*) woodland and savannah to ponderosa pine (*Pinus ponderosa*) forest to mixed conifer forest to sub-alpine coniferous forest and, finally, to sub-alpine grasslands at the highest elevation. The upper elevations are dominated by Rocky Mountain flora and fauna but also support flora and fauna typical of the Madre Mountains to the south. Both mountain ranges are characterized by steep slopes and canyons that drop off precipitously from the mountain crest. The crest top has little or no protection from the high velocity winds that blow over the ridgetop affecting the vegetation that grows on the shallow, rocky soil.

The Magdalena Mountains are isolated from mountain ranges other than the San Mateo Mountains, which are about 15 miles to the south. This isolation creates an island-like environment with the mountain range surrounded by grasslands and desert. Such an environment has the potential to promote island-like biogeographic effects that can result in the formation of endemic species or subspecies (Sullivan and Knight 1993).

3.3.1 Vegetation

3.3.1.1 Affected Environment

Region of Influence

The ROI for vegetation includes the land that would be directly disturbed during project construction along with an associated buffer zone. This land would include the land between the Langmuir Laboratory and South Baldy Peak on top of the mountain (Map 1-3); Water Canyon Road from Water Canyon Campground to the crest of the mountain (Map 1-2); the existing utility corridor from near the base of the mountain to the crest; and potential water supply corridors (Map 2-2). The potential for fire associated with project construction assessed in this EIS could substantially enlarge the area of influence for vegetation and other biological resources (see Map 3-11). Fire would affect the same plant community types as would be affected by mechanical disturbance of the ground (described below).

Existing Conditions

Upland Vegetation

The proposed MRO project area covers approximately 980 acres and includes eight major plant community types (Map 3-12). Mixed conifer forest covers the largest area, totaling 439 acres (or 45 percent) of the area (**Table 3-20**).

Table 3-20. Number of Acres of Major Plant Community Types in the Proposed MRO Project Area

Plant Community Type	Number of Acres	Percent
Piñon-Juniper Woodlands	15	1.5
Oak Woodlands	26	2.7
Ponderosa Pine Forest	59	6.0
Mountain Scrub Forest	4	0.4
Mixed Conifer Forest	439	44.8
Subalpine Conifer Forest	164	16.7
Mountain Meadow	273	27.9
Total	**980**	**100.0**

Sources: SAIC 2003b; USFS 2002a.

Piñon-Juniper Woodland

Piñon pine, alligator juniper (*Juniperus deppeana*), oneseed juniper (*Juniperus monosperma*), and gray oak (*Quercus grisea*) are the dominant trees of this community. A few ponderosa pine and Gambel oak (*Quercus gambellii*) also occur here. The larger alligator junipers have an estimated dbh of over 3 feet (0.9 m). Common shrubs in piñon-juniper woodland are tree cholla (*Cylindropuntia imbricata*), prickly pear cactus (*Opuntia polyacantha*), New Mexican prickly pear (*Opuntia phaeacantha*), and apache plume (*Fallugia paradoxa*). Common grasses include nineawn pappus grass (*Enneapogon desvauxii*), alkali sacaton (*Sporobolus airoides*), sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), and three-awn (*Aristida spp.*). There are numerous herbaceous plant species (USFS 2002a). Piñon-juniper woodland occurs along the lower end of Water Canyon Road and the lower end of the utility corridor. It covers an estimated 15 acres (about 2 percent) of the project area (Table 3-20).

Oak Woodland

The oak woodlands are typically dominated by homogeneous stands of Gambel oak. These stands are widely dispersed throughout the MRD and are likely the result of past wildfires. Conifers such as piñon pine, ponderosa pine, and juniper are becoming established in some of these stands. Oak woodland covers approximately 26 acres (about 3 percent) of the project area (Table 3-20) along Water Canyon Road.

Ponderosa Pine Forest

Ponderosa pine is the dominant tree species in this plant community type. In addition, tree species such as Douglas fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii,* and quaking aspen (*Populus tremuloides*) that characterize mixed conifer forests occur in the ponderosa pine forest at higher elevations. Species such as piñon pine, alligator juniper, and oneseed juniper that characterize piñon-juniper woodlands occur in ponderosa pine forests at lower elevations. Gambel oak is found throughout ponderosa pine forest. This plant community type occurs along the lower end of the utility corridor and the lower half of Water Canyon Road. It covers approximately 59 acres (6 percent) of the project area (Table 3-20).

Mountain Scrub

Mountain scrub typically occurs on dry south to southeast facing slopes in and near the project area. Mountain mahogany (*Cercocarpus montanus*) and oak (*Quercus spp.*) are the dominant shrubs. Only 4 acres (less than half a percent) of mountain scrub occurs in the project area in two small areas along Water Canyon Road (Table 3-20).

Mixed Conifer Forest

The dominant trees in mixed conifer forests are Douglas fir, southwestern white pine (*Pinus strobiformis*), ponderosa pine, and quaking aspen. Dominant shrubs include gooseberry (*Ribes spp.*), mountain spray (*Holodiscus dumosus*), Gambel oak, and broom snakeweed (*Gutierrezia sarothrae*). Several different grasses and herbaceous plants such as tall daisy (*Erigeron elatior*), night-flowering silene (*Silene noctiflora*), western wheatgrass (*Pascopyrum smithii*), fringed brome (*Bromus ciliatus*), and sedge (*Carex spp.*) occur in this plant community type (USFS 2002a).

Mixed conifer forests occur throughout much of the project area. Along the upper reaches of the utility corridor, on steep talus slopes, scattered trees and shrubs typical of mixed conifer forests are found along with fivepetal cliffbush (*Jamesia americana*). Trees growing on the talus slopes are smaller and more widely separated from one another than they are in the mixed conifer forest lower down the utility corridor. This forest type is also found along much of the upper portion of Water Canyon Road as well as on slopes around the Langmuir water source. Mixed conifer forest covers 439 acres (about 45 percent) of the project area (Table 3-20).

Subalpine Conifer Forest

Several shrubs found in the subalpine conifer forest include mountain spray, Rocky Mountain maple (*Acer glabrum*), and fivepetal cliffbush. Dominant trees include Engelmann spruce (*Picea engelmannii*), southwestern white pine, Douglas fir, and scattered quaking aspen. All trees, as well as down trees and branches, have lichen on them. In many places this forest type has a closed canopy, and there is a build-up of branches and needles on the ground. The subalpine conifer forest covers an estimated 164 acres (about 17 percent) of the project area (Table 3-20). It occurs on the steep east-facing slope adjacent to the crest of the mountain as well as along a small portion of upper Water Canyon Road.

Mountain Meadow

Mountain meadow habitat occurs primarily on top of the mountain. Trees in the mountain meadow include scattered Engelmann spruce, southwestern white pine, and Douglas fir. Shrubs include two species of currant (*Ribes leptanthum* and *R. pinetorum*). Vegetation studies in the project area on Magdalena Ridge indicate a 39 percent coverage of vascular plants involving over 100 species. Dominant species include blackroot sedge (*Carex elynoides*), Arizona fescue (*Festuca arizonica*), junegrass (*Koeleria cristata*), and white ragweed (*Hymenopappus biennis*) (Sullivan and Knight 1993). Other common herbaceous species include Missouri iris (*Iris missouriensis*), harebell (*Campanula rotundifolia*), San Mateo Mountain beardtongue (*Penstemon pseudoparvus*), and sagebrush (*Artemisia spp.*) (Sullivan and Knight 1993; USFS 2002a). The mountain meadow also occur along the upper portions of Water Canyon Road. They cover approximately 273 acres (about 28 percent) of the project area (Table 3-20).

There are widely scattered, stunted old trees in the mountain meadows. These trees, though possibly hundreds of years old, are dwarfed possibly because of the extreme environmental conditions on top of the mountain (a phenomenon known as the Krummholz Effect). The exact age of the dwarfed trees on the ridgetop has not been determined (Sullivan and Knight 1993).

Wetland and Riparian Vegetation

There are no wetlands in or near the potentially affected areas (Bleakly 1998; USFS 2002b). A riparian plant community occurs at the lower end of Water Canyon where Arizona walnut (*Juglans major*), boxelder (*Acer negundo*), and narrow-leaf cottonwood (*Populus angustifolia*) are the dominant large trees. These tree species also occur along the road in the area of Water Canyon Campground. Few other wetland and/or riparian plant species occur in this area (Bleakly 1998).

Hardy Spring is about 1,000 feet (305 m) east of the existing utility corridor (Map 2-2). Most of the water from this spring is piped overland about 2,500 feet (762 m) southwest to Arrowhead Tank in the piñon-juniper savannah plant community. The tank is so full of water that water flows over the sides creating a wet area that extends about 50 yards (46 m) downgradient from the tank. The junipers growing there are noticeably larger than nearby trees. There are wetland plants growing in this wet area such as sedge, rush (*Juncus spp.*), speedwell (*Veronica spp.*), and yellow monkey flower (*Mirabilis glabratus*). This tank and associated small wetland are well out of the ROI of this project.

At the site of the existing water supply source for Langmuir Laboratory in the East Fork of Sawmill Canyon Creek, a small dam was constructed in the perennial stream in the 1960s. The area behind the dam was excavated but silted up soon after. It now supports a dense growth of vegetation. The vegetated area covers less than 0.1 acre and common plant species were upland species dominated by wild strawberry (*Frageria virginiana*), dandelion (*Taraxacum officinale*), and western yarrow (*Achillea millefolium lanulosa*). During a recent site visit, a hole was dug about 6 inches (15 cm) deep, and the soil was wet but not saturated. The area lacks hydrophytic plants, but may have wetland soils and hydrology based on USACE criteria (USACE 1987).

Invasive Weeds

Many plants introduced from Europe in the nineteenth century have the ability to spread more rapidly than do the native species (Heil and White 2000). These invasive weeds alter ecological systems in various ways by affecting nutrient cycles, displacing native plant species, producing negative changes in wildlife habitat, and affecting the use of rangelands.

Invasive weeds appear to be a minor problem along Water Canyon Road and on top of the mountain. Prostrate knotweed (*Polygonum aviculare*) is the most common species observed along Water Canyon Road (Bleakly 1998). Weeping lovegrass (*Eragrostis curvula*) has been observed in Water Canyon Campground. Other invasive weeds observed include mullein (*Verbascum thapsus*), white sweet clover (*Melilotus albus*), and yellow sweet clover (*Melilotus officinalis*).

Very few invasive weeds are found along the existing utility corridor. These include a few mullein, pigweed (*Amaranthus spp.*), and ground cherry (*Physalis spp.*). Chinese thornapple (*Datura ferox*) occurs just southwest of the lower end of the utility corridor (USFS 2002a).

Special Status Species

A total of 13 special status plant species occur or have the potential to occur in the proposed MRO project area (**Table 3-21)**. The list consists of federally listed species, Forest Service sensitive species, and state sensitive species (Nicholopoulos 2002; NMRP 2002; USFS 2001a).

Table 3-21. Special Status Plant Species that Occur or May Occur in the Proposed MRO Project Area

Common Name	Scientific Name	Status[a]
Black Range groundsel[b]	*Packera cynthioides*	Formerly rare
Organ Mountain Indian paintbrush	*Castilleja organorum*	Rare
Parish’s alkali grass	*Puccinellia parishi*	FSS, Rare
Plank’s catchfly	*Silene plankii*	Rare
Rock fleabane	*Erigeron scopulinus*	Rare
San Mateo beardtongue[b]	*Penstemon pseudoparvus*	FSS, Rare
Sandia alumroot[b]	*Heuchera pulchella*	Rare
Spellenberg’s groundsel	*Packera spellenbergii*	FSS, Rare
Spiny aster	*Eurybia horrida*	FSS, Rare
Tall bitterweed	*Hymenoxys brachyactis*	Rare
Vasey’s bitterweed	*Hymenoxys vaseyi*	Rare
Wright’s catchfly	*Silene wrightii*	Rare
Zuni fleabane	*Erigeron rhizomatus*	FT, Rare

Sources: Nicholopoulos 2002; NMRP 2002; USFS 2001a.

Notes: (a) Formerly rare = much more common than originally thought, and is no longer considered a New Mexico rare plant
FSS = Forest Service sensitive species
FT = federal threatened

(b) Species recorded in the area of the proposed MRO in the Magdalena Mountains.

The federally listed species on Table 3-21 are only those listed for the MRD (USFS 2001a). Not included in the table are other species that are listed, proposed, and candidate species in the USFWS letter but that would not occur on the MRD. The BA/BE report (USFS 2003a) provides greater detail regarding the USFWS and Forest Service special status species that have the potential to occur in the project area. The BA/BE (USFS 2003a) is summarized below.

Of the 13 plant species in Table 3-21, nine are known from Socorro County and occupy habitats that are similar to those found in the study area. These species are listed in **Table 3-22**. The Black Range groundsel (*Packera cynthioides*) was found on a talus slope near the proposed MRO project area at about 9,920 feet (3,024 m) in 1998 (Bleakly 1999, 2002). There is potential habitat for the Black Range groundsel at the upper end of the utility corridor and at other locations in the project area. Because it has been determined that this species is much more abundant than originally thought, it is no longer considered a New Mexico rare plant (NMRP 2002).

The Sandia alumroot (*Heuchera pulchella*) is a New Mexico rare species found in the high mountains in central New Mexico. Its preferred habitat consists of moist rock cliffs, cracks, and ledges. This species has been found in five locations near the project area on rock outcrops and cliffs near the top of the mountain (Sullivan and Knight 1993).

The San Mateo beardtongue is a Forest Service sensitive species and a New Mexico rare species. Various surveys have shown that this is a common species in the mountain meadows on the mountaintop as well as in open areas in the subalpine coniferous forest near the meadows (Sullivan and Knight 1993; Bleakly 1998, 1999; USFS 2002a). It also occurs along the upper reaches of Water Canyon Road (Sullivan and Knight 1993) and in the subalpine conifer and mixed conifer forests along the upper section of the utility corridor (USFS 2002a).

Of the remaining plant species in Table 3-22, Organ Mountain Indian paintbrush (*Castilleja organorum*), Vasey's bitterweed (*Hymenoxys vaseyi*), and Wright's catchfly (*Silene wrightii*) have a low potential to occur in the project area. Plank's catchfly (*Silene plankii*), rock fleabane (*Erigeron scopulinus*), and tall bitterweed (*Hymenoxys brachyactis*) could occur in the survey area. Plank's catchfly and tall bitterweed are found in piñon-juniper plant communities. The rock fleabane occurs in mixed conifer and ponderosa pine forests (NMRP 2002).

3.3.1.2 Environmental Consequences

Method of Analysis

This section considers the direct, indirect, and cumulative impacts of the alternatives on upland vegetation. No wetland or riparian areas would be affected by any of the alternatives. This section also addresses the potential impacts to sensitive plant species from the alternatives.

Information regarding the vegetation in the project area was obtained principally from existing survey data and Forest Service files. Impacts to these resources were determined based on the characteristics of the alternatives and information from vegetation field surveys.

Table 3-22. Sensitive Plant Species Known to Occur in Socorro County in Habitats Similar to Those in the Survey Area

Species	Status[a]	Habitat and Potential to Occur in Project Area
Black Range groundsel *(Packera cynthioides)*	Formerly rare	Mixed conifer and ponderosa pine forest. Occurs on one location on a talus slope in project area.
Organ Mountain Indian paintbrush *(Castilleja organorum)*	Rare	Piñon-juniper woodlands, ponderosa pine forest. Low potential to occur, endemic to the Organ Mountains.
Plank's catchfly *(Silene plankii)*	Rare	Cliffs and rocky outcrops in piñon-juniper woodlands in central New Mexico including the nearby San Mateo Mountains. Potential to occur in or near project area.
Rock fleabane (*Erigeron scopulinus*)	Rare	Cliffs in the mixed conifer and ponderosa pine forests. Occurs in the nearby San Mateo Mountains. Potential to occur in or near the project area.
Sandia alumroot (*Heuchera pulchella*)	Rare	Cliffs and outcrops in the mixed conifer and subalpine conifer forest. Grows on cliffs and outcrops near the project area.
San Mateo beardtongue (*Penstemon pseudoparvus*)	FSS, Rare	Mountain meadow and subalpine conifer and mixed conifer forest. Common at high elevations in project area.
Tall bitterweed (*Hymenoxys brachyactis*)	Rare	Piñon-juniper woodlands and ponderosa pine forest. Potential to occur in project area.
Vasey's bitterweed *(Hymenoxys vaseyi)*	Rare	Piñon-juniper woodlands. Low potential to occur. Found mostly farther south in the Organ and San Andres mountains.
Wright's catchfly *(Silene wrightii)*	Rare	Cliffs and rocky outcrops in the mixed conifer and subalpine conifer Forests. Low potential to occur. Found mostly further south.

Sources: Bleakly 1998, 1999; NMRP 2002; Sullivan and Knight 1993; USFS 2001a.

Notes: (a) Formerly rare = more common then originally thought, and no longer considered a New Mexico rare species;
Rare = globally rare, according to the NMRP 2002;
FSS = Forest Service sensitive species.

Alternative 1: Proposed Action

Direct Impacts

Direct impacts to biological resources include those that involve vegetation, the clearing of land for construction of facilities, widening roads, and placement of utility corridors.

Construction Phase

Ridgetop

Approximately 24 acres of the total land to be cleared under the Proposed Action (i.e. 67 percent of the 36 acres for the entire project) would be in the mountain meadows on top of the mountain. Of this, 7 acres would be covered with buildings, parking lots, and other facilities and would be a long-term loss. The remaining 17 acres (temporary staging areas, storage areas, and utility trenches) would be revegetated. The contractor would be required to prepare a revegetation plan in consultation with the Forest Service using native species. This plan would include measures to monitor the success of the revegetation plan and provide measures to reduce invasive weeds should they become a problem. It would also include measures to be taken if the revegetation efforts failed in some areas.

No federally listed plant species occur in the project area. The San Mateo beardtongue is the only Forest Service sensitive species detected in the project area. This species occurs primarily in the mountain meadows; approximately 24 acres of potential San Mateo beardtongue habitat would be disturbed. Approximately 7 acres would represent a long-term loss of habitat while the remainder (17 acres) would be lost only for the short-term and revegetated with native plant species. The feasibility of including San Mateo beardtongue in the revegetation plan would be evaluated. There are an estimated 273 acres of mountain meadows in the project area and an additional 208 acres near the project area (mostly on Timber Ridge) for a total of 481 acres. The loss of 24 acres represents an 8.8 percent loss of San Mateo beardtongue habitat in the project area and only a 5.0 percent loss relative to all mountain meadow habitat in the general area. If this species can successfully be included in the revegetation plan, then the long-term loss of beardtongue habitat would be 2.6 percent of the project area and 1.5 percent overall.

Utility Options

Under all three options, electrical power would be supplied to the mountaintop using the existing power poles. No disturbance of vegetation would be expected to occur as a result. Water would be brought to the mountaintop via pipe laid on the surface of the ground. Little, if any, disturbance to vegetation would occur as a result.

On the mountaintop, most disturbance would occur under Option 1. Both the electric line and water supply pipeline would be buried in a trench approximately 2,200 feet (670 m) long running through mountain meadows. This disturbance has been included as part of the 24 acres affected by this project on the ridgetop.

None of these options are likely to lead to a substantial impact on vegetation, including the San Mateo beardtongue.

Water Canyon Road

Up to 24 acres could be disturbed during maintenance and repair of Water Canyon Road. Of this total, 12 acres would be in the current roadbed, which is not vegetated. Maintenance and repair along the 8 miles (13 km) of Water Canyon Road between Water Canyon Campground and the top of the mountain could affect community types ranging from piñon-juniper woodlands at the lowest elevation to mountain meadows at the highest elevation. Overall, the loss of 12 acres of wooded and meadow habitat along the edge of Water Canyon Road in the 980-acre proposed MRO project area (Map 1-2) is considered to be minimal.

The San Mateo beardtongue has the potential to be disturbed along Water Canyon Road, where it passes through about 2,000 feet (610 m) of mountain meadows downslope from the main gate into the Langmuir facility. Because only limited disturbance outside the existing roadbed would take place in this region, road maintenance and repair would have little impact on the mountain meadows and, therefore, little impact on the San Mateo beardtongue.

Operational Phase

Little or no vegetation would be directly affected during the operational phase because construction would be complete and only existing roads would be used to transport observatory personnel.

Indirect Impacts

Indirect impacts, which occur secondarily to direct impacts, include land clearing during construction that could lead to erosion in adjacent land; transport of sediments or pollutants into surface or groundwater; and construction activities that could result in a fire in adjacent lands. Any of these would affect vegetation and habitats in the project area.

Construction Phase

Ridgetop

Fires started as a result of operating equipment on the ridgetop could spread to the ridgetop and affect vegetation including the San Mateo beardtongue. Since 1900, the number of fires in the Magdalena Mountains and elsewhere in the southwestern U.S. has been greatly reduced (Swetnam and Baisan 1996). The advent of grazing and improvements of fire suppression measures in these forests have resulted in an increase in fuel loads, understory density, and stand density, all of which increase the probability of stand replacement fires (Covington and Moore 1992). Prescribed burns can reduce total fuel loading by 55 percent and dead woody vegetation by 64 to 80 percent (Sackett et al. 1996).

Measures would be taken to minimize the potential for project construction-related fires. The construction contractor would have a construction phase fire plan in place that would address the fire issue, and this plan would be reviewed by the Forest Service. This plan would include 1) having a water pumper follow the equipment up the mountain during the road improvement phase; 2) putting spark suppressors on equipment; 3) prohibiting the use of equipment with catalytic converters in tall grass or shrubby areas; 4) having an on-site water supply for emergency fire suppression; and 5) having a backup water supply that would be brought to the top of the mountain. Given these measures, and assuming fire management actions by the Forest Service (including possible closure of the CNF and evacuations in extreme cases), the project would have low potential to cause widespread ecological damage from fire.

Utility Options

The potential for fire associated with construction would be very low along utility option corridors. Only a small amount of equipment would be required to replace the electrical line on the existing electrical poles, and only hand-held equipment would be used to install the water supply line. Electrical cable would be contained in suitable conduit (as per the National Electrical Code) and laid on the ground, which would eliminate it as a fire hazard.

Water Canyon Road

The principal indirect effect to vegetation including the San Mateo beardtongue would be the increased potential for human-caused fire, especially during maintenance and repair, due to the large increase in vehicle traffic along Water Canyon Road. Such accidental fires could result in the loss of vegetation and additional losses or degradation through post-fire flooding, erosion, and sedimentation. Prescribed burns have been conducted in the Magdalena Mountains but much of the steep terrain along Water Canyon Road has not undergone such burns. Therefore, fires started as a result of project construction activities have the potential to become stand replacing and could spread to the mountain meadows on top of the mountain.

Operational Phase

Operation of the proposed MRO facility would be expected to result in essentially no indirect impacts to vegetation.

Alternative 2: No Action

Under this alterative, the proposed MRO construction would not take place so there would be no direct loss of vegetation along Water Canyon Road or on top of the mountain from construction or operations. There would be no loss of potential San Mateo beardtongue habitat. Ongoing periodic maintenance and repair of Water Canyon Road would continue to have the potential for additional ground disturbance along the sides of the road, but the acreage (about 12 acres) would be small. Maintenance of the road is expected to reduce erosion.

The Forest Service would continue its program of prescribed burns on the Forest. The probability of wildfire would not increase.

Alternative 3: Preferred Alternative

Direct Impacts

The principal difference in Alternative 3 relative to Alternative 1 would be changes in the location of some of the facilities on the ridgetop. Approximately the same amount of land would undergo short-term and long-term disturbance for both alternatives. In addition, the improvement and use of Water Canyon Road and the consideration of three utility options would be the same under both alternatives. Therefore, the potential impacts to vegetation including the San Mateo beardtongue would essentially be the same for Alternative 3 as they would be for Alternative 1.

Indirect Impacts

Given the similarities between Alternatives 1 and 3, the potential indirect impacts to vegetation (i.e., possible project-related fires) would be similar for both alternatives.

Alternative 4

Direct Impacts

Alternative 4 would differ from Alternative 1 in that some of the facilities on the ridgetop would be in different locations (see Chapter 2). All other features of this alternative would be the same as those proposed under Alternative 1. Therefore, the potential direct impacts to vegetation for Alternative 4 would be the same as for Alternative 1.

Indirect Impacts

Potential indirect impacts to vegetation under Alternative 4 would be similar to those described for Alternative 1.

3.3.1.3 Cumulative Impacts

Cumulative impacts consider the impacts of other past, present, and future projects in the area along with the impacts of the proposed project. The proposed project may be seen as having only a minor impact on sensitive habitat, but when added to the impacts from other projects described below, the overall level of impact may increase.

The greatest potential cumulative impact in terms of vegetation would be the loss and degradation of mountain meadows on top of the mountain. Construction activities on top of the mountain would result in the combined long- and short-term loss of 8.8 percent of this plant community type in the project area and a 5.0 percent loss of this type in the general area (South Baldy Peak and Timber Ridge areas). Current development on top of the mountain has eliminated several acres of the mountain meadow type. The cumulative long-term loss of mountain meadow habitat due to current development and this proposed project would be less than 5 percent of the San Mateo beardtongue primary habitat in the general area. Also, additional development on top of the mountain could take place in the future contributing to additional cumulative loss of habitat for this species. Some possible projects described in Section 3.1.3 would not contribute any significant change over the proposed MRO construction under Alternatives 1, 3, or 4. However, the extent of this future development is not known at this time.

The implementation of utility options under Alternatives 1, 3, or 4 would result in very few cumulative impacts to plant communities because it would result in very little direct loss of these vegetation types. No additional infrastructure needs that may have biological consequences are expected.

As indicated above, the direct impacts to vegetation along Water Canyon Road from maintenance and repair activities are considered minor. As a result, these activities would add very little to the cumulative loss of the plant community types it would impact. Potential increased public use of the CNF could increase the risk of human-caused fires. The relative increase is not known. The Forest Service would continue to manage fire hazards according to policies, plans, and forest practices.

Operations of the proposed MRO project, along with Langmuir and other projects that may occur in the area, are expected to result in essentially no cumulative impacts to biological resources.

There would be no cumulative impacts under Alternative 2 because the proposed MRO project would not occur.

3.3.1.4 Mitigation

Measures to reduce impacts that could directly or indirectly affect vegetation are described in Table 2-6.

3.3.2 Wildlife

This section provides a general overview of wildlife in the project area, including representative species, and then focuses on the effects on species that fall under the following authorities.

- Cibola National Forest Long Term Resource Management Plan (1985) as amended.
- The Migratory Bird Treaty Act of 1918 (16 United States Code [U.S.C.] §§ 701-715s, as amended) and Executive Order (EO) 13186 of January 10, 2001.
- The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§ 1531-1544, as amended).

Detailed analyses of impacts from the Proposed MRO on Management Indicator Species (MIS), neotropical migratory birds, and special status species can be found in: 1) The MIS Report for the Proposed MRO (USFS 2003g), 2) The Neotropic Migratory Bird Report for the Proposed MRO (USFS 2003h), and 3) The Biological Assessment and Biological Evaluation for the Proposed MRO (USFS 2003a). The following sections provide summarized information from these reports.

3.3.2.1 Affected Environment

Region of Influence

The area of influence for wildlife is generally the same as for vegetation although noise and human activity would extend beyond the project boundary particularly along Water Canyon Road.

Existing Conditions

Much of the information on wildlife in the project area is from surveys conducted in 1992 and 1993 on top of Magdalena Mountain and along Water Canyon Road. Line transects and belt transects were used to sample birds and reptiles, respectively, in various habitats (Sullivan and Knight 1993). Additional information comes from the Forest Service, other site-specific surveys, and pertinent literature.

Reptiles and Amphibians

Of the 16 species of reptiles detected during field surveys, all of them were observed along Water Canyon Road (Sullivan and Knight 1993). This is to be expected because between Water Canyon Campground and the top of the mountain the road passes through all habitat types. Fourteen species were detected at Water Canyon Campground including: four species of whiptails (*Cnemidophorus spp*.), collared lizard (*Crotophytus collaris*), two species of skink (*Eumeces spp*.), coachwhip (*Masticophis flagellum*), bullsnake (*Pituophis melanoleucus*), and western rattlesnake (*Crotalis viridis*). Although reptile surveys have not been conducted along the utility corridor, it is expected that the species composition along the corridor would be similar to that observed along Water Canyon Road because the utility corridor traverses the same habitat types.

Only four species of reptiles were detected on or near the top of the mountain in the project area. This is to be expected because these surveys involved only mountain meadow and nearby conifer forests. Species detected on or near the top of the mountain were eastern fence lizard (*Sceloporus undulatus*), tree lizard (*Urosaurus ornatus*), short-horned lizard (*Phrynosoma douglassi*), and bull snake (Sullivan and Knight 1993).

Amphibians are scarce in high altitude environments including the proposed MRO project area because of low temperatures and lack of aquatic and moist habitats. No amphibians were detected on top of the mountain or near Baldy Spring. Their absence here is probably due to the fact that the habitat around this spring has been degraded. The tiger salamander (*Ambystoma tigrinum*) has been observed along Water Canyon Road at the campground. This species breeds in temporary bodies of water such as the widely scattered pools that occur during the summer along Water Canyon Creek. Other amphibians that could use the pools in the lower sections of Water Canyon include the Great Plains toad (*Bufo cognatus*), red-spotted toad (*Bufo microscaphus*), western green toad (*Bufo debilis*), and Woodhouse toad (*Bufo woodhousei*) (Sullivan and Knight 1993).

Birds

General

A total of 200 species of birds have been recorded from the MRD (USFS n.d.). The flora and fauna of the Magdalena Mountains is a combination of Rocky Mountain and Madrean influences. As a result, certain southern species such as the bridled titmouse (*Baeolophus wollweberi*), olive warbler (*Peucedramus taeniatus*), and red-faced warbler (*Cardellina rubrifrons*) reach their northern breeding limits in these mountains.

A total of 95 birds were observed in the mountaintop mountain meadows and conifer forests in the project area during the 1992 and 1993 surveys (Sullivan and Knight 1993). Common species encountered in the grasslands included the northern flicker (*Colaptes auratus*), mountain bluebird (*Sialia currucoides*), and green-tailed towhee (*Pipilo chlorurus*). Birds commonly encountered in the conifer forest were Steller's (*Cyanocitta stelleri*) and other jay species, mountain chickadee (*Poecile gamneli*), red-breasted nuthatch (*Sitta canadensis*), golden-crowned kinglet (*Regulus satrapa*), yellow-rumped warbler (*Dendroica coronata*), Merriam's turkey (*Meleagris gallopavo),* and pine siskin (*Carduelis pinus*).

Common birds detected along Water Canyon Road include but are not limited to: band-tailed pigeon (*Columba fasciata*), Steller's and other jay species, house finch (*Carpodacus mexicanus*), and American gold finch (*Carduelis tristis*) (Sullivan and Knight 1993, USFS n. d.). Although breeding bird surveys have not been conducted along the existing utility corridor, it is expected that species recorded elsewhere in the project area would also occur in this area.

An additional 13 species were recorded in the nearby Sawmill Canyon during recent breeding bird surveys (Schwarz 2002). Common breeding birds in Sawmill Canyon include the mourning dove (*Zenaida macroura*), western wood pewee (*Contopus sordidulus*), violet-green swallow (*Tachycineta thalassina*), Virginia's warbler (*Vermivora virginiae*), western tanager (*Piranga ludovicana*), black-headed grosbeak (*Pheucticus melanocephalus*), and spotted towhee (*Pipilo maaculatus*). Unpublished data received during the 45-day comment period suggest that painted redstart

(*Myioborus pictus*) were nesting in this area during the summer of 2003 (Myers 2003, Rominger 2003).

Birds of prey that have been observed in all areas include the red-tailed hawk (*Buteo jamaicensis*) and the American kestrel (*Falco sparverius*). Cooper's hawk (*Accipiter cooperii*) and sharp shinned hawk (*A. straitus*) have been observed in the riparian woods along lower Water Canyon and in nearby conifer forest. A golden eagle (*Aquila chrysaetos*) has been observed flying near cliff habitat in lower Water Canyon and in the area of Timber Ridge near the top of the mountain. In addition, the peregrine falcon (*Falco peregrinus anatum*), Mexican spotted owl (MSO) (*Strix occidentalis lucida*), and other species of owls are known to occur in or near the project area. Although no raptor nests were reported in the 1992 and 1993 surveys (Sullivan and Knight 1993), a large stick nest that may be a raptor nest was recently observed on a cliff about 2,000 feet (610 m) northwest of Hardy Spring (USFS 2002a). It looked as though it had been used recently but no birds of prey were observed in the area.

The peregrine falcon and MSO are discussed below under Special Status Species and in more detail in the BA/BE (USFS 2003a).

Neotropical Migratory Birds

On January 10, 2001, President Clinton signed EO 13186 placing emphasis on conservation of migratory birds. No Forest Service Regional, Forest, or District level policies have been developed to provide guidance on how to incorporate migratory birds into the National Environmental Policy Act (NEPA) analysis. Advice from the Regional Office is to analyze the following effects: 1) effects to Highest Priority Birds listed by Partners in Flight (PIF); 2) effects to Important Bird Areas (IBA); and 3) effects to important over-wintering areas. The results of this analysis appear in a Neotropical Migratory Bird Report (USFS 2003h) and are summarized below.

The CNF 2002 Breeding Bird Survey report provides a summary of the potential occurrence of priority bird species by habitat type (Schwarz 2002). Fifteen of these species have the potential to occur in the project area (**Table 3-23**).

Some of these species can be found in multiple habitats in the project area. The largest number of species has the potential to occur in ponderosa pine forest, followed by mixed conifer forest and piñon-juniper woodlands. Species typical of the piñon-juniper woodland include the gray flycatcher (*Empidonax wrightii*), juniper titmouse (*Baeolophus ridgwayi*), Bendire's thrasher (*Toxostoma bendirei*), and black-throated gray warbler (*Dendroica nigrescens*). These species are common to uncommon in the piñon-juniper habitats on the MRD (Schwarz 2002). All could occur at the lower elevations along Water Canyon Road and the utility corridor.

The Montezuma quail (*Cyrtonyx montezumae*), dusky flycatcher (*Empidonax oberholseri*), and Virginia's warbler, often found in piñon-juniper woodlands, can also be found in ponderosa pine and mixed conifer forests (Table 3-23). The Montezuma quail and dusky flycatcher, uncommon on the MRD (Schwarz 2002), would have only a slight chance of occurring in the project area. Virginia's warbler, common on the MRD, likely occurs in forested habitats in the project area.

Table 3-23. Priority Bird Species that Could Occur in the Project Area by Habitat Type

Species	Habitat Types			
	Piñon-Juniper	**Ponderosa Pine**	**Mixed Conifer**	**Spruce-Fir**
Montezuma quail (Cyrtonyx montezumae)	X	X	X	
Flammulated owl (Otus flammeolus)		X	X	X
Lewis's woodpecker *(Melanerpes lewis)*		X		
Williamson's sapsucker (Sphyrapicus thyroideus)		X	X	
Red-naped sapsucker (Sphyrapicus nuchalis)		X	X	X
Olive-sided flycatcher (*Contopus cooperi)*		X	X	
Dusky flycatcher (Empidonax oberholseri)	X	X	X	
Gray flycatcher (Empidonax wrightii)	X			
Juniper titmouse (Baeolophus ridgwayi)	X			
Bendire's thrasher (Toxostoma bendirei)	X			
Virginia's warbler (Vermivora virginiae)	X	X	X	
Black-throated gray warbler (*Dendroica nigrescens)*	X			
Grace's warbler (Dendroica graciae)		X		
Red-faced warbler (Cardellina rubrifrons)		X	X	
Olive warbler (*Peucedramus taeniatus*)		X	X	
Total	**7**	**11**	**9**	**2**

Source: Schwarz 2002.

The remaining eight species are found in conifer forests (Table 3-23). The flammulated owl (*Otus flammeolus*), red-naped sapsucker (*Sphyrapicus nuchalis*), Grace's warbler (*Dendroica graciae*), and red-faced warbler are considered common on the MRD. Lewis's woodpecker (*Melanerpes lewis*) is uncommon. These eight species have been recorded in the vicinity of the project area and are likely to occur within or near some of the project features. The Williamson's sapsucker (*Sphyrapicus thyroideus*), olive-sided flycatcher (*Contopus cooperi*), and olive warbler are rare on the MRD (Schwarz 2002) and would likely not occur in the project area.

There are no areas categorized as IBAs or important bird wintering areas in or near the project area (Schwarz 2002). However, the Central New Mexico Audubon Society has nominated the Water Canyon area for IBA status (Rominger 2003). Additional detailed information regarding migratory birds can be found in the Migratory Bird Report for the Proposed Magdalena Ridge Observatory (USFS 2003h)

Mammals

Twenty-eight species of mammals were detected during biological surveys in 1992 and 1993 on top of the mountain and along Water Canyon Road (Sullivan and Knight 1993). The highest diversity of mammals occurred along Water Canyon Road where 26 species were detected. Only seven species were recorded on top of the mountain.

Elk (*Cervus canadensis*) and mule deer (*Odocoileus hemionus*) use the Magdalena Mountains year-round with some seasonal variation based on weather conditions (Heft 2002). Mule deer were common in most areas. The most signs of this species were observed at the lower reaches of Water Canyon where browse shrubs such as Gambel oak, New Mexico locust (*Robinia neomexicana*), and mountain mahogany were common (Sullivan and Knight 1993). Neither elk nor their sign was observed in the 1992 and 1993 surveys (Sullivan and Knight 1993) but elk sign was fairly common along the utility corridor 10 years later (USFS 2002a).

Other large mammal sign observed in the project area includes the porcupine (*Erethizon dorsatum*), bobcat (*Felis rufus*), mountain lion (*Felis concolor*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canis latrans*) (Sullivan and Knight 1993). The black bear uses a variety of habitats from piñon-juniper up to subalpine conifer forest. Although the presence of black bear (*Ursus americanus*) was not detected (Sullivan and Knight 1993), it is known to occur on the MRD. Numerous bears were harvested from the MRD between 1990 and 1999 (Costello et al. 2001). Much of the MRD is rated as primary black bear habitat due to its high mast production potential.

Management Indicator Species

The CNF LRMP identifies 15 MIS (USFS 1985). Because each species listed as an MIS inhabits at least one specific habitat type, its population trends can be interpreted as an indication of the health of the habitat(s). Of these, eight occur in the project area (**Table 3-24**). The status of elk, mule deer, and black bear in the project area is discussed above under Mammals. The juniper titmouse is addressed above under Birds and in the attached Neotropical Migratory Bird Analysis report. More details regarding the 15 MIS species appears in the MIS Report (USFS 2003g).

The red-breasted nuthatch (*Sitta canadensis*) is a year-round resident on the MRD and is an MIS species for subalpine conifer forest (also referred to as spruce-fir forest). This nuthatch is also found in other conifer forest types and in mixed deciduous woodlands. A primary cavity nester, the red-breasted nuthatch typically nests in trees with a dbh of 12 inches (15 cm) or more (USFS 1991). The pygmy nuthatch (*Sitta pygmaea*) is an MIS species for ponderosa pine forests. It can also be found in other conifer forest types and in pine-oak woodlands. A year-round resident, the pygmy nuthatch prefers open forest where it is a primary cavity nesting species. The species seems to be limited by the availability of soft, 30-foot (9-m) tall ponderosa pine snags that have a dbh of over 12 inches (30 cm) (USFS 1991).

Merriam's turkey (*Meleagris gallopavo*) is an MIS species for ponderosa pine forest although it can also be found in other conifer forests, grasslands, shrublands, and deciduous woodlands. A year-round species on the MRD, its roost sites are often in mature ponderosa pines with relatively open crown and large horizontal branches starting at 20 to 30 feet (6 to 9 m) off the ground. These trees typically have a dbh of 14 inches (36 cm) or greater. Merriam's turkeys nest on the ground, usually within 0.5 mile (0.8 km) of water in shady areas on north facing slopes (NMGF 2002a). The hairy woodpecker (*Picoides villosus*) is an MIS for mixed conifer forests although it can also be found in other conifer forest types and in riparian forests. It typically nests in snags and in live aspen trees with a dbh of 15 inches (38 cm) or greater.

Table 3-24. Management Indicator Species that Occur or Have the Potential to Occur in the Project Area

Species	MIS Habitat		
	Plant Community Type	Number of Acres in Project Area (acres)	Population Trend[a]
Elk (*Cervus elaphus*)	Mountain meadow/ mixed conifer	273/429 (702 total)	Up
Mule deer (*Odocoileus hemionus*)	Mountain scrub/piñon-juniper	4/15 (19 total)	Down
Black bear (*Ursus americanus*)	Mixed conifer/subalpine conifer forest	439/164 (603 total)	Stable
Juniper titmouse (*Baeolophus ridgwayi*)	Piñon-juniper	14	Stable
Red-breasted nuthatch *(Sitta canadensis)*	Subalpine conifer forest	164	Stable
Pygmy nuthatch *(Sitta pygmaea)*	Ponderosa pine	59	Stable[b]
Hairy woodpecker (*Dendrocopos villosus*)	Mixed conifer	439	Stable[b]
Merriam's turkey (*Meleagris galapavo*)	Ponderosa pine	59	Stable

Source: USFS 2002e,f, 2003g.

Notes: (a) The population trends are based on information provided in USFS 2002e, f, and 2003g. The trends are intended to represent the entire CNF and it is understood that localized populations may vary.

(b) Unpublished data received during the 45-day comment period suggest that these species are declining on a localized level in the Magdalena Mountains (Myers 2003, Rominger 2003).

The red-breasted nuthatch, the pygmy nuthatch, Merriam's turkey, and the hairy woodpecker have all been observed in the Magdalena Mountains in the project area (Sullivan and Knight 1993) as well as in Sawmill and Copper canyons (Schwarz 2002). The hairy woodpecker has also been observed in ponderosa pine forest near the utility corridor (USFS 2002a). All four species are likely to occur along Water Canyon Road and the utility corridor.

Special Status Species

Twenty-four special status animal species occur or have the potential to occur in the Magdalena Mountains **(Table 3-25).** None of the aquatic species (fish, amphibians, springtail) would occur in the project area due to the lack of aquatic habitat. Although the mammals in this table may have occurred on the MRD in the past, they almost certainly no longer occur on the MRD (USFS 2001a). The two subspecies of the silverspot butterfly are found in streamside meadow wetland habitat and open seepage areas in the desert (blue-black silverspot butterfly [*Speyeria nokomis Nokomis*]) and at higher elevation (New Mexico silverspot butterfly [*Speyeria nokomis nitocris*]) (NatureServe 2002). Neither would occur in the project area due to the lack of suitable habitat.

The American peregrine falcon is a known breeding species on the MRD (USFS 2001a). It breeds on the cliffs near lower Water Canyon Road on Forest Service land. This nest site has been active since at least 1982. For more details, see the attached BA/BE. The bald eagle (*Haliaeetus leucocephalus*) has been observed on the MRD (USFS 2001a) and may occur sporadically on the MRD during the winter or migration.

Bell's vireo (*Vireo bellii*) is not known to occur on the MRD (USFS 2001a; Schwarz 2002; Sullivan and Knight 1993). The gray vireo (*Vireo vicinior*) has not been observed on the MRD but could occur because of the presence of suitable habitat (USFS 2001a; Schwarz 2002; Sullivan and Knight 1993). Potential habitat for the species occurs at the lower end of the utility corridor particularly on the steep south to southwest facing piñon-juniper covered slopes.

The loggerhead shrike (*Lanius ludovicianus*) is a documented breeding species on the MRD (USFS 2001a) and has been observed during previous biological surveys (Sullivan and Knight 1993). It could occur as a breeding species at the lower end of Water Canyon Road and the utility corridor in the piñon-juniper habitat.

The MSO is a breeding species in the Magdalena Mountains. Two MSO PACs occur in the project area. Water Canyon Road runs through the edge of the Timber Peak PAC and part of the project area extends into the Baldy Spring PAC. In addition, other parts of Water Canyon Road and the utility corridor pass through MSO protected and restricted habitat. Owls have been detected in the two PACs in recent years (Stahlecker 1998, 1999). More details regarding the MSO in the project area appear in the attached BA/BE (USFS 2003a).

Table 3-25. Special Status Wildlife Species that Occur or May Occur in the Proposed MRO Project Area

Common Name	Scientific Name	Status[a]
Invertebrates		
Alamosa springtail	*Tryonia alamosae*	FSS, FE
Blue-black silverspot butterfly	*Speyeria nokomis nokomis*	FSS
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	FSS
Socorro springtail	*Pyrgulopsis neomexicana*	FE
Fish		
Canadian speckled chub	*Macrhybopsis aestivalis tetranemus*	FSS
Rio Grande silvery minnow	*Hybognathus amarus*	FE
Rio Grande sucker	*Catostomus plebius*	FSS, SC
Zuni bluehead sucker	*Catostomus discobolus yarrowi*	FSS
Amphibians and Reptiles		
Chiricahua leopard frog	*Rana chiricahuensis*	FSS, FT
Northern leopard frog	*Rana pipiens*	FSS
Texas horned lizard	*Phrynosoma cornutum*	FSS, SC
Birds		
American peregrine falcon	*Falco peregrinus anatum*	FSS, SC, SE
Bald eagle	*Haliaeetus leucocephalus*	FSS, FT, SE
Bell's vireo	*Vireo bellii*	SE
Gray vireo	*Vireo vicinior*	FSS, SE
Loggerhead shrike[b]	*Lanius ludovicianus*	FSS, SC
Mexican spotted owl[b]	*Strix occidentalis lucida*	FSS, FT, SP
Montezuma quail	*Cyrtonyx montezumae*	FSS
Northern goshawk	*Accipiter gentilis*	FSS, SP
Southwestern willow flycatcher	*Empidonax trallii extimus*	FSS, FE, SE
Varied bunting	*Passerina versicolor*	SE
Mammals		
Black-tailed prairie dog	*Cynomys ludovicianus*	FSS, FC
Mexican gray wolf	*Canus lupus baileyi*	FT
Desert big horn sheep	*Ovis canadensis mexicana*	FSS

Sources: Nicholopoulos 2002; NMRP 2002; USFS 2001a.

Notes: (a) FE = federal endangered;
FSS = Forest Service sensitive species;
FT = federal threatened;
SC = federal species of concern;
SE = state endangered;
SP = state protected.

(b) Species recorded in the area of the proposed MRO in the Magdalena Mountains.

The northern goshawk (*Accipiter gentilis*) nests in mature coniferous forests. It is considered a breeding species on the MRD (USFS 2001a). However, no goshawk nests have been observed in the Magdalena Mountains. The closest confirmed goshawk nest is in the San Mateo Mountains to the south (Sullivan and Knight 1993). Although this species has not been observed during previous surveys in the project area (Schwarz 2002; Sullivan and Knight 1993; USFS 2002a), there is potential breeding habitat along much of Water Canyon Road and the utility corridor.

The southwestern willow flycatcher (*Empidonax traillii extimus*) would not occur in the project area due to the lack of suitable riparian breeding habitat. The varied bunting (*Passerina versicolor*) nests in arid canyons and is primarily a Mexican species. It does occur in southern New Mexico in Hidalgo, Eddy, and Otero counties (NMGF 2002b). The Magdalena Mountains are likely north of its breeding distribution in New Mexico. The varied bunting has not been observed on the MRD (Schwarz 2002; Sullivan and Knight 1993) and would not be expected to occur in the project area.

Aquatic Species

There is essentially no perennial aquatic habitat in the project area. As indicated under Wetlands and Riparian Vegetation above, the temporary pools along the lower reaches of Water Canyon would support only limited aquatic species.

3.3.2.2 Environmental Consequences

Method of Analysis

This section concentrates on addressing potential impacts—direct, indirect, and cumulative—on neotropical migratory birds and other bird species of concern, Forest Service MIS, and special status species.

Information regarding the wildlife in the project area was obtained principally from existing survey data, Forest Service files, and other sources. Impacts to wildlife resources were determined based on the characteristics of the alternatives and information from sources relevant to wildlife in the project area. The potential impacts of noise on wildlife were determined by comparing the estimated noise levels from construction equipment to information regarding the effects of noise on wildlife from the scientific literature. Methods used to estimate the noise emanating from construction equipment appears in Noise (Section 3.2.4) of this EIS.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

Under Alternative 1, there would be a short-term loss of almost 24 acres and a long-term loss of about 7 acres of mountain meadow on the top of the mountain. Additional disturbance could occur due to maintenance and repair of Water Canyon Road. Overall, the direct impacts to wildlife are relatively minor given the small amount of habitat.

Ridgetop: Neotropical Migratory Birds and Other Bird Species of Concern (Priority Bird Species)

Fifteen priority bird species are known to occur or have the potential to occur in the habitat affected by Alternative 1. A few of the priority bird species may use the mountain meadows for foraging (especially at the edge of the wooded areas) but these grasslands are not the primary habitat for these species. Therefore, the loss of mountain meadow habitat on the ridgetop would have little or no impact on priority bird species. Loss of a small amount of subalpine conifer forest from tree removal (less than 1 acre and about 31 trees) would also have little effect.

Utility Options: Neotropical Migratory Birds and Other Bird Species of Concern (Priority Bird Species)

Most of the priority bird species occur or have the potential to occur along the utility corridors. It is expected that the implementation of any option would have minimal impact on these species because little land disturbance would occur.

Water Canyon Road: Neotropical Migratory Birds and Other Bird Species of Concern (Priority Bird Species)

The primary habitats in the project area for the priority bird species are the forests and woodlands that occur along Water Canyon Road. The potential loss of forested habitat of various types along Water Canyon Road for road developments would have a minimal impact on these species because of the small amount of habitat affected (12 acres and about 9 trees) and the fact that the road maintenance and repair would be spread out over about 8 miles (13 km) of Water Canyon Road.

Ridgetop: MIS Species

Eight Forest Service MIS occur in the project area. Elk is the only MIS species listed for the mountain meadows on the ridgetop. Merriam's turkey is listed for the ponderosa pine habitat and also uses the mountain meadow areas. Although there would be no loss of ponderosa pine habitat, 24 acres of mountain meadow would be cleared under Alternative 1, which is 8.8 percent of this habitat type in the project area. Approximately 17 of these acres would be revegetated with native plant species following the completion of construction. It is expected that this 17 acres would again be available for elk to use. Given the small amount of elk habitat lost over the long term (7 acres) it is believed that Alternative 1 would have a negligible impact on this species. There would be no effect on population trends as a result of implementing Alternative 1.

Utility Options: MIS Species

Most of the MIS species occur or have the potential to occur along the utility option corridors. However, it is expected that the implementation of any option would have minimal impact on these species because little land disturbance would occur. There would be no effect on population trends.

Water Canyon Road: MIS Species

As with neotropical migratory birds, the potential loss of 12 acres of various forested habitat types over 8 miles (13 km) of Water Canyon Road would have minimal impact on the MIS species. The possibility of increased "road kill," an issue raised in scoping, is low due to the low speed of traffic on the road. The Traffic and Safety Plan(s) would set speed limits for construction crews to avoid accidents and collisions of this nature (or any other). Also, construction traffic would not operate after dark when the possibility of stunning or not seeing (and therefore running into) an animal is higher. There would be no effect on population trends.

Ridgetop: Special Status Species

Seven special status species were considered in the BA/BE report for this project (USFS 2003a). The only federally listed species is the MSO. No direct loss of PAC habitat used by this species would occur under the Proposed Action. Habitat on the ridgetop that would be disturbed under Alternative 1 would not affect the peregrine falcon because it is unlikely this species travels from its nest site to forage over the ridgetop. The remaining species would not be expected to use this habitat type except for an occasional MSO that may forage over the grasslands near its forested habitat.

Utility Options: Special Status Species

Placement of water pipelines and electrical conduit would occur in the Baldy Spring MSO PAC. The new water supply pipeline (1.5-inch [3.8-cm] diameter) and electrical conduit (1.5-inch [3.8-cm] diameter) in Option 2 would be placed on the surface of the ground by hand resulting in essentially no disturbance to the MSO habitat. The pipes would be flexible enough so most, if not all, trees would be avoided in the placement of these lines. No PAC areas would be affected by developing Hardy Spring (Option 1) or Option 3 using the existing system. Special status species would not be affected by any of the utility options.

Water Canyon Road: Special Status Species

Water Canyon Road passes through the Timber Peak PAC. Road maintenance and repair work would avoid sensitive hours and the most sensitive breeding months. Part of the 12 acres of forested habitat along the road would be in MSO protected and restricted habitat. It was determined that the potential for direct habitat loss as a result of implementing the Proposed Action may affect but would not be likely to adversely affect the MSO (USFS 2003a).

The remaining special status species considered in the BA/BE (USFS 2003a) are Forest Service sensitive species and include five species of birds. Of these, the northern goshawk is not known to occur in the project area. The Montezuma quail and gray vireo could occur but are either very rare or have not been recorded in the project area or in the Magdalena Mountains as a whole. The American peregrine falcon is known to nest in the area and likely forages in the project area. The loggerhead shrike may occur in the piñon-juniper habitat in the project area but is more likely to occur in the desert grasslands and shrubland habitats outside the project area. All five of these species could use the various wooded habitats along Water Canyon Road. However, it is believed that the potential loss of about 12 acres of wooded habitat along 8 miles (13 km) of this road would have little or no impact on these special status bird species.

Operational Phase

It is expected that operation of the proposed MRO facility would not result in the direct loss of wildlife habitat.

Indirect Impacts

Construction Phase

Potential indirect impacts to wildlife include 1) the disruption of wildlife near the construction sites due to noise and other human activities and 2) the potential for fire caused by human activities especially during the project construction phase. The potential effects of fire are addressed above under vegetation and measures taken to protect vegetation from fires listed above would also benefit wildlife.

Ridgetop: Neotropical Migratory Birds and Other Bird Species of Concern (Priority Bird Species)

Construction activities on the ridgetop would take place mostly in open mountain meadow habitat. Noise from these activities would not be expected to affect priority bird species in forested habitat at the edge of the grasslands. The one exception would be road construction through about 420 feet (128 m) of subalpine conifer forest. Noise and human activity in this area would have the potential to affect the flammulated owl and red-naped sapsucker. However, this potential impact would be short-term in that road construction activities in this area would take place over a 1- to 2-week period.

Utility Options: Neotropical Migratory Birds and Other Bird Species of Concern (Priority Bird Species)

The potential for noise to disrupt priority bird species would be very low along utility option corridors. Only a small amount of equipment would be required to replace the electrical line on the existing electrical poles, and only hand-held equipment would be used to install the water supply line. Personnel would be in a given area for only a short period of time. Therefore, it is expected that noise associated with construction of the utility options would have little impact on priority bird species.

Water Canyon Road: Neotropical Migratory Birds and Other Bird Species of Concern (Priority Bird Species)

Maintenance and repair activities resulting in the generation of noise as well as other human activity have the potential to affect priority bird species along Water Canyon Road. In a study of the effects of gas well compressor noise on breeding birds in piñon-juniper woodlands in northern New Mexico, it was determined that the number of bird species actually decreased away from the noise source (maximum noise level of 70 dBA and higher at the well pad). Species specific effects were noted where the spotted towhee (*Pupil maculates*) numbers were significantly lower at the highest noise levels while the number of juniper titmouse and house finch (*Carpodacus mexicanus*) were higher nearer the noise source (LaGory et al. 2001). In an unpublished study in California, preliminary results indicate that the effects of noise on the nesting success of Bell's vireo and California gnatcatcher (*Polioptila californica*) was limited to the highest noise levels (greater than 80 dBA). In another unpublished study, the red-cockaded woodpecker (*Picoides arctius*) did not flush from its nest at noise levels of 80 dBA or less. From this, it is reasonable to assume that the negative effects of noise on perching birds may occur at noise levels of 80 dBA or higher.

A terrain-trimming track vehicle may be used to repair or maintain Water Canyon Road. This activity would usually take about a month. The estimated noise level of this machine and haul vehicles used during construction and the methods used in noise analysis appear in Noise (Section 3.2.4). Repair work would generally be timed to avoid sensitive breeding and nesting times for MSOs but would also be limited to 2 hours after sunrise and 2 hours before sunset. Based on the analysis in the BA/BE (USFS 2003a), noise levels from the terrain-trimming machine are estimated to be about 92 dBA at a distance of 50 feet (15 m), 80 dBA at about 200 feet (61 m), and about 75.2 dBA at 345 feet (105 m). Although this machine is fairly noisy, it would only be in any given area for a short period of time as it moves along the road. In addition, dust would be controlled by a water truck following the machine; no work would take place at night; no blasting would be required; and no machinery such as crushers, D-9 caterpillars, and trucks hauling road base would be required. Therefore, it is concluded that road maintenance and repair for this project would have little effect on priority bird species.

Traffic associated with project construction is estimated to average about 50 round trips per average day, with about eight heavy trucks. The remainder would be medium-sized trucks and vans during the first year. On a busy day in the first year, about 60 round trips are estimated. Vehicle traffic associated with facility construction would likely start in April and continue until about November, encompassing the breeding season of most of the priority bird species. Thereafter, vehicle travel to the top of the mountain would be greatly reduced in the winter as well as during subsequent years when construction of the remaining facilities would occur.

Noise levels of loaded trucks going up and down the road would likely fall within the same range as other equipment reported in Table 3-12. That is, levels of 74 to 91 dBA (at a recording distance of 125 feet [38 m]) would be typical. It is expected that regular four-by-four pickup trucks (the majority of the vehicle type on the road) would be at the lower levels (i.e., <80 dBA at 125 feet [38 m] from the noise source). There may be between 8 and 30 of these events by heavier vehicles each day at any given location along the road.

The estimated distance from Water Canyon Road to the 80-dBA noise levels from vehicle traffic would depend on the vehicle type. For example, it is estimated that this distance would be about 100 feet (30.5 m) for heavy trucks, 80 feet (24.5 m) for medium trucks, and 63 feet (19 m) for vans and cars. Most of Water Canyon Road passes through ponderosa pine and mixed conifer forest, and the elevated noise levels above 80 dBA could affect priority species in these habitats (see Table 3.23). These effects could include movement away from the road and/or reduced nesting success for birds that have breeding territories that fall within about a 200-foot (61-meter) zone centered on the road, if any maintenance or repair activity were conducted during breeding season. In addition, as indicated above there may be positive and negative species-specific reactions to truck noise along the road.

Noise levels from vehicles currently using the road most likely resemble noise levels from trucks and vans assessed above. Therefore, it is unlikely that project-related traffic would have an impact on wildlife on average days. On busy days, vehicle use may be fivefold greater and may affect some bird species. Therefore, it is concluded that the noise from large, construction-related vehicles on Water Canyon Road may have a negative affect on priority bird species during the first year of construction.

Ridgetop: MIS Species

Of the eight MIS likely to occur in the project area, five are birds. The potential impacts of noise under Alternative 1 described above for the priority bird species would likely apply to these five species. The remaining three MIS (elk, mule deer, and black bear) are mammals.

Noise associated with construction on the ridgetop would likely reduce elk use of the mountain meadow at least during daylight hours. However, construction would not take place at night. In addition the elk population is probably habituated to the current level of human activity on the ridgetop. It is therefore expected that the reduction in elk use of the ridgetop would be somewhat mitigated by the fact that construction would not take place at night and the herd is likely currently habituated to a certain level of human activity on the ridgetop.

Utility Options: MIS Species

The potential for noise to disrupt MIS species would be very low along utility corridors. Only a small amount of equipment would be required to replace the electrical line on the existing electrical poles, and only hand-held equipment would be used to install the water supply line. In addition, personnel would be in a given area only for a short period of time. Therefore, it is believed that noise associated with implementation of either utility option would have little impact on MIS species.

Water Canyon Road: MIS Species

The avoidance of roads by large species of mammals has been documented. Avoidance is defined “as lower than expected use of areas adjacent to development compared with use of areas further from development” (Dyer et al. 2001). This avoidance can result in the functional loss of habitat and reduced carrying capacity (Dyer et al. 2001, Rowland et al. 2000). Ungulates including mule deer and elk may be affected by roads depending on their distance from roads (Rost and Bailey 1979; Rowland et al. 2000; Dyer et al. 2001), road density (Lyon 1983; Unsworth et al. 1998; Millspaugh et al. 2000), vehicle use levels (Cole et al. 1997; Dyer et al. 2001), road distribution and management (Cole et al. 1997; Rowland et al. 2000), surrounding habitat and terrain (Unsworth et al. 1998; Rowland et al. 2000; Dyer et al. 2001), season (Millspaugh et al. 2000; Rowland et al. 2000), sex and age of animals (Unsworth et al. 1998), and hunter use (Cole et al. 2000; Millspaugh et al. 2000).

Studies have shown that mule deer and elk generally avoid roads. This seems to be a widespread phenomenon (Rost and Bailey 1970; Lyon 1983, Rowland et al. 2000). Deer and elk avoid roads particularly within 656 feet (200 meters) on each side of secondary roads (Forman 2000; Rost and Bailey 1979). These ungulates avoid roads ranging from interstates to gravel roads; the avoidance distance for each road type was similar. Elk have been found to avoid both an Interstate Highway and secondary gravel roads out to about one-quarter mile and were more sensitive to road traffic than were mule deer (Ward 1976). Research indicates that elk are less affected by vehicles at low rates of use (fewer than 4 vehicles per week) but that rates of 1 to 4 and 1 to 6 vehicles per day result in elk avoidance of roads (Cole et al. 1997; Rowland et al. 2000). The estimated current summer use of 20 vehicles per day is well above this threshold for elk avoidance of roads and it is assumed that elk and mule deer avoid Water Canyon Road during the summer under current conditions. The increase in traffic and noise along Water Canyon Road during construction would likely increase big game avoidance of Water Canyon Road, but this increase cannot be quantified.

Ridgetop: Special Status Species

Construction activities on the ridgetop would take place mostly in open mountain meadow habitat. Noise from these activities would not be expected to affect special status wildlife species that may occur in forested habitat at the edge of the meadow. The MSO may occasionally forage over the mountain meadows near its forested habitat, but is not likely to be adversely affected by construction in this area. Construction activities on the ridgetop are well away from the Timber Peak PAC and associated grassland habitat (almost 1 mile [1.6 km]) so noise from the construction zone would not be expected to affect this species.

During nine military jet overflights, MSOs showed no response 22 percent of the time, low response (open eyes, slow head turn) 67 percent of the time, intermediate response (sudden body movement) 11 percent of the time, and no flush response was observed (Johnson and Reynolds 1996). The owls' responses to environmental influences (e.g., thunder, rain, mobbing by small birds) were similar and in some cases greater than the owls' responses to noise generated by F-16s flying overhead. MSOs did not flush when helicopter noise levels were less than or equal to 92 dBA (Delaney et al. 1999). Overall, the MSO tends to be less affected by nearby non-threatening human activity than most other raptor species. Noise levels of 92 dBA or less should not have a detrimental affect on nesting MSOs (Delaney et al.1999).

Utility Options: Special Status Species

The potential for noise to disrupt the MSO and other special status species would be very low along utility option corridors. Only a small amount of equipment would be required to replace the electrical line on the existing electrical poles, and only hand-held equipment would be used to install the water supply line. In addition, personnel would be in a given area only for a short period of time. Therefore, it is believed that noise associated with construction of either utility option would have little impact on special status species.

Human activity associated with the implementation of water supply Option 2 has the potential the affect the MSOs that inhabit the Baldy Spring PAC. It is expected that work on this water supply option would take 5 to 7 days and work in the PAC itself would be completed in less than 1 week. However, no activity associated with this option would take place during the sensitive MSO incubation and early to mid-brood rearing period (late March through June) (USFWS 1995). The water supply system would likely be installed in July during the late brood rearing and fledging period, thus reducing the potential impact of human activity on this species. Under Option 3, the existing repaired system would be used, and further work would take place in the PAC. Trenching on the ridge would have no impact on special status species.

Water Canyon Road: Special Status Species

Maintenance and repair of Water Canyon Road is not planned to take place during the MSO nesting season. However, vehicle traffic associated with ridgetop construction could be traveling along the road during nesting, including the egg laying and incubation, brooding, and fledging periods (USFWS 1995). Thereafter, vehicle travel to the top of the mountain would be greatly reduced in the winter as well as during subsequent years when remaining facilities would be constructed. Approximately 2,000 feet (610 m) of Water Canyon Road passes through the Timber Peak PAC but does not run through the core area. Another 2,000 feet (610 m) of the road runs just outside the PAC boundary (see Map 5 in USFS 2003a). The core area is within about 375 feet (114 m) of the road at its closest point. The center of the core area where the nest is most likely located is about 2,000 feet (610 m) down a steep slope from the road at its closest point.

There may be as many as 30 heavy vehicle trips each day during the first year of construction. Noise levels of 91 dBA from some equipment or vehicles may be experienced in areas within 125 feet (38 m) of the road. Levels would be much lower (and below levels of concern—92 dBA) in the Timber Peak PAC core area. MSO use of areas with a 100- to 125-foot (30.5- to 38-m) wide strip of habitat centered on the road for 2,000 feet (610 m) may be temporarily reduced. In addition, about 28 acres of the PAC is above Water Canyon Road (USFS 2003a) and noise from vehicle traffic may affect MSO use of this area. However, most of this part of the PAC (64 percent) is mountain meadow, which would typically not be used by the MSO except, possibly, for occasional foraging. The number of vehicles traversing Water Canyon Road during the second and subsequent construction year would be much less than during the first years of construction.

The estimated distance from Water Canyon Road to the noise level of concern for the MSO (92 dBA) from vehicle traffic would depend on the vehicle type. For example, it is estimated that this distance would be about 25 feet (7.6 m) for heavy trucks, 20 feet (6.1 m) for medium trucks, and 16 feet (4.9 m) for vans and cars. None of these noise levels would reach the Timber Peak PAC core area, which is about 375 feet (114 m) from the road. Noise from these vehicles may somewhat reduce MSO use of a 36- to 50-foot (11- to 15.2-m) wide strip of habitat centered along the road based on the 92 dBA noise level.

Other human activity also has the potential to affect the MSO. Water Canyon Road would be plowed all winter during construction and operation of this project providing access to the general public. The road to the top of the mountain has been plowed throughout the winter about every third year for at least the last 20 years. As a result, traffic through the Timber Peak PAC and other MSO protected habitat along the road has taken place during the winter in the past. Therefore, it is believed that the periodic use of Water Canyon Road by the public during the winter would have little impact on the MSO due to the low number of vehicles and the fact the road through the PAC has been open to the public during past winters.

Noise generated during construction and other human activity may affect but would not be likely to adversely affect the MSO. Based on early communication, it is expected that the USFWS will agree with this determination in their Biological Opinion. This determination applies to potential disturbance of this species on the ridgetop and along the utility corridors as discussed below.

Other special status species of wildlife have the potential to be affected by project-related noise along Water Canyon Road. The northern goshawk is not known to occur in the project area but were it to occur in the future, project-related noise along Water Canyon Road could affect it. Based on the effects of noise on the MSO as described above, it is reasonable to assume that noise from road maintenance and repair and from truck traffic could result in reduced goshawk habitat use within areas exposed to sound events of 92 dBA or higher. For road maintenance and repair using the terrain-trimming process, this would include areas within about 50 feet (15 m) of the road. For some heavy trucks, this distance may extend out to 100 or 125 feet (30.5 to 38 m) (see Table 3-14) for noise levels up to 91 dBA.

Project-related noise along Water Canyon Road has the potential to disrupt the peregrine falcon at the nest site as well as in foraging habitat along or near the road. A number of studies have addressed the impacts of aircraft noise on raptors. The behavior of peregrine falcons and other species of raptors during 1,000 overflights has been evaluated (Ellis 1981). Alarm behavior was observed when aircrafts were 500 to 1,650 feet (150 to 490 meters) from nesting birds. Alarm responses were temporary and did not result in reproductive failures. In general, raptors appear to have the ability to adapt to noise and human activities (Anderson et al. 1990).

Falcons did not respond appreciably to aircraft that were farther away than 1,650 feet (500 meters). The noise levels tested ranged from 82 to 114 dBA. The effects of low flying jet aircraft have been evaluated for several nesting raptor species (including peregrine falcons) in Arizona (Ellis et al. 1991). Jet aircraft flying 500 feet (150 meters) or more from the nest sites had little impact on these species. These studies indicate that nest abandonment, nesting success, and fledging success were not different between nests that were overflown and nests that were not overflown. Noise levels at the nest sites resulting from passes fewer than 500 feet (150 meters) away ranged from 97 to 110 dBA.

Although the location of the peregrine falcon eyrie cannot be provided, it is well over 500 feet (150 meters) from Water Canyon Road, a distance at which there was no response to jet noise by peregrine falcons according to the above studies. In addition, the eyrie is well past any area that would be affected by equipment and vehicle noise. Maintenance and repair and construction-related vehicle traffic would not be likely to have an impact on nesting peregrine falcons in the project area.

Noise and human activity associated with construction could have an affect on the Montezuma quail, loggerhead shrike, and gray vireo. As indicated above in the priority bird section, perching birds may be negatively affected by noise levels greater than 80 dBA and this would also likely apply to these species. However, any impacts of noise on Montezuma quail and gray vireo would be minimal because they are, at best, very rare in the project area. The loggerhead shrike would most likely occur along Water Canyon Road north of Water Canyon Campground in grassland habitat outside of the project area.

Operational Phase

In general, operations would be expected to have only minor indirect impacts on biological resources.

Ridgetop

The amount of human activity on the ridgetop would be greatly reduced compared to the construction phase. Although there would be an increase in human activity on the ridgetop relative to current levels, it is believed that this increase would have little impact on wildlife that use the habitats in this area.

Utility Options

The amount of human activity as a result of any of the utility options during the operational phase would be minimal. Occasional reconnaissance surveys or trips for repairs would take place. This activity along the utility corridor would have very little impact on wildlife.

Water withdrawal from East Sawmill Canyon Creek would not exceed the current state authorization of 84,375 gallons per year. Any needs above that amount would be met by hauling water to the site. The current water source (East Fork of Sawmill canyon Creek) for operational usage at the existing Langmuir Laboratory has been used for greater than four decades.

Water Canyon Road

The amount of traffic along Water Canyon Road would be greatly reduced during operations (close to preconstruction levels) with possibly 5 round trips per day to and from the proposed MRO. In addition, most traffic would be vans, cars, and small trucks. It is expected, therefore, that noise levels during operations would be similar to current levels.

Alternative 2: No Action

Under Alterative 2, no proposed MRO construction would take place so there would be no direct loss of wildlife or wildlife habitat on top of the mountain from construction or operations. There would be no indirect effects to wildlife from construction-related noise or other human disturbance. Ongoing maintenance and repair of Water Canyon Road would continue as needed to support continued use of Langmuir Research Site, as well as Forest Service management, recreation, and other uses.

Alternative 3: Preferred Alternative

Direct Impacts

The principal difference between Alternative 3 and Alternative 1 would be changes in the location of some of the facilities on the ridgetop. Approximately the same amount of land would undergo short-term and long-term disturbance for both alternatives. In addition, the consideration of three utility options would be the same under both alternatives. Therefore, the potential direct impacts to wildlife would essentially be the same for both of these alternatives.

Indirect Impacts

Given the similarities between Alternative 1 and Alternative 3, the potential indirect impacts to wildlife (i.e., possible project-related impacts of noise and fires) would be the same for both alternatives.

Alternative 4

Direct Impacts

Alternative 4 would differ from Alternative 1 in that some of the facilities on the ridgetop would be in different locations (see Chapter 2). All other features of this alternative would be the same as for Alternative 1. Therefore, the potential direct impacts to wildlife for this alternative would be the same.

Indirect Impacts

Potential indirect impacts to wildlife under Alternative 4 would be the same as those described for Alternative 1.

3.3.2.3 Cumulative Impacts

The mountain meadows would exhibit the greatest loss due to proposed MRO construction under Alternative 1. This, combined with the currently cleared mountain meadows on the ridgetop for the Langmuir project, would result in the cumulative loss of fewer than 10 acres in the project area of this habitat type. The mountain meadow habitat would be reduced by less than 3 percent (see Table 3-20) from the proposed MRO. Slight increases in competition may occur with wildlife and livestock species due to the reduction in habitat. However, this will likely be minimal due to the upward trend the mountain meadow habitat displays (see Section 3.3.3 Rangelands) and the minimal loss of this habitat on the Forest. Alternatives 3 and 4 would contribute slightly less to cumulative habitat loss.

The loss of a very small amount of forested habitat (0.1 acre or less) under all utility options would not contribute to the cumulative loss of wildlife habitat.

It is believed that the potential loss of 12 acres of forested habitat along Water Canyon Road spread out over 8 miles (13 km) of road would contribute to very few, if any, cumulative impacts to wildlife. The improved road may facilitate public access resulting in an increase in the use of the road, but additional human activity (mostly recreational) would be dispersed and sporadic and not amount to any appreciable difference to the current low level of public use on the Forest. Therefore, cumulative impacts on wildlife are expected to be negligible.

With increased access and use of Water Canyon Road, there may also be increased ATV use in the area. This increase would likely be minimal because ATV use is and will continue to be prohibited in the 31,000-acre Langmuir Research Site. The Baldy Spring PAC is completely within this boundary as well as the upper part of the Timber Peak PAC including the portion of Water Canyon Road that passes through this PAC. Overall, it is believed that year-round use of Water Canyon Road by the public would have little impact on the MSO. This activity may affect, but would not be likely to adversely affect, the MSO.

The effect of fire on habitats and wildlife can be extensive. Project-related risks of fire are estimated to be low, even with increased visitation to the CNF, but given existing conditions of the CNF, the potential for a large fire to occur is considerable.

It is expected that operation of the proposed MRO facility would not contribute to cumulative loss of wildlife habitat.

The proposed MRO would not occur under Alternative 2 and would not therefore contribute to cumulative impacts.

Cumulative impacts under Alternatives 3 and 4 would be the same as under Alternative 1.

3.3.2.4 Mitigation

Several mitigation measures have been incorporated into the proposal. They are listed in Table 2-6. These would be implemented under all of the action alternatives to reduce impacts on wildlife, specifically MSO. The USFWS has been involved in defining measures, particularly to safeguard the sensitive nesting and brooding seasons. Also, several measures would be used to minimize soil and water impacts that can indirectly affect vegetation, habitats, and wildlife.

3.3.3 Rangelands

3.3.3.1 Affected Environment

Region of Influence

The rangelands affected by the Proposed Action are within the Baldy and Muleshoe Allotments. The 27,395-acre Baldy allotment is located in the center of the Magdalena Mountains and ranges from 6,500 feet (1,981 m) at the allotment boundary in Water Canyon to 10,700 feet (3,261 m) at the top of South Baldy. The allotment consists primarily of high ridges separated by steep-walled, deep canyons and is drained by Sawmill and Ryan Hill Canyons to the south, Water Canyon to the north, and Sixmile and South Canyons to the east. The 20,813-acre Muleshoe Allotment is located about 7 miles (11.2 km) south of Magdalena on the west side of the Magdalena Mountains. Elevations in the allotment range from 6,500 feet (1,981 m) at the CNF boundary in the southwest corner of the allotment to 10,400 feet (3,170 m) near the summit of South Baldy Peak. The topography of the allotment varies from relatively flat terrain to areas of moderate and steep relief scattered throughout the allotment.

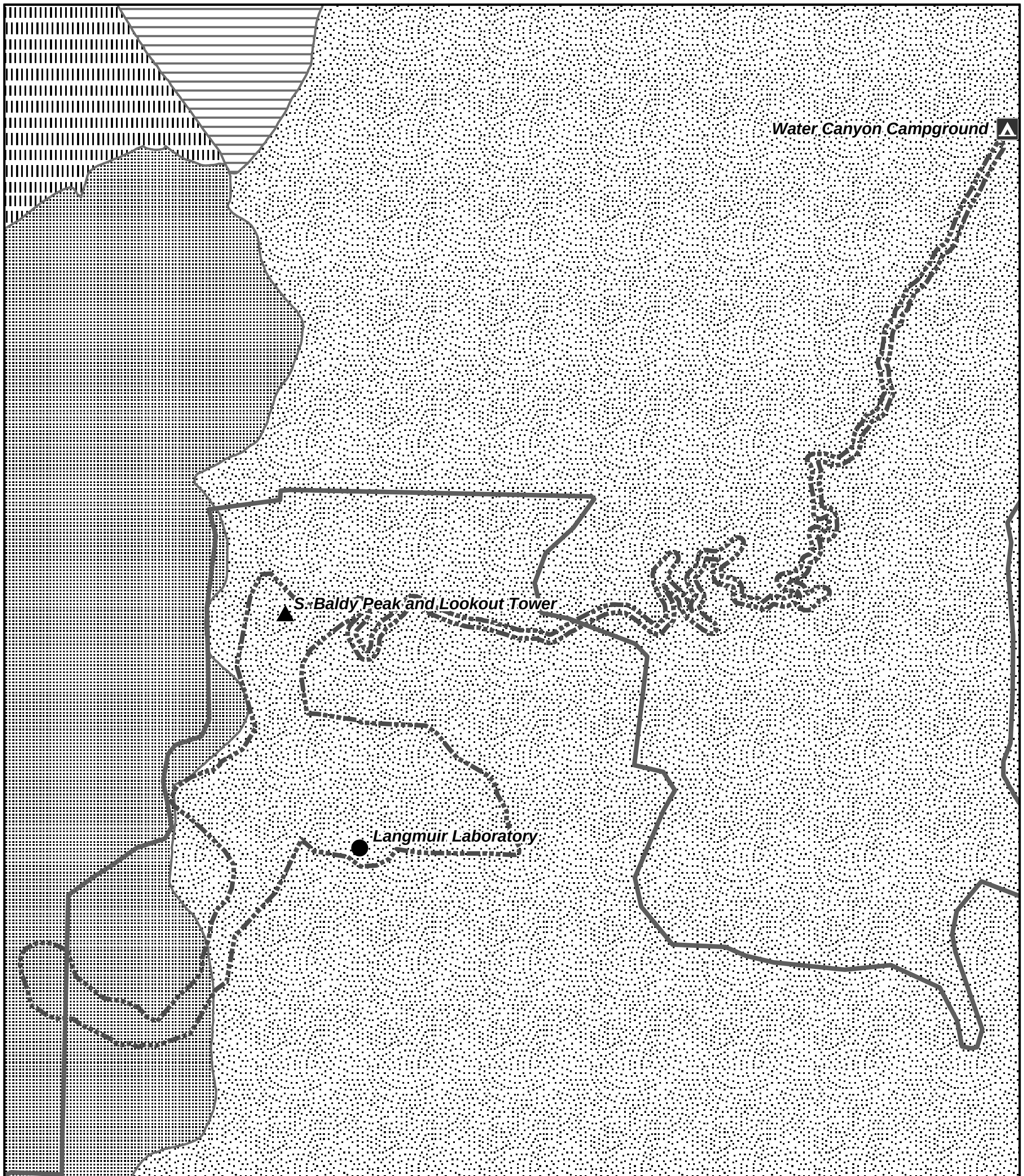
Existing Conditions

The Baldy allotment is permitted to a single user for 40 cow/calf pairs year-long and 17 yearlings from January 1 through April 30, for a total of 580 animal unit months (AUMs). About 608 acres of the total allotment is within the defined project area, all of which is considered full capacity rangeland. This represents 15 percent of the full capacity range in the allotment, about 87 AUMs, or about 6 cow/calf pairs and 2.5 yearlings. The most current range analysis (USFS 1987) lists the range condition as fair.

Map 3-15 shows the distribution of allotments in the vicinity of the project area. The project area consists of the Muleshoe and Baldy allotments. **Table 3-26** describes the range condition of each of the four vegetation zones in the proposed MRO project area.

Table 3-26. Range Condition in the Proposed MRO Project Area—Baldy Allotment

Vegetation Zone	Condition	Trend
Mountain Meadow	Fair	Upward
Piñon-Juniper Woodlands	Poor	Downward
Ponderosa Pine and Mixed Conifer Forests	Fair	No Apparent
Riparian	Poor, Very Poor	Downward



Legend

Langmuir Research Site Boundary
MRO Project Boundary

Allotment

Baldy
Hop Canyon
Kelly
Muleshoe

0.5 0.25 0 0.5
Scale in Miles

Scale 1:47,500
Projection UTM, Zone 13, NAD 1927

Sources: USFS 2001b, c
Produced by: SAIC-Albuquerque, NM
Date: 6/16/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-15
Allotments in the Project Area

Vegetation suitable for grazing within the Baldy Allotment consists of four zones.

- Mountain meadow dominated by Arizona fescue and sedge;
- Piñon-juniper woodlands with an understory of blue grama, side-oats grama, wolftail (*Lycurus phleoides*), mountain muhly (*Muhlenbergia montanus*), and ring muhly (*Muhlenbergia torreyi).* Mountain mahogany, gray oak, and Gambel oak make up the browse;
- Ponderosa pine and mixed conifer forest with an overstory of ponderosa pine, Douglas fir, and Engelmann spruce. In the lower elevations, grama grasses (*Bouteloua spp.*) form the understory; in the higher elevations, mountain muhly, Arizona fescue, Junegrass (*Koeleria macrantha*), and nodding brome (*Bromus anomalus*) form the understory;
- Riparian vegetation, consisting of narrowleaf cottonwood, Arizona alder (*Alnus oblongifolia*), Gambel oak, Arizona walnut, narrowleaf willow (*Salix angustifolia*), wild grape (*Vitis arizonica*), chokecherry (*Prunus virginiana*), western yarrow, mullein, columbine (*Aquilegia spp.*), dandelion, and wild onion (*Allium geyeri*).

The Muleshoe Allotment is permitted to a single user year-round for 253 cow/calf pairs or 3,078 AUMs. The entire allotment is 20,813 acres, of which approximately 120 acres (all non-capacity rangeland) are within the project area. This represents about 18 AUMs or about 1.5 cow/calf pairs. The most current range analysis (USFS 1987) lists the range condition as poor.

There are three major vegetation zones on the allotment: the high mountain grasslands; the piñon-juniper woodlands; and the ponderosa pine and mixed conifer forests. The high mountain grasslands consist of blue, black, sideoats, and hairy grama; wolftail, ring muhly, bottlebrush squirreltail, sand dropseed, and three awns. The browse consists of mountain mahogany, Apache plume, gray oak, and four-winged saltbush. The piñon-juniper zone consists of wooded lands with an overstory of piñon, one-seed and alligator juniper with an understory of the above grasses, mountain muhly, and Junegrass. Browse includes mountain mahogany, gray oak, and Gambel oak. The ponderosa pine and mixed conifer zone is located primarily along the east boundary of the allotment and consists of ponderosa pine, alligator juniper, and Douglas fir. The understory includes Arizona fescue, pine dropseed, mountain muhly, and blue grama. Browse is primarily Gambel oak. The primary forb is western yarrow.

3.3.3.2 Environmental Consequences

Method of Analysis

Impact assessment describes changes that would affect accessibility and use for livestock and range management, amount and quality of land available for grazing, and changes in conditions that may affect permit holder(s). Indirect impacts are considered qualitatively such as potential changes in surface and ground water sources and increased fire hazards.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

The proposed MRO project would have a small effect on the rangeland resource due to the minimal number of acres that would be disturbed. There would be about 24 acres disturbed on the ridgetop for staging, the development area, new roads, parking areas, and trenches for utility distribution lines in an area of full-capacity range in the Baldy Allotment, specifically in the South Baldy pasture. In the short term, this would reduce grazing in the Baldy Allotment by about 3 AUMs. This represents about a 4 percent reduction of the allotment acreage within the project area.

Successful revegetation of the areas initially disturbed that are not directly covered by a building footprint or gravel may take up to 5 to 7 years. After successful revegetation, the long-term effects on the rangeland resource would consist of the removal of about 13.4 acres of vegetation due to the proposed MRO project (including fenced area). Maintenance and repair of Water Canyon Road could also disturb about 12 acres of rangeland and result in a long-term loss of 6 acres. Combined with the ridgetop construction, this could result in a short-term reduction of about 4 AUMs and a long-term reduction of about 2 AUMs in the Baldy Allotment. This would represent a permanent loss of about 2 AUMs (2 percent of the allotment acreage within the project area), representing about 1cow/calf pair. This would affect one permittee. There would be no effect on the Muleshoe Allotment because the rangeland here is “non-capacity” range that does not support grazing and thus does not influence AUMs.

Operational Phase

Proposed MRO operations are not expected to affect rangelands.

Indirect Impacts

Closures of Water Canyon Road for proposed MRO construction and road maintenance and repair could temporarily inconvenience permit holders. Arrangements would be made to provide access for grazing permit holders as needed.

Indirect impacts may result from fire in the project area. Given the measures to reduce potential for fire from project-related activities, fire effects on rangelands and grazing from this action would be minimal. Site drainage would be managed through BMPs, so indirect effects on quality of grazing forage from soil and water effects are not expected.

Alternative 2: No Action

The district would continue with their current rangelands management strategy agreed upon by the permittees under these special operating instructions. There would be no reduction in AUMs or decrease in cow/calf pairs due to loss of rangeland habitat. Periodic maintenance and repair of Water Canyon Road could temporarily affect access by grazing allotment permittees. Arrangements would be made to provide access for grazing permit holders as needed.

Alternative 3: Preferred Alternative

Direct and indirect impacts on rangelands and grazing would be the same as under Alternative 1.

Alternative 4

Direct and indirect impacts on rangelands and grazing would be the same as under Alternative 1.

3.3.3.3 Cumulative Impacts

The proposed MRO development under Alternative 1, 3, or 4 would contribute to a decrease in available rangeland habitat, combined with ongoing maintenance and repair of Water Canyon Road, potential fire impacts, and drought conditions.

Alternative 2 would have no new cumulative impacts.

3.3.3.4 Mitigation

As indicated in Table 2-6, the Forest Service would coordinate access during road closures with the Baldy Allotment permittee.

3.4 Human Environment

3.4.1 Lands and Realty

3.4.1.1 Affected Environment

Region of Influence

The ROI for lands and realty issues involves all lands within the boundaries of the Magdalena Mountains Geographic Area including the Langmuir Research Site and potential areas of influence of the Proposed Action (Map 1-1).

Existing Conditions

Land Uses, Ownership, and Development Patterns

The project site and most of the land in the vicinity is located on National Forest System Lands. Included within the area administered by the Forest Service are private lands, some of which have been developed with buildings and/or other facilities (USFS 2000a). Additionally, utility and communication facilities, concessions, and rights-of-way are authorized by the Forest Service under special use authorizations. Many areas are also open to livestock grazing and contain range improvements. Map 3-14 shows the location of public and private lands in the vicinity of the project site.

Forest System Land

Cibola National Forest Land and Resource Management Plan (CNF LRMP)

The CNF LRMP defines the long-term direction for managing the CNF (USFS 1985). The purpose of the Forest Plan is to provide for multiple use and sustained yield of goods and services from the CNF in a way that maximizes long-term net public benefits in an environmentally sound manner. To accomplish this, the Forest Plan:

- Briefly describes the major public issues and management concerns pertinent to the CNF and how each one is addressed in the Forest Plan;
- Briefly summarizes the Analysis of the Management Situation (AMS) including the existing management situation, projected future use, and supply conditions;
- Establishes long-range policies, goals, and objectives, and contains the specific management prescriptions planned to meet the policies and to achieve the multiple use goals and objectives;
- Specifies the vicinity, timing, and standards and guidelines for proposed management practices; and
- Establishes monitoring and evaluation requirements needed so that direction is carried out to determine how well outputs and effects were predicted.

Langmuir Research Site: Formation, Site Development History, and Existing Uses

The 31,000-acre Langmuir Research Site was established under P.L. 96-550 (US Congress 1980) in 1980 and has been operating under permit since the 1960s. The site was established under Title II, Section 201 “to encourage scientific research into atmospheric processes and astronomical phenomena, and to preserve conditions necessary for that research." Title II, Section 205a, further provides that the site will "consist of approximately thirty-one thousand acres, including a principle research facility of approximately one thousand acres." Section 205b of Title II states, "a comprehensive management plan for the site will be developed consistent with the requirements of the National Forest Management Act of 1976" (P.L. 94-558) (16 U.S.C. 1604), to be incorporated into the initial the CNF LRMP.

Section 205 (f) sets forth four management objectives:

1. The PRF shall be managed primarily for scientific research purposes. Dispersed recreation, grazing, and other uses which the Secretary determines to be compatible with scientific research may be permitted.
2. The research site shall be managed to enhance scientific research objectives. Scientific research activities and associated research equipment and structures shall be permitted within the research site in accordance with the plan.
3. Roads shall be limited to those necessary for scientific research activities and other reasonable activities as determined by the Secretary. Motor vehicle use shall be restricted to roads designated in the plan.
4. The landing of small-instrumented research rockets shall be permitted to continue in portions of the research site designated for such purposes in the plan.

The Langmuir Laboratory, built in 1963, has operated under a SUP from the Forest Service since before the area was so designated by Congress. The basis for the SUP is the annual Langmuir Laboratory Operation and Maintenance Plan (USFS 2002c). With each annual Plan update, the application and conditions of the SUP are reviewed and modified accordingly. The site is built out according to the 1992 SUP and subsequent updates. If substantial improvements or modifications are proposed in the plan, the Forest Service may find that the requirements of the NEPA apply. This is the case with the currently proposed Annual Operations and Maintenance Plan. This EIS is part of the SUP review and update process.

Land Grants

There are no land grants within the MRD or project area. Three land grants exist in the vicinity: the Sevilletta, Socorro, and Pedro Armendaris Land Grants.

Private Lands

The Magdalena Mountains Geographic Area as a whole contains approximately 6,837 acres of private inholdings. No federal agency private land acquisitions are planned at the present time (USFS 2000a).

Private land inholdings within the area of potential project activities are located both along Water Canyon Road and in the vicinity of the proposed utility corridors. Two mining claims, involving a total of approximately 40 acres of land, are present in the area but do not fall within the project area. These sites are undeveloped (no buildings, no occupancy). Some minor improvements may exist, but there is no ongoing mining activity other than potential prospecting (USFS 2000a).

Surface and Subsurface Rights

A mineral withdrawal is an administrative action through the BLM that prohibits entry for mineral development including both exploration and mining. There are two mineral withdrawals currently located in the Magdalena Mountains Geographic Area—960 acres located in the Langmuir PRF and 95 acres in Water Canyon Campground. The Langmuir Laboratory PRF has been segregated from mineral entry (USFS 2000a). Withdrawal from mineral entry by Public Land Order is expected to be complete in 2003.

There are no active mining claims in the project area. Frenchie's Cabin in Mill Canyon is the only active mill site. According to the Forest Plan, the demand for mining is being met without detriment to other resource values, and minerals are extracted with no damage to other resources.

There are no existing oil and gas leases nor known potential for oil or gas within this area.

Easements and Rights-of-Way

Legal right-of-way must be granted to enter any private lands for the purpose of access on existing roads for road improvements, construction, or modification. A review of available records indicates that Socorro County right-of-way exists across all private lands along Water Canyon Road from US 60 to Water Canyon Campground (McHenry 2003). Rights-of-way along Water Canyon Road from Water Canyon Campground to Magdalena Ridge have not been acquired by the Forest Service or Socorro County. The road crosses two private landholdings in the 8-mile (13 km) road segment.

Water Canyon Road has been used by the public to access Magdalena Ridge and forested areas along the road since the Langmuir Laboratory was established in 1963.

Infrastructure and Utilities

Water

Reliable water sources have been in short supply in the upper reaches of the Magdalena Mountains. The existing science facilities, including Langmuir Laboratory, have relied historically on drawing water from the Sawmill Canyon stream via an aboveground pipeline and electric pumps (Sea West 2002). Additionally, the facilities rely on runoff and vehicle transportation of additional potable water to the site.

Wastewater

Wastewater from the Langmuir Laboratory and associated facilities is currently disposed of by using septic tanks and leach fields (Sea West 2002). Water Resources are discussed in detail under Section 3.2.2.

Electricity and Natural Gas

The Forest Service establishes corridors for major utility facilities such as natural gas pipelines, electric transmission lines, and major transportation routes through Forest Service lands. There are no major utility corridors in the Magdalena Mountains Geographic Area (USFS 1985), but existing power distribution lines under special use authorization do serve the Langmuir Laboratory.

An existing utility right-of-way is located along the southwest slopes of Magdalena Ridge and carries Socorro Electric Power lines past Hardy Canyon and up to the Langmuir Laboratory. Near Mill Place, the existing electric lines connect to the existing Socorro Electric grid and the Western New Mexico trunk system (USFS 1985).

Telecommunications

Currently, Western New Mexico Telephone Company has fiber optic and copper wire service into Magdalena and a central office located in the Village of Magdalena. Additionally, the company has existing underground telecommunications ducts in place (Sea West 2002). Fiber designated duct is installed for several miles south along Highway 107. The Western New Mexico Telephone Company does not serve the ridge or the Langmuir Laboratory. Telephone and Internet communications for existing facilities on the ridge are handled via radio. Additionally, the Forest Service maintains a radio communication site within the PRF at West Knoll. This electronic site consists of a building for housing equipment and a tower.

3.4.1.2 Environmental Consequences

Method of Analysis

The four alternatives described in Chapter 2 are analyzed in the following discussion on the basis of their conformity with existing plans and policies for the site and on how the project's construction, operation, and maintenance would impact public and private lands and the utility infrastructure serving the site and surrounding area.

Alternative 1: Proposed Action

Direct Impacts

Direct impacts are those impacts that would occur immediately in the project area as a result of construction, maintenance, or operation activities associated with an alternative and would be in close proximity to these activities.

About 14 acres of undeveloped land would be converted to developed land. This conversion would not be considered significant because the proposed changes would be considered consistent with current management practices and policies (USFS 1985), and they represent an extremely small portion of the MRD (less than 0.1 percent).

The demand for electricity would incrementally increase the need for new energy generating facilities and/or increased energy conservation. Given that the energy demand from the project would be relatively low, this incremental impact would not be considered significant.

The Proposed Action would connect to existing telecommunication facilities. No new infrastructure beyond connection point would be required and no new demand areas would be served.

The demand for groundwater is addressed in Water Resources (Section 3.2.2).

Construction Phase

Ridgetop

The proposed ridgetop buildings, scientific equipment, and associated facilities would be constructed on currently undeveloped lands on Magdalena Ridge. These improvements would convert about 24 acres of undeveloped land to developed area in the short-term and about 13 acres in the long term. This land use change would not be considered significant because it would occur within or near areas that are already developed and because development in this location has been anticipated as part of the Langmuir Research Site. The proposed facilities would be located completely within the boundaries of the 30,606-acre publicly owned Langmuir Research Site, which is coincident with Management Area 7 in the CNF LRMP. The Langmuir Research Site was set aside to encourage scientific research into atmospheric processes and astronomical phenomena. It is managed, both in the LRMP and under the SUP, to enhance scientific research objectives. Construction of new facilities on Magdalena Ridge, therefore, is consistent with existing land use policies. There would be no change to land use or administration of those lands within the Langmuir Research Site. The reduction in grazing land in the Baldy allotment would be minimal (see Rangelands [Section 3.3.3]).

The LRMP and SUP both allow for secondary uses of the Langmuir Research Site as deemed compatible with atmospheric research including grazing, timber harvest, dispersed recreation, and firewood harvest (USFS 1985). Construction and operation of the proposed facilities could temporarily and incrementally impact secondary uses by reducing the total open space on the ridge, but would not result in a permanent conflict since secondary use opportunities would not be precluded and improved access to the ridgetop would reduce one barrier (the transportation/access barrier) to opportunities for dispersed recreation and grazing operations (see Recreation [Section 3.4.3] and Rangelands [Section 3.3.3], respectively, for additional information and findings).

During the operational phase, increased density in the development area and increased scientific use of the area for both atmospheric and astronomical research would be entirely consistent with the mission and intended use of the Langmuir Research Site.

Utility Options

Improvements would be required to provide electricity, telecommunications, and water to the project site to serve increased demand created by new facilities and additional workers.

Under Utility Option 1, the existing power supply corridor from Muleshoe Canyon through Management Areas 7 and 16 would be used for expanded water, electric, and communication services. A new well would be drilled at Hardy Spring, and water would be pumped to the ridge through a 1.5-inch (3.8 cm) diameter surface pipe (see Water

Resources [Section 3.2.2] for more information). Since a right-of-way currently exists along this corridor, expanded use of the corridor would continue to be consistent with Management Area 7 and 16 land use allocations (USFS 1985).

Under Utility Options 2 and 3, electric and communication provisions would be the same as under Option 1 (along the existing right-of-way) where they would not conflict with current land use designations. Under Options 2 and 3, water would be pumped from the surface water sources in Sawmill Canyon currently used to supply water to the Langmuir Laboratory, but the alignment of the overground pipe (Option 2) would be rerouted along a more accessible alignment (see Map 2-2). This reroute could change approximately 0.5 acre of timberland to a utility easement. Since the new water alignment falls completely within the Langmuir Research Site/Management Area 7, and would not pass through any private lands, it would be consistent with land use designations (USFS 1985). A new trench under Option 3 (from Langmuir Laboratory to the proposed MRO complex) would be placed in the existing roadbed on the ridge, therefore not committing additional land to infrastructure uses.

Under all utility options, the existing power supply to the ridge would be upgraded to 14,000 volts, three-phase from the existing 7,200-volt, single phase. The need for energy requiring the upgrade would contribute incrementally to the demand for energy in the region, but no significant impacts due to the Proposed Action on the capacity of these systems or on the local service providers are anticipated.

For all utility options, the Proposed Action would also extend telecommunication infrastructure along existing overhead power lines to the ridgetop to support research activities and facilities. Both copper and fiber optics lines would be added. The capacity of local service would not be adversely impacted by proposed improvements.

The Proposed Action would increase demand for wastewater and sewage removal. This increased demand would be met with improvements associated with new buildings including additional septic tank and leach fields near the proposed Operations Center, the Main Telescope, and Interferometer Array site. The proposed systems are expected to address site needs adequately and would impose no adverse impact to land use.

Water Canyon Road

The use of Water Canyon Road to provide access to the proposed MRO would be consistent with land use designations along the corridor located in Management Areas 7, 12, 13, and 16 (USFS 1985). Consistency with other Forest Plans and Policies is addressed in Transportation (Section 3.2.6). Maintenance and repair of the 8-mile (13-km) road could convert about 6 acres from current multiple use access to roadway features. Much of this roadside land has low value for recreation or grazing due to proximity to the road and would not impact multiple use objectives.

Use of Water Canyon Road has the potential to conflict with two private landholdings along the road corridor. Although the road has been used by the Forest Service, NMIMT, and the public to access the ridgetop and trailheads since it was created, legal access across the private lands for the public still needs to be acquired. This potential impact would not be considered significant since the functional use of the remaining private property and access to that property would remain unchanged or would be improved.

Maintenance and repair activities and transportation of materials and persons to the ridgetop would result in temporary closures of Water Canyon Road to protect public health and safety. Access to both public and private lands along the road corridor would be restricted when these closures are necessary. This access constraint would be expected to be a temporary inconvenience, not a significant impact. Related details are described in Transportation (Section 3.2.6) and Recreation (Section 3.4.3). The Forest Service would continue coordination with tribal groups that may need access for specific sacred or traditional uses. Arrangements would be made to provide access for grazing permit holders, as needed.

Operational Phase

Proposed MRO operations would have no additional impacts on lands and realty.

Indirect Impacts

Growth inducement and related impacts associated with the site development would not be expected because the site is surrounded by Forest Service land that is not available for development. Furthermore, the proposed use of the site would generate limited or no need for additional infrastructure development because the proposed facilities would serve their own needs.

Alternative 2: No Action

Alternative 2 would allow existing ridgetop land uses, minor facilities improvements, and current operations of the Langmuir Laboratory and associated facilities to remain as they now exist. Demolition and clean up activities would continue as per the existing SUP, including the dismantling of the astronomy tower as funding becomes available. General maintenance may involve some clearing of vegetation needed for removal and clean up of facilities. Other facilities and equipment that are no longer in use are also to be removed under the permit as funding allows.

Under Alternative 2, no new or expanded development would take place within the allocated utility corridors. This includes the existing aboveground power line from Muleshoe Canyon that carries Socorro Electric Power and New Mexico Telecommunication lines to the Langmuir Laboratory and the aboveground water lines, which pump surface water from Sawmill Canyon as provided for in the SUP. Use of these existing utility corridors would remain consistent with both the LRMP and the SUP. No land use changes would be expected. Under the existing SUP, repairs and replacement to Langmuir's water supply system are being undertaken and will result in improved reliability of the existing water supply.

Under Alternative 2, Water Canyon Road would continue to be maintained and repaired to Forest Service standards. Ongoing maintenance and repair would address deteriorated conditions of the surface of the roadway and improve safety. The access road would continue to cross two private landholdings with no legal right-of-way. Legal access through these parcels would be sought and the functional use of the remaining private property and access to that property would remain unchanged so there would be no land use impact.

There are no indirect land use or realty impacts associated with Alternative 2.

Alternative 3: Preferred Alternative

Direct and indirect impacts under Alternative 3 would be identical to those under Alternative 1.

Alternative 4

Direct and indirect impacts under Alternative 4 would be identical to those under Alternatives 1 and 3.

3.4.1.3 Cumulative Impacts

There are no other reasonably foreseeable land use or realty actions planned for the project area. Therefore, development of the proposed MRO would not contribute to cumulative impacts under Alternative 1, 3, or 4.

Under Alternative 2, proposed MRO-related construction and operations would not contribute to cumulative impacts on lands and realty.

3.4.1.4 Mitigation

Legal rights-of-way would be sought across two private landholdings along Water Canyon Road.

3.4.2 Visual Resources

3.4.2.1 Affected Environment

Region of Influence

The project area lies within the Magdalena Mountains Geographic Area of the CNF and falls primarily within the 1,000-acre PRF on Magdalena Ridge. The PRF is part of the 31,000-acre Langmuir Research Site set aside by Congress in 1980 (P.L. 96-550) for the purpose of encouraging scientific research into atmospheric processes and astronomical phenomena. Visual areas of influence include Magdalena Ridge, Water Canyon Road, and surrounding areas with views of the proposed construction areas including US 60, Highway 107, FRs, and trails in the vicinity. The Magdalena Mountains are one of the key visual elements in the landscape for the residents of the Village of Magdalena and the Town of Socorro, as well as the Alamo Navajo tribe, local ranchers, highway travelers, and visitors to the area. The visual quality of the mountains has been altered to varying degrees from its original state by timber harvest, road construction, farming, vegetation manipulation, mineral exploration and production, and the construction of utility corridors.

Existing Conditions

Magdalena Ridge is located at an elevation of over 10,000 feet (3,048 m) approximately 25 miles (40 km) west of Socorro, New Mexico. The ridge runs north-south, with South Baldy Peak marking the northernmost point. The elevation of South Baldy Peak is 10,783 feet (3,287 m), making the peak a major background landscape element visible from much of the surrounding area, including the towns of Socorro and Magdalena. Beyond the ridgeline, the terrain slopes off to deep canyons along both the east and west flanks. Approximately 3,000 feet (914 m) to the south of South Baldy Peak, at an elevation of about 10,400 feet (3,170 m), the ridge divides to the southeast and to the west. The southeasterly projection of the mountain climbs to its terminus at an elevation of about 10,500 feet (3,200 m) mean sea level (MSL). At the far end of the west ridge is a small knoll separated from the main ridge by a lower lying saddle (10,350 feet [3,155 m]). The west knoll is located at an elevation of 10,400 feet (3,170 m). Tree lines along most of the mountaintop perimeter are well off of the ridge. Steep forested ridges and deep canyons surround the ridgetop. This rugged topography provides visual screening of the project site from many vantage points.

Visual Management System

To address the visual quality and aesthetics in the CNF, each ranger district used the 1974 Visual Management System (VMS) (USFS 1973, 1974) to analyze the visual conditions of the CNF in 1978. The VMS evaluates characteristics of the landscape and determines their overall importance to the visual quality in the area. The VMS further outlines the process for landscape evaluation and provides measurable standards for management. The factors used to determine visual quality include “Character Type” and “Variety Class,” which address the aesthetics of physical features of the landscape. Another factor used to determine visual quality is “Sensitivity Level,” which determines the public’s concern for the visual quality in the area expressed in terms of the number of viewers who are able to view the area and the background and expectations of those viewers. The VMS process is used to establish "Visual Quality Objectives" (VQOs) to define how the landscape will be managed as well as the degrees of acceptable alteration of the area.

Visual Quality Objectives on the Project Site

The Langmuir Research site as a whole is 75 percent in a "partial retention" VQO and 25 percent in a modification VQO. These terms are defined as follows:

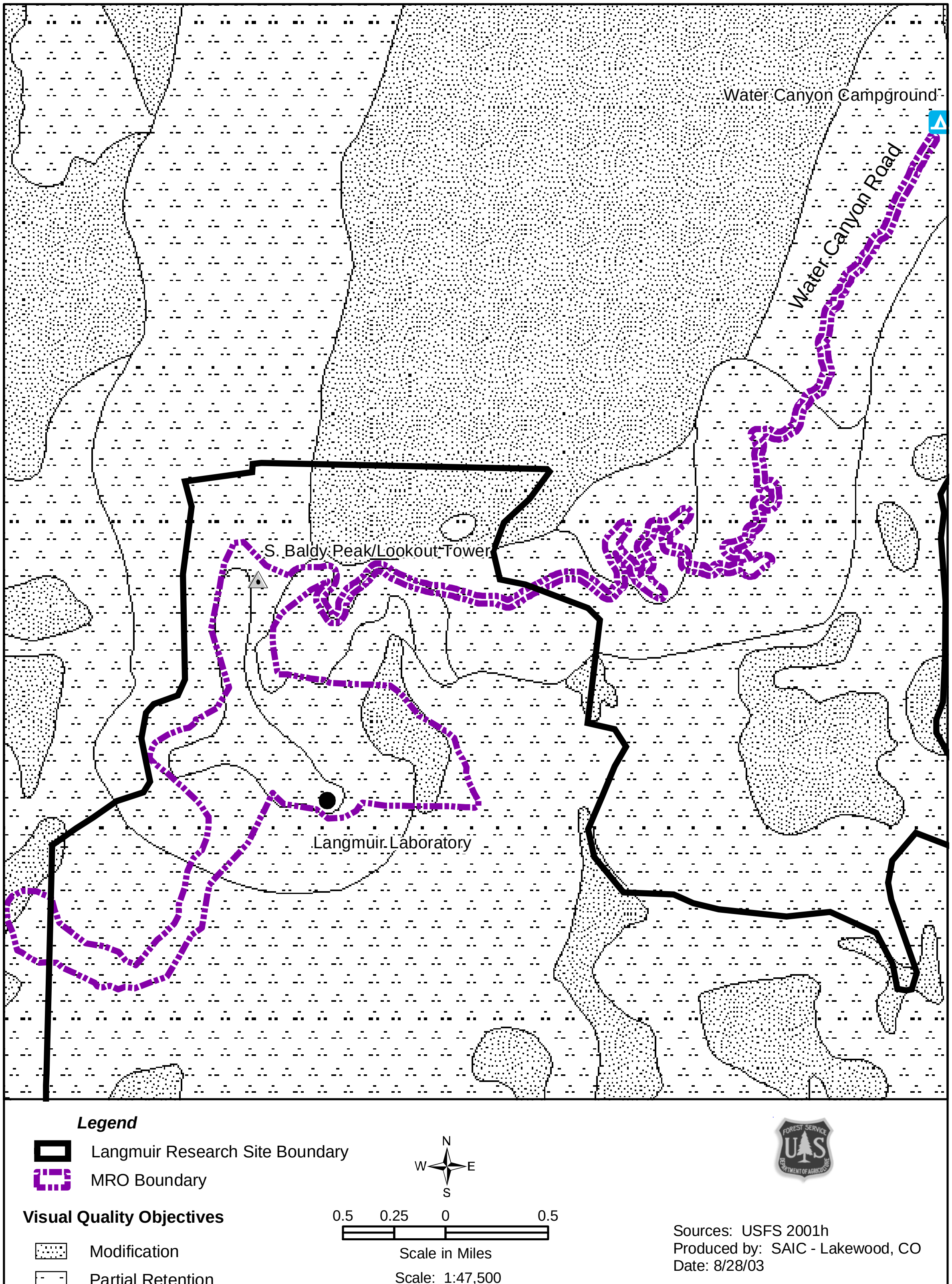
- Partial Retention: Management activities remain *visually subordinate* to the characteristic landscape. Activities may repeat form, line, color, or texture common to the characteristic landscape; and
- Modification: Management activities may visually dominate the original characteristic landscape. However, activities of vegetative and land form alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character types.

The majority of the area of potential project activities is allocated to partial retention (889 acres) with two small parcels designated as modification (91 acres). The VQO designation for the project area and surrounding lands is shown in **Map 3-16**. The Forest Plan contains management requirements to maintain VQOs at current inventory objectives with emphasis on maintenance of retention and partial retention VQOs.

Scenery Management System

The CNF is in the process of converting from the VMS to the SMS (USFS 1995), and it is Forest Service policy to use SMS to replace the VMS whenever a project of sufficient scope presents the opportunity. Conceptually, the SMS differs from the VMS in that it increases the role of constituents throughout the inventory and planning process, and it borrows from and is integrated with the basic concepts and terminology of Ecosystem Management. Like the VMS, the process involves identifying naturally evolving scenery components and their relationship to the viewing public, mapping these components, and developing a value unit for aesthetics from the data gathered. The SMS includes the cultural/social dimension of ecosystem management and expresses the biological and physical dimensions at various scales.

It is possible by using existing VMS classifications to determine what the SMS of the area would likely be, given a direct translation from VMS to SMS. Assuming the existing scenic conditions are consistent with those used to develop the VQOs, then the "cross-walk" from VMS VQOs to SMS Scenic Integrity Objectives (SIO) is as shown in **Table 3-27**.



Scale: 1:47,500
Projection: UTM, Zone 13, NAD 1927

Sources: USFS 2001h
Produced by: SAIC - Lakewood, CO
Date: 8/28/03

Map 3-16
Visual Quality Objectives in the Vicinity of the Project Area

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Table 3-27. Conversion of VQO to SIO Classifications

VMS	SMS	Definition of SMS
Preservation	Very High	Unaltered
Retention	High	Appears Unaltered
Partial Retention	Moderate	Appears Slightly Altered
Modification	Low	Appears Moderately Altered
Maximum Modification	Very Low	Appears Heavily Altered

Source: USFS 1995.

The definitions would be as follows (USFS 1995):

<u>Low Scenic Integrity Objective (25 percent of area)</u>:

> Landscapes where the valued landscape character "appears moderately altered." Deviations begin to dominate the valued landscape character being viewed; but they borrow valued attributes such as size, shape, edge effect, pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but also appear compatible or complimentary to the character.

<u>Moderate Scenic Integrity Objective (75 percent of area)</u>:

> Landscapes where the valued landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being viewed.

<u>Ridgetop Facilities</u>

The Langmuir site, operated under a special land use permit since 1980, is designated as an atmospheric and astronomical research area. As a result, modification of the natural landscape through clearing and construction of various types of structures and access ways has occurred. A number of long-standing structures and facilities exist within the 1,000-acre PRF within the Langmuir Research site in the vicinity of the project area on South Baldy, including:

- Main Langmuir Building and Visitor Center, Langmuir Annex, and A-Frame Dormitory;
- Balloon Hangar, associated trailers, and radiosonde receiver;
- NMIMT Remote Observatory (formerly JOCR), including a rocket launching and instrument platform and an instrument tower to the north;
- West Knoll, including an instrument trailer, rocket storage container, and rocket launching pad;
- The Kivas (I and II): underground metal rooms for the study of electromagnetic radiation from lightning, complete with diesel generators;
- Socorro Electric Co-Op power line to the main buildings, West Knoll, Balloon Hangar, and the Remote Observatory;

- Power and signal lines from the main buildings to West Knoll, Balloon Hangar, Remote Observatory, and the Kivas;
- Water feed from Sawmill Canyon to the Main Langmuir Building;
- Two 150-kW diesel generators in Quonset bunkers;
- Storage yard, including trailers;
- Supernova telescope facilities;
- Instrument trailer at Microphone Hill; and
- Miscellaneous debris.

Figure 3-2 illustrates the geographic coverage of existing structures along with photos, which present a visual account of the more dominant structures upon the ridge. Generally, although the project area is visible from a number of locations in all viewing distances, existing structures are only visible from the foreground and middle ground and, even then, are often obscured by the variable terrain and dense tree cover. The only exceptions are the JOCR building, which can be seen from Highway 107, and sun glare off of the metallic surface of the Langmuir Laboratory building, which is occasionally visible along US 60. The research facilities cannot be seen from either Socorro or Magdalena.

Existing facilities within the proposed site were not constructed in consideration of either the *Partial Retention* or *Modification* categories. The Forest Plan does, however, make allowances for structures required for research purposes as designated in the SUP (USFS 1985).

Utility Corridors

An existing utility right-of-way exists along the southwest slopes of Magdalena Ridge. This corridor carries overhead Socorro Electric power lines past Hardy Canyon and up to the Langmuir Laboratory. Underground power lines feed the numerous facilities on the ridge. A second utility corridor carries water from Sawmill Canyon up the southeast slope to Langmuir Laboratory via aboveground pipes. The existing utility corridors are visible from the ridgetop but generally remain visually subordinate to the surrounding landscape. Both corridors meet the current prescribed VQOs.

Access Route

Water Canyon Road (FR 235) provides the sole access route following the ridgeline up to the northeast face of South Baldy Peak and the existing facilities (see Transportation [Section 3.2.6] for more information). The access road is visible only from foreground and middle ground viewing distances from the ridgetop and along the road itself. The road is primitive and unpaved through its upper extent so the visual characteristics are reasonably subordinate to the natural landscape and meet the current prescribed VQOs. However, the road was not built in consideration of visual quality but was essentially pioneered in where access was possible.

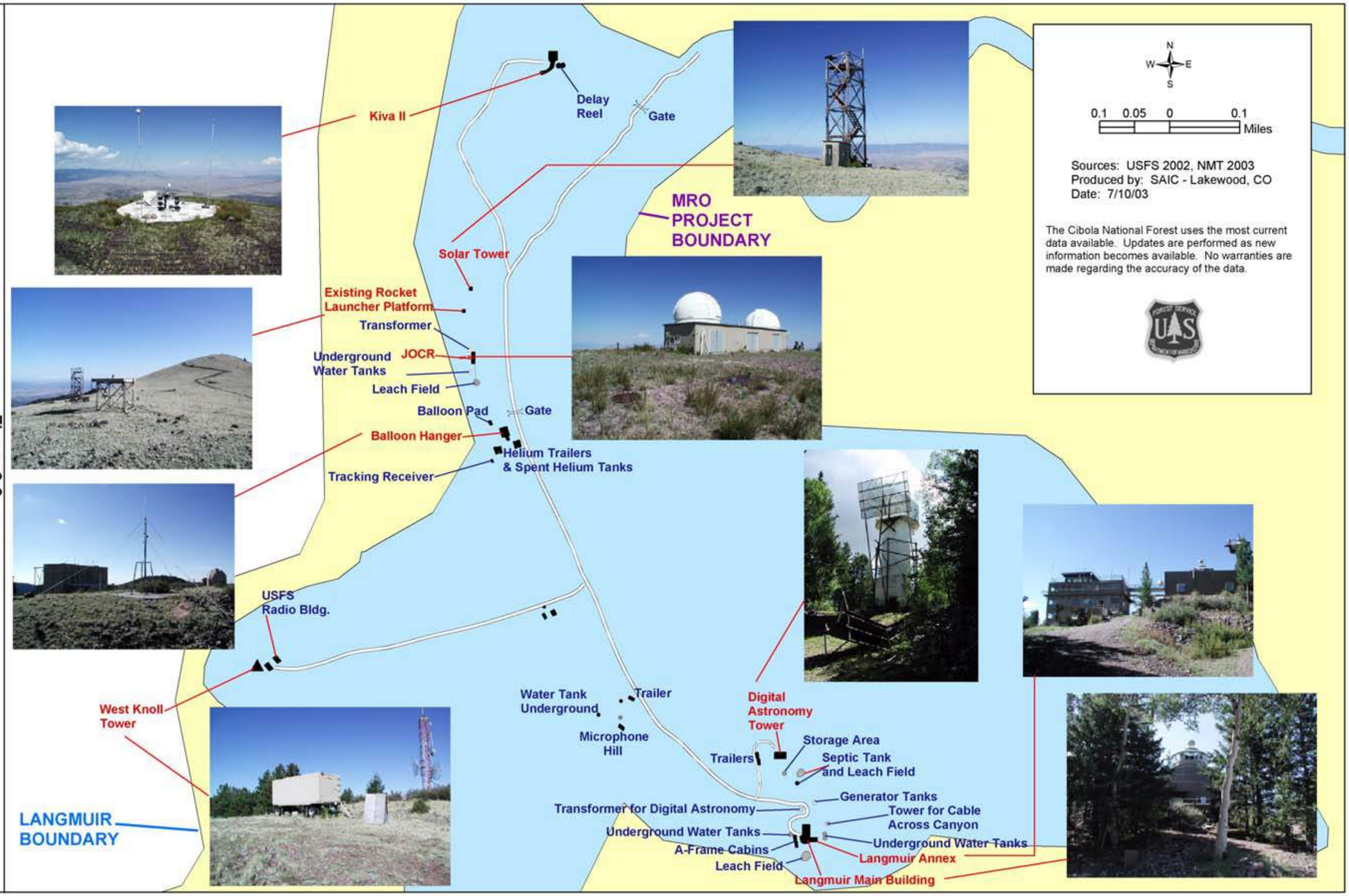


Figure 3-2
Photographs of Existing Structures in the Project Area

3.4.2.2 Environmental Consequences

Method of Analysis

The Forest Service's VMS was used as the basis for the visual resources assessment and VQOs for the Magdalena Mountains Geographic Area (USFS 1973, 1974). Assumptions relative to the newer SMS and the associated SIOs were made based upon a "crosswalk" between VQO and SIO values as presented in Table 3-27 (see Affected Environment in Section 3.4.2.1). These planning tools are considered in the following impact analysis.

The visual impact analysis is focused on three primary factors: 1) assessment of the terrain; 2) viewing distance; and 3) the construction actions under each alternative (e.g., for buildings, utility corridors, and road reconstruction). These Forest Service viewing distances are used: foreground is within 0.25 to 0.5 mile (0.4 to 0.8 km) of the viewer; middle ground is from the foreground (0.5 mile [0.8 km]) to within about 5 miles (8 km) of the viewer; and background is over 5 miles (8 km) from the viewer. These definitions are presented in the Forest Service VMS guidelines for visual resource management (USFS 1973, 1974).

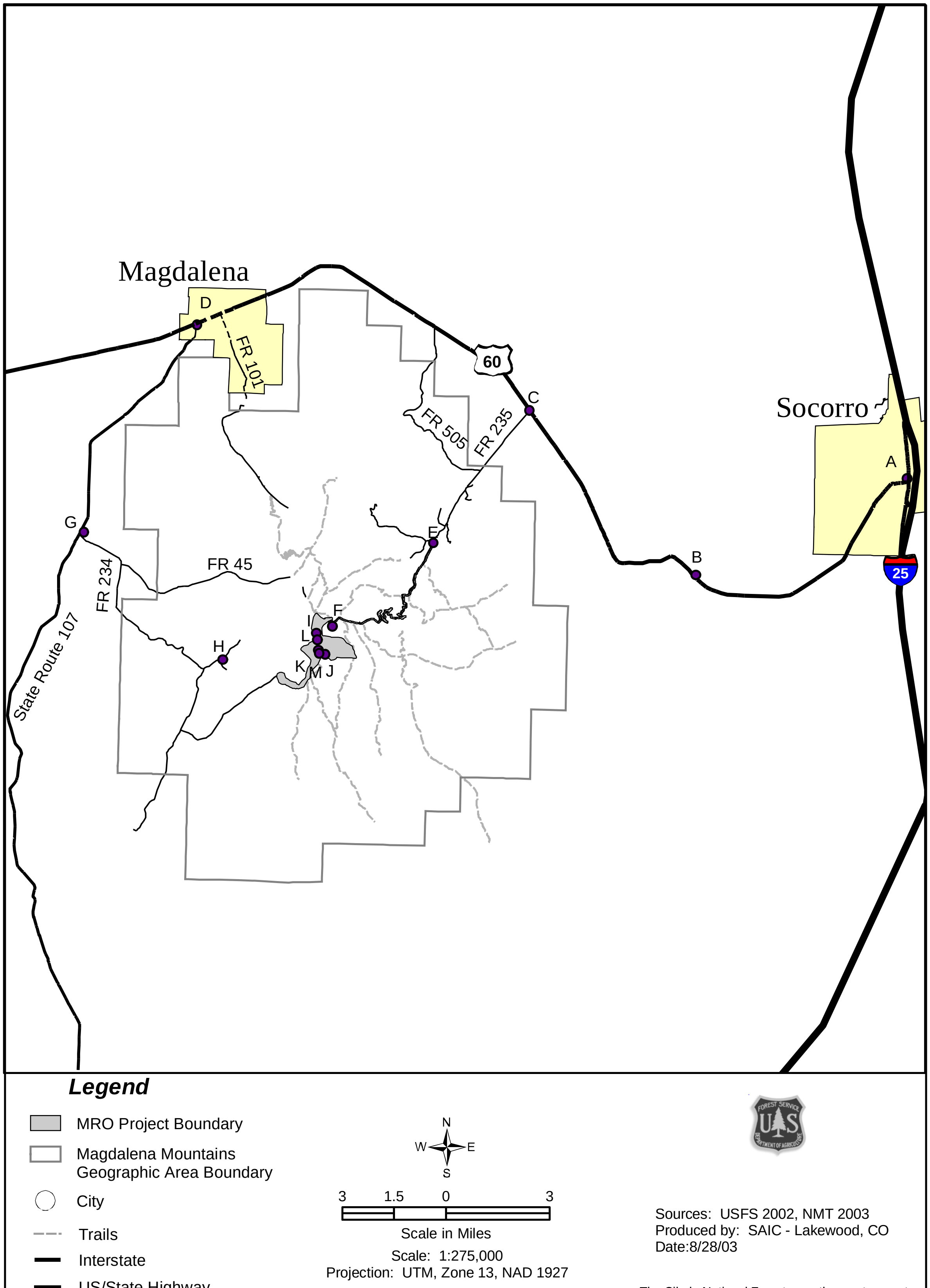
For the visual analysis of the Proposed Action, the Forest Service selected 16 potential vantage points for the foreground (0.25 to 0.5 mile [0.4 to 0.8 km]) and background (5 miles [8 km] to infinity) viewing distances (**Map 3-17**). Five (5) additional vantage points were defined for middle ground viewing distances (0.5 to 5 miles [0.8 to 8 km]). A GIS "seen areas" analysis was used whereby locations, heights of proposed structures, distances, and viewing angles are all calculated using a terrain model to determine locations of potential vantage points. All 21 potential vantage points were then field surveyed to determine actual site visibility.

From the points surveyed, a total of 13 were selected as a representative sample of viewing distances and angles (see **Figure 3-3** for vantage point locations). **Table 3-28** characterizes the vantage points as foreground, middle ground or background.

Table 3-28. Vantage Points by Viewing Distance Type

Viewing Distance	Vantage Point
Foreground	I, J, K, and L
Middle Ground	F and M
Background	A, B, C, D, E, G, and H

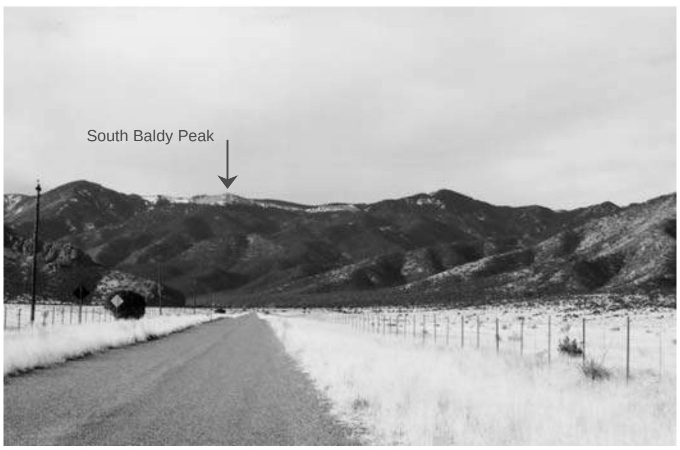
Note: Vantage points shown in Map 3-16.



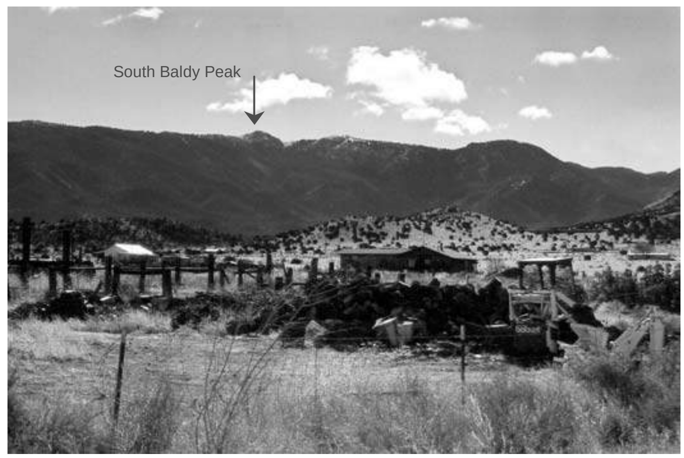
Map 3-17
Visual Analysis Points

A. Magdalena Ridge from Socorro (intersection of California and Spring Street)

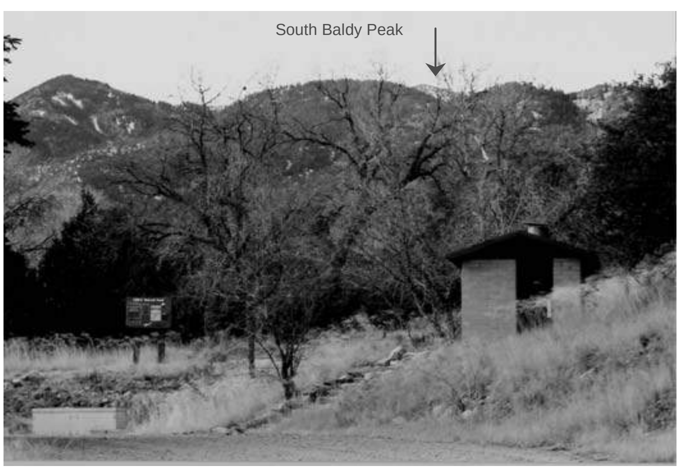
B. Magdalena Ridge from US 60 turnout



C. Magdalena Ridge from US 60/Water Canyon Road intersection



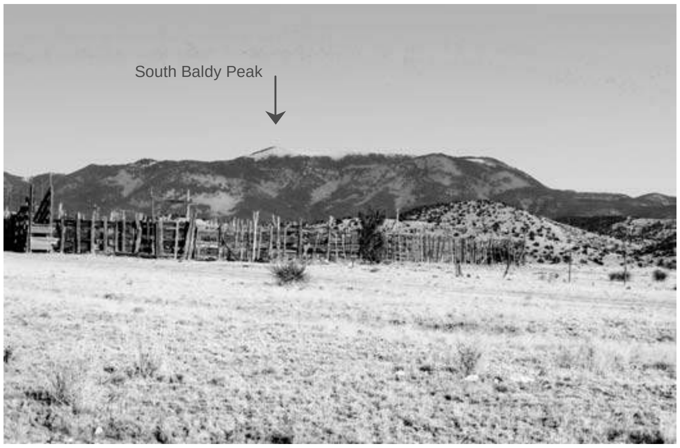
D. Magdalena Ridge from Magdalena (US 60/Hwy 107 intersection)



E. Magdalena Ridge from Water Canyon Campground

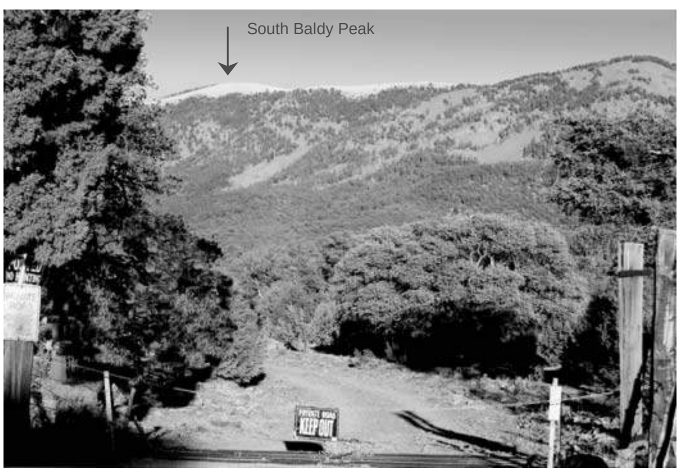
F. Magdalena Ridge from Water Canyon Road

Figure 3-3. Site Views from Key Vantage Points (A–F)



G. Magdalena Ridge from Hwy 107/FR 234 intersection

G. (Zoom). Magdalena Ridge from Hwy 107/FR 234 Intersection



H. Magdalena Ridge from FR 234 (intersection with private land)

H. (Zoom). Magdalena Ridge from FR 234

Figure 3-3. Site Views from Key Vantage Points (G and H)

I. Alternative 1, proposed site of Operations Center, view from gate

J. Alternative 3, proposed site of Operations Center, view from bottom of Langmuir access road

K. Proposed site of Interferometer, view from existing Balloon Hangar

L. Alternative 4, proposed site of Operations Center, view from existing JOCR site

M. Existing Utility Corridor, view from ridge top

M. (Zoom). Existing Utility Corridor

Figure 3-3. Site Views from Key Vantage Points (I–M)

The visual impact analysis focuses on proposed construction of new facilities and the heights of future structures. Heights of the proposed structures are listed in **Table 3-29**.

Table 3-29. Heights of Proposed Structures

Structure	Approximate Height (feet)
Large Telescope Pair and Combining Building: Pair Garage Building	20 25
2.4-meter Single Telescope (enclosure): Access way tunnel Support Building	38 10 12
Main Operations Building (1 story) (Alt. 3 and 4)	16
Main Operations Building (2 story) (Alt. 1 only)	32
Interferometer Array (enclosures): Array travel crane Beam-Combining Facility Array Garage	20 35 13 20
Sprung Building (temporary structure)	22

Source: Howell 2003.

Alternative 1: Proposed Action

Direct Impacts

Direct impacts to visual resources are those associated with any immediate physical changes to the resources that would result from construction and operations associated with proposed improvements or activities.

Construction Phase

Ridgetop

The Proposed Action would introduce visually contrasting elements (human-caused, introduced, unnatural forms, lines, colors, and textures) to the ridgetop including:

- Grading/ground disturbance;
- Construction of roads and parking areas;
- Clearing and removal of vegetation;
- Fencing of science areas;
- Construction of buildings and telescope arrays;
- Demolition and clean up of existing facilities and debris; and
- Construction of temporary staging areas.

Proposed ridgetop modifications and construction are detailed in Table 2-1. Locations of the new facilities and rerouted ridgetop roads under Alternative 1 are displayed in Map 2-1. Sixteen (16) photographs are presented in Figure 3-3 to characterize the views of the site, proposed buildings, telescopes, and other site facilities and features from 13 key vantage points.

The new facilities associated with Alternative 1 and the other alternatives would be located between the main Langmuir Laboratory and South Baldy Peak along the broad, flat areas of the ridgeline. This area has low vegetation screening so aboveground structures silhouetted against the sky would become visually dominant with respect to foreground vantage points. All new development on the ridgetop, therefore, would contrast in form, line, color, and texture with the environmental setting, adding to the built character of the ridge from foreground viewing distances. From middle ground and background viewing distances, existing topography would provide visual screening from most vantage points. Proposed facilities would not be visible from either Socorro or Magdalena (Figure 3-3, Photographs A and D).

Construction of ridgetop facilities under Alternative 1 would not comply with the VQO designation of Partial Retention making development on the ridge further out of compliance with the prescribed VQO for the area (USFS 1973, 1974). Ridgetop facilities would also conflict with the "crosswalk" SMS SIO designation of Moderate (appears slightly altered) (USFS 1995). However, these policy conflicts would not be considered significant because the pending reevaluation of the site under the SMS will take existing features and the scientific purpose of Magdalena Ridge into consideration. The unique nature of the site for research and celestial observation justifies applying a special "landscape character" under SMS, which would encompass the built elements as well as the natural setting. Following future analysis and the Forest Plan amendments that encompass SMS evaluations, all constructed scientific elements in the designated area would be suited and would achieve appropriate scenic objectives. Consequently, future development of the ridge may ultimately be consistent with future CNF policy.

Specific impacts for the primary facilities and structures associated with Alternative 1 are discussed below.

Operations Center

Under Alternative 1, the Operations Center, water storage tanks, electric substation, and fuels Storage Facility would be located directly to the east of the existing JOCR building (Figure 3-3, Photograph I). The Operations Center would be a two-story structure (approximately 32 feet [10 m] tall) with a 18,600-sf (1,728-sm) footprint. The building would be offset from the apex of the ridge and partially sunk into the mountainside, which would minimize its visibility from background viewing locations, such as those along US 60 and Water Canyon Road (Figure 3-3, Photographs B and C). Glass window panels would be coated, which would lessen the potential for glint and glare. The Operations Center would be visible from sites along the upper reaches of Water Canyon Road (middle ground vantage points. Occasional glint or glare would be visible from US 60 (background vantage points), as is the case currently with the Langmuir Laboratory. The frequency and duration of this potential incremental impact would be minimal.

Main Telescope

The existing JOCR building and telescope housing (Figure 3-3, Photograph I) would be demolished. A new telescope with a 7.9-foot (2.4-meter) diameter mirror (main telescope) would be erected in its location. Although the new telescope (about a 30-foot [9.1-m] diameter structure with a 38-foot [11.6-m] domed roof) would be larger than the existing double-domed JOCR structure, additional visual impacts would be negligible. The new structure would be visible as a distant background object from the same viewing distances and locations along Highway 107 and FR 234 as the current JOCR building (see Figure 3-3, Photographs G and H). As with the JOCR building, the structure would not be obvious to the casual observer from this vantage point. The dome would also be painted a color that would minimize visibility.

Interferometer Array

The Interferometer Array, Interferometer Support Facility, Site Characterization Facility, and Storage Facility would be located to the south of the Operations Center and Main Telescope (Figure 3-3, Photograph K). Although the array would be positioned on a broad, flat portion of the ridgetop, vegetative screening would obstruct its visibility from most middle ground and background vantage points. The only exception would be when a telescope is placed at the furthest pad on the westernmost arm, where it may be visible as a distant background object along Highway 107 and FR 234. As with the main telescope, the structure would not be obvious to the casual observer.

Temporary Structure

This 22-foot tall structure has a light-colored fabric covering. It is used occasionally at the Langmuir Research Site and is moveable. The location proposed would not be visible from distant viewing spots but would be visible to persons touring or walking through the site. This would be similar to current structures at the Langmuir Research Site.

Roads and Parking

The Proposed Action includes expanded parking and rerouted roads on the ridgetop for the new facilities. Four small gravel parking areas would be constructed next to the Operations Center, Interferometer Array, 7.9-foot (2.4-meter) telescope, and Storage Facility. Roadways leading to Langmuir Laboratory and West Knoll would be rerouted around the arms of the array (total of 1 mile of new road), and the old road alignment would be revegetated. The roads and parking areas would not be visible from middle ground or background vantage points.

Tree Removal

Removal of up to 80 trees along the east side of the ridge and along Water Canyon Road may be noticeable in the foreground when traveling along the ridge road. However, the removal would be along the edge of the tree line and would slightly alter the location of the Forest edge. Visually, from middle distance vantage points, this would be a minor modification since the new forest edge would have the same linear appearance as the old one and would only extend for about 800 feet (244 m). Removal of felled trees would minimize the impact of dead trees littering the Forest floor and would not alter the character or degree of modification of the road corridor. The overall visual impact would be minor and with mitigation (see Section 3.4.3.4) would, over time, be unnoticeable in the future.

Night Lighting

An initial Lighting Plan has been in development for the proposed MRO. It provides for the following measures to protect the dark skies required for scientific experiments:

- Outdoor lighting at the proposed MRO will use full-cutoff fixtures whenever possible. Full-cutoff fixtures allow light to go downward and outward, but allow no light to travel horizontally or above horizontally.
- Lighting at the proposed MRO will have the minimum brightness needed to do the job. This may mean that some lights will have dimmer switches.
- Unneeded lights will be turned off. This can be automated with the use of motion sensors and timers.
- Mercury vapor lamps will be avoided whenever possible because their blue light is easily scattered in unintended directions.
- Labs and offices that must be staffed at night will have light-blocking blinds or curtains so that the indoor light does not get outdoors.
- Vehicles that must be driven above the gate will be capable of being driven using parking lights only. This may require special modification, and will require a strict, low, nighttime speed limit.

Utility Options

Utility Option 1 would have minimal impacts on visual resources. Expanded electrical and telecommunication lines would be added to the existing poles; therefore, no change would be noticeable. A well would be drilled at Hardy Spring and water would be pumped along the existing power supply corridor to the ridge in a 1.5-inch (3.8-cm) surface pipe. The water line would require no clearing and the pipe would be inconspicuous along most of the corridor due to topographic screening, established vegetation along the majority of the corridor, and pipe materials (galvanized steel) which would oxidize and blend with the natural landscape. Where the pipeline is visible, the existing electric utility poles would dominate the view (Figure 3-3, Photograph M). At the point where utilities, including the water supply pipeline, reach the ridge, all utility infrastructure necessary to maintain the proposed development would be installed below the ground under existing and planned roads, negating the visual impact of utilities on the ridgetop itself.

Under Option 2, electrical and telecommunication lines would be identical to Option 1 and would have no additional visual resource impact. Under Options 2 and 3, water would be pumped from the spring currently used for Langmuir Laboratory. The new water pipeline alignment for Option 2 would not require clearing a new corridor and would be installed around and within the existing vegetation. Pipe would not be visible from viewing locations along the road or trails as it would be screened by topography and vegetation. Trenching within the roadbed from Langmuir Laboratory to proposed water storage tanks would not change the existing visual condition under Option 3.

Water Canyon Road

The corridor of Water Canyon Road would remain unchanged as would the "primitive" quality of the road. In accordance with Forest Service direction and policy, the road would remain unpaved. The existing VQO for Water Canyon Road is Partial Retention meaning that management activities must remain visually subordinate to the characteristic landscape and that all visual impacts must be reduced as soon after project completion as possible within the first year.

Any maintenance and repair of Water Canyon Road would take place within 74 feet (22.5 meters) to the left and right side of the road centerline from Water Canyon Campground to the base of Langmuir Laboratory. The total area of disturbance could be approximately 24 acres, with half (12 acres) occurring outside the roadbed. Visual impacts resulting from road maintenance and repair would be minimal from middle ground and background vantage points, as the corridor is already an established linear feature in the landscape. From foreground vantage points, road work would be noticeable to travelers along Water Canyon Road, but would not be out of context with the already-modified road corridor. Therefore, visual impacts would be minimal.

Operational Phase

The operational phase of the proposed MRO would not add any new visual impacts. The modifications caused by permanent structures would continue, but the additional ground disturbance caused by construction activities would recover after time with revegetation.

Indirect Impacts

With the exception of a small increased risk of human-caused fire, which could change the landscape, there would be no indirect visual impacts associated with the Proposed Action.

Alternative 2: No Action

Under Alternative 2, there would be no additional visual impacts due to the proposed MRO. Existing buildings on Magdalena Ridge (including Langmuir Laboratory, the JOCR, Balloon Hanger, and other associated structures) would remain in place. Existing conflicts with prescribed VQOs would continue until SMS policies and reevaluation consider the existing development. Under the existing Langmuir Laboratory SUP, and as funding becomes available, the astronomy tower would be dismantled, and facilities and equipment that are no longer in use would be removed. Removal of facilities and equipment would incrementally improve the visual quality of the ridgetop by returning associated lands to a more natural state. Utility corridors would not be altered and would continue to meet prescribed VQOs.

Periodic maintenance and repair of Water Canyon Road would continue under this alternative. The impact would be as described for Alternative 1.

Alternative 3: Preferred Alternative

Alternative 3 differs from Alternative 1 (Proposed Action) in the location, heights and number of new facilities on the ridge and would have minimal differences in visual impact (Map 2-3). Locations of the new facilities and rerouted ridgetop roads under Alternative 1 are displayed in Map 2-1.

Alternative 3 would result in less overall impact to ridgetop scenic resources from foreground vantage points than Alternative 1 because it would cluster the Operations Center and support facilities in a central location around the existing West Knoll Road/Water Canyon Road intersection and the Interferometer Array site (see Map 2-3 and Figure 3-3, Photograph J). Locations of the Main Telescope and Interferometer Array would be identical to those under the Proposed Action. Under Alternative 3, the Operations Center would be a single story building (16 feet [2.4 m] tall) with a smaller footprint (9,800 sf [910 sm]) reducing the visibility of the building from middle ground and background viewing locations. Vegetative screening would also reduce the visibility of the Operations Center from vantage points outside the project area. The Interferometer Support Facility would not be necessary since the Operations Center would be in close proximity to the Array. The electric substation would also be downsized. A 1,400-sf (130-sm) support building would be required for the main telescope. All other visual impacts related to ridgetop facilities would be identical to those described for the Proposed Action. Therefore, overall, this alternative would result in slightly less visual impact than would Alternative 1.

Direct and indirect impacts to visual quality along the road and utility corridors under Alternative 3 would be identical to those discussed under Alternative 1.

Alternative 4

Alternative 4 differs from the Proposed Action and the Preferred Alternative in terms of the location of certain facilities on the ridge (Map 2-4). Locations of the new facilities and rerouted ridgetop roads under Alternative 1 are displayed in Map 2-1.

Under Alternative 4, the Operations Center and associated support facilities would be located further north on the ridge near the existing visitor kiosk (see Map 2-4 and Figure 3-3, Photograph L). Locations of the Main Telescope and Interferometer Array (and support facilities) would be identical to the Proposed Action. Under Alternative 4, the Operations Center would be a single story building (16 feet [2.4 m] tall) with a smaller footprint (9,800 sf [910.5 sm]). The location is flatter than that of the Proposed Action location, which would reduce the visibility of the building from off-site locations. The location has minimal topographic and vegetative screening. The facilities would not be clustered as in Alternative 3 leading to a more expansive visual impact from foreground vantage points. The electric substation would be downsized to 1,500 sf (140 sm). A 1,400-sf (130-sm) support building would be required for the main telescope. All other visual impacts related to ridgetop facilities would be identical to those described for the Proposed Action.

Direct and indirect to visual quality along the road and utility corridors under Alternative 4 would be identical to those discussed under Alternative 1 and 3.

3.4.2.3 Cumulative Impacts

The following incremental visual resource impacts would contribute to related cumulative impacts created by past, present, and reasonably foreseeable projects or actions in the area:

- Loss of natural features to manufactured features (buildings, improved roads, institutional facilities and utility corridors) within the landscape.
- Increased visibility of manufactured features from key vantage points.
- Additional facilities and structures on Magdalena Ridge would make the area further out of compliance with currently established VQOs.

Within the existing surrounding landscape, the NRAO's Very Large Array (VLA) is visible in the distance from vantage points on Magdalena Ridge, as are other human-made feature such as roads, fences, and communication towers. All these elements create a landscape context that has large-scale, constructed features within the existing fabric that are nonetheless visually subordinate to the natural context. The proposed MRO would be barely noticeable from distant vantage points, and would be similar to these other features within the landscape context.

General maintenance and repair activities may include some clearing of vegetation, but these would be localized and directly within the context of previously altered landscape (such as along the roadside). This would not change the visual context of the road corridor. Any projects on Forest land involving more extensive changes with new structures or clearing would be assessed and designed to Forest Service standards.

Under Alternative 2, the proposed MRO would not contribute to cumulative impacts on visual resources.

Cumulative impacts under Alternatives 3 and 4 would be identical to those under Alternative 1.

3.4.2.4 Mitigation

Mitigation measures to reduce visual impacts are listed in Table 2-6.

3.4.3 Recreation

3.4.3.1 Affected Environment

Region of Influence

The CNF comprises a collection of dispersed land parcels throughout central and western New Mexico. The CNF landscape is characterized by separate and distinct mountain ranges rising from the lowland deserts generally surrounding the Albuquerque metropolitan area. Lands at lower elevations are characterized by rolling hills cut by sand washes and small canyons. In sharp contrast, prominent canyons and exposed rock faces define the mountain ranges. The diverse landscape of the CNF offers an abundance of recreational opportunities making the area an important regional resource.

The ROI for recreational use encompasses the entire Magdalena Mountains Geographic Area but is specifically focused on the Magdalena ridgetop, Water Canyon Road, Water Canyon Campground, and surrounding trails.

Existing Conditions

Recreation Activities

Dispersed recreation accounts for the largest amount of recreation activity in the CNF and is projected to be the fastest growing segment in the future. Several types of dispersed recreation currently take place throughout the year in the Magdalena Mountains Geographic Area, which includes the Langmuir Research Site and project site. Recreational activities include hunting, camping, hiking, horseback riding, cross-country skiing, ATV use, picnicking, biking, auto touring, sightseeing, wildlife viewing, and gathering of forest products. The Magdalena Mountains Geographic Area is known for its trophy elk herd and has been designated as a quality deer unit by the New Mexico Department of Game and Fish (NMGF). Specific recreation uses related to visual resources and wildlife are discussed in Sections 3.4.2 and 3.3.2, respectively.

Recreation Resources and Use Patterns

Overall, the Magdalena Mountains Geographic Area is described as a quiet, peaceful place to take part in recreational activities (USFS 2002h). Overcrowding, which is an issue in other portions of the CNF, is not an issue here (Carter 2003). The primary recreation resources in and around the project area include Water Canyon Road; Magdalena Ridge; Water Canyon Campground; various trails and trailheads leading through the numerous canyons, mountaintops, and ridges; and supporting infrastructure including parking areas, signage and interpretive displays.

Detailed visitor use numbers are not documented for the Magdalena Mountains Geographic Area, Water Canyon Campground, or Langmuir Research Site.

Langmuir Laboratory and Ridgetop

Langmuir Research Site is a 31,000-acre area within the CNF set aside by Congress in 1980. The primary activity at the Laboratory since its inception has been the study of thunderstorms and lightning. Astronomy, biology, and ecology are also studied at the site (USFS 2002h).

Langmuir is of great interest to the scientific community and is a desirable destination for a few tourists, especially in the summer. The Laboratory welcomes visitors from the end of June through August during the "monsoon season." The facilities provide interested visitors with views through high technology equipment and, at times, observation of ongoing scientific experiments. The Laboratory facilities are closed to the public for the remainder of the year, but the Langmuir Research Site is open year-round for hiking and other permitted recreational activities subject to National Forest regulations. The Forest Plan has designated the Langmuir Laboratory as a "Special Area" for recreation indicating that recreational activities are limited by research needs and safety concerns (USFS 1985). The Langmuir Research Site is closed to ORV use to protect the site and to ensure public safety. A Forest Service information kiosk near the laboratory is available to provide visitor information and to identify the posted closures that are required from time to time by the MRD.

Views from the ridge and South Baldy Peak are also an attraction to visitors (see Visual Resources [Section 3.4.2]). From Magdalena Ridge, visitors can see the VLA to the west. The VLA is one of the world's premier astronomical radio observatories consisting of 27 radio antennas in a **Y**-shaped configuration similar to the configuration of the proposed MRO Interferometer Array, but larger in size.

Water Canyon Road

Water Canyon Road (FR 235) extends approximately 4 miles (6.5 km) from US 60 to Water Canyon Campground and continues from the northeast to the southwest up an additional 8 miles (13 km) of steep grade from the Campground to the top of Magdalena Ridge. This upper portion of the road from Water Canyon Campground to Langmuir Laboratory is included as a popular sightseeing destination in the New Mexico Wildlife Viewing Guide (USFS 2002h). Access to various trailheads and fall color viewing are common uses of the upper stretch of Water Canyon Road.

Water Canyon Campground

Water Canyon Campground, which is located approximately 4 miles (6.5 km) off US 60 on Water Canyon Road (FR 235), was constructed in the 1960s and is open to year-round use. The campground is popular and receives heavy use by Socorro residents. The campground has 16 improved camping sites, picnic sites, grills, trashcans, a small group site, and recently upgraded toilets. Special use authorizations allow large group use of picnic sites (USFS 1985). Camping sites are big enough for recreational vehicles/trailers less than 22 feet (6.7 m) long. There is no potable water.

Long-range plans for current and anticipated use of the campground balance public demands for recreation with resource sustainability and community stability (USFS 1985). Water Canyon Road is currently routed directly through the campground, where it passes through a sensitive canyon and riparian area and crosses the arroyo. Reconstruction of the campground is scheduled to occur in 2005 (Carter 2003). Reconstruction is likely to consist of removing and replacing all tables and grills and the group shelter in order to make the area and its facilities accessible to all users in accordance with the Americans with Disabilities Act.

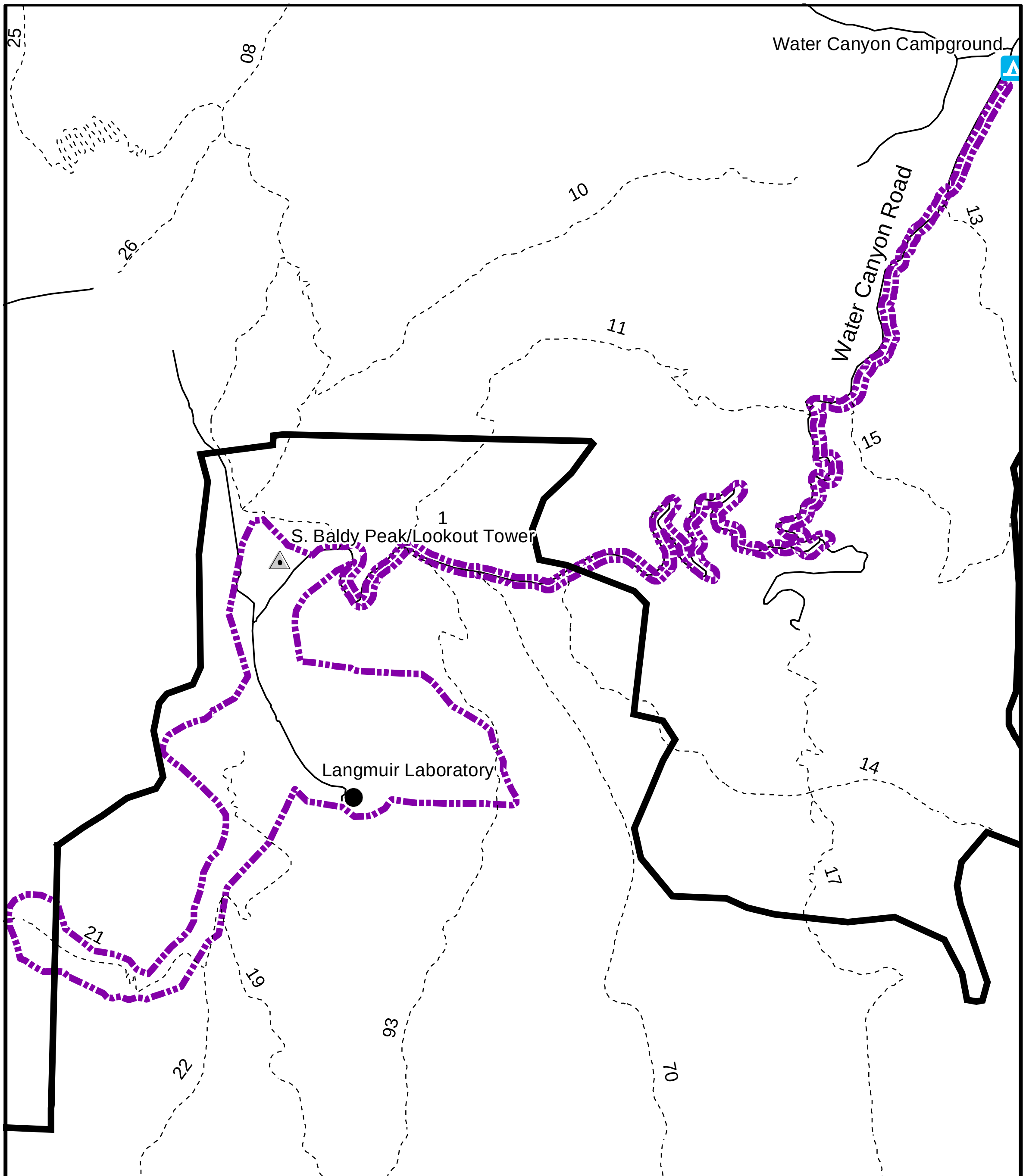
Trails and Trailheads

The trail network in the area is extensive and is composed of a formal system, old mining trails (in the area of Frenchie's Cabin and Mill Canyon), and undesignated trails. Hiking, backpacking, and mountain biking are the most common trail use activities (USFS 1985). Horseback riding is also common on the developed equestrian system. As provided for in the Forest Plan, annual trail maintenance is undertaken by Forest Service personnel and Adopt-A-Trail volunteers (USFS 1985). However, the plan also notes that current management direction does not permit adequate maintenance of trails for the future. The location of trails can be seen in **Map 3-18**. A summary of trails is shown in **Table 3-30**.

Table 3-30. Trails In and Around the Project Area

Name and Trail Number	Length (Miles)	Capacity (Persons at One Time)	Facilities Available
North Baldy 8	5.8	15	Parking lot
Copper Canyon 10	4.3	15	Parking lot
South Baldy 11	2.9	15	Parking lot
Dead Horse 12	0.8	Not available	None
Mesa Trail 13	4.75	15	Gravel parking lot, parking barriers, bulletin board, vault toilets
Sixmile 14	5.5	9	Parking lot
South Canyon 15	5.1	15	Parking lot
Ryan Hill 17	5.1	15	Parking lot
West Fork Sawmill 19	7.2	60	Parking lot
Hardy Spring 21	1.4	15	Parking lot
Hardy Ridge 22	4.1	Not available	None
Hop Canyon 15	7.3	Not available	Parking lot
Mill Canyon 26	0.9	15	Parking lot
Timber Peak 70	5.2	3	Parking lot
East Fork Sawmill 93	4.6	15	Parking lot

Source: USFS 1985.



Legend

Langmuir Research Site Boundary

MRO Boundary

Trails

Forest Route/Road

N
W E
S

0.5 0.25 0 0.5

Scale in Miles

Scale: 1:47,500

Projection: UTM, Zone 13, NAD 1927

Sources: USFS 2001g
Produced by: SAIC - Lakewood, CO
Date: 8/28/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-18
Trails in the Vicinity of the Project Area

Popular formal hiking trails include Trail 8 to the top of the Crest, Trail 25, and Trail 13 (Mesa Trail) from Water Canyon. Trails 8 and 25 are easily accessed from FR 101. The Forest Service is making a loop of these trails, which includes 2.5 miles (4 km) of new trail construction for a total loop length of approximately 9 miles (14.5 km) (USFS 2002h). Trail 13 receives heavy use from Socorro residents and is the only trail with developed trailhead infrastructure including a parking lot, parking barriers, bulletin board, and vault toilets. The trailhead is located off Water Canyon Road approximately 1 mile (1.6 km) above the campground.

A number of trailheads exist within the boundaries of the Langmuir Research Site including Forest Service Trailhead 8: North Baldy; Trailhead 11: South Baldy; Trailhead 14: Sixmile Canyon; Trailhead 19: West Fork Sawmill Canyon; Trailhead 21: Hardy Springs; Trailhead 70: Timber Peak; and Trailhead 93: East Fork of Sawmill Canyon. The final mile of FR 235 (Water Canyon Road) is gated and locked when the laboratory is closed. Trailheads 19 and 21, located within this gated area, are accessible by foot and trailhead parking exists outside the gate. Road conditions and parking are discussed under Transportation (Section 3.2.6).

Future plans include conducting an inventory of all trails and conditions and dropping trails from the system if they are not used or if other trails serve the same purpose (USFS 2002h). Plans also exist to reroute Trail 13 (Mesa Trail) and build two new overlooks along it. Additional parking at trailheads is needed along with more trail system loops.

The Socorro Chamber of Commerce has produced a brochure that shows several undesignated bicycle trails (USFS 2000a). These undesignated routes are not maintained by the Forest Service and are not part of the federally designated trail system. There are no components of the federally designated bicycle trail system in the area.

ATV use of trails occurs in the Magdalena Mountains Geographic Area and has generated public complaints and environmental concerns (USFS 1985). The Langmuir Research Site is closed to ORV use.

Canyons, Mountain Ridges and Peaks

South Baldy Peak and the adjacent ridgetop to the southeast are flanked (from the north clockwise around the peak) by Water Canyon, Sixmile Canyon, Sawmill Canyon, Hardy Canyon, Seven Mile Canyon, and Bear Canyon. All of these canyons are accessible to various degrees by designated trails and FRs, and offer visitors dispersed recreation opportunities. South Baldy Peak and the adjacent ridgetop offer visitors extensive views and the opportunity to see the high technology features associated with the Langmuir Research Site.

Wilderness Areas and Research Natural Areas

There are no WAs within the Magdalena Mountains Geographic Area. Two WAs exist within the nearby San Mateo Mountains: Mount Withington WA and Apache Kid WA. The boundaries of these areas are well beyond the project area—approximately 13 and 20 miles (21 and 32 km) away, respectively.

There are no Research Natural Areas (RNAs) in the Magdalena Mountains Geographic Area. There is, however, an ecological study area that extends from the Sevilleta National Wildlife Refuge, 19 miles (31 km) north of Socorro, to Magdalena Ridge by agreement between the Refuge and NMIMT. The area is being used for a Long-Term Ecological Research Program as a part of the National Ecological Observatory Network (NEON).

Interpretation and Conservation Education

Interpretive signs are planned for two recently developed scenic overlooks on Trail 13 (USFS 1985). Currently, there are interpretive exhibits at the Magdalena Ranger Station, a kiosk at Langmuir, and two interpretive signs at Crest Trail 13. As funding becomes available, the Forest Service has plans to move the visitors' kiosk at Langmuir to the head of Trail 8 and expand the parking at this trailhead (USFS 1985).

Special Events

Each September, the Socorro Fat Tire Fiesta mountain biking event is held in and around the town of Socorro, including portions of the Magdalena Mountains Geographic Area. The event includes a 4,000-foot (1,219-m) vertical hill climb race from Water Canyon Campground to the 10,783-foot (3,287-m) summit of South Baldy (USFS 1985).

Recreation Policy

According to the Forest Management Plan (USFS 1985), the "desired condition for the recreation program includes providing a recreational experience in a natural setting for forest users." The desired condition for the Langmuir Special Area is "providing a quality recreation experience for tourists while meeting the needs of the scientific community."

Recreation Opportunity Spectrum

To meet the goals of the Forest Management Plan, the CNF adopted a methodology called the Recreation Opportunity Spectrum (ROS), which was developed in the late 1970s and is used to apply formal designations for recreation (USFS 1995). The ROS is a framework for understanding the relationships and interactions between recreational benefits from the CNF and the settings in which the user experiences them. The desired conditions are that all ROS types: (a) are fully integrated in forest land management planning; (b) reflect current management direction and use patterns; and (c) are compatible with resource values. ROS classes provide the framework for defining types of recreation opportunities and identifying what recreational experience the CNF might be able to provide. Classes are defined based upon three settings: (a) physical (including size, remoteness, and evidence of humans); (b) social (including number and type of encounters); and (c) managerial (including regimentation, control, and facilities).

Based on the combination of classes, lands are categorized into one of six ROS classes, four of which occur in the project area. The six ROS classes include the following:

1. Roaded Natural (RN) is found along several of the main roads. RN is usually a natural-appearing environment with low to moderate interaction between users.

2. Semi-Primitive, Motorized (SPM) covers large areas. SPM is usually a natural-appearing environment of large size with low interaction between users and the opportunity for a high degree of interaction with the natural environment
3. Semi-Primitive, Non-Motorized (SPNM) is intermixed and covers large areas. SPNM is the same as SPM but without motor vehicle use.
4. Primitive (P)
5. Rural (R)
6. Urban (U)

The majority of the Magdalena Mountains Geographic Area falls within the SPNM designation given the extensive geographic coverage of the Langmuir Research site. SPM and RN make up the next two most prevalent categories. A small patch designated as Rural exists along Magdalena Ridge and includes the laboratory. Within the area of potential project activities, the following ROS acreages are designated in **Table 3-31**:

Table 3-31. ROS Classifications in the Project Area

ROS Class	Acres
Semi-Primitive, Motorized	790
Semi-Primitive, Non-Motorized	72
Roaded Natural	9
Rural	108

Source: USFS 2003b

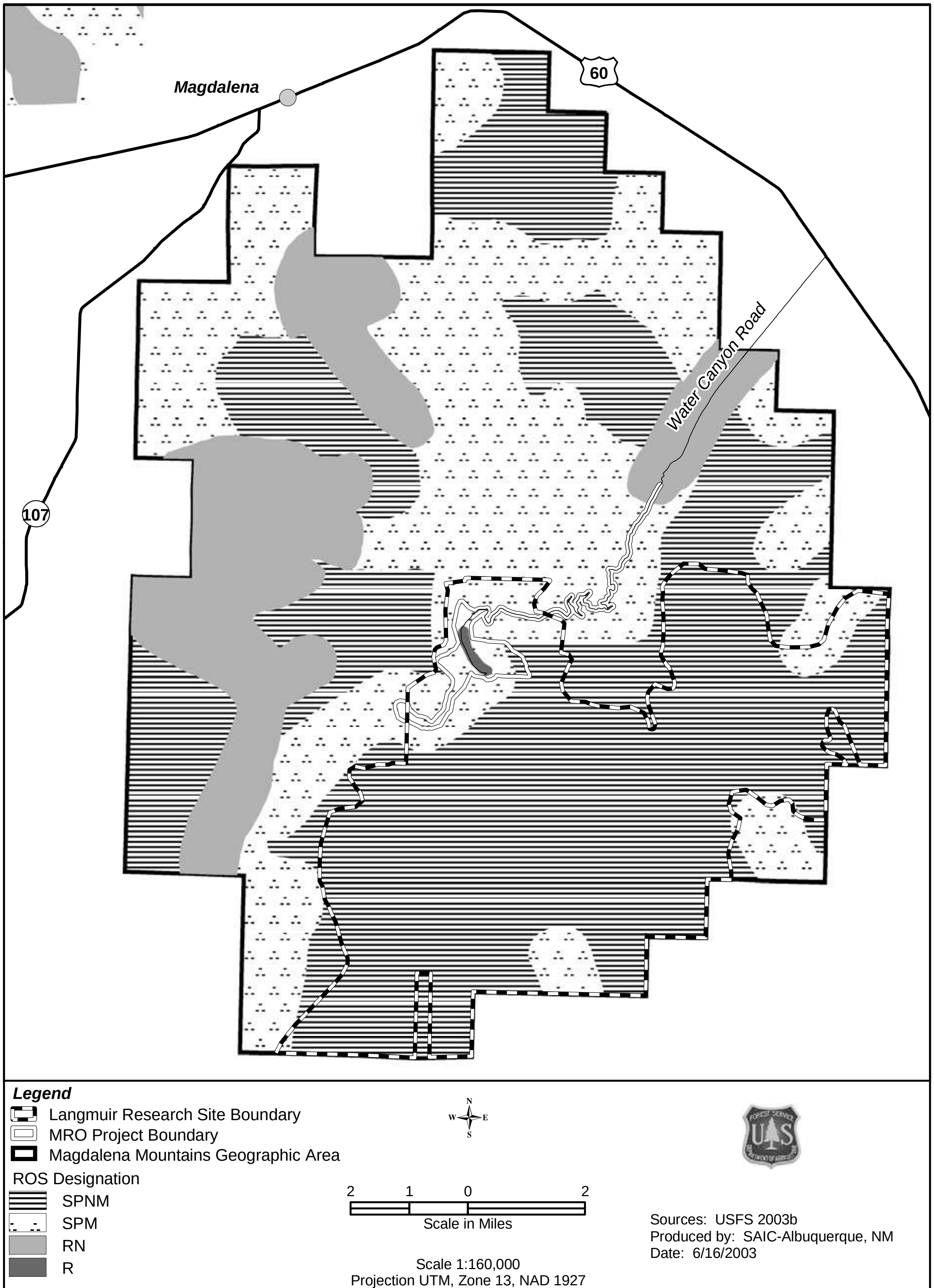
Map 3-19 presents the ROS designations in the Magdalena Mountains Geographic Area highlighting the area of potential project activities.

3.4.3.2 Environmental Consequences

Method of Analysis

Recreation impacts are analyzed by evaluating direct impacts on known resources and by characterizing disruptions caused by ridgetop construction, changes to the Water Canyon Road access corridor, and utility corridor improvements and/or construction. Potential impacts are based on the development scenarios for each alternative described in Chapter 2 and the ROS class definitions developed for the CNF described above in the Affected Environment section (Section 3.4.3.1).

All proposed alternatives represent varying degrees of adverse and beneficial impact to the recreational resources of the area. Some effects would be temporary and some would be long-term. The intensity or severity of impact varies by alternative. The following discussion describes the impacts to the recreational opportunities that could occur and how Forest Plan compliance would be affected from construction, development and operation of the proposed MRO and associated utility corridor and access construction and/or maintenance and repair.



Map 3-19
ROS Designations in the Vicinity of the Project Area

Alternative 1: Proposed Action

Direct Impacts

Direct impacts to recreation are those associated with changes to the resources, opportunities, or experiences that would result from construction and operations associated with proposed improvements or activities.

Construction Phase

Ridgetop

Facilities construction along Magdalena Ridge is expected to have the most direct impact to ridgetop recreation. Although non-motorized recreational use of the ridgetop and access to trailheads would not be changed, several construction activity areas would be located on the ridge and would impact the recreational experience. Construction and staging areas (approximately 12 acres) would be fenced for safety reasons during the construction phase, effectively blocking walking through some areas for recreation. Additionally, at times, public access to the ridge could be completely prohibited for public safety reasons. These closures could be in addition to or concurrent with road closures (see Water Canyon Road discussion below). However, they would be temporary and avoided on the most popular holiday weekends.

During the construction phase, noise, dust, and air pollutant emissions would detract from the recreational experience of ridgetop visitors. These impacts would be of short durations and variable intensities during the construction period. The duration and intensity of these impacts would be highest during earth moving operations, foundation excavation, and construction of buildings, which are expected to occur primarily during the first two years of the construction period.

Upon completion, Alternative 1 construction would result in the removal of approximately 13.4 acres of undeveloped land on the ridgetop from potential open space recreational use. However, the recreation uses and activities of the ridgetop would be essentially the same as they are now since the new facilities can be characterized as infill development. Also, the density of development would remain relatively low, non-motorized public use of the ridge would continue to be allowed, and access to trailheads and scenic vistas from the ridgetop would remain unchanged. Although the ridgetop itself would have a more developed appearance, which may detract from the recreational experience of visitors expecting a more natural experience, some visitors may find the new facilities beneficial in terms of their interest in seeing new technology.

Overall, the direct construction and operational impacts on the ridgetop would not be considered significant and the ROS designations on the ridgetop or rural and semi-primitive motorized would not be changed.

Utility Options

Under Utility Option 1, expanded electrical and telecommunication lines would be added to existing overhead structures, and an aboveground water line would be installed along the existing corridor. As a result, the quality of experience provided by Trail 21 and small portions of Trails 19 and 22 (where they intersect with Trail 21) would be disrupted due to their proximity to the construction activity and by the presence of slightly more infrastructure in the environment (see Map 3-18). However, due to the current built character of the corridor, the impacts would be insignificant.

Under Utility Option 2, expanded electrical and telecommunications lines would be identical to Utility Option 1, but water would be pumped from the existing Sawmill Canyon site along a new alignment through an aboveground pipe. The proximity of the construction activity would be similar to Option 1, but only one trail (Trail 93) would be involved, and the length of trail in close proximity would be about 0.5 mile (0.8 km). The pipeline would be offset from the trail sufficiently to avoid direct overlaps and to minimize visibility to the extent possible.

Utility Option 3 would be the same as Utility Option 2, except that water would be pumped from Langmuir Spring through the existing aboveground pipe to Langmuir Laboratory, which would be extended through a buried pipe to the new proposed MRO facilities. There are no trails in the vicinity of the area where the new pipe would be installed.

Water Canyon Road

Movement of materials and workers to and from the ridgetop during construction and anticipated long-term increases in vehicle traffic along Water Canyon Road would directly impact recreational resources and opportunities associated with Water Canyon Campground, trails along and in the vicinity of Water Canyon Road, and the road itself.

Maintenance and repair currently ongoing under the existing Langmuir Laboratory SUP along the entire length of Water Canyon Road from Water Canyon Campground to the ridgetop will make the road safe and serviceable for larger construction vehicles. Potential additional maintenance and repair in the future could temporarily limit access to some trailheads. Campground access is not expected to be affected. Movement of equipment and persons to the ridge would result in delays and closures of Water Canyon Road to protect public safety, the timing of which would be determined by the construction contractor after discussions with the District Ranger. To minimize impacts, all necessary road closures would be scheduled in advance and the dates and times would be posted at the campground kiosk, district office, at the Water Canyon Road/US 60 intersection, in local newspapers, and on the Forest Service web site. The contractor would work closely with the District Ranger before closing the area on weekends and will make every effort to ensure that access is not restricted on specific major holidays, such as Easter, Mother's Day, and others as specified by the District Ranger. Work accomplished in the first year is expected to represent about 75 percent of the heavy construction, including construction-related trip generation on Water Canyon Road. During this period, delays and closures of Water Canyon Road are expected for traffic that is not construction-related. During the closures, approximately 50 to 60 vehicle round trips per day would be made for construction-related purposes. Construction-related use of the road is then expected to taper off significantly during the remaining 3 to 4 years of construction activity. Closures would be made effective by locking the access gate located just above Water Canyon Campground. Access to the campground is not expected to change.

The proposed construction schedule assumes that Water Canyon Road would be needed five days per week with occasional weekend use when additional hauling and/or construction activity is required. The construction schedule also assumes that winter use would be limited at times due to weather.

During construction, the quality of the recreation experience along trails within close proximity to the road and within Water Canyon Campground would be degraded by noise, dust, air pollutant emissions, and degradation of natural conditions along the road to varying degrees. The degree of impact would depend on the nature of the construction activity, the number of construction vehicle trips up and down the road, topography, wind direction, and the sensitivity of individuals to construction-related impacts. Overall, construction-related recreation impacts, including restricted access, would not be considered significant because they would only involve temporary and geographically limited inconveniences.

Operational Phase

Once construction is completed, continued maintenance and repair of Water Canyon Road would allow for safer passage from Water Canyon Campground to the ridge providing increased accessibility to trailheads along the roadway. Additionally, the road would be snowplowed during winter months. This would have the potential to increase winter recreational use of the area. Expanded parking at Trailhead 8 (see Cumulative Impacts section below) would provide for the increased visitor use. On-foot departure from this locale would serve to minimize the number of vehicles driving to the gate at the observatory site entrance where turn around space is minimal. The improved access could exacerbate the existing problem of parking along Water Canyon Road (where no roadside parking is allowed) in order to access trailheads. Existing and new parking signs and notices would be used to inform forest visitors and reduce related impacts. No changes to the existing ROS designation (semi-primitive motorized) would be required along the road corridor.

Indirect Impacts

Potential indirect impacts include visual quality degradation from a distant and significant vantage point, long-term growth caused by improved access to recreation facilities or opportunities, or a new attraction.

Visual impacts are discussed under Visual Resources (Section 3.4.2.2). In summary, impacts caused by the Proposed Action that are associated with degradation of visual quality and the quality of the recreation experiences available in more distant locations would be insignificant.

Growth in recreational use may be facilitated by road improvements and visitors may be attracted to the proposed MRO. This could include ATV use along Water Canyon Road, although ATV use is not allowed in the Langmuir Research Site. However, given that the area has relatively low use now, any induced use is likely to be low. Proposed MRO visitation is not expected to be appreciable, given its relatively remote location down a high-clearance vehicle road and the need to walk the last several hundred yards.

Alternative 2: No Action

There would be no additional impacts to recreational resources or opportunities due to the proposed MRO under Alternative 2. Existing resources, opportunities, facilities and experiences would remain unchanged. The area would continue to be used for dispersed recreational activities including, but not limited to, hunting, camping, hiking, horseback riding, cross-country skiing, ATV use, picnicking, biking, auto touring, sightseeing, wildlife viewing, and gathering of forest products. The demand for dispersed recreational activities would increase commensurate with general regional population growth, or roughly at an average annual rate of 2 percent.

Impacts from maintenance and repair of Water Canyon Road, both adverse (temporary limits in access) and beneficial (improved safety), would be the same under this alternative as described for Alternative 1.

Alternative 3: Preferred Alternative

Direct and indirect impacts under Alternative 3 would be identical to those under Alternative 1 except that the total area removed from open space recreational use due to construction of new buildings and facilities is expected to be about 0.3 acre less than under the Alternative 1.

Alternative 4

The impacts under Alternative 4 would be identical to those under Alternative 1 except that the total area removed from open space recreational use due to construction of new buildings and facilities is expected to be under 0.3 acre less than under the Proposed Action, and 0.03 acre smaller than under Alternative 3.

3.4.3.3 Cumulative Impacts

The following incremental recreation impacts would contribute to related cumulative impacts created by past, present, or reasonably foreseeable projects or actions in the area:

- Construction disturbance and the conversion of natural lands to more urban uses (buildings, improved roads, institutional facilities, scientific equipment, and utility corridors) on the quality of recreational experiences in Forest Service lands; and
- Recreation demand increases and corresponding limits on the capacities of the natural environmental and existing recreation facilities and support infrastructure, maintenance, and staffing to handle more activity.

In the near future, as funds become available, the Forest Service will relocate the visitor's kiosk, currently located just inside the access gate to the ridgetop, to the expanded parking area at Trailhead 8 (Map 2-1). This kiosk would provide information about timing and duration of site closures and other information as necessary. The expanded parking at Trailhead 8 would provide space for 8 to 10 vehicles within 200 feet (61 m) of the gate and would be a departure point for non-motorized recreational use of the ridgetop.

Road maintenance and repair may facilitate public access although the number of additional visitors is not known. The road may be smoother for travel and may result in a better experience for visitors. The combined attractions may be synergistic in popularizing this area for this recreational experience. In addition, there may be incremental growth in recreational use and demand consistent with general regional population growth, or roughly at an average annual rate of 2 percent. Use of ATVs could also increase in areas where permitted. This is perceived as a benefit by some users and a detriment by others.

If public use greatly increases in the future, measures could be taken to organize and manage public visitation to the proposed MRO. This would be mutually beneficial for public safety and for comfort to the researchers, who would be the primary users of the facility. Along with increased visitors and traffic, recreational experiences that are more conducive to quiet or naturalness may be impacted negatively, but this would be minor overall.

The overall cumulative impact on recreation opportunities (both positive and negative) as a result of the Proposed Action is not considered significant.

Under Alternative 2, proposed MRO-related construction and operations would not contribute to cumulative impacts on recreation.

The cumulative recreation impacts of Alternatives 3 and 4 would be virtually identical to Alternative 1.

3.4.3.4 Mitigation

As discussed in Transportation (Section 3.2.6), should visitor numbers significantly increase in the future, measures to organize and facilitate controlled access (such as tours and shuttle vans) may be prudent (see Table 2-6).

3.4.4 Minerals

3.4.4.1 Affected Environment

Region of Influence

The ROI for minerals would include the Langmuir PRF and all lands accessible by Water Canyon Road.

Existing Conditions

The current Langmuir PRF, on which the proposed MRO would be built, has been proposed for withdrawal from mineral entry for a period of 20 years to begin publishing of a Public Land Order by the BLM in the Federal Register. This is expected to take place in summer of 2003 (USFS 2002g).

No current mining activity is known in the ROI (USFS 2002d, Linden 1995), but there has been historical mining activity in this area (Linden 1995). Past mining districts in the general area include the Water Canyon district (a couple of miles north and east of the proposed MRO site) and the Hop and Mill Canyon districts (a couple of miles west of the proposed MRO site). Mining activities began in the 1890s and continued intermittently until the late 1930s. The mines and prospects produced gold, silver, copper, and lead. The Water Canyon district was the most active of the three districts, producing 1,161 tons of ore including 196 ounces of gold, 2,064 ounces of silver, 15,377 pounds of copper, and 125,884 pounds of lead (Linden 1995).

The PRF has been segregated from mineral entry since July 23, 2001, so no mining claims have been recorded since that date. According to a search of the BLM's Mining Claim Recordation database on February 1, 2001, there are no current mining claims in the area of the proposed MRO site.

There is low to moderate potential for locatable minerals in the region of impact. Past mining activity in the general area indicates there may be favorable conditions for metallic mineral deposits associated with geologic conditions of the project area (Linden 1995).

There is low potential for leasable minerals in the region of impact. The Magdalena Mountains are covered by a thick deposit of Tertiary volcanics, making oil and gas potential unlikely. No geothermal potential is known to exist in this area (Linden 1995).

There are abundant supplies of salable minerals in the region of impact. However, very poor access, similar materials widely available elsewhere, and great distances to markets preclude this area from having anything but very low potential for development of salable minerals (Linden 1995).

3.4.4.2 Environmental Consequences

Method of Analysis

Environmental consequences for this action were evaluated by determining the current levels of mineral extraction, determining the potential for future mineral extraction, and assessing how activities associated with this action might affect existing or potential future mineral extraction activities.

Alternative 1: Proposed Action

Direct Impacts

A direct impact of this action on mineral extraction would occur if the existing or potential future level of mineral extraction activity were affected, positively or negatively, by the activities associated with construction or operation of the proposed MRO.

Construction Phase

Although there is low to moderate potential for locatable minerals in the general area of the proposed MRO site, there are no currently operational claims in the area. It is anticipated that the current level of activity will extend through the construction phase of the project, primarily because mineral extraction in this area would likely be uneconomic. Should any claims off Water Canyon Road become operational during the construction phase, construction traffic could impede access to and removal of material from these claims. It is expected, however, that this impact would be minor because of the inactive status of the claims and the low probability of the claims becoming active.

There is only low potential for oil and gas, and no potential for geothermal energy in the vicinity of the proposed MRO. It is anticipated that because of the low potential for oil and gas, it would be uneconomic to extract either oil or gas in the area, and there would essentially be no impact on oil or gas extraction activities.

As a separate action, the 851.72 acres within the PRF have been proposed to be withdrawn from mineral extraction for a period of 20 years to protect research activities from the negative impact of mining operations. A decision has been made to recommend withdrawal to the BLM. A Public Land Order is expected to be published in the *Federal Register* in 2003. For this reason, there would be no impact of this action on mineral extraction on the ridgetop.

Operational Phase

Because of the low volume of traffic along Water Canyon Road associated with the operational phase of this project and the projected withdrawal of land at the proposed MRO site, there would be no impact on mineral extraction associated with this action.

Indirect Impacts

There would be no indirect impacts on mineral extraction as a result of this action.

Alternative 2: No Action

Under the Alternative 2, there would be no potential for impacts to mineral extraction in the area from the proposed MRO. As a separate action, the 851.72 acres within the PRF would be withdrawn from mineral extraction for a period of 20 years

Alternative 3: Preferred Alternative

Alternative 3 differs from Alternative 1 only in the location and size of facilities that would be built on the ridgetop. Since land on the ridgetop is already proposed for withdrawal and the differences in size would not be associated with appreciable differences in the time of construction, there would be no difference in impacts between this alternative and Alternative 1.

Alternative 4

Alternative 4 differs from Alternative 1 only in the location and size of facilities that would be built on the ridgetop. Since land on the ridgetop is already proposed for withdrawal and the differences in size would not be associated with appreciable differences in the time of construction, there would be no difference in impacts between this alternative and Alternative 1.

3.4.4.3 Cumulative Impacts

Because of the absence of active claims in the area and the proposed withdrawal, the proposed MRO would not contribute to any cumulative impact on mineral extraction activity in the area under any alternative.

Periodic maintenance and repair of Water Canyon Road has a remote potential for temporarily impeding mineral extraction from any claims along the road. The combination of these actions and effects with proposed MRO development would not affect mineral resources.

3.4.4.4 Mitigation

No mitigation measures are identified for mineral resources.

3.4.5 Heritage and Cultural Resources

3.4.5.1 Affected Environment

Region of Influence

The ROI for heritage and cultural resources consists of the MRD. Within the ROI, the area of potential effect (APE), within which resources could experience direct or indirect impacts, consists of the project location (i.e., the areas of construction or operation) and immediately adjacent locations that could be accessed on foot.

Existing Conditions

Historical Setting

Human occupation of the region is known to date back at least 11,000 years (Sechrist et al. 1992). The climate was colder and wetter than today, and early inhabitants are thought to have been small bands of mobile hunter-gatherers who followed herds of large game animals. They may also have used smaller game and plant foods. As the climate grew drier, about 8,000 years ago, forests and woodlands shrank to higher elevations, and people began using a wider diversity of resources, especially wild plant foods. Ground stone tools for processing plant food appeared around 5,000 years ago. Domesticated plant foods were evident about 3,500 years ago. By about 1,800 years ago, pithouse villages and associated ceramics were found in the region as groups became increasingly sedentary (Sechrist et al. 1992). During this period, people relied on a large variety of wild plants, large and small game, and some cultivated plants. By about 1,100 years ago, pueblo villages were found in similar settings as the earlier pithouse villages. The pueblos also spread into previously unoccupied areas along major drainages and *cienegas*, suggesting a population increase. Black-on-white ceramics, enlarged kivas, and some water-control devices appeared during this period as domesticated plants became increasingly important. About 900 years ago, certain areas were abandoned, and people gathered in larger planned communities, developing water-control devices and polychrome and glaze pottery. By 600 years ago, most settlements to the south and west of the Magdalena Mountains were unoccupied. People retreated to the Zuni area and concentrated along the Rio Grande (Sechrist et al. 1992).

Spanish explorers in the region in the 1540s encountered traveling bands of hunter-gatherers along the Rio Grande and found occupied pueblos such as those of the Piro people in the Socorro area. In 1680, when the northern pueblos banded together in revolt to drive the Spanish out, many of the Piro retreated southward with the Spanish, while others assimilated with the northern Pueblo peoples.

The Navajo people are thought to have migrated to the region around the 15th century. They began moving further southward into the New Mexico region after the Pueblo Revolt. The Mescalero Apache people lived in eastern and southern New Mexico where they moved from the mountains to the basins and plains in seasons when edible wild plants and game became available. After the U.S. took control of the region in 1854, American settlers in the area encountered raiding Apaches and Navajos. The U.S. Army established Fort Craig on the Rio Grande and the Ojo Caliente post to impede Apache mobility (Sechrist et al. 1992).

Eventually, the U.S. Army developed a plan to relocate the tribes. About 400 Mescalero Apache moved to the Bosque Redondo in eastern New Mexico, but in 1865 they returned to their lands in the south (MNM 2000). In 1864, nearly 8,500 Navajo people were forced to travel 350 miles (563 km) to the Bosque Redondo in a journey that became known as the “Long Walk” (MNM 2000). After the failure of the Bosque Redondo Reservation in 1868, the Army conceded the right of the Navajo people to live in their homelands to the west (MNM 2000). The Alamo Band of Navajos are said to have formed after the “Long Walk” by a group of Navajo slaves who had escaped from the Mexicans and fled to the mountainous area of what is now the CNF (Lowe 2003). After the Navajos were released in 1868, a leader was identified within the new band and the small camp grew into a community. The Alamo Navajo Indian Reservation was established in 1946 and became a certified chapter of the Navajo Nation in 1955 (Lowe 2003).

After 1692, the Spanish army moved northward on El Camino Real and reconquered Santa Fe, eventually recolonizing New Mexico (BLM 2003). When Mexico gained independence from Spain in 1821, El Camino Real expanded its importance as a trade route and linked with the Santa Fe Trail. Traffic on El Camino Real ended when the Atchison, Topeka, and Santa Fe Railroad extended its tracks from Santo Domingo on the upper Rio Grande to El Paso in the 1880s (BLM 2003).

Ranchers and miners settled the area beginning in the 1880s. With the coming of the railroad and the ability to easily ship ore and cattle to market, local communities boomed. In the late 1850s, the community of Socorro numbered about 600 people. With the coming of the railroad in 1880, its population jumped to more than 4,000 people in two years (City of Socorro 2002). By 1886 the present town was incorporated. There was extensive mining in the mountains and hills, with smelters to process the ore. Farming, ranching, and the associated support services added to the economy. In 1889, the New Mexico School of Mines (now NMIMT) was established, with the first students arriving in 1892 (City of Socorro 2002).

Lead was discovered in the Magdalena Mountains in 1866, and the townsite of Kelly was laid out on the western slope of the mountains around 1879 (Kelly Mine 2000). In 1881, a smelting plant was built near Socorro to treat ore from the Kelly Mine and other area mines. A branch line of the Atchison, Topeka and Santa Fe Railroad reached the town of Magdalena, four miles from Kelly, in 1885. In 1896, with the construction of the Graphic Smelter, Magdalena became the smelting town for Kelly and treated its ore until 1902. Around the turn of the century, a zinc carbonate called smithsonite was discovered in the waste dumps of local mines, which were quickly leased and stripped for the ore. Kelly became the state’s leading producer of zinc. By 1931, smithsonite deposits were exhausted, and mining throughout the district began to decrease (Kelly Mine 2000).

From 1884 to 1925, the nearby town of Magdalena was a prosperous railhead that supplied the substantial mining and ranching industries in the area (Magdalena COC 2003a). The town, established in 1884, reached a peak just before 1920. It was located at the end of a spur line from Socorro. Miners from local lead, zinc, and silver mines shipped ore out on this line. In addition, ranchers from throughout western New Mexico and eastern Arizona drove cattle to the railhead at Magdalena (Magdalena COC 2003a). Miners and ranchers bought their supplies from stores in Magdalena and used other resources of the town (Magdalena COC 2003a).

The MRD traces its roots to the 1899 establishment of the Gila Forest Reserve. The MRD was named in 1906, making the U.S. Forest Service the oldest continuous business in the town of Magdalena (USFS 2002d). The MRD is the largest of four mountain districts and four grasslands administered by the CNF. The MRD consists of four mountain ranges in Socorro, Catron, and Sierra counties, including the Magdalena Mountains (USFS 2002d).

Langmuir Laboratory was built in 1963 near the summit of South Baldy Peak to provide a base for the study of cloud processes that produce lightning, hail, and rain (NMIMT 2001). The need for the laboratory arose following the pioneering research into thunderstorms over New Mexico by E.J. Workman that began in the 1930s. Workman was joined by other scientists at NMIMT (previously the New Mexico School of Mines), including Nobel Laureate Dr. Irving Langmuir, for whom the laboratory is named. The JOCR was established in 1973 under a cooperative agreement between the Goddard Space Flight Center of the National Aeronautics and Space Administration (NASA) and NMIMT. The facility was used for basic research on comets and other astronomical phenomena. When the original telescopes became too small for the needs of the observers, they were removed in 1994 (NMIMT 2001).

In 1980, President Carter signed P.L. 96-550 establishing the Langmuir Research Site, consisting of approximately 31,000 acres of the CNF surrounding Langmuir Laboratory. This legislation preserves the land in its undeveloped state and encourages scientific research as a prime land use (NMIMT 2001).

Archaeological and Architectural Resources

According to records held by the State of New Mexico Archaeological Records Management Section (NMARMS), 126 heritage resources have been recorded in the Magdalena Mountains in the Water Canyon, Molino Peak, South Baldy, Magdalena, Arroyo Landavaso, and Squaw Peak quadrangles. Of these, eight resources have been determined eligible for listing in the National Register of Historic Places (NRHP), 13 are not eligible, and the remainder are unevaluated. The resources date from about 11,000 years ago through the 20th century. They include archaeological sites with Paleoindian, Archaic, Anasazi, and Mogollon components; rock alignments, rockshelters, Anglo and Hispanic Euro-American residences, outbuildings, and commercial structures; ranching and agricultural features; mining and railroad features; roads and trails; petroglyphs; and historic graffiti (NMARMS 2003).

Several archaeological surveys have been conducted in the project area. The Main Antenna Array, North Loop Array-A and North Loop Array-B, and part of the northwest portion of the South Baldy Array were surveyed in 1987 (Sechrist et al. 1992). Some of the resources from the 1987 survey were relocated in 1992 during an archaeological survey of 563 acres of the Millimeter Array Area and road right-of-way (Sechrist et al. 1992). Most of the project area lies within the bounds of the 1992 survey. This survey identified five archaeological sites and 78 isolates, most relating to mining activities in the area. A report for another survey conducted in 1987 (Martin 1987) found one site (LA69492).

Two sites identified during these projects are eligible for the NRHP (LA98425 and LA98427), two are not eligible (LA98424 and LA98426), and the others (LA98423 and LA69492) are unevaluated (NMARMS 2003).

Three other archaeological inventories were conducted. In the Water Canyon Road clearance inventory (USFS 1999), no resources were identified within the project area. In the Trail 13 Relocation Survey (Cartledge 1996), one site was found: LA112715. It has been determined not eligible for the National Register. In a survey of two utility easements (Ackerly 2003), one historic site and eight historic isolated occurrences were found. The historic site (LA139368) is a corral dating to ca. 1935-1954 located in the Socorro Electric Corridor. In consultation with the State Historic Preservation Office (SHPO), the site has been determined not eligible for the National Register.

Table 3-32 summarizes recorded archaeological sites within the present project area. Both sites near, and the one within, the project area would need to be considered in planning for the Proposed Action.

Table 3-32. Archaeological Sites within the Proposed MRO Project Area

LA Number	FS Number	Site Type	Age Range	National Register Status
LA98426	AR 03-03-573	Lithic scatter	Undated Native American	Not Eligible
LA139368	Not available	Corral and barbed wire enclosure	ca. 1935-1954	Not Eligible
LA112715	AR 03-03-646	Mine shaft with three pits and tailings	19^{th} and 20^{th} century	Not Eligible

Sources: Ackerly 2002; Martin 1987.

American Indian Consultation

The CNF consults with eight Indian tribes and one Navajo Chapter that may have used or may continue to use the MRD lands for traditional cultural or religious activities. The eight tribes are the Pueblo of Acoma, the Pueblo of Zuni, the Hopi Tribe, the Navajo Nation, the Alamo Navajo Chapter, the Mescalero Apache, the Ft. Sill Chiricahua-Warm Springs Apache, and Ysleta del Sur Pueblo. The tribes were initially informed about the proposed project in the CNF's annual tribal consultation letter, sent to each tribe in May 2002. At the request of the Mescalero Apache, the White Mountain Apache were also invited to consult in October 2002. Between October and November 2002, each tribe was sent the following documents: a NEPA pre-scoping letter, an invitation letter for a field trip, and the NEPA scoping letter. Section 4.2.3 lists the tribes consulted; the project record contains the documentation of tribal consultation.

Follow-up meetings were held with six tribes. The purpose of the consultation meetings was to discuss the project proposal in detail and determine whether the proposed project will have an effect upon sites of traditional cultural or religious significance to the tribes.

Pueblo of Acoma

During the consultation with the Pueblo of Acoma in June 2002, the Pueblo did not express specific concerns but requested to be kept informed of the planning process. The Forest Service contacted the Pueblo again in January 2003 to see if the Pueblo wished to meet again to discuss the project proposal in greater detail. The Pueblo responded that no meeting was necessary at the time, but that they wish to continue to receive written information about the project.

Pueblo of Zuni

A consultation meeting was held with the Pueblo of Zuni in July 2002. The Tribal Council did not respond with any comments or concerns regarding the proposal. Another consultation meeting was held in March 2003 to discuss the project in greater detail. The Tribal Council stated that the project area would likely be beyond the Zuni's traditional use area, except for hunting, but agreed to send written comments if any concerns arise.

Navajo Nation

During the consultation meeting with the Navajo Nation in June 2002, the Director of the Traditional Culture Program did not express any concerns regarding the proposal. He stated that a mountain called South Baldy Peak has a place name in the Navajo oral tradition. He could not confirm whether the place name was attached to the South Baldy Peak within the current project proposal or to a different mountain in Arizona. He requested that the CNF consult directly with the Alamo Chapter to see if the mountain is considered significant to that Chapter.

Mescalero Apache

The Mescalero Apache were consulted in October 2002. The Tribal Historic Preservation Officer (THPO) stated that South Baldy Peak is considered a TCP because it is a location where ceremonies were once held. Although current use of the mountain is infrequent, the area is still considered significant to the tribe. The tribe is most concerned about continued vehicular access to the top of the mountain. Written comments were received by the tribe in February 2003, and those comments confirmed the tribe's view of South Baldy Peak as a TCP. In subsequent correspondence, the tribe stated that additional consultation was not needed, provided that their concern regarding access is addressed.

Hopi Tribe

During the consultation with the Hopi tribe in November 2002, the Cultural Preservation Officer stated that the area has no current use by the Hopi tribe and that the tribe wishes to defer to the Pueblo of Acoma and other neighboring Pueblos for subsequent consultation regarding the proposed project.

Alamo Navajo Chapter

A consultation meeting was held with the Alamo Navajo Chapter in January 2003. The Chapter President stated that South Baldy Peak is a sacred mountain and that continued access to the mountain is important to the Chapter members. He stated that herbs are collected in early spring by some elders. Attempts to take a field trip were unsuccessful.

The Forest has been unsuccessful in obtaining sufficient information necessary to determine what, if any, impact might occur to the herb plant population due to the construction of the MRO.

3.4.5.2 Environmental Consequences

Method of Analysis

Analysis of potential impacts to heritage resources considers both direct and indirect impacts. Direct impacts may occur by physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the resource's significance; introducing visual or audible elements that are out of character with the property or alter its setting; or neglecting the resource to the extent that it deteriorates or is destroyed. Direct impacts are assessed by identifying the types and locations of proposed activity and determining the exact location of heritage resources that could be affected. Indirect adverse impacts result primarily from the effects of increases in, or losses of, access to an area. Impacts to heritage resources are considered to be either adverse or not adverse rather than low, medium, and high or substantial.

Impacts to heritage resources are evaluated under Section 106 of the NHPA. Significant heritage resources are those that are listed in, or eligible for listing in, the NRHP.

Some heritage resources, such as certain traditional resources, may not be eligible for the NRHP but may be considered significant by members of a cultural group, such as American Indians or other groups, for maintaining their traditional culture. Impacts to these significant resources are evaluated through consultation with the relevant groups.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

Direct impacts to heritage resources are not expected during the construction phase of the Proposed Action. Facility removal would include demolition of the JOCR facility, established in 1973, and dismantling of the astronomy tower. Neither of these facilities is historic in age. Archaeological inventory of the project area, including roads and utility corridors, has been completed (Ackerly 2002, 2003; Cartledge 1996; Martin 1987; USFS 1999; Sechrist et al. 1992). Two sites, 03-573 (LA98426) and 03-646 (LA112715), are within the area of potential effect. Both have been determined not eligible to the NRHP and will not constrain project activities. One historic archaeological site (LA139368) was identified on private land along the utility corridor in the existing Socorro Electric corridor. In consultation with the SHPO, the site has been determined not eligible to the NRHP. Section 106 consultation has been completed. The SHPO concurred with a No Adverse Effect finding on November 17, 2003.

Direct impacts to traditional resources as a result of project construction also are not expected under the Proposed Action; however, this cannot be determined definitively because the results of consultation with the Alamo Navajo Chapter are inconclusive. The Forest cannot definitively state whether or not the project will have an effect upon a traditional cultural property. The Forest will continue to be available for consultation with the Alamo Chapter on this matter. If the Chapter chooses to provide information to the Forest at a later date regarding the location(s) of the herb gathering, the Forest will take mitigative steps to protect these plant populations to the extent feasible, provided that these measures do not result in a need to greatly modify the location or design of the facilities. The Forest will also work with the Chapter to re-establish desired plant populations during the re-vegetative effort that is scheduled after construction.

Operational Phase

Direct impacts to significant heritage resources are not expected during the operational phase of the Proposed Action.

Indirect Impacts

Construction Phase

Indirect impacts to heritage resources could occur during construction due to increased use of the proposed MRO project area. Incidental use of areas adjacent to, but outside, project boundaries by contractors or employees could result in inadvertent or intentional effects to nearby heritage resources. Potential indirect impacts during construction could be lessened through education and management practices that require contractors and employees to avoid heritage resources.

Indirect impacts to traditional resource use could occur if access to traditional resource locations is limited or restricted during project construction. The CNF has consulted with eight Indian tribes and one Navajo Chapter who may have used or may continue to use the MRD lands for traditional cultural or religious activities. The Mescalero Apache THPO stated that South Baldy Peak is considered a TCP because it is a location where ceremonies were once held. Although current use of the mountain is infrequent, the area is still considered significant to the tribe. The tribe is most concerned about continued vehicular access to the top of the mountain and has stated that additional consultation for this project is not needed provided that their concern regarding access is addressed. The Alamo Navajo Chapter President also stated that South Baldy Peak is a sacred mountain and that continued access to the mountain is important to some Chapter members for plant collection purposes. Mitigation measures will be developed in consultation with the Mescalero Apache Tribe and the Alamo Navajo Chapter to accommodate their access needs to the extent that safety allows throughout the construction phase.

Operational Phase

Indirect impacts to heritage resources could occur during the operational phase through increased use of the proposed MRO project area. Incidental use of areas adjacent to, but outside, project boundaries by visitors or employees could result in inadvertent or intentional effects to nearby heritage resources. Potential indirect impacts during operations could be lessened through education and management practices that require employees and visitors to avoid heritage resources. Periodic monitoring of nearby heritage resources would identify whether indirect effects are occurring. Potential indirect impacts to traditional cultural properties cannot be determined conclusively at this time.

Alternative 2: No Action

Impacts to heritage resources are not expected under Alternative 2. Conditions would remain as they are today. Heritage resources would continue to be managed in compliance with federal law and Forest Service regulation.

Alternative 3: Preferred Alternative

Direct and indirect impacts to heritage resources under Alternative 3 are expected to be the same as those described for Alternative 1. As discussed under Alternative 1, archaeological inventory of the project area, including roads and utility corridors, has been completed. Potential indirect impacts to traditional cultural properties cannot be determined conclusively at this time. The results of consultation with the Alamo Navajo Chapter are inconclusive. The Forest cannot definitively state whether or not the project will have an effect upon a traditional cultural property. The Forest will continue to be available for consultation with the Alamo Chapter on this matter. Mitigation measures will be developed in consultation with the Mescalero Apache Tribe and the Alamo Navajo Chapter to accommodate their need for ongoing vehicular access to the mountaintop.

Alternative 4

Direct and indirect impacts to heritage resources under Alternative 4 are expected to be the same as those described for Alternatives 1 and 3.

3.4.5.3 Cumulative Impacts

Cumulative impacts to heritage resources are not expected under the Proposed Action or any of the other alternatives. Significant heritage resources are not expected to be adversely affected.

3.4.5.4 Mitigation

Mitigation measures are listed in Table 2-6.

3.4.6 Human Health and Safety

3.4.6.1 Affected Environment

Region of Influence

This section addresses safety considerations and issues associated with human activities conducted in the vicinity of the proposed observatory complex in the Magdalena Mountains. The ROI for safety includes Water Canyon Road (used for site access), the area that supports the existing Langmuir Laboratory facilities, the area used for the utilities infrastructure, and the area south of South Baldy Peak where new facilities would be developed.

Existing Conditions

Staff at the Langmuir Laboratory perform their day-to-day tasks in accordance with federal and state occupational safety and health requirements. Small quantities of solvents and cleaners are stored at the facility. The procurement, storage, use and disposition of these materials are managed by NMIMT.

Current access to the proposed site is by means of Water Canyon Road. This road is regularly used by Forest Service staff, Langmuir Laboratories employees, recreationists, and tourists (USFS 2000a). Average levels of traffic are generally low. The portion of this road between US 60 and Water Canyon Campground is paved and is considered adequate to support all types of vehicle travel. Maintenance and repair of this road is performed in accordance with the existing Langmuir Laboratory SUP and Annual Operations and Maintenance Plan.

The remoteness and relatively undeveloped character of the region contribute to concerns about fire. Time between fire detection and initial attack and suppression efforts could be excessive depending on factors such as fire location, ability to access the fire, and availability of fire-fighting resources. Forest density and high fuel loading increase the risk of major wildfires. Human presence and the use of vehicles in the area, especially ATVs, increase risk. Nevertheless, historic data show that most fires have been contained with minimal involvement. Fire history for the CNF from 1975 to 1994 reflects a total of 131 wildfires within the Magdalena Mountains. Of these, 88 percent were contained within 10 acres or less; fewer than 2 percent involved more than 100 acres (USFS 2000a).

The Forest Service has identified several specific fire risks surrounding Langmuir Laboratory. One of the laboratory's operations involves firing rockets to attract lightning. To support these rocket launches, the FAA has designated Restricted Airspace around the rocket launch area. This airspace, designated R-5113, extends from the surface to 45,000 feet (13,716 m) above MSL and covers approximately 25 mi^2 (65 km^2) of surface area. This equates to approximately 165 cubic miles of airspace dedicated to supporting this project (USDOT 2001). The rocket launch, as well as the lightning, in conjunction with a high fuel level in the area, creates the risk of fire.

A further consideration involves access to the area. Access is limited by topographic features. Cables across Sawmill Canyon used by the laboratory have been removed. The existing power line, from Muleshoe Canyon on the southwest side of the Langmuir Research site, is aboveground until it reaches the ridge, where it is buried. These obstructions pose safety-of-flight concerns with the use of helicopters, especially if they are being used during fire response.

Due to topography, there are numerous communication dead spots throughout the area. These conditions are specifically applicable to cell telephones and radios. The inability to communicate in some areas contributes to concerns about fire, as well as other human health and safety issues (USFS 2000a).

Water quality in the ROI is generally good. The State of New Mexico requires regular testing of potable water supplies for the presence of VOCs and heavy metals. All existing potable water supplies in the ROI are within acceptable limits. However, there are numerous abandoned mines in the region, and the presence of hazardous mine tailings cannot be discounted. Additionally, many of these abandoned mines have open shafts, contributing to other safety risks (USFS 2000a).

Human health concerns in the area involve the potential presence of bloodborne pathogens, plague, and Hanta Virus. Although the possible presence of plague is a concern, no cases have been identified in the ROI. However, Hanta Virus can be present in any area that is exposed to mouse or rodent urine or feces. If observed, these areas would be disinfected immediately to minimize and control potential contamination and human exposure (USFS 2000a).

3.4.6.2 Environmental Consequences

Method of Analysis

Safety issues are considered qualitatively and quantitatively. Impacts are assessed according to the potential to increase or decrease safety risks to personnel developing or implementing the proposal, the public, and property. Proposal-related activities are considered in order to determine if additional or unique safety risks are associated with their undertaking. If any proposal-related activity indicated a major variance from existing conditions, or created an extraordinary safety risk, it would be considered a significant safety impact.

Alternative 1: Proposed Action

Direct Impacts

The Proposed Action is to develop and operate the proposed MRO south of South Baldy Peak in the Magdalena Mountains of the CNF. This action is divided into two major phases: a construction phase and an operational phase.

During the construction phase, development of this facility would involve construction of the proposed MRO support facilities and infrastructure on South Baldy Peak, and expansion of utilities to provide more robust services to the new observatory, and possible maintenance and repair of Water Canyon Road. At the completion of the construction phase, the facility would begin its operational phase. Safety issues addressed during this phase include operational activities, and road, site, and equipment maintenance necessary to maintain the facility and keep it accessible and operable.

Construction Phase

Ridgetop

Facilities required for the proposed MRO include those specifically designed to house, support, and operate the facility's scientific equipment, and those that would provide educational and research support. Details describing each of the facilities are provided in Section 2.2.1.2.

Activities involved in the construction of these facilities are not unique. Standard building and construction procedures and BMPs would be followed by the construction contractor(s).

This phase does involve ground activities that could expose workers performing the required site preparation, grading, and building construction to some risk. The U.S. Department of Labor (USDOL), Bureau of Labor Statistics maintains data analyzing fatal and non-fatal occupational injuries based on occupation. Due to the varying range of events classified as non-fatal injuries, the considerations described below focus on fatal injuries since they are the most catastrophic. Data are categorized as incidence rates per 100,000 workers employed (on an annual average) in a specific industry (Standard Industrial Code [SIC]).

For purposes of risk assessment, it was assumed that the construction phase would involve a total of approximately 200 full-time equivalent workers over the 4- to 5-year construction period. It was further assumed that only two-thirds would be construction workers on-site. To assess relative risk associated with the construction activity, it was assumed that the industrial classifications of workers involved would be the Construction Trades (SIC 15, 16, and 17). USDOL data for workers in these categories reflect a fatal injury rate of 13.3 per 100,000 workers (USDOL 2003). Based on these rates, and postulated worker exposure, a fatal injury would be statistically predicted to occur once every 606.1 years. This equates to a probability of a fatal injury of 0.00013, or about one in 7,600 (USDOL 2003). While the potential result must be considered undesirable, the risk is low. Strict adherence to all applicable occupational safety requirements would further minimize the relatively low risk associated with these construction activities.

During early stages of construction, water for construction support and fire suppression would be trucked to the work sites. During the first year of construction activity, the site utility infrastructure would be upgraded. Among other capabilities, this would provide a 120,000-gallon water storage tank to support fire suppression.

During actual construction on the ridge, all construction and storage sites (approximately 24 acres) would be temporarily fenced for safety and security. Within equipment storage areas, protected areas would be monitored for the presence of rodent feces. If detected, the area would be decontaminated and disinfected, thus minimizing the risk of exposure to Hanta Virus.

Given the relatively remote and mountainous location of the construction site and the nature of the access road, a Transportation/Safety Plan would be developed by the construction contractor. The plan would cover measures to address specific safety hazards of the project, ranging from fire to the need to address rapid response to worker injuries and driver safety. During some parts of the construction process, the contractor may limit or totally curtail public access to Water Canyon Road to ensure public safety.

Utility Options

Under the proposal, utility services would be upgraded. There are three options for these upgrades. Under the first, the existing power supply corridor would be used. Water, electric, and communications would be expanded to meet the demands of the new facilities. As previously stated, a portion of the utility upgrades would include the installation of a 120,000-gallon underground water storage tank on the proposed MRO site for fire suppression.

The second option proposed for the utilities upgrade is essentially the same as the first, with the exception of the development of the water supply. However, only the location of the water supply source would change; there would be no change in water availability or storage capacity.

The third option would use the same water supply as Option 2 but a different conveyance line. There would be no difference in water availability or storage capacity.

As previously discussed in the description of the road improvements, during the facilities construction process and upgrade of the utility corridor, fire safety procedures would be incorporated. All powered equipment would be equipped with spark suppressors, and vehicles with catalytic converters would be prohibited from grassy and brushy areas where fuels could come in contact with hot surfaces. Therefore, the probability of a project-caused fire would be low, and if a fire were started, the likelihood of it becoming a large fire is low, given the measures to be used.

Many of the proposed construction and upgrade activities would result in surface disturbance and some de-vegetation. After activity completion, all disturbed areas will be reseeded and revegetated. This maintenance and repair would be conducted in coordination with the Forest Service, and vegetation that is reestablished would be based on the use of site-specific seed mixtures. This would avoid the introduction of exotic species, and minimize the potential for the invasion of fine-fuel species that could contribute to fire risk in the future.

Water Canyon Road

Water Canyon Road would continue to be maintained and repaired as needed in accordance with the Langmuir Laboratory SUP and Annual Operations and Maintenance Plan to maintain and improve driving safety for all vehicles using the road. Vehicles and equipment used for maintenance and repair would be equipped with spark arrestors, and vehicles with catalytic converters would not be allowed off-road in areas where grasses or other fuels could come in contact with the catalytic converter. These precautions would reduce the risk of fire ignition, and a fire engine with water supply would be available during the maintenance and repair activity to suppress any ignitions that might occur.

Operational Phase

During the operational phase, scientific activities would be conducted at the proposed MRO facility, the access road would be maintained, and some minor maintenance would be performed on the site and its support equipment.

Prime activities at the proposed MRO itself would be categorized as scientific, research, and educational. The majority of the proposed MRO users would be at the facility for daily visits. While the facility would have a capacity of housing up to 20 residents, normally only two or three persons would inhabit the site on a 24-hour basis. Users of the proposed MRO would be required to adhere to the amended New Mexico Tech Safety Manual. This document currently outlines procedures for addressing: emergency situations, general safety policies, accident reporting, radiological safety, confined spaces, lockout/tag out procedures, chemical hygiene plans, spills, respirators, earthquakes, energentic materials, hazardous material shipping and receiving, the hazardous communication program, and state motor vehicle regulations (NMIMT n.d.). Additional information that would be included in the manual would include: solid and liquid waste management, liquid fuel and hazardous material storage procedures, water storage and safety, transportation safety, and an emergency evacuation plan.

Water Canyon Road from the campground to Langmuir Laboratory would be maintained to Forest Service standards. During winter months, the road would be plowed to allow access to the facility by researchers and the public, in accordance with Forest Service direction.

Grounds maintenance, avalanche control, and road maintenance would be conducted in accordance with an amended SUP and an Annual Operations and Maintenance Plan. Equipment stored at the site would include site maintenance support equipment and fire suppression equipment. Household cleansers and small quantities of solvents would continue to be stored and used at the proposed MRO. The development of the proposed MRO would result in increased demand for these materials. However, the increase is not significant. Procurement, storage, use, and disposition of these materials would continue to be managed by NMIMT. Major maintenance on the proposed MRO equipment would be performed off-site at NMIMT facilities under environmentally controlled conditions.

Overall, there are minimal safety risks associated with the development, construction, and operation of the proposed MRO facility. Some elements of the proposal result in enhancing safety. The proposed road improvements have a positive safety impact on vehicle and driving safety, and the proposed addition of an on-site person trained as an Emergency Medical Technician supported by a specially equipped vehicle enhances safety for all persons in the immediate vicinity of the site. The facility and improved road would benefit fire response capabilities for the MRD.

Indirect Impacts

Maintenance and repair of Water Canyon Road would benefit resource management and fire suppression activities by the Forest Service. Having employees on the ridge on a 24-hour basis would also assist in any emergency event and in communications.

Alternative 2: No Action

Under Alternative 2, no changes would occur to current conditions. No changes would be made to current management plans and permits. Activities at Langmuir Laboratory, recreation, and other permitted forest uses would continue as under current conditions. Periodic maintenance and repair of Water Canyon Road would continue to improve driving safety and enhance long-term maintainability of the road. During these activities, measures to reduce fire risk would be used.

Alternative 3: Preferred Alternative

Under this alternative, the proposed MRO would still be developed on South Baldy Peak. This alternative differs from the Proposed Action in that the location of some of the facilities on the ridge would change, and the size of some of the facilities would be reduced. Locating the facilities farther south on the ridge decreases the amount of excavation required for site development, and would also result in reducing the scope of some of the proposed construction projects. However, in terms of safety, although worker's exposure to risk would be somewhat lessened, the reduction would be minimal. Overall, the safety assessments detailed for the Proposed Action (Alternative 1) would remain the same for this alternative.

During the operation phase of the proposed MRO project, safety assessments would be identical to those discussed under the Proposed Action.

Alternative 4

This alternative is similar to Alternative 3 in that some of the facilities would be located on different sites on the ridge than under Alternative 1, and the scope of some facilities would be reduced. However, in terms of safety, as with Alternative 3 although worker's exposure to risk would be somewhat lessened, the reduction would be minimal. Overall, the safety assessments detailed for the Proposed Action (Alternative 1) would remain the same for this alternative.

During the operation phase of the proposed MRO project, safety assessments would be identical to those discussed under the Proposed Action.

3.4.6.3 Cumulative Impacts

Increased human activity associated with the proposed MRO development may correlate to increased risk of human-caused fires or other emergency situations from a variety of non-project-related activities (such as ATV use, cigarettes thrown from car windows). Because the service level of Water Canyon Road (for high clearance vehicles) would not change, a large increase in traffic and visitors is not expected. The increased risk of ignition would be relatively low, but general conditions here are hazardous for fires, given the dry conditions and fuel content. The proposed MRO supply of water for fire suppression would defend facilities against small fires. Even though most facilities are in unforested open grassland, a large fire in the surrounding forest could generate heat that could damage or consume facilities and endanger personnel. Improved access and water supply on the ridge would improve fire suppression capabilities for the surrounding forest, somewhat offsetting the increased risk. The Forest Service would continue to manage the CNF fire hazards. Existing conditions would benefit from fire management actions.

As the technology develops, it is possible that lasers may be employed to work in concert with telescopes at the observatory. Lasers would be used for aiming optical equipment at a designated target-object (e.g., a star). The lasers themselves would be aimed upward, and the beam would be projected skyward. Considering the elevated orientation of the projected laser beam, and that operators would use standard safety practices when operating the lasers, the use of such devices would not be expected to create any human health or safety impacts.

3.4.6.4 Mitigation

Mitigation measures for Human Health and Safety are listed in Table 2-6.

3.4.7 Socioeconomics

3.4.7.1 Affected Environment

Region of Influence

The geographic area most directly affected by the proposed MRO action is encompassed within Socorro County, New Mexico. The affected region can be characterized as rural in nature, and the communities most impacted by the alternatives are the Village of Magdalena and the City of Socorro. Economic effects may extend to a wider region of Socorro County. Since it is difficult to predict where materials and services for the construction would be purchased, the State of New Mexico is the broadest area considered.

Existing Conditions

Table 3-33 shows the historical and current population for the state, Socorro County, and the two communities that are within 30 miles (48 km) of the site.

The City of Socorro and the Village of Magdalena grew at a much slower pace (9 percent and 6 percent, respectively) over the past decade than did either the state or the county (17 percent and 18 percent, respectively). Much of the growth in Socorro County is a result of activity and development along Interstate 25 south of Albuquerque.

Table 3-33. 1990 and 2000 Population for the Region of Interest

	New Mexico	Socorro County	Village of Magdalena	City of Socorro
1990	1,515,069	14,764	883	8,159
2000	1,819,046	18,078	940	8,986
% Change	17%	18%	6%	9%

Source: US Census 2000.

Table 3-34 presents various demographics within the region. The 2000 Census is the source for all characteristics.

In New Mexico, about ⅔ of the population are identified as White. However, 42 percent of individuals identify themselves as Hispanic or Latino. In Socorro County nearly 50 percent identify with the Hispanic community.

The communities of Socorro and Magdalena exhibit similar demographics, as shown in Table 3-34. Both towns contain large Hispanic populations constituting the majority segment. In both areas Hispanics account for over 50 percent of local population.

Table 3-34. Demographics in the Region, 2000

Characteristic	New Mexico		Socorro County		Village of Magdalena		City of Socorro	
	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)
Population								
2000	1,819,046		18,078		940		8,986	
Ethnicity								
Total	1,819,046		18,078		940		8,986	
White	1,214,680	67	11,338	63	551	59	5,926	66
Black or African-American	33,513	2	119	1	2	0	69	1
American Indian and Alaska Native	172,276	9	2,017	11	71	8	256	3
Asian	18,286	1	167	1	0	0	148	2
All Other Races	380,291	21	4,437	25	316	34	2,587	29
Identifying as Hispanic or Latino	765,610	42	8,782	49	491	52	4,963	55
Gender								
Female	927,502	51	8,907	49	500	53	4,391	49
Male	891,544	49	9,171	51	440	47	4,595	51
Educational Attainment (18 years and older)								
Less than 9th grade	111,534	8.5	1,332	10.3	53	7.9	514	7.6
9^{th} to 12^{th} grade, no diploma	180,562	13.8	2,119	16.3	96	14.2	1,009	15.0
High school graduate	356,396	27.2	3,770	29.0	232	34.4	1,701	25.3
Some college, no degree	317,706	24.2	2,965	22.8	135	20.0	1,762	26.2
Associate degree	72,008	5.5	561	4.3	39	5.8	297	4.4
Bachelor's degree	160,781	12.3	1,245	9.6	75	11.1	763	11.4
Graduate or professional degree	112,491	8.6	990	7.6	45	6.7	676	10.1
Poverty Status								
1999	328,933	18	5,539	31	235	25	2,730	30

Source: US Census 2000.

Native Americans make up 11 percent of Socorro County's population, slightly larger than the state as a whole. As a percent of the populations of Magdalena and the City of Socorro, Native Americans make up a much smaller component. The reason for this difference is that many American Indians reside on tribal lands in rural and more scattered patterns in surrounding tribal lands.

All jurisdictions in the region have relatively high poverty rates when compared to the state level of 18 percent. Both Socorro County and City of Socorro are at or above 30 percent while Village of Magdalena has a slightly lower rate of 25 percent.

County Employment, Income and Industry

Labor Force

Table 3-35 shows information on the labor force in Socorro County for the years 1993 to 2002.The labor force for Socorro County has remained fairly stable over the past decade, fluctuating slightly in the late 1990s, then making a recovery in 2000. Similar changes in employment and unemployment have preceded these labor force movements likely precipitating the migration in and out of the county.

Table 3-35. Employment Summary of Socorro County, 1997-2003

Year	Labor Force	Employment	Unemployment	Unemployment Rate
1993	6,380	5,742	638	10.0
1994	6,387	5,877	510	8.0
1995	6,490	5,978	512	7.9
1996	6,375	5,816	559	8.8
1997	6,395	5,958	437	6.8
1998	6,450	6,035	415	6.4
1999	6,262	5,932	330	5.3
2000	6,501	6,152	349	5.4
2001	6,600	6,199	401	6.1
2002	6,695	6,259	436	6.5

Source: Bureau of Labor 2003b.

Industry of Workers

The profile of employment by the major industrial sector from 1997 to 2000 presented in **Table 3-36** indicates a heavy reliance on government employment in Socorro County. Public sector jobs account for over ⅓ of total employment and lead the second largest sector, services, by two percentage points. Rounding out the top three industrial sectors is retail trade with 14 percent of total employment.

Table 3-36. Percent Employment By Industrial Sector in Socorro County, 1997-2003

Industrial Sector	1997	1998	1999	2000
Agricultural Services, Forestry, and Fishing	(D)	(D)	(D)	(D)
Mining	(D)	(D)	(D)	(D)
Construction	2	2	3	3
Manufacturing	2	2	2	2
Transportation and Public Utilities	1	1	1	1
Wholesale trade	1	(D)	(D)	(D)
Retail Trade	10	9	9	9
Finance, Insurance, and Real Estate	2	2	3	3
Services	19	18	20	20
Government and Government Enterprises	22	23	22	22
Federal, Civilian	2	2	2	2
Military	1	1	1	1
State and Local	19	20	19	19
State	12	13	12	12
Local	7	7	7	7
Total Employed	**10,504**	**10,497**	**10,550**	**10,732**

Source: Bureau of Labor 2003a.
Note: (D) = Not reported due to disclosure issues.

Income

Per capita income has risen steadily in the late 1990s from $13,683 to $15,352 (see **Table 3-37**). Those employed in the public sector account for the highest percentage of total personal income with 46 percent. The number two industrial sector by contrast supplies only 31 percent of total income in the county. This disparity, while not uncommon, does highlight potential economic vulnerabilities inherent in communities that are heavily invested in a single employment category.

Table 3-37. Socorro County Personal Income Summary, 1997-2003

	1997	1998	1999	2000
Personal Income ($000)	237,378	255,171	261,192	277,395
Population	17,348	17,568	17,959	18,069
Per Capita Personal Income ($)	13,683	14,525	14,544	15,352

Source: Bureau of Labor 2003c.

3.4.7.2 Environmental Consequences

Method of Analysis

Jobs and expenditures resulting from the project are quantified as a percentage of current levels within the region. Changes of more than 5 percent in any given category would indicate a moderate level of effect (either positive or negative). The analysis also considers qualitatively the importance of estimated change in the context of the stability of local and regional economy. Other issues are addressed qualitatively with respect to NMIMT's proposed methods to mitigate their effects.

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

By far, the majority of direct economic impacts from the project would occur during the construction phase, and the greatest of these during the first 2 years. Based on demographics of the local communities, the technical skills required for road improvement and infrastructure construction could be provided by the local area labor force. Based on a workforce estimated at a maximum of 100 and an average of 50 workers employed for the first 2 years, the construction sector of Socorro County could increase by 31 percent. Given this sharp increase in construction jobs, it is possible that labor, particularly during peak periods, would be imported from areas beyond the county. The occurrence of such an event would depend on the availability of labor and their technical skill level relative to the job requirements at the time such positions are being filled. For example, there may be an abundance of workers available for general labor associated with road construction, concrete work, or structure framing. Since there is a relatively low skill level involved with many aspects of these tasks, employable workers could be drawn away from other industrial sectors and thus increase construction jobs from within the region. However, as work progresses and the need arises for more skilled tradesmen such as journeymen electricians, if these specialized workers are not available from the local area, they would be hired from beyond the region.

As part of the project, approximately 2,400 cubic feet[4] of marketable timber could be removed from the CNF. The sale price of salable timber is estimated at around $1,200 and would be sold under contract to NMIMT (Marks 2003). It is NMIMT's decision as to how they would divest themselves of the timber. However, the forest product industry in Socorro County is too small even to be measured without violating disclosure rules. Given this, it is very unlikely that such a small sale would have any discernable effect on the local economy.

Expenditures on construction materials would likely provide some injection of dollars into the local economy. There is potential for some general building materials to be purchased locally. However, in all likelihood, most specialized items would be purchased

[4] "Cubic Feet" is a measurement of lumber volume. A cubic foot is a solid piece of wood 1 foot (0.3 m) wide, 1 foot thick, and 1 foot long that equals 1,728 cubic inches.

from outside the area. Given the project's relatively close proximity to Albuquerque, it is not unreasonable to assume that a larger building supply firm from the metro area could supply the bulk of the building materials at a more competitive price even when delivery costs are considered. Even under this scenario, local suppliers would still be relied on to provide many unforeseen items, as well as periphery services such as vehicle parts and maintenance. The specific supply channels for materials would be determined by NMIMT and the General Contractor.

Over half of the total funded amount would be used to purchase the very specialized optical equipment and computers. Some procurements would be with suppliers in Albuquerque, yet a good portion may be contracted with out-of-region suppliers.

Activity on Water Canyon Road would increase due to the construction of the proposed MRO. Impacts of the estimated 12,800 vehicle trips could be felt by Socorro County taxpayers in connection with the approximately 5-mile (8-km) stretch of road from US 60 to Water Canyon Campground. Deterioration of, and the associated maintenance costs for, this road classified as light duty, would be a function of vehicle weight and number of trips. The initial work plan estimates 3,200 heavy truck and 9,600 light truck trips over the course of Stage I construction, 75 percent of which would occur in the first year. The condition of this road segment would be monitored before and after the proposed MRO construction, and any repairs needed would be performed in accordance with an agreement developed among NMIMT, the Forest Service, and Socorro County. Maintenance and repair of Water Canyon Road beyond the campground would be conducted under the existing SUP and Annual Operations and Maintenance Plan.

Vehicular access to the area would be limited during the construction phase and therefore may have some impact on recreation and tourism. However, non-motorized travel would still be available. The road could be subject to closure during maintenance and repair and during peak construction time. This would occur only between the campground and the ridgetop. The campground itself would remain open. As such, very little impact on recreation and tourism should be felt as a result of the closure.

Risks of fire would be mitigated through several methods during the construction phase. Firefighting equipment would be on-site and alterations to machinery made so as to reduce the risk of fire from human sources. Due to the unpredictability associated with any forest fire situation, it is difficult to assess the potential costs associated with increased fire risk.

Operational Phase

Once construction is complete, direct impacts on employment would be reduced substantially. A small core staff of two to three individuals would be on-site and would be drawn from NMIMT staff. The influx of researchers into the area could provide additional revenue to local lodging facilities and retail establishments, particularly during the winter months, which is the optimal use period for the proposed MRO. The lodging demands generated by researchers would generally be less than 2 percent of the total supply of rooms in the City of Socorro. However, an annual weeklong conference could swell occupancy substantially for a short period each year. This would have positive economic effects on local business.

Upon completion of the project, Water Canyon Road would remain open as a Forest Service Level 2 road, suitable for high clearance vehicles. Year-round road maintenance would allow greater potential for winter recreation.

Potential impairment of visual aesthetics due to development of the proposed MRO is addressed in Section 3.4.2. It is not expected to alter recreation use in the area. While there would be no day-to-day public access to the facility, periodic tours of the site are planned, which may draw some limited tourists to the area. In addition, fencing around the installation would be limited to the scientific equipment, primarily to deter cattle from interfering with the instruments. As such, the public would be allowed access to the ridge and could observe the facility from the exterior. The increase in visitor levels is expected to be low to moderate and, overall, the effects on tourism are expected to be minimal.

On-site firefighting equipment would be in place to aid in early fire suppression. As stated before, it is difficult to anticipate the level of resources required to protect a facility of this kind, and how that could affect the current budget. The existence of the observatory would also provide several potential benefits in the event of a fire including:

- Early detection;
- On-site equipment;
- Availability, albeit limited, of a ready water source;
- Improved road access; and
- A good base of operations.

Indirect Impacts

The project is not expected to stimulate population immigration to any measurable degree. Therefore, the need for additional community services is not expected. Feedback from local residents of Magdalena during public tours and meetings indicates a sense of interest and community pride in having the new facility named after the community. While not measurable, this provides some positive social benefit to the local area. NMIMT is actively promoting the new facility for K-12 educational programs and is engaged in educational outreach activities that should benefit local communities.

Alternative 2: No Action

Under Alternative 2, any employment benefits from MRO construction would be forgone. Employment would remain as described for the affected environment. Access for recreation activities would not change from the current state, and no change in current tourist activities would be expected. The MRO would not pose any additional fire-fighting requirements.

Alternative 3: Preferred Alternative

Direct and indirect impacts under this alternative would be the same as under Alternative 1. Differences associated with this alternative would not change employment levels. However, they could reduce the duration of certain construction jobs. The effects of these difference are expected to be minimal.

Alternative 4

Direct and indirect impacts under this alternative would be the same as under Alternative 1. Differences associated with this alternative would not change employment levels. However, they may reduce the duration of certain construction jobs due to changes in building design. The effects of these changes are expected to be minimal.

3.4.7.3 Cumulative Impacts

In combination with other attractions in the area, particularly the NRAO and the winter season spectacle of wintering waterfowl at Bosque del Apache, the proposed MRO could raise interest in this area as a tourist destination for a small niche market. Total increases in tourism are likely to be small but could be important locally for small businesses that are aimed at tourist sales and services. These cumulative impacts would be common to Alternatives 1, 3, and 4 and benefit the local economy.

There would be no new cumulative impacts under Alternative 2.

3.4.7.4 Mitigation

No mitigation measures are identified for economic and social resources.

3.4.8 Environmental Justice

3.4.8.1 Affected Environment

Region of Influence

The ROI for the Environmental Justice analysis is Socorro County.

Existing Conditions

EO 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations, signed by President Clinton on February 11, 1994, requires all federal agencies to address the impact of their programs with respect to Environmental Justice. The order requires that minority and low-income populations not receive disproportionately high or adverse human health or environmental impacts and requires that representatives of any low-income or minority populations that could be affected by the project be involved in the community participation and public involvement process.

Table 3-38 shows the minority populations in Socorro County and the poverty level by census block. **Table 3-39** displays the same information for the 20-mile (32-km) area likely to be most affected by the project. All tracts except Tract 9783.01 (Block Group 1) and Tract 9783.02 (Block Group 2) have higher proportions of minorities than the county or state as a whole. Similarly, all tracts except Tract 9783.02 (Block Group 2) in Socorro have higher poverty levels than the state as a whole. **Map 3-20** shows the locations of these block groups and tracts. While the project is not likely to adversely affect these populations, some beneficial consideration may be given to these communities during the construction phase.

The area has a high portion of American Indians. The CNF regularly consults and coordinates with tribes and pueblos on its undertakings. There has been some concern, particularly regarding access and the valued status of South Baldy Peak. In general, however, Indian groups have been supportive of the project and its potential to bring prosperity, educational benefits, and jobs to the area. The outreach activities and consultation for tribes, pueblos, and local communities for this project are described in Chapter 1, Section 1.7.

3.4.8.2 Environmental Consequences

Method of Analysis

For the Environmental Justice analysis, the construction and operational phases of the proposed MRO were examined to determine whether siting of facilities, construction activities, or operations could result in disproportionately high and adverse impacts on minority or low-income populations, based on census data.

Table 3-38. Detailed Population Characteristics of Socorro County by Census Block Group, 2000

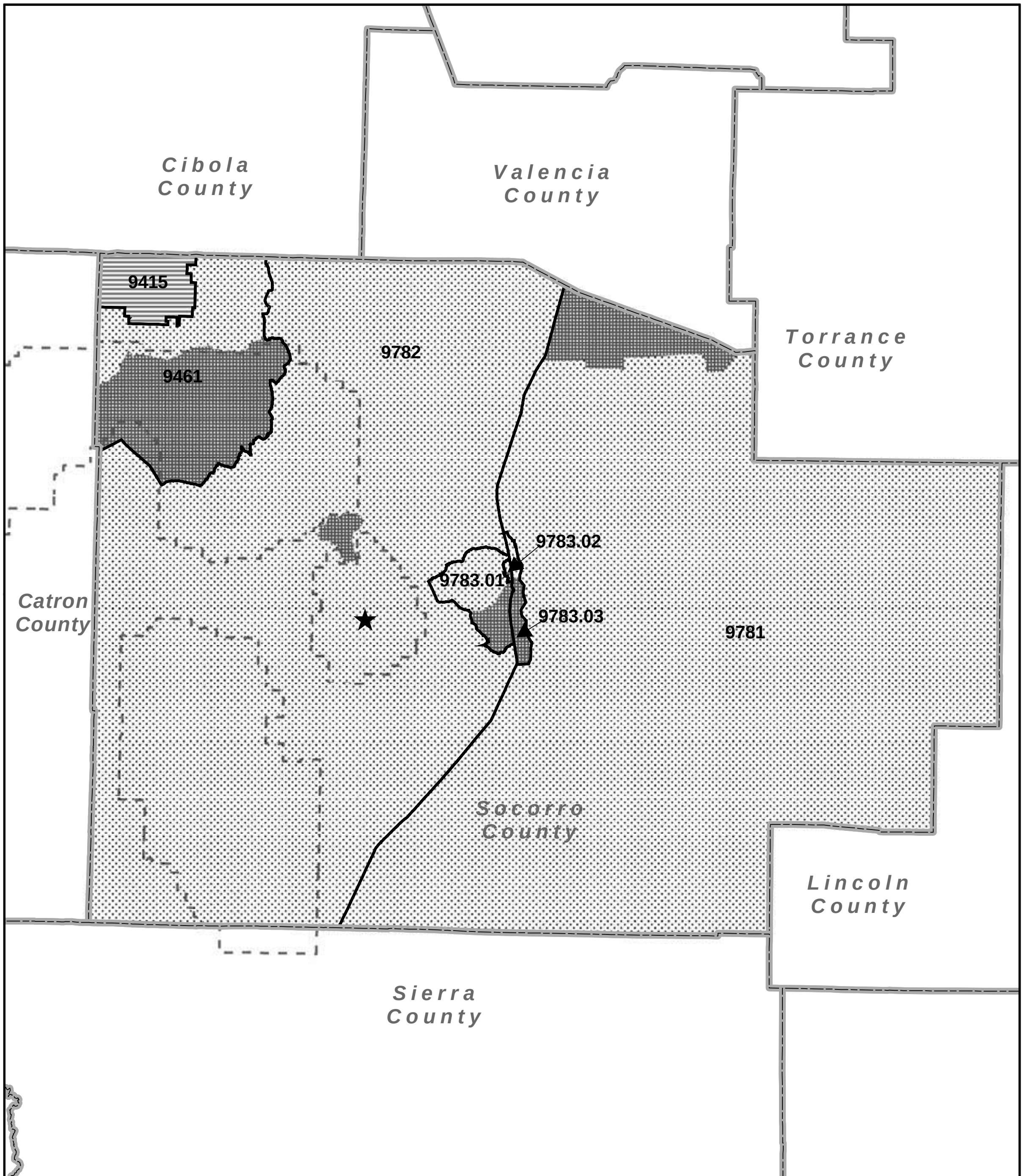
Census Tract	Block Group	Population	White	% White	African-American	% African-American	American Indian	% American Indian	Other	% Other	Hispanic Origin	% Hispanic Origin	Below Poverty	% Below Poverty
9415.00	Blk-Grp 3	–	–	–	–	–	–	–	–	–	–	–	–	–
9461.00	Blk-Grp 1	223	–	–	–	–	223	100	–	–	–	–	223	100
9461.00	Blk-Grp 2	1,368	9	1	–	–	1,356	99	3	–	16	1	893	65
9781.00	Blk-Grp 1	2,177	1,631	75	–	–	16	1	530	24	1,108	51	348	16
9781.00	Blk-Grp 2	2,370	1,677	71	39	2	45	2	609	26	1,393	59	677	29
9782.00	Blk-Grp 1	834	647	78	–	–	26	3	161	19	247	30	210	25
9782.00	Blk-Grp 2	969	566	58	2	–	77	8	324	33	496	51	235	24
9783.01	Blk-Grp 1	2,066	1,437	70	–	–	36	2	593	29	936	45	526	25
9783.01	Blk-Grp 2	813	526	65	–	–	–	–	287	35	637	78	348	43
9783.02	Blk-Grp 1	1,507	1,066	71	–	–	8	1	433	29	868	58	525	35
9783.02	Blk-Grp 2	1,020	810	79	25	2	8	1	177	17	156	15	76	7
9783.02	Blk-Grp 3	1,087	750	69	37	3	55	5	245	23	540	50	422	39
9783.03	Blk-Grp 1	1,927	1,213	63	7	–	62	3	645	33	1,183	61	588	31
9783.03	Blk-Grp 2	1,717	1,006	59	9	1	105	6	597	35	1,084	63	468	27

Source: US Census 2000.

Table 3-39. Detailed Population Characteristics of the 20-Mile Area by Census Block Group, 2000

Census Tract	Block Group	Population	White	% White	African-American	% African-American	American Indian	% American Indian	Other	% Other	Hispanic Origin	% Hispanic Origin	Below Poverty	% Below Poverty
9782.00	Blk-Grp 1	834	647	78	–	–	26	3	161	19	247	30	210	25
9782.00	Blk-Grp 2	969	566	58	2	–	77	8	324	33	496	51	235	24
9783.01	Blk-Grp 1	2,066	1,437	70	–	–	36	2	593	29	936	45	526	25
9783.01	Blk-Grp 2	813	526	65	–	–	–	–	287	35	637	78	348	43
9783.02	Blk-Grp 1	1,507	1,066	71	–	–	8	1	433	29	868	58	525	35
9783.02	Blk-Grp 2	1,020	810	79	25	2	8	1	177	17	156	15	76	7
9783.02	Blk-Grp 3	1,087	750	69	37	3	55	5	245	23	540	50	422	39
9783.03	Blk-Grp 1	1,927	1,213	63	7	–	62	3	645	33	1,183	61	588	31
9783.03	Blk-Grp 2	1,717	1,006	59	9	1	105	6	597	35	1,084	63	468	27

Source: US Census 2000.



Legend

- MRO Project Area
- USFS Boundary
- County Boundary
- Census Tract

Census Block Group
- 1
- 2
- 3

10 5 0 10
Scale in Miles

Scale 1:1,170,000
Projection UTM, Zone 13, NAD 1927

Sources: US Census 2001a, b
Produced by: SAIC-Albuquerque, NM
Date: 6/16/03

The Cibola National Forest uses the most current data available. Updates are performed as new information becomes available. No warranties are made regarding the accuracy of this data.

Map 3-20
Census Tracts and Block Groups in the Vicinity of the Project Area

Alternative 1: Proposed Action

Direct Impacts

Construction Phase

Census tract analysis of the area reveals several locations of high minority concentration and high poverty levels. While the project is not likely to adversely affect these populations, some beneficial consideration may be given to these communities during construction phase. Availability of construction jobs may provide a small benefit for minorities and persons whose income is affected by the lack of job opportunities. This benefit would depend on the skills of individuals (particularly, local residents of Magdalena and the Alamo Chapter of The Navajo Nation).

Effects on sites of value to Native Americans are addressed in Heritage and Cultural Resources (Section 3.4.5).

Operational Phase

No disproportionate effects on minority populations in the area were determined from the ongoing operation of the proposed MRO.

Indirect Impacts

The proposed MRO construction and operations is not expected to have indirect environmental justice impacts.

Alternative 2: No Action

There would be no changes to the existing conditions under Alternative 2.

Alternative 3: Preferred Alternative

Direct and indirect impacts for environmental justice would be the same as under Alternative 1.

Alternative 4

Direct and indirect impacts for environmental justice would be the same as under Alternative 1.

3.4.8.3 Cumulative Impacts

Under Alternatives 1, 3, or 4, the proposed MRO's contribution to any cumulative increase in recreational use and tourism in the area may benefit local small businesses, which could be minority-owned. This may also slightly benefit the service industry by generating some local jobs. Any economic benefits from the project could have the potential to positively affect low-income and minority persons in the local area.

Alternative 2 would not result in any new cumulative impacts.

3.4.8.4 Mitigation

No mitigation measures are identified for environmental justice.

3.5 Short- and Long-Term Uses

The proposed MRO is being developed to operate for several decades. The actual amount of land to be dedicated to this use (and therefore inaccessible for other uses) is about 19 acres. This would result in a long-term loss of 13 acres on the ridgetop for multiple uses such as grazing, dispersed recreation, and wildlife habitat in the areas where scientific facilities would be developed, and an additional 6 acres along Water Canyon Road. Although there would be some impacts to the physical and biological environment extending over a larger area, these are estimated to be relatively minor, and most can be minimized by using appropriate and proven methods for controlling impacts. Many of these effects would be most prevalent during construction in the short term and become less of a concern after vegetation is reestablished on the disturbed land. Other effects potentially could increase over time (such as accumulation of polluting materials, soil loss, and sedimentation) but would not be problematic given the regulations and practices that would govern their sources.

Access along Water Canyon Road above Water Canyon Campground could be intermittently impeded during construction of the proposed MRO. This short-term impact is not expected to result in any long-term effects.

3.6 Unavoidable Adverse Effects

The mitigation measures identified in Table 2-6 would reduce potential adverse impacts from the construction and operation of the proposed MRO. The only unavoidable adverse impact would be the permanent loss of 19 acres (about 2 AUMs) in the Baldy grazing allotment.

3.7 Irreversible and Irretrievable Commitments of Resources

There would be few irreversible commitments of resources from implementing the proposal because all facilities could be dismantled and efforts taken to return areas to the natural conditions of surrounding areas. For the three action alternatives (Alternatives 1, 3, and 4), irretrievable commitments for a period of time include the following:

- Loss of about 2.6 percent of potential habitat for San Mateo beardtongue, a Forest Service sensitive species and a New Mexico rare species in the project area.
- Loss of about 19 acres currently available for grazing. This would equate to approximately 2 AUMs. This land would be covered with new structures or other constructed features (such as parking area, road, or leach field), or contained within a fence that precludes general access by the public.
- Loss of about 19 acres of recreational open space.

CHAPTER 4. CONSULTATION AND COORDINATION

4.1 Introduction

This chapter lists the persons involved in the preparation of the Final EIS, including agencies that provided input, direction, or regulatory approval. It also includes individuals, agencies, and organizations who received the Draft and Final EIS.

4.2 Preparers and Contributors

4.2.1 Interdisciplinary Team Members

Table 4-1 provides the contact information for the Forest Service Magdalena Ridge Observatory ID Team. **Table 4-2** lists SAIC's project team and their project role. **Table 4-3** provides the contact information for the NMIMT project team.

Table 4-1. Forest Service Proposed MRO ID Team

Proposed MRO ID Team Skills	Proposed MRO ID Team Member
Lead District Ranger	Dennis Aldridge
Wildlife Biologist	David Heft
Archeology/Heritage	Cynthia Benedict
Lands/Special Uses	Sue McHenry
Recreation/Visual	Karen Carter
Visual	Marti Dodds
Range	Chad Horman
Minerals	Sue McHenry
Roads/Engineering	John Elmquist, Mike Gurule
Water	Dave Pawelek, Wayne Green
Soils	Dave Pawelek, Wayne Greem
Air	Laura Hudnell
Noise	Laura Hudnell
Timber/Vegetation	Tom Marks
Fire Management	Fred Hernandez
Public Affairs	Mark Chavez
Landscape Architect	Marti Dodds

Proposed MRO ID Team Skills	Proposed MRO ID Team Member
GIS	TerryYeh
Budgeting/Fiscal	Bob Knauer
Agreements	Gloria Delgado
NEPA Planner	Deborah Walker
Project Coordination/Liaison	Laura Hudnell
Environmental Justice	Dave Seesholtz
Hazardous Materials/Waste	Marcia Miolano

Table 4-2. SAIC EIS Project Team

Resource/Role	SAIC
Program Manager	Robin Brandin
EIS Project Manager	Susan Goodan
QA Manager, Minerals	Bob Kelly
Air Quality	Dave Lingner
Geology and Soils; Rangelands (Lead)	Ellen Dietrich
Rangelands, Fire Management	Joe Sena
Water Resources	Tom Greengard
Biological Resources (Lead); BA/BE	Chuck Burt
Biological Resources; GIS	David Dean
Transportation (and Access); Visual; Recreation; Lands and Realty (Lead)	Brian Kennedy
Transportation (and Access); Visual; Recreation; Lands and Realty	Tanya Butler
Heritage and Cultural Resources (Field surveys)	Neal Ackerly
Heritage and Cultural Resources (EIS)	Claudia Druss
Safety; Noise	Bill Wuest
GIS	Heather Gordon
Socio-Economics; Environmental Justice	Jon Burnham
Graphics Technician	Nancy Cabber
Technical Editor; Project Record; and Document Coordinator	Winnie Devlin
Word Processing; Deliverable Production; and Data Entry	Jonathan Cohen

Table 4-3. NMIMT Project Team

Role	Team Member
Vice President, Research & Economic Development	Van Romero
Project Scientist/Liaison	Dave Westpfahl
Project Engineer	Pierce Howell, Leonard Truesdell
Project Scientist	Dan Klinglesmith
Technical Editor	Kimberly Coleman

4.2.2 Federal, State, and Local Agencies

Table 4-4 contains a list of government agencies consulted with during the preparation of this Draft and Final EIS.

Table 4-4. List of Agencies Consulted or Contacted During Preparation of the Draft and Final EIS

Federal Government
Naval Research Laboratory
U.S Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish & Wildlife Service
State Government
NM State Highway & Transportation Department
NMIMT, Langmuir Laboratory
State Historic Preservation Office
NM Environment Department
County/Municipal Government
City of Socorro
Village of Magdalena
Socorro County Commission
Other
Apache Point Observatory, Sunspot, NM

4.2.3 Tribes

Table 4-5 contains a list of tribal governments and organizations contacted concerning the proposed MRO project.

Table 4-5. List of Tribal Governments and Organizations

Tribal Governments and Organizations
The Navajo Nation
Alamo Navajo Chapter
Pueblo of Acoma
Pueblo of Zuni
The Hopi Tribe
Ysleta del Sur Pueblo
Mescalero Apache Tribe
Ft. Sill Chiricahua-Warm Springs Apache Tribe
White Mountain Apache

4.2.4 Others

Table 4-6 contains a list of organizations included in pre-scoping for the project. Recipients were asked to select options to receive further information or EIS documents.

Table 4-6. List of Other Entities and Organizations

Other Organizations	
Albuquerque Wild Turkey Federation	Moore Anthropological Research
American Endurance Ride Conference	Muleshoe Land & Cattle Corporation
Back Country Horseman of New Mexico	Museum of New Mexico
C&S Trucking Company	New Mexico Cattle Growers Association
Center for Biological Diversity	New Mexico Mountain Club
Central New Mexico Audubon Society	New Mexico Museum of Space History
Chavez Cattle Company	Ojo Grande Homeowners Association
Double H Ranch	Middle Rio Grande Chapter, National Wild Turkey Federation
El Defensor Chieftan	PNM Environmental Services
Forest Guardians	Rimrock Guides & Outfitters
Forest Trust	Rio Grande Botanic Garden
Handrich Guides/Outfitters	Sky Island Alliance
Historic Preservation Association	Sloan Contracting, Inc.
Hurd Brothers Logging	Southwest Wildlife Solutions
Hydro Resources Corporation	Tetra Tech, Inc.

Other Organizations	
Kentucky Wolf Information Center	TRC
Laguna Construction Company, Inc.	Zephyr Design, Inc.
McCollaum Partnership	

4.3 Distribution of the EIS

Table 4-7 lists agencies and organizations on the mailing list for the Draft and Final EIS. **Table 4-8** lists members of the public on the mailing list for the Draft and Final EIS. This Final EIS has been distributed to individuals who specifically requested a copy of the document or who commented on the Draft EIS.

Table 4-7. Agencies and Organizations on Proposed MRO Draft and Final EIS Mailing List

Agency or Organization	City	State	Draft EIS	Final EIS
Federal				
Advisory Council on Historic Preservation	Washington	DC	X	X
Bosque del Apache National Wildlife Refuge	Socorro	NM	X	X
Bureau of Land Management	Albuquerque	NM		X
Bureau of Land Management	Santa Fe	NM	X	X
Bureau of Land Management	Socorro	NM	X	X
Environmental Protection Agency – Office of Federal Activities	Washington	DC	X	X
Environmental Protection Agency – Region 6	Dallas	TX	X	X
Federal Aviation Administration	Fort Worth	TX	X	X
Federal Highway Administration, Midwestern Region	Olympia Fields	IL	X	X
National Radio Astronomy Observatory	Socorro	NM	X	X

Agency or Organization	City	State	Draft EIS	Final EIS
Naval Research Laboratory	Washington, DC	NM	X	X
Naval Research Laboratory – Remote Sensing Division	Kirtland AFB	NM	X	X
U.S. Air Force	Albuquerque	NM	X	X
U.S. Army Corps of Engineers, Southwestern Division	Dallas	TX	X	X
U.S. Department of Energy	Washington	DC	X	X
U.S. Department of Housing & Urban Development (HUD)	Washington	DC	X	X
U.S. Fish & Wildlife Service	Albuquerque	NM	X	X
USDA APHIS PPD/EAD	Riverdale	MD	X	X
USDA Forest Service	Washington	DC	X	X
USDA National Agricultural Library	Beltsville	MD	X	X
USDA Natural Resources Conservation Service	Washington	DC	X	X
USDI National Park Service	Lakewood	CO	X	X
USDI Office of Environmental Policy and Compliance	Washington	DC	X	X
USDOC National Oceanic and Atmospheric Administration	Washington	DC	X	X
White Sands Missile Range	White Sands Missile Range	NM	X	X
State/Local				
City of Albuquerque	Albuquerque	NM	X	X
City of Socorro	Socorro	NM	X	X
Bernalillo County Commission	Albuquerque	NM	X	X
Magdalena Public Library	Magdalena	NM	X	X

Agency or Organization	City	State	Draft EIS	Final EIS
NM Bureau of Geology & Mineral Resources	Socorro	NM	X	X
NM Dept. of Game & Fish	Las Cruces	NM	X	X
NM Dept. of Game & Fish	Santa Fe	NM	X	X
NM State Forestry Division	Santa Fe	NM	X	X
NM State Forestry Division – Socorro District	Socorro	NM	X	X
NM State Highway & Transportation Dept.	Santa Fe	NM	X	X
NM State Representative	Socorro	NM	X	X
NM Environment Department (NMED)	Santa Fe	NM		X
NMED-SWQB	Silver City	NM	X	X
NMED-SWQB-WPS (Middle Rio Grande)	Santa Fe	NM	X	X
Sandoval County Commission	Bernalillo	NM	X	X
Skeen Library – NMIMT	Socorro	NM	X	X
Socorro County Commission	Socorro	NM	X	X
Socorro Public Library	Socorro	NM	X	X
University of New Mexico – Zimmerman Library	Albuquerque	NM	X	X
U.S. House of Representatives – 1st District	Albuquerque	NM	X	X
U.S. House of Representatives – 2nd District	Socorro	NM	X	X
U.S. House of Representatives – 3rd District	Santa Fe	NM	X	X

Agency or Organization	City	State	Draft EIS	Final EIS
U.S. Senate – Bingaman and Domenici	Albuquerque	NM	X	X
Utah State University – Quinney Library	Logan	UT	X	X
Village of Magdalena	Magdalena	NM	X	X
Tribal				
Alamo Navajo Chapter	Magdalena	NM	X	X
Ft. Sill Chiricahua-Warm Springs Apache	Apache	OK	X	X
Mescalero Apache Tribe	Mescalero	NM	X	X
Navajo Nation, The	Cuba	NM	X	X
Navajo Nation, The	Window Rock	AZ	X	X
Pueblo of Acoma	Acoma	NM	X	X
Pueblo of Zuni	Zuni	NM	X	X
Torreon/Star Lake Chapter	Cuba	NM	X	X
Ysleta del Sur Pueblo	El Paso	TX	X	X
MRO Consortium				
Air Force Research Laboratory	Albuquerque	NM	X	X
Los Alamos National Laboratory	Los Alamos	NM	X	X
Naval Research Laboratory	Albuquerque	NM	X	X
New Mexico Highlands University	Las Cruces	NM	X	X
New Mexico Institute of Mining and Technology	Socorro	NM	X	X
New Mexico State University	Las Cruces	NM	X	X
University of Cambridge	Cambridge	UK	X	X
University of Puerto Rico	Mayaguez	PR	X	X

Table 4-8. Individuals on Proposed MRO Draft and Final EIS Mailing List

Name	City	State	Draft EIS	Final EIS
Acklen, Chris	Albuquerque	NM	X	X
Adair, Bryan	Bloomfield	NM	X	
Adamcik, L.B.	Panorama City	CA	X	X
Allan, Peter	Gladstone	NJ	X	X
Allen, Jay	Albuquerque	NM		X
Alvarez, David	Albuquerque	NM		X
Apachito, Wanda	Magdalena	NM	X	
Archer, Shannon	Socorro	NM	X	X
Arterberry, Jimmy	Lawton	OK	X	X
Aster, Richard	Socorro	NM	X	X
Becker, Bill & Lynda	Albuquerque	NM	X	X
Becker, Richard W.	Albuquerque	NM	X	X
Begay, Steven	Window Rock	AZ	X	
Bentley, Rick J.	Datil	NM	X	X
Bhasker, Ravi	Socorro	NM	X	
Bingaman, Jeff	Albuquerque	NM	X	X
Blatnik, John	Estancia	NM		X
Borgstrom, Carol M.	Washington	DC	X	X
Boykin, Doug	Socorro	NM	X	X
Brammer, Alpha Lee	Socorro	NM		X
Brandvold, Don	Socorro	NM	X	X
Broaddus, Luther	Magdalena	NM		X
Brody, Jean & Jerry	Sandia Park	NM	X	
Brown, David A.	Stratford	TX		X
Brown, Gary	Socorro	NM	X	X
Bush, S.M.	Clayton	NM	X	X
Campbell, Bel	Port Tobacco	MD	X	X
Campbell, Doug	Albuquerque	NM	X	
Cannon, Greg	Albuquerque	NM	X	X
Chamberlain, Richard	Socorro	NM	X	X
Chang, Mark	Mayaguez	PR	X	X

Name	City	State	Draft EIS	Final EIS
Chapman, Richard C.	Albuquerque	NM	X	X
Charlton, Gerald	Bosque Farms	NM	X	X
Chavez, Martin	Albuquerque	NM	X	
Chavez, Eduardo	San Antonio	NM	X	
Claussen, Andrew	Socorro	NM	X	X
Claypool, Dan	Silver City	NM	X	X
Cobb, Mike	Socorro	NM	X	X
Dahms, Cathy	Albuquerque	NM	X	X
Damp, Jonathan E.	Zuni	NM	X	
Daugherty, Ron	Sandia Park	NM	X	X
Davis, Hubert O.	Albuquerque	NM	X	
Day, Dan	Albuquerque	NM		X
Domenici, Pete V.	Albuquerque	NM	X	X
Donisthorpe, Bruce	Albuquerque	NM	X	X
Doyle, Kevin	Santa Fe	NM	X	X
Drumheller, Phylis	Cedar Crest	NM		X
Duda, George	Santa Fe	NM	X	X
Duvarney, Andree	Washington	DC	X	X
Early, Caroline	Beltsville	MD	X	X
Ellison, Debra	Los Lunas	NM	X	
Ferguson, Tom	Albuquerque	NM	X	X
Ferranti, Bill	Datil	NM	X	X
Finley, David G.	Socorro	NM	X	X
Fleck, John	Albuquerque	NM	X	X
Fleming, Jock	Taos	NM	X	
Ford, Glenn	Albuquerque	NM	X	
Fowler, Kevin	Placitas	NM	X	X
Foy, Bernard	Santa Fe	NM	X	X
Franklin, Martina	Socorro	NM	X	X
Gandee, Scott H.	Albuquerque	NM		X
Geddie, John	Albuquerque	NM	X	X
Geluso, Ken & Keith	Omaha	NE		X

Name	City	State	Draft EIS	Final EIS
Gilbreath, Charmaine	Washington	DC	X	X
Goebel, Don	Albuquerque	NM		X
Gordon, William	Magdalena	NM	X	X
Gravagne, Pamela	Sandia Park	NM		X
Griscom, Jim & Blanch	Albuquerque	NM	X	X
Gutierrez, Junior	Magdalena	NM		X
Hall, Jack	Albuquerque	NM	X	X
Hall, G. Emlen	Albuquerque	NM		X
Hallmark, Cullen	Santa Fe	NM	X	X
Handrich, Dave	Glenwood	NM	X	X
Harbin, Chris & Robin	Louisville	KY	X	X
Harris, Dennis	Socorro	NM	X	X
Hays, Debbie	Bernalillo	NM	X	X
Heft, David L.	Socorro	NM	X	X
Henke, Andre	Placitas	NM	X	X
Hennig, Marvin D.	Tucumcari	NM		X
Hicks, Martin W.	Grants	NM	X	X
Higgins, Howard C.	Albuquerque	NM	X	X
Hill, Bill	Truth or Consequences	NM		X
Hills, Richard	Las Cruces	NM	X	X
Hopkins, Larry W.	Cliff	NM	X	X
Horn, C.M.	Leucadia	CA	X	
Horne, Arlene	Las Vegas	NM	X	X
Houser, Jeff	Apache	OK	X	
Howell, Pierce	Socorro	NM	X	X
Hurst-Waitz, Beth	Albuquerque	NM	X	X
Hutchinson, Howard	Glenwood	NM	X	X
Jackson, David G.	Albuquerque	NM	X	X
Jamieson, Quentin	Socorro	NM	X	X
Jaramillo, Frank	Socorro	NM	X	
Jorgensen, Anders	Los Alamos	NM	X	X
Kelly, James	Magdalena	NM	X	X

Name	City	State	Draft EIS	Final EIS
Kelly, Tom & Hilda	Magdalena	NM	X	X
Kempton, Marvin & Leva G.	Socorro	NM	X	X
Ketzeback, William	Sunspot	NM	X	X
Kieft, Tom	Socorro	NM	X	X
Kirk, Michael	Gallup	NM	X	
Kistler, John	Socorro	NM	X	X
Klinger, Timothy C.	Fayetteville	AR	X	X
Klinglesmith, Daniel A.	Socorro	NM	X	X
Knecht, David D.	Bowdle	SD		X
Krehbiel, Paul	Socorro	NM	X	X
Kreiner, Dick	Tome	NM	X	X
Kuchta, Tom	Rio Rancho	NM	X	X
Kyser, Lindsay R.	Dade City	FL	X	
Lagoyda, John P.	Socorro	NM	X	X
Larson, Chris	St. Cloud	MN	X	X
Laubscher, Bryan	Los Alamos	NM	X	X
Lee, Carol	Magdalena	NM		X
Longair, Malcolm	Cambridge	UK	X	X
Lopez, Daniel H.	Socorro	NM	X	
Lord, Mike	Cedar Crest	NM	X	X
MacCallum, Crawford	Tijeras	NM	X	X
Maloy, Mary Beth & Pat	Albuquerque	NM	X	X
Marcy, Bill	Socorro	NM	X	X
Marquez, Ron	Albuquerque	NM		X
Martin, Jeff	Kirtland Air Force Base	NM	X	X
Martin, Philip	Albuquerque	NM		X
Martinez, Joseph J.	Chamisal	NM	X	X
Martinez, Israel	Albuquerque	NM		X
Mascarenas, Margaret	Bosque Farms	NM		X
Mathis, Pat	Las Cruces	NM	X	X
Mayer, Tom	Albuquerque	NM	X	
McCollaum, Ben	Carlsbad	NM		X

Name	City	State	Draft EIS	Final EIS
McCormack, T.J.	Socorro	NM	X	X
McCormick, Randall	Hobbs	NM	X	X
McCune, Bernie & Ryoko	Las Cruces	NM	X	X
McGee, Glenn D.	Estancia	NM	X	X
McKee, Ron & Ruth	Los Alamos	NM		X
Monahan, Peter	Santa Fe	NM	X	X
Mong, Brian	Socorro	NM	X	X
Moore, Roger	Aztec	NM	X	X
Moore, Barbara	Magdalena	NM	X	X
Moran, Brad	Lubbock	TX	X	
Muirhead, Dennis A.	Tijeras	NM	X	
Myers, Jeffrey D.	Albuquerque	NM	X	X
Nicholopoulos, Joy E.	Albuquerque	NM	X	X
Norbury, Fred	Washington	DC	X	X
Nowicki, J.	Lemitar	NM	X	X
Oseguera, J.	Hot Springs	AR	X	
Padilla, Kate	Socorro	NM	X	X
Parmenter, Bob	Albuquerque	NM	X	X
Pearce, Steve	Socorro	NM	X	X
Petersen, Lyle W.	Albuquerque	NM	X	X
Plank, Norm	Las Cruces	NM	X	X
Polk, R. Jeff	Cedar Crest	NM		X
Popp, Carl	Socorro	NM	X	X
Pregenzer, M.V.	Albuquerque	NM		X
Quetawki, Arlen	Zuni	NM	X	
Ramacciotti, Peter D.	Albuquerque	NM	X	X
Ray, Rayburn & Mary C.	Winston	NM	X	X
Reed, Bill & Mary	Sandia Park	NM	X	X
Reed, Steve	Santa Fe	NM	X	X
Rendt, Lilly K.	Albuquerque	NM		X
Restaino, Sergio	Kirtland Air Force Base	NM	X	X
Rico, Dave	Cuba	NM	X	X

Name	City	State	Draft EIS	Final EIS
Rison, William	Socorro	NM	X	X
Roberson, Carole Newberry	Austin	TX		X
Romero, Van	Socorro	NM	X	X
Rominger, Andrew J.	Albuquerque	NM	X	X
Ruekgaoer, Tom	Socorro	NM	X	X
Ruekgaoer, Bernie & Ruth	Lambertville	NJ	X	X
Salandre, John D. & Gerry	Albuquerque	NM	X	X
Savery, Jim	Socorro	NM	X	X
Saylors, David	Albuquerque	NM		X
Scholle, Peter & Dana	Socorro	NM	X	X
Schubert, D.M.	Washington	DC	X	X
Schumann, Martha	Santa Fe	NM	X	X
Schumann, Patrik	Albuquerque	NM	X	X
Segee, Brian	Tucson	AZ	X	X
Selgado, Steve	Albuquerque	NM		X
Servoss, Rick	Albuquerque	NM	X	
Shepard, Diane	Placitas	NM	X	
Silva, Grace S.	Monticello	NM	X	
Silva, Grace	Truth or Consequences	NM	X	X
Sinclair, Arturo	El Paso	TX	X	
Sowa, Lawrence	White Sands Missile Range	NM	X	
Starr, Jean A.	Albuquerque	NM	X	X
Stern-McFadden, Donna	Mescalero	NM	X	X
Stevenson, Tod	Santa Fe	NM	X	X
Stewart, Jon	Albuquerque	NM	X	
Stout, David	Albuquerque	NM		X
Suiter, Judith N.	Albuquerque	NM	X	X
Taylor, Roger W.	Albuquerque	NM	X	X
Taylor, Willie R.	Washington	DC	X	X
Timmerman, Chad & Rachel	Farmington	NM		X
Tims/Groppe, Julia/Kevin	Annapolis	MD	X	X

Name	City	State	Draft EIS	Final EIS
Toledo, Wally	Cuba	NM	X	
Tracy, David	Albuquerque	NM	X	
Trennel, Anthony & Joy	Albuquerque	NM	X	X
Tripp, Don	Socorro	NM	X	X
Turk, Chris	Lakewood	CO	X	X
Udall, Thomas	Santa Fe	NM	X	X
Ulibarri, Paul	Socorro	NM	X	X
Vallo, Fred	Acoma	NM	X	
Vicente, Dennis	Socorro	NM		X
Vigil, Juan	Albuquerque	NM	X	X
Volkman, Michael & Denise	Placitas	NM	X	
Wagner, Charlie & Charlene	Magdalena	NM		X
Walker, Craig	Socorro	NM	X	X
Walker, Robert & Dorothy	Tesuque	NM	X	X
Walsh, Arlene	Edgewood	NM	X	X
Wasser, Allyn	Pueblo West	CO	X	X
Watson, Mark	Santa Fe	NM	X	X
Weaver, Matthew	Magdalena	NM	X	X
Wentland, Jerold	Saint Joseph	MI	X	
Westpfahl, Dave	Socorro	NM	X	X
Whitehorse, Lucinda	Socorro	NM	X	X
Whitney, John	Santa Fe	NM	X	X
Willis, Garry	Albuquerque	NM		X
Wilson, Margot	Elephant Butte	NM	X	
Wilson, Heather	Albuquerque	NM	X	X
Winn, William P.	Socorro	NM	X	X
Wolf, Mark	Albuquerque	NM	X	X
Wolfe, James A.	Magdalena	NM	X	X
Wolfe, Jim	Magdalena	NM	X	
Wood, Joyce	Silver Spring	MD	X	X
Worthem, Ellbry E.	Albuquerque	NM	X	X
Zing, Robert L.	Albuquerque	NM	X	X

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CHAPTER 6. GLOSSARY

Accessibility—A concept used in transportation planning to describe the ease with which an individual has an opportunity to participate in an activity. The more accessible an activity is, the fewer travel barriers and less travel friction need be overcome to reach the activity. Often involves making buildings and pathways passable by wheelchair.

Action Alternatives—Any alternative that proposes upgrading and/or expansion of existing facilities.

Adverse Effect—An action that has an apparent direct or indirect detrimental effect.

Affected Environment—Surface or subsurface resources (including social and economic elements) within or adjacent to a geographic area that potentially could be affected by the proposed action or alternatives.

Allotment (range)—A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under management of an authorized agency.

All-Terrain Vehicle (ATV)—Motorized, wheeled vehicle capable of cross-country travel but not legal on road.

Alluvial Gravel—A general term for clay, silt, sand, and gravel deposited during comparatively recent geologic time by a stream or other body of running water, a process that sorts the sediments.

Alternative—A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of a number of plans or projects proposed for decision-making.

Animal Unit Months (AUM)—Amount of forage required to sustain a cow/calf unit (one cow and one calf) for one month.

Appeal Eligibility—It is the responsibility of persons providing comments on the Draft EIS to submit them by the close of the comment period. Those who provide substantive comments during this comment period are eligible to appeal the decision under Forest Service regulations. Individuals and organizations wishing to be eligible to appeal must provide the following information: (1) name and address; (2) title of the proposed action; (3) specific substantive comments (36 CFR 215.2) on the proposed action, along with supporting reasons that the Responsible Official should consider in reaching a decision; (4) signature or other verification of identity upon request, identification of the individual or organization who authored the comments(s) is necessary for appeal eligibility; (5) for multiple names or multiple organizations, a signature must be provided for the individual authorized to represent each organization, or for each individual that wishes to have appeal eligibility; and (6) individual members of organizations must submit their own substantive comments to meet the requirements of appeal eligibility as an individual, comments received on behalf of an organization are considered as those of the organization only.

Aquifer—A water-bearing layer of permeable rock, sand or gravel. A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to conduct groundwater and yield large quantities of water to wells and springs.

Arroyo—A term used in the arid and semiarid regions of the southwestern United States to refer to the small, deep, flat-floored channel or gully of an ephemeral stream or of an intermittent stream usually with vertical or steeply cut banks of unconsolidated material at least 2 feet (60 centimeters) high; it is usually dry, but may be transformed into a temporary watercourse or short-lived torrent after heavy rainfall.

A-weighted—A weighting function applied to the noise spectrum, which approximates the response of the human ear.

Background—A visual resource term that describes visible terrain beyond the foreground and middle ground where individual trees are not visible but blend into the total fabric of the forest stand. Areas located 3 to 5 miles to infinity from the viewer.

Best Management Practices (BMPs)—A practice or combination of practices, that is determined by the State (or designated area-wide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable (including technological, economical, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals.

Big Game—Large species of wildlife that are hunted, such as elk, deer, bighorn sheep, and pronghorn antelope.

Biological Assessment/Biological Evaluation—An evaluation conducted to determine whether a proposed action is likely to affect any species that are listed as sensitive (USFS), candidate (USFS) or other rare designations.

Cambrian—The oldest of the periods of the Paleozoic Era; also the system of strata deposited during that period.

Candidate Species—Those plant and animal species that, in the opinion of the U.S. Fish and Wildlife Service, may become threatened or endangered. Not protected under the Endangered Species Act.

Ceramic Sherd—A shard or fragment of pottery.

Cienega—A swampy or marshy area.

Class I Area—International parks, national wilderness areas greater than 5,000 acres, national memorial parks greater than 5,000 acres, and national parks greater than 6,000 acres that existed before August 8, 1977.

Class II Area—Areas where a moderate deterioration in air quality may be allowed under the Clean Air Act.

Class III Area—No areas have been designated as Class III airsheds at this time.

Clean Air Act—Federal legislation governing air pollution. The Clean Air Act established National Ambient Air Quality Standards for carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and lead.

Council on Environmental Quality (CEQ)—An advisory council to the President of the United States established by the national Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the president on environmental matters.

Critical Habitat—An area occupied by a threatened or endangered species that contains physical and biological features that are essential to the conservation of the species, and that may require special management considerations or protection. Unoccupied suitable habitat for the threatened or endangered species is not automatically included unless such areas are essential for the conservation of the species.

Cultural Resources—Remains of human activity, occupation, or endeavor, as reflected in districts, sites, buildings, objects, artifacts, ruins, works of art, architecture, and natural features important in human events.

Cumulative Impact—The impact on the environment that results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Direct Impact—An effect that occurs as a result of an action associated with implementing the proposal or one of the alternatives including construction, operation and maintenance.

Diversity—The relative abundance of wildlife species, plant species, communities, habitats, or habitat features per unit of area.

Duff—The decaying vegetable matter, such as twigs and leaves, on the floor of a forest.

Easement—A right afforded a person or agency to make limited use of another's real property for access or other purposes.

Emission—Effluent discharge into the atmosphere, usually specified by mass per unit time.

Environmental Assessment (EA)—A document that identifies potential effects of a proposed action on the human and/or natural environment in order to determine whether or not those effects may be significant.

Environmental Impact Statement (EIS)—A document prepared to analyze the impacts on the environment of a proposed action and released to the public for review and comment. An EIS must meet the requirements of NEPA, CEQ, and the directives of the agency responsible for the proposed action.

Ephemeral Spring—A stream or reach of stream that flows briefly only in direct response to precipitation in the immediate locality and whose channel is at all times above the water table.

Erosion—The general process or group of processes whereby earth's crust is loosened, dissolved, or worn away and simultaneously moved from one place to another by natural agencies.

Erosion Control—Material, structure and techniques designed to reduce erosion associated with the construction process. Erosion control may include revegetation, avoiding steep or highly erosive areas, and constructing water bars.

Fault—A rock fracture along which displacement has occurred.

Federal Candidate Species—Sensitive wildlife species currently under consideration for inclusion to the list of federal threatened or endangered species.

Floodplain—The flat ground along a stream that is covered by water when the stream overflows its banks at flood stages.

Foreground View—The landscape area visible to an observer up to within 0.5 mile.

Habitat—A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Historic—Archaeological and archival known sites related to the activities of non-native peoples, whether they are of Euro-American, Afro-American or Asian-American origin, in the period after the European discovery of the New World (ca. A.D. 1492).

Hydric Soil—A soil that formed under conditions of saturation, flooding or ponding where the water sat long enough during the growing season to allow for the development of anaerobic conditions in the upper layer. Hydric soils, hydrophytic vegetation and wetland hydrology are used together to define wetlands.

Impact—A modification of the existing environment caused by an action (such as construction or operation of facilities), which can be positive or negative.

Indirect Impacts—Secondary consequences to the environment that occur in a location or at a time other than where and when the initial action occurred.

Infrastructure—The facilities, services, and equipment needed for a community to function including roads, sewers, water lines, police and fire protection, and schools.

Interferometer Array—A system wherein the light from a number of telescopes is combined to form an image. The resulting image has a resolution that is far sharper than an image obtained with a single telescope.

Intermittent Stream—A stream or reach of a stream that is below the local water table for at least some part of the year.

Jurisdiction—The legal right to control or regulate use of land or a facility. Jurisdiction requires authority, but not necessarily ownership.

Landscape—An area composed of interacting ecosystems that are repeated because of geology, landform, soils, climate, biota, and human influences throughout the area. Landscapes are generally of a size, shape, and pattern that are determined by interacting ecosystems.

Landscape Character—Particular attributes, qualities, and traits of a landscape that give it an image and make it identifiable or unique.

Lithic Scatter—A type of archaeological site consisting of a small distribution of chipped stone materials, which may include fragments, flakes, or stone tools.

Management Area—The Carson National Forest (CNF) Management Plan (USFS 1985) divides CNF into 18 distinct Management Areas, each having a unique set of management objectives, standards, and guidelines.

Management Indicator Species (MIS)—A representative group of species that are dependent on a specific habitat type. The health of an indicator species population is used to gauge the functioning level of the habitat on which it depends, and to inform land management practices and policies.

Mass Wasting—The downslope transportation of earth's material under the direct application of gravitational body stresses.

Middle Ground View—One of the distance zones of a landscape being viewed. This zone extends from the limit of the foreground to three to five miles from the observer.

Mitigation—The abatement or reduction of an impact on the environment by (1) avoiding a certain action or parts of an action; (2) employing certain construction measures to limit the degree of impact; (3) restoring an area to preconstruction conditions; (4) preserving or maintaining an area throughout the life of a project; or (5) replacing or providing substitute resources to the environment; or (6) gathering archaeological and paleontological data before disturbance.

Monitoring—The periodic evaluation of resources or activities of a representative sample in order to establish long-term trends, assess the impacts of land management activities, determine how well objectives have been met, and/or check compliance with established standards.

Multiple Use—Multiple use as defined by the Multiple Use—Sustained Yield Act 1960 refers to the management of all the various renewable surface resources so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will given the greatest dollar return or the greatest unit output.

National Ambient Air Quality Standards (NAAQS)—The allowable concentrations of air pollutants in the air specified by the federal government. The air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public welfare) from any unknown or expected adverse effects of air pollutants.

National Environmental Policy Act of 1969 (NEPA)—An Act that encourages productive and enjoyable harmony between people and their environment, and promotes efforts to prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humankind; enriches the understanding of the ecological systems and natural resources important to the Nation, and establishes the Council on Environmental Quality.

Negligible Impact—Impact that is small in magnitude and importance, and is difficult or impossible to quantify relative to those occurring naturally or due to other actions.

Neotropical Migratory Bird—A bird that breeds in Canada and the United States during our summer, and spends our winter in Mexico, Central America, South America or the Caribbean islands.

No Action Alternative—The alternative that continues current management direction.

Nonpoint Sources of Pollution—Pollution that originates from many indefinable sources. These often include agricultural and urban runoff, and runoff from construction activities. Nonpoint source pollutants are generally carried over, or through, the soil and ground cover by way of streamflow processes.

Noxious Weed—An undesirable weed species introduced from elsewhere that can crowd out more desirable species native to the area.

Particulate Matter—Particular matter is regulated under the Clean Air Act. PM_{10} is particulate matter that is 10 microns or less in effective diameter (also called Fine Particulate Matter). $PM_{2.5}$ is particulate matter that is 2.5 microns or less in effective diameter.

Perennial Stream—A stream receiving water from both surfaces and underground sources that flows throughout the entire year.

pH—A numeric value that gives the relative acidity or alkalinity of a substance on a 0 to 14 scale with the neutral point at 7. Values lower than 7 show the presence of acids, and values greater than 7 show the presence of alkalis.

Point Source Pollution—Pollution resulting from a confined, discrete source, such as a pipe, ditch, tunnel, well, container, or concentrated animal feed operation.

Pre-settlement—See Historic.

Prevention of Significant Deterioration (PSD)—A regulatory program based not on the absolute levels of pollution allowable in the atmosphere but on the amount by which a legally defined baseline condition will be allowed to deteriorate in a given area. Under this program, geographic areas are divided into three classes, each allowing different increases in nitrogen dioxide, particulate matter, and sulfur dioxide concentrations.

Project Area—The area where the proposed activities would occur.

Proposed Action—The set of activities proposed by the applicant, outlining what they would like to do, where they would like it to be done, and how.

Protected Activity Center (PAC)—Areas delineated by the U.S. Fish and Wildlife Service for the protection of the Mexican spotted owl that include an activity center with the best nesting and roosting habitat in the area surrounded by at least 600 acres.

Quaternary—The younger of the two geologic periods or systems in the Cenozoic Era.

Rangeland—Land used for grazing by livestock and big game animals on which vegetation is dominated by grasses, grass-like plants, forbs, or shrubs.

Raptor—Bird of prey with sharp talons and strongly curved beak; e.g., hawk, owl, vulture, eagle.

Rare or Sensitive Species—Species that have no specific legal protection under the Endangered Species Act as threatened or endangered species, but are of special concern to agencies and the professional biologic community due to low populations, limited distributions, ongoing population decline, and/or human or natural threats to their continued existence.

Region of Influence—The broadest area that can be affected by an action for a given resource.

Rehabilitation—Refers to improving the condition of Water Canyon Road without changing the road's rating. Rehabilitation could include building up the surface in locations where the road is outsloped, and widening of three or four of the tight hairpin curves near the top of the mountain.

Resource Management Plan (RMP)—A land use plan that establishes land use allocations, multiple-use guidelines, and management objectives for a given planning area. The RMP planning system has been used by the BLM since 1980.

Revegetation—The replacement of vegetative cover which as been harvested or lost due to natural occurrences. Accomplished either through planting of nursery stock or seeding, or through natural processes.

Rhyolite—A type of volcanic rock that has a high silica content and resembles granite in

Riparian—Situated on or pertaining to the bank of a river, stream, or other body of water. Normally used to refer to the plants of all types that grow along, around, or in wet areas.

Road Maintenance Level 2— Assigned to roads open for use by high clearance vehicles. Passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either to (1) discourage or prohibit passenger cars or (2) accept or discourage high clearance vehicles.

Scenery Management System (SMS)—An updated system that evaluates characteristics of the landscape (similar to VMS) but includes more participation by the public in the inventory and planning process, and attributes values pertaining to the cultural and social dimensions.

Scoping—A term used to identify the process for determining the scope of issues related to a proposed action and for identifying issues of significance to the public that need to be addressed in an EIS.

Scoria—Loose, cinderlike lava.

Sediment—Soil or mineral transported by moving water, wind, gravity, or glaciers, and deposited in streams or other bodies of water, or on land.

Sensitive Plant Species—Those plant or animal species susceptible or vulnerable to activity impacts or habitat alterations.

Snag—Any standing dead tree or portion of a tree with a minimum diameter at breast height of 10 inches and minimum height of ten feet.

Special Status Species—Plant and animal species that are protected to varying degrees by state and federal organizations because of a concern that they are in danger of becoming extinct.

Special Use Permit—A legal document issued by the U.S. Forest Service. These permits are issued to private individuals or corporations to conduct private commercial operations on National Forest System Lands. They specify the terms and conditions under which the permitted activity can be conducted.

Tackifier—A compound used in seeding operations that is usually applied with the seed and then covered by a mulch. Once moistened, the tackifier becomes sticky, essentially gluing the seed, mulch and soil together. This helps keep the seed in place against the erosive forces of wind and water.

Talus— Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Terrestrial Ecosystem Survey (TES)—A database with numerous fields of information (such as soil types, vegetation cover type) that are delineated spatially. Used by the U.S. Forest Service in establishing management practices.

Tertiary—The older of the two geologic periods comprising the Cenozoic Era; also the system of strata deposited during that period.

Threatened or Endangered Species—Animal or plant species that are listed under the federal Endangered Species Act of 1973, as amended (federally listed), or under the Colorado or New Mexico Endangered Species Act (state listed).

Total Suspended Particulates (TSP)—All particulate matter less than 70 microns in effective diameter.

Tuff— Hard volcanic rock composed of compacted volcanic ash.

Vegetation Manipulation—Planned alteration of vegetation communities through use of prescribed fire, plowing, herbicide spraying, or other means to gain desired changes in forage availability or wildlife cover.

Vegetation Type—A plant community with distinguishable characteristics described by the dominant vegetation present.

Visual Management System (VMS)—The VMS evaluates characteristics of the landscape and determines their overall importance to the visual quality in the area. The VMS provides measurable standards for management depending on the classification assigned to the landscape.

Visual Resources—the visible physical features of a landscape (topography, water, vegetation, animals, structures, and other features) that constitute the scenery of an area.

Water Table—The top of the water surface of an unconfined aquifer; that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

Wetland—Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wilderness Area (WA)—An area formally designated by Congress as a part of the National Wilderness Preservation System. Qualities identified by Congress in the

Wilderness Act of 1964, include size; naturalness; outstanding opportunities for solitude or a primitive and unconfined type of recreation; and supplemental values such as geological, archaeological, historical, ecological, scenic, or other features.

CHAPTER 7. INDEX

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APPENDIX A. SCOPING COMMENTS AND RESPONSES

List of Categories and Sub-Categories for Scoping Comments and Responses

Comment	Sub-Category Comment	No. of Comments
Economics	Employment	1
	Tourism	1
Fire Management	Effects on Risk	2
	Impacts Analysis	1
	Mitigations	1
NEPA Procedures	Adequacy of EIS Document	2
	Non-Adherence to NEPA	1
Proposed Action	Fire Management	1
	General Approval	9
	General Disapproval	1
	Inadequate Detail/Definition	3
	Project Feasibility	2
	Project Needs Underestimated	1
	Site Development/Infrastructure	2
	Timing of Construction	1
Recreation	Access	5
	Facilities	1
Social	Education	3
	Local Values	1
Soils	Impacts Analysis: Erosion	2
Transportation	Impacts Analysis	1
	Rehabilitation	2
	Road Capacity/Capability	1
	Road Safety	3
Visual Resources	Alternatives	1
	Effects on Aesthetics	3
	Visibility from Sensitive Locations	1

Comment	Sub-Category Comment	No. of Comments
Water Resources	Effect on Wildlife	2
	Water Quality	3
	Water Supply	1
Wildlife	Avian Species (Non-Raptors)	1
	Big Game Species	1
	Effects of Construction	2
	Effects of Noise/Human Activity	1
	Sensitive/Protected Species	2

Category: Economics

Subcategory: Employment

Comment:

This project would be (able) to provide challenging employment opportunities for our citizens and students. They would not have to leave the area for jobs.

J. Nowicki

Response:

Comment noted.

Subcategory: Tourism

Comment:

Water Canyon is a nominated Important Bird Area in New Mexico (see www.audubon.org/chapter/nm/nm/rdac/iba). Water Canyon is always a spot for designated field trips during the annual Crane Festival held by Bosque del Apache National Wildlife Refuge and the City of Socorro, and is a popular tourism draw at all times of year, in large part because of the wildlife and recreational values of the area.

Jeffrey Myers, Central New Mexico Audubon Society

Response:

The EIS will address potential effects on wildlife (including birds) and recreation.

Category: Fire Management

Subcategory: Effects on Risk

Comment:

Statements concerning fire danger in the scoping document are not understood. Is the current site not completely free of trees? Large fires in that habitat happen primarily because of the density of trees in the area rather than because of ground litter. Could a prescribed burn in the area be conducted in order to reduce fire danger? This would help promote aspen growth as well as reduce fire danger for the next presumed 200 years or so.

Jeffrey Myers, Central New Mexico Audubon Society

Response:

Decisions on fire management are not within the scope of this EIS, although the current fire hazard will be considered in the analysis of this action.

Comment:

Reviewing the document, it appears that the personnel to be associated with the program will be well positioned to observe vast surrounding areas to detect fires. Such observations could be quickly reported to the Cibola Ranger District, thereby enhancing the protection of this national forest.

Anthony & Joy Trennel

Response:

Comment noted. This will be considered in the EIS analysis.

Subcategory: Impacts Analysis

Comment:

Impacts to resource management activities such as prescribed burns due to researchers whining about smoke in the air.

David Heft

Response:

The Forest Service will continue to be responsible for and to implement fire management actions. These may include prescribed burns. Management actions that reduce the risk of fire would benefit the new facility.

Subcategory: Mitigations

Comment:

With increased presence of heavy machinery and construction, there is inevitably an increased fire risk. Fires in the habitat of the South Baldy area occur as a result of the density of vegetation, particularly from excessive shrubby growth. While a controlled burn could help in reducing this problem, the effort might not live up to its full potential unless there were changes in the grazing regime of the area, given that ineffective grazing by cattle leads to a decrease in grass cover, which allows for shrub invasion. This scenario has been studied in New Mexico by Craig Allan, a research ecologist with the U.S. Geological Survey. It is potentially due to grazing practices that the forest areas of South Baldy have become fire-prone. For this reason, not only is a control burn a technique to be considered for forest fire management, but also consideration of a holistic grazing policy could further protect the integrity of forests of South Baldy.

Andrew Rominger

Response:

The proposal includes measures to safeguard against fire ignitions during construction and operation of the facility. The level of fire hazard in the area, due to grazing, drought and other causes are considered within the existing conditions of the environment in the EIS. However, decision regarding changes in grazing and fire management is beyond the scope of this EIS.

Category: NEPA Procedures

Subcategory: Adequacy of EIS Document

Comment:

In the event the project is criticized or attacked by radical environmental groups, I believe the method to thwart this is the inclusion of a BENEFIT VS. IMPACT analysis. You may wish to do this in any case. Clearly, the national and perhaps international value as well as Defense Department value of the proposed activities would far exceed the relatively minor impact on a very limited land area.

Anthony & Joy Trennel

Response:

Comment noted.

Comment:

I am surprised that little is said in the proposal about the scientific opportunities and objectives and capabilities.

Robert & Dorothy Walker

Response:

Comment noted. Section 1.4 in the EIS describes the scientific purpose and need for the proposal.

Subcategory: Non-Adherence to NEPA

This EIS process already appears to be a sham since NMIMT has already hosted ribbon-cutting ceremonies with the big wigs at the site, and the 10/12/02 issue of the Socorro *Defensor Chieftain* announced the construction manager hiring. This is already a preconceived decision, which in itself violates NEPA. If the Cibola National Forest had any integrity in management, it would simply send the request to Senator Domenici or Representative Skeen for rubber-stamping to bypass the law.

David Heft

Response:

The Forest Service has not yet made a decision as to whether the MRO should be allowed to proceed or not. However, NMIMT has pursued specialized technical support to further define the proposal. This is necessary in order to be able to analyze potential impacts.

Category: Proposed Action

Subcategory: Fire Management

Comment:

I noted that a non-potable water supply would be provided for the fire suppression defense of the facility. Perhaps this concept could be more fully described and analyzed. Will a water system with “fireplugs” be used? I assume fire trucks will be used with the utilities for suppression activities. However, for areas away from utilities will self-contained pumper trucks be used? If so, the potential exists for such vehicles to be used for fire suppression in support of forest fire fighting activities off of the site. Necessary rules, restrictions and agreements would be necessary for such a concept. However, this is another means to be a valuable resource to protect the forest.

Anthony & Joy Trennel

Response:

As required by the Forest Service, the proposal includes provision for defending facilities against small fires that may occur at the project site. These do not provide the capability for fighting large fires, although there will be benefits from rehabilitating the road and having a base of operations on the mountain. Fire Management and safety issues are addressed in Sections 3.2.5 and 3.4.6 of the EIS, respectively.

Subcategory: General Approval

Comment:

Proposal acceptable.

Cathy Dahms

Response:

Comment noted.

Comment:

I am a life-long hiker and have hiked and hunted the Magdalena Mountains extensively. I was once the director of public information at NMIMT and am familiar with the operations at Langmuir Laboratory. I am in favor of the proposed project. But I want to emphasize that the public use of the area should be taken into consideration as an integral part of the construction and operation of the facilities.

David Jackson

Response:

Comment noted. During construction, construction sites would be fenced as a public safety concern, and some facilities may be fenced to avoid damage by cattle. There may be temporary road closures when the road is being repaired. Otherwise, the project would not exclude public access to the forest.

Comment:

MRO is a good idea.
Crawford MacCallum

Response:

Comment noted.

Comment:

This is a huge project and I'm very interested in it.
Barbara Moore

Response:

Comment noted.

Comment:

It is my opinion that the MRO project would be a tremendous asset to our community as well as our state.

This is a world-class instrument we are planning here. Look what the Very Large Array has done for us. Who would like to see the VLA go away! The MRO is very much like the VLA; it carries the same wonderful idea a step further.

The advances in science and discovery would be incredible. We would leave a legacy for our future generations to marvel at. The MRO is a prime example of unselfish inheritance for others to build upon.

The site is an ideal location since it is already an existing scientific location with several facilities and structures already in place. Far simpler than construction on a "virgin" site. The MRO would complement our public lands philosophy of multiple use on our National Forest Lands. It is my belief that we should preserve our public lands that are of the utmost value for natural scientific discoveries, in this case the ridge is a highly desirable location for crystal clear observing of dark skies.

In conclusion, I wholeheartedly feel that the MRO would be immensely valuable to us all. The benefits are far reaching and the negative impact if any is very slight in comparison. The time is upon us to act on this monumental opportunity.
J. Nowicki

Response:

Comment noted.

Comment:

We love being informed about happenings in the Cibola Forest, especially the Magdalena District.
Rayburn & Mary C. Ray

Response:

Thank you for your comment. The Forest Service is committed to keeping the public informed and appreciates public interest.

Comment:

Thank you.

Martha Schumann, Forest Trust

Response:

Comment noted.

Comment:

The project sounds worthy, especially considering the relatively small area requested that falls within an existing site.

It appears that the building period would comprise the most environmental impact and that would be temporary at most.

Anthony & Joy Trennel

Response:

Comment noted.

Comment:

I think this is a very interesting project. Optical telescope interferometers are fairly new and are surely very promising…The possible negative impacts of the project do not seem very serious.

Walker, Robert & Dorothy

Response:

Comment noted. The EIS will provide an analysis of the impacts and the public will have an opportunity to read and comment on the findings.

Subcategory: General Disapproval

Comment:

I read through the description of the proposed project and find that it is quite misleading and unrealistic. I also believe that potential irreversible environmental damage will result if the project is to be accepted as described.

William Ketzeback

Response:

Comment noted. The EIS will provide an analysis of the impacts and the public will have an opportunity to read and comment on the findings.

Subcategory: Inadequate Detail/Definition

Comment:

Will the construction of MRO involve the use of blasting equipment to create the mentioned mile long trench? What future access to this trench will be required? Does a service road or access trail exist? Will one need to be created?

Telescopes require fragile glass optical elements. Every few years, these optical mirror surfaces require to be "refinished." Most often, this requires that these mirrors need to be taken off the mountain and taken to a facility where the old reflective surface is removed and a new coating is placed on the glass. When conditions are too dangerous to transport these fragile, very heavy, and very expensive pieces of glass off-site, some facilities often elect to build on-site recoating facilities. This process is not environmentally friendly, requiring caustic chemicals to lift the old metallic coatings off the glass and provide a clean surface that a new metallic surface will adhere to. The MRO Project Description does not describe whether they will incorporate such a facility on-site, or whether they choose to undergo the dangerous transport of several million dollars of glass up and down Water Canyon Road every few years. Other Astronomical Observatories are uneasy doing this even if they have an excellent paved road from their telescope to the coating facility. Their intentions should be discussed in the EIS.

William Ketzeback

Response:

No blasting is proposed. Several concepts for utility provision have been considered and refined since the scoping process, in response to issues raised by the public and operational concerns. The trenches described in the public information material are no longer proposed. No on-site refinishing of mirrors is proposed. Section 2.2 of the EIS describes what is being proposed during construction and operational phases.

Comment:

More fundamentally, is the project proposal to the point yet where the environmental study is ready to be conducted?

In view of where things are at, and as further substantiated and suggested below, the Forest Service and Tech should consider delaying the start of the environmental study until a clearer picture of the proposed action and alternatives is developed.

Another feature of the infrastructure proposal is its emphasis on potential "follow-on" or future-phase projects (p. 8-9). In conjunction with overestimating the needs of the MRO itself, this has lead to a substantial overdesign of the utility requirements of the project. An important example of this is the electric power facilities proposed by Sea West, which calls for 5 megawatts of power and facilities to handle this amount of power. By contrast, the power usage of the entire VLA site, a much larger and more substantial installation, is only about 1.2 megawatts average and 1.5 megawatts peak. The Sea West proposal provides no estimates of the power needs of the MRO project beyond those of the operations center, and it is presumably not known yet what the power needs will be. But they will not even begin to approach 5 megawatts. I haven't attempted to assess how realistic the projected water needs are, but it would not be surprising if these were substantially overestimated as well.

Given the above questions concerning the support facilities and developments, and the importance of the resolution of these questions on the environmental impact, a basic issue is how the questions are going to be decided. The environmental analysis should not result in a "blank check" for yet-to-be-determined developments, but should be based on more realistic proposals than have been developed to this point. For this reason, careful consideration should be given to delaying the environmental analyses until the project proposal is more carefully developed. This could actually save money and time for the MRO project in the long run. A project of this magnitude cannot be constructed without having plans well worked out (and agreed upon) in advance, not only for the scientific issues but also for environmental issues.

A number of important measurements being made by the atmospheric studies at Langmuir Lab require a "quiet" electrical environment. The design of the MRO project and the environmental analyses need to address the need for maintaining the current environment in this regard. Several issues are at stake here. The first is that the increased power distribution facilities not increase 60-Hz electric fields in the atmosphere, as occurs for example when power lines are not well shielded. Such fields are directly picked up by sensitive electric field sensors used to study close and distant lightning discharges.

Of greater importance is that higher frequency electric and magnetic transients not be produced on the power lines, such as those generated by variable speed or variable frequency motors or rapid switching devices such as UPS units. Such transients are considerably more difficult to shield and can readily contaminate wideband electric and magnetic field measurements along much or all of the ridge area. Important measurements of this type are continually made on South Baldy peak and often in the vicinity of the Balloon Hangar. Future studies of lightning charge centers in storms over Langmuir, similar to those that have been conducted over the plains in past years, would require measurements at a number of sites along the ridge.

Finally, there is a substantial need to maintain a quiet radio frequency (RF) environment along the ridge. This and the high frequency power line transients are the ones most likely to be compromised and to be most damaging to the atmospheric research at Langmuir. The Langmuir Lab group has long been on the forefront of detailed studies of lightning discharges with electric and radio frequency measurements, and we have recently started installing our Lightning Mapping Array (LMA) in a compact configuration in the Laboratory area to make highly detailed pictures of lightning inside and around storms. The LMA is similar to the VLA in that it "listens" for radio signals produced by nearby or distant lightning discharges and makes highly accurate pictures of the discharge channels and development. Like the VLA, individual stations of the LMA require a quiet RF environment to function properly; even very weak RF signals can significantly affect the operation of a station. The system operates with sensitive receivers in an unused television channel, the lower VHF band (typically TV Channel 3, 60-66 MHz). In terms of a specific number, the RF background noise needs to be less than -95 to -100 dBm within the receiver bandwidth.

The compact version of the LMA was deployed in the Langmuir Lab area this past summer and will become a permanent facility of the thunderstorm studies being conducted at the laboratory. The compact array has eight or more stations deployed with a 4-km diameter area around the Laboratory, including several along the ridge itself in relatively close proximity to the proposed MRO facilities. Radio frequency signals coming from the various MRO facilities will have to be kept at a very low level to allow for these studies. This could even require turning equipment off during critical storm periods.

To help ensure that the various concerns are properly taken into consideration and addressed, Langmuir Laboratory researchers have suggested that two working groups be set up, one on the infrastructure and development issues and one on environmental issues. This idea has been acceptable to MRO personnel and needs to be formalized and acted upon.

Paul Krehbiel, NM Tech

Response:

The proposal has been refined over the past year, much in response to concerns by the public and the need to have adequate information to evaluate impacts in this EIS. Telecommunication to the site will be supplemented with fiber optics. Management and operational concerns are valid, but are beyond the purview of the Forest Service's decision based on this EIS.

Comment:

I would also like to know how much acreage 16 movable telescopes, in addition to the 52,000 square feet of supporting facilities and 1 mile of gravel parking lot, comprises for this project.

Arlene Walsh, Back Country Horsemen of New Mexico

Response:

It is estimated that the entire project, including road rehabilitation would disturb about 48 acres. Upon completion of construction, about 19 acres in the Magdalena Ranger District would be covered with new project features or fenced.

Subcategory: Project Feasibility

Comment:

The NPOI design and construction has yet to be realized more than a dozen years after conception of the project. Combined with a lack of experience managing a construction project of such large magnitude, the collaborative management of NPOI also failed to form a strong leadership and project plan from the very beginning. A lack of vision regarding the resources required to build such a large complex, than one of a kind engineering project, has doomed NPOI from the beginning. Without the “glue'' of responsible management to hold the project together each member of the collaboration meandered on with their own agendas. This poor planning has resulted in many redesigns of NPOI. The additional requirement that the facility be operational while construction continued slowed the progress of NPOI to a crawl. The combined management of US Naval Observatory (USNO), Naval Research Lab (NRL), and Lowell Observatory each should hold a portion of the blame in the failures of NPOI. However, since NRL is also a partner on the MRO project, I will restrict further comments to that organization and individuals involved on both MRO and NPOI. It does not appear to seem likely to me that those involved at NRL have learned much from NPOI and MRO; the public and the forest will unlikely suffer from their advice.

William Ketzeback

Response:

Comment noted. NMIMT intends to learn from management of efforts at the other facilities.

Comment:

Every step needs to be taken to ensure that the environmental impact of the MRO is minimal, consistent with the scientific needs of the project. As currently proposed, the MRO does not do this. The conceptual design study by Sea West proposes major support infrastructure facilities and developments whose environmental impact would not be acceptable and that also do not make sense from an operational or cost standpoint on the project.

Paul Krehbiel, NM Tech

Response:

The MRO is incorporating many measures to minimize environmental impacts. Refinements to the design have been made, particularly downsizing the infrastructure plans in the early conceptual study.

Subcategory: Site Development/Infrastructure

Comment:

Rumors already abound in the Astronomical community that this collaboration does not have a clear consensus of what the scope of the project should be. Very much like NPOI in its early stages, MRO seems to be at a stage of disagreement to the full scope of design. It is very likely that like NPOI, the construction of this project will grow uncontrolled. NPOI did not originally contain any plans for storage of parts on site. I did not see any mention in the project plan for storage. NPOI suffered greatly from large numbers of crates littering the site for years before a temporary tent was erected. Likewise, several large storage containers, not part of the original plan, became semi permanent fixtures on the property. These variety of temporary structures make the site appear unsightly to the public and invite occupation by the rodent population. Several additions to original buildings as well as unplanned structures eventually found there way onto the NPOI site. Is MRO going to suffer from the same lack of managerial foresight? Will it result in an unplanned environmental imbalance not addressed in this EIS? Chances are the answer is yes.

Likewise, the project plan made no mention of emergency generators or fuel storage on site. Will the facilities be heated by natural gas or propane? Fuel spills although unlikely could damage the surrounding site and contingent plans should be addressed in the EIS.
William Ketzeback

Response:

Comment noted. Management and operational concerns are valid, but are beyond the purview of the Forest Service's decision based on this EIS. Emergency generators fuelled by gas are proposed for the project and facilities would be heated by propane. The facility would be required to have contingency plans for the proper handling and treatment of all on-site hazardous materials and fuels in compliance with all applicable federal, state, and local laws and regulations. A description of proposed facilities are provided in the Chapter 2 of the EIS.

Comment:

The study was conducted by the Sea West while Tech was still in the process of organizing the project and had insufficient input in terms of the overall goals and needs of the project. There was also essentially no interaction with Langmuir Laboratory personnel during the work. Subsequent to the field tour and the open house, there has been some interaction between MRO and Langmuir Laboratory personnel concerning changes to the infrastructure proposal, but there are still no specifics on this.

The Sea West proposal is a poorly thought-out design that likens the MRO to a mountaintop "resort" area (p. 54 of their document), in need of a centralized Operations Center not only for operations personnel but also for research scientists and administrative personnel. This completely ignores the experience of the Very Large Array (VLA) radio telescope facility that the scientific and administrative aspects of the operations should (and will) be based on the Tech campus in Socorro.

The location selected for the operations center is on substantially sloped terrain that would require excavation to construct. It is so far away from the interferometer itself that another Interferometer Support Facility (with additional living space) is required at an intermediate, closer location.

It also places more emphasis on providing a grand vista for visitors than on the operational aspects of the MRO, which would be much better served by having the operational and support facility closer to and within view of the optical interferometer itself. A simple way of minimizing the environmental impact while at the same time maximizing the operational aspects of the facility and minimizing the cost would be to combine a substantially scaled-back version of the operations center with the interferometer support facility at the site used for the MRO dedication. The terrain at this site is essentially flat and would require little if any excavation, as compared to the extensive excavations that would be needed at Sites A or B.

As much as possible, the scientific and administrative aspects of the MRO, and perhaps even the operations itself, should be located not on the mountaintop but on the Tech Campus in Socorro. It should be possible even to operate the instrument remotely from Socorro.

The project needs to much more carefully evaluate what it really needs in terms of electricity and water. A more common-sense solution to the utilities issue, both from an environmental and cost standpoint, would be to upgrade the existing utilities corridor to 3-phase power at a more realistic power level and to add a fiber optics communication line at the same time. Rather than try to undertake adding a buried water pipeline along the corridor, with all the complications of pumps, wells, etc., the environmental analysis should stipulate that MRO design a water-efficient system and either tie into the existing water supply used by Langmuir Lab or truck water as needed up to the site. Distribution of utilities within the project area should be done along existing roads and in ways to minimize the additional impact upon the ridge environment.

The environmental studies should ensure that the facility is constructed with as few buildings and with as little excavation as possible. There are a number of things that can be done to minimize the environmental impact of the interferometer array itself, which need to be identified and evaluated. MRO project personnel are working to lay out the “Y”-shaped interferometer with a minimum amount of excavation, and this is to be applauded. Similarly, the access methods along the legs of the “Y” and the ways of repositioning the telescopes should be such as to minimally impact the environment in terms of access roads and transport means. Finally, it would be best if there did not need to be an enclosure fence around the interferometer array. To allow this, the environmental analysis should consider closing off the south science area to livestock grazing. This could readily be done at the cattle guard and fence immediately north of the Balloon Hangar facility.

Paul Krehbiel, NM Tech

Response:

Comment noted. The EIS will provide an analysis of environmental impacts of the proposal and alternative sites, and this information would be available to decision-makers. Operational aspects and funding would factor in to any final decision.

Subcategory: Project Needs Underestimated

Comment:

The NPOI site was built as a remotely operated facility with minimal support facilities and staff in mind. Many additional structures and additions of buildings, roads, trenches and a perimeter fence are now part of the project. The number of staff required to keep the NPOI running over the past 10+ years swelled from the 3 or 4 personnel to 30 in 1998-1999. The support infrastructure for NPOI has seriously been over stressed for years. Over-crowded office spaces, too small a cistern system and septic made NPOI an unpleasant work place. The large amount of vehicle and human traffic has undoubtedly not been healthy for the environment on Anderson Mesa near Flagstaff, AZ. Also, this additional construction has made NPOI a stark contrast to the surrounding forest. Completely ignoring the idea that the interferometer maintain a low profile and merge with its natural surroundings. This has been reflected recently in the large numbers of letters to the editor of the local Flagstaff paper showing the public's disapproval with the industrial look on Anderson Mesa. Clearly, NPOI is not blending naturally with its surroundings.

The MRO project description describes the number of staff to be 3 or 4 staff members on a regular basis to nearly two-dozen infrequently during normal operations. This seems to be an underestimate to me. The normal daytime staffing at other professional astronomical facilities such as NPOI, Apache Point Observatory (at Sunspot, NM), Very Large Array (west of Magdalena, NM) range from a dozen to about 60 people. Since MRO is advertising 3 times the number of telescopes as NPOI, it seems inconceivable to even the casual person that the number of persons required to keep it maintained will be more than just a few people.

MRO has not addressed the impact of its staff on the surrounding environment. Will they need to install a leach field on site? What is the capacity of the septic system? Will the proposed trench provide potable and/or nonpotable water to the site? Will there be any water treatment (chemicals added to nonpotable water) to reduce the bacterial levels? What is the danger that leaks of treated water pumped up the mile long trench would eventually leech into nearby streams?
William Ketzeback

Response:

The EIS describes the staffing and personnel expected at the facility in Section 2.2 as accurately as is known. Researchers would be able to use the telescope through remote computer connections. An analysis of visual impacts is part of the EIS (Section 3.4.2). Facilities and infrastructure needs are sized adequately to meet the research needs and in accordance with applicable building codes.

Subcategory: Timing of Construction

Comment:

NPOI, also a collaborative project of independent organizations (US Naval Observatory, Lowell Observatory and Naval Research Labs) was originally conceived and presented to the general public as a site that would have minimal on-site staffing requirements and was presented to be completed in a very short timeframe from the approval of its EIS. In reality, the project was plagued with time and cost overruns that continue to the present. NPOI was slated to be completed in 1995. Seven years past this original completion date, the NPOI is still far from complete.
William Ketzeback

Response:

Comment noted. Management and operational concerns are valid, but are beyond the purview of the Forest Service's decision based on this EIS. Conceptualization behind this project has not been hasty. The project has been under consideration for several years and planned in more concrete terms over the last two years.

Category: Recreation

Subcategory: Access

Comment:

We are concerned that hiking access will be lost.
Chris Acklen

Response:

Access for hiking and recreation will be addressed in the EIS.

Comment:

We would like to make sure that there is a hiking trail that will replace the ridgeline that is being removed from access by the planned installation. If there will be a fenced off area, we would like access to the area around it.

If there are going to be road improvements, we would like a trailhead added that would be suitable for access into the area.
Greg Cannon, NM Mountain Club

Response:

No change in access for hiking is expected. The public will be able to walk on the ridge with the exception of areas that are fenced to directly protect structures from damage by cattle. Several existing trails provide access into the area and would continue to provide access. The rehabilitation of the road is expected to make existing trailheads more accessible.

Comment:

All trailheads on the road leading to the Observatory should be clearly marked with adequate parking provided for at least ten vehicles. This parking should be away from the main road, particularly during the construction phase when there will be a lot of traffic.

A trail should be established across the ridge where the observatory will be built. This ridge is currently used by hikers and their concerns should be addressed.
David Jackson

Response:

The Forest Service is planning to improve parking for Trailhead 8 located near the top of the ridge and to provide a kiosk with information for the general public. Other proposals for the trail system in the forest are beyond the scope of the current project. Signage for trailheads in and around the ridge would be provided.

Comment:

The American Endurance Ride Conference (AERC) has as one of its main purposes the preservation and enhancement of trails for use by hikers, bikers, and horseback riders. We are a long distance horse-riding group. If there is the ability to discuss trails and trail access in the EIS, I would like the opportunity to participate. I would also like to know if trails and trail access will not be affected and therefore not included.

Roger Taylor, American Endurance Ride Conference

Response:

The EIS will evaluate impacts on trails and trail access. The Magdalena Ranger District welcomes public input regarding needs and improvements for the trail system in the forest. However, decisions regarding the trail system in general are beyond the scope of this EIS.

Comment:

Most importantly, I am concerned with the freedom of access for recreational horse and pack animals in the Water Canyon area. How would this be affected? Will access be severely restricted or will it continue as it historically has?

Arlene Walsh, Back Country Horsemen of New Mexico

Response:

The EIS will evaluate access for recreation. Temporary, periodic road closures are expected during the construction phase, mostly in the first year. Closures would be posted at the Water Canyon campground, at the district office, in local newspapers and on Forest Service websites.

Subcategory: Facilities

Comment:

Why must the visitors' kiosk be moved? Can kiosk expansion be handled at the same site? What will be done with the old site?

Jeffrey Myers, Central New Mexico Audubon Society

Response:

The existing kiosk is located on the ridge beyond the Langmuir gate, which is frequently locked. It is proposed to move the kiosk to a location outside the gate along Water Canyon Road where the public would have better access to it.

Category: Social

Subcategory: Education

Comment:

My husband and I think this sounds like a good, educational project. Will the facility be open at certain times for the lay public to visit?
Chris Acklen

Response:

NMIMT plans to have periodic organized tours that would allow the public to view the facilities close-up.

Comment:

Another huge advantage is to provide educational opportunities for our youth of every age, since there is a large educational program associated with the project.
J. Nowicki

Response:

Comment noted. NMIMT is promoting the educational opportunities that the facility would provide.

Comment:

Being a member of The Navajo Nation, the leader of my community, and being a traditional practitioner, I would support this joint venture by various entities in supporting education, optical, and astronomical research by NMIMT and the consortium members.

We have a commitment to our youth to get any and all levels of education possible, and this project will be an exception for our college bound youth, and we have a youth organization that is willing to learn.
Dave Rico, The Navajo Nation

Response:

Comment noted. NMIMT shares the same commitment to youth and education and wishes the facility to be used for the benefit of public education.

Subcategory: Local Values

Comment:

There should be a good sign giving information about the scientific activities in the area. Information sheets giving the history of the area and trails should be available at the sign, unless a visitor center is established where the information would be available.

There should be an advisory committee made up of persons interested in the scientific activities at the site, person who use the area for hiking and other recreational activities such as horseback riding and hunting. This group should meet periodically to discuss current operations, problems, and any propose changes in the status quo.
David Jackson

Response:

A new kiosk at Trailhead 8 near the ridge (and district office in Magdalena) would provide information about trails and the MRO. NMIMT would favor any initiative to address mutual issues of concern for the MRD in a participatory framework.

Category: Soils

Subcategory: Impacts Analysis – Erosion

Comment:

Impacts to soil resources due to increased ground disturbance along the proposed new 3,000-foot utility route.

Impacts to soil resources with construction "improvement" of the access route and additional maintenance.
David Heft

Response:

Since scoping, utility provision concepts have been modified and no longer involve extensive trenching from water sources off the ridge top. Measures to minimize impacts from ground disturbance are proposed and addressed in the EIS analysis.

Comment:

Directly related to grazing is the issue of erosion. Grasses are the most efficient plant for preventing and healing erosion. Grazing on South Baldy has reduced grass cover, making the soil more vulnerable to erosion. Making a change in grazing practice would be a hard feat to achieve but one that may be very beneficial in the effort to minimize the negative ecological effects of construction.
Andrew Rominger

Response:

Conditions resulting from ongoing grazing and management practices are reflected in existing conditions for the project area. However, grazing management is outside the scope of this EIS.

Category: Transportation

Subcategory: Impacts Analysis

Comment:

Public outreach is most often part of the mission statement of many science institutes. An exciting facility such as MRO is inevitable to draw large amounts of attention during construction and afterwards when in normal operations phase. What precautions or visitor facilities will be available to the public? Currently, the Forest Service Road restricts the number of cars that travel to the site. If the road is improved enough to give access to construction, the amount of civilian traffic will certainly increase with the publicity. This will likely increase the amount of trash and waste from the Water Canyon Campground to the top of South Baldy. This needs to be addressed in the EIS.

William Ketzeback

Response:

Some increase in visitation is expected as a result of road rehabilitation and the new MRO. However, the road will remain a Level 2 Forest road, suitable for high-clearance vehicles (i.e., not maintained for passenger vehicles). These issues are considered in the EIS analysis. The Forest Service's responsibility to collect trash is ongoing and would continue.

Subcategory: Rehabilitation

Comment:

Road widening should be handled by USFS personnel and should be done to affect watershed and creek functioning as little as possible. Dumping outside of the canyon should be done at all times.

The level of truck traffic is a major wildlife concern. For example, measures need to be taken to prevent large trucks from running their tires through the creek water. With as many as 60 trips a day (120 creek crossings), there could be a significant water loss from the creek just by trucks running through it and tracking water on either side of the road. How much more expense would it take to build a small temporary platform (bridge) over the creek at the campground? Or could a cost-share (USFS-NMIMT) small permanent bridge be built here?

Jeffrey Myers, Central New Mexico Audubon Society

Response:

Road widening will be the responsibility of the Forest Service. NMIMT will be responsible for contracting for construction of the MRO if the proposal is approved. All state of New Mexico contracting regulations would apply. Reasonable measures to minimize impacts are in being included in the proposal and considered in the EIS.

Comment:

The first thought I had was the road from hardtop to the site. Besides the maneuverability issue around certain turns and stabilization in some areas, I would consider improving the road with a good gravel base. It has been a long time since I have been on that road, but I recall a dirt road with dusty conditions in dry weather.

Besides keeping dust to a minimum, a good gravel road would provide better access year-round to fire responders and emergency vehicles, as well as the employees and visitors.

Anthony & Joy Trennel

Response:

The road will be rehabilitated to meet the needs of the vehicles anticipated during construction and to improve safety. It will remain a native-surfaced road, with some gravel added to provide more uniformity in the surface as needed. Best Management Practices would be used during facility design, construction, and operations.

Subcategory: Road Capacity/Capability

Comment:

Public access impacts due to heavy construction traffic along the Baldy access road during the project life. Road is pretty much one lane along most of its length.
David Heft

Response:

Comment noted. Impacts on access and safety are considered in the EIS. Traffic would be managed during the construction phase. Public access would be maintained during construction to the extent possible and safe, and may be improved once construction is complete.

Subcategory: Road Safety

Comment:

Impacts to public safety due to construction traffic and increased researcher traffic along the access route.
David Heft

Response:

Comment noted. Impacts on access and safety are considered in the EIS. To the extent possible and safe, public access would be maintained during construction, and may be improved once construction is complete.

Comment:

During the construction phase, there should be adequate signs to inform the public about safety on the road, or if the road to the laboratory will be closed. This information should be in public notices available on a web site, or listed in the outdoor sections of the Socorro and Albuquerque newspapers.
David Jackson

Response:

Comment noted. The proposal describes how the public would be informed of temporary road closures.

Comment:

The Forest Service Road, Water Canyon Road, must require extensive upgrades not mentioned in the project description. This 4x4 unimproved road is unprepared for heavy or light construction transport without major improvements and continued upkeep. It could not support a project of this magnitude in its current condition. I have traveled this road and there are few places where it is not wide enough to support two vehicles traveling in opposing directions to pass each other. Likewise, much of the road is tops of boulders sticking up out the surface of the road that would require clearing with the use of explosives and other heavy equipment. In its current state, it would be dangerous for large construction vehicles, particularly large cement and gravel trucks.

Often in construction projects like these the drivers of these vehicles will push the speed limits and blatantly disregard safety to meet the desired number of trips per day. In the case of MRO Project Description this was stated to be 30 trips up and 30 trips down the 12-mile road safely during construction and sustained for several years. This has to be a difficult goal to meet in the timeframe safely without doing significant damage to the road and surrounding environment. Without a strict enforcement of traffic control and detailed traffic planning. Frankly, NRL and this project does not seem up to this challenge. Due to the condition to this road, there exist life-threatening dangers to those who plan to travel up and down this road for this 5-year period. Those in danger: include the construction crews, potential staff of MRO, Langmuir Labs, Forest Service, local residents of Water Canyon, vehicles that travel on US Highway 60, campers at Water Canyon Campground and picnic area, and the significant number of civilians that travel the Water Canyon Road during the summer months and wildlife. Unforeseen problems such as road washouts, landslides, traffic accidents, or vehicle breakdowns in inconvenient places along the path of construction would stall the proposed amount of traffic, therefore delaying the project and increase the impact to the surrounding forest and environment.

William Ketzeback

Response:

Several projects would be undertaken along the road to make it safer and serviceable for construction vehicles and the public. Specific designs are still being developed. The Construction contractor addressing circulation on this roadway would develop a plan addressing traffic and safety.

Category: Visual Resources

Subcategory: Alternatives

Comment:

The argument against an alternative site, Site “B," near the existing Balloon Hangar site, is that Site B "is tucked farther into the trees of the mountaintop and will not have near the visible impact to visitors as Site A, nor the vista from Site A" (p. 57).

Paul Krehbiel, NM Tech

Response:

As a response to concerns about visibility of facilities, alternative sites for some facilities are being considered in the EIS, relative to possible visual impacts. Chapter 2 includes maps showing alternate sites.

Subcategory: Effects on Aesthetics

Comment:

Impacts to aesthetic values already degraded by continued and increased littering from research activities associated with the site.

David Heft

Response:

Comment noted. Under the existing permit, NMIMT is responsible for disposing of litter and discarded equipment on site.

Comment:

The number of buildings associated with the MRO needs to be kept to a minimum, and ground disturbance around the buildings also minimized to maintain the mountain "meadow" nature of the ridge area.

The experience of driving up the Langmuir road above Water Canyon Campground is similar to that of driving up to and along the road to Mt. Withington and Grassy Lookout in the San Mateos. Namely, it is a scenic, primitive drive through an essentially undeveloped wilderness. This needs to be maintained, and the road needs to be kept as a primitive road without concrete water crossings, widened radius turns, extensive berming, etc., as proposed in the Sea West design. This should include not building the proposed kiosk in the turnaround and parking area at the starting point of the trail along the ridge to North Baldy.

Paul Krehbiel, NM Tech

Response:

Areas that are not directly used for a constructed feature would be revegetated with seed mixes designed to conform to surrounding vegetation. Any road improvements would be the minimum needed to provide for safe access during construction. The service level of the road would not be changed, and the types of upgrades needed for Level 3 roads (suitable for passenger vehicles) are not planned.

Forest Service plans for the kiosk and parking at Trailhead 8 are not yet developed, but would address existing parking and safety problems. Depending on the scope of the project, the Forest Service would include public input for this project.

Comment:

The other environmental issue that ironically enough MRO would preserve is in fact our virgin unpolluted night skies. The presence of a world-class observatory would deter and/or restrict unnecessary light pollution, which is a natural result of human development and encroachment. More responsible and less offensive lighting would be encouraged.

J. Nowicki

Response:

Comment noted.

Subcategory: Visibility from Sensitive Locations

Comment:

While conceding that the selected location (their Site "A") is inefficient from the standpoint of utilities routing, the proposal confirms what I suspected from the field tour: that the site was selected at least in part because of the spectacular view of the plains and Rio Grande valley. Quoting from the discussion of the site on p. 55 of the Sea West Conceptual Design document, Site A "is rich in vista of the terrain below and would surely be a captive site to visitors arriving at the top of the mountain." Contrary to "conserving the skyline," the operations center and its proposed location extends the infrastructure developments much further along the ridge than they need to be, and would substantially increase the visible impact of the MRO as one approaches it along the road.

The above is completely at odds with the need to minimize rather than maximize the visible impact of the infrastructure facilities.

In addition to minimizing the visual impact of the buildings and utility corridors, a major problem with astronomical observatories is the high visibility of the domes covering the telescopes caused by the fact that they are coated with highly reflecting white paint. Serious consideration should be given both in the design of the telescopes and in the environmental analyses to ways of making the domes blend in with the mountaintop environment and be less visually intrusive from surrounding areas. The atmospheric facilities at Langmuir Lab have been required to have reduced visibility and this should be continued for the MRO facilities. With some thought and ingenuity, this should be a solvable problem.

The MRO needs to be built so as to have the minimal impact possible on the visual, natural, and research environment of the mountain. In keeping with the current visual levels, this should include restricting the interferometer and support facilities to be primarily beyond the Balloon Hangar area, so as to be hidden by the treeline as one approaches the laboratory along the final stretch of the access road on the slopes of South Baldy. In addition, the large aperture telescope should be made no more visible than the Comet Observatory telescopes that it will replace.

The views of the South Baldy Peak and ridge area that one has from a distance from the west, south, and east need to be maintained and not be spoiled by numerous, highly reflective white telescope domes.

Paul Krehbiel, NM Tech

Response:

The EIS will evaluate the visibility of project features and expected effects on the landscape. The proposal includes some measures to minimize visual impacts.

Category: Water Resources

Subcategory: Effect on Wildlife

Comment:

Impacts to wildlife and downstream water users with increased diversion and use of water for the observatory.
David Heft

Response:

The proposed facility would use the same amount of water as one average household each year. The EIS evaluates impacts to wildlife in Section 3.3.2 and other users in Section 3.4.1, Lands and Realty.

Comment:

Water Canyon, being one of few significant sources of water in the Magdalena Mountains, is an invaluable resource and haven for wildlife, and a "hotspot" for biodiversity. The proximity of the road through Water Canyon in relation to the stream creates issues for wildlife and the integrity of the ecosystem…With such close proximity between road and water, any extreme human activity along the road (i.e., widening, or numerous truck trips) would contaminate the water and potentially prevent wildlife from utilizing this resource.

Water Canyon, because of its perennial water source, is crucial to wildlife and botanical diversity. For this reason, Water Canyon warrants even greater protection.
Andrew Rominger

Response:

Comment noted. The EIS analyzes potential impacts on water bodies (Section 3.2.2.) and wildlife (Section 3.3.2.).

Subcategory: Water Quality

Comment:

Wastewater treatment is apparently to be handled by septic tanks and fields. Where will the water eventually end up within the watershed? What will the quality of that water be? Will it help to maintain flows within the watershed where the water is being taken? Will the system function in the winter when temperatures are significantly below freezing?
Jeffrey Myers, Central New Mexico Audubon Society

Response:

Effect of wastewater system on water resources is addressed in the EIS in Section 3.2.2.

Comment:

The road creates channelization of water, which leads to erosion, floods, and deprivation of water to other areas. In addition, the running water of the stream magnifies the extent of erosion. Road construction would mean more channelization, more erosion, and thus more sedimentation of the water—all issues which can hopefully be addressed and minimized to the greatest extent possible.
Andrew Rominger

Response:

The EIS describes measures to be used to manage and control drainage, erosion and run off in appendix F. The analysis of impacts assumes the use of these measures.

Comment:

I am concerned with the amount of runoff and contamination of water from the increased use (i.e., estimated 13,000 truck trips over a 4- to 5-year period) and reconfiguring of the Water Canyon Road from resulting soil disturbance, and oil and gas fumes and leaks.

Arlene Walsh, Back Country Horsemen of New Mexico

Response:

Potential for contamination to surface water and streams is considered in Section 3.2.2 of the EIS.

Subcategory: Water Supply

Comment:

It is unclear whether water will be coming from a well drilled in the Water Canyon watershed, but we suspect it will be. How will this well affect water levels in the creek? This water should not come from the creek or its groundwater-supplying watershed. Wildlife, habitat and recreational values would be SEVERELY affected negatively. We are very concerned about how taking water out of the system here will affect wildlife, and especially riparian habitat, wherever this well is placed. How much water is projected over an average year's use?

Jeffrey Myers, Central New Mexico Audubon Society

Response:

Neither of the proposed water sources is within the Water Canyon drainage. Water needs for the project are described in Section 2.2.1 of the EIS.

Category: Wildlife

Subcategory: Avian Species (Nonraptors)

Comment:

Two of the birds at most risk of population devastation are: 1) The Mexico Spotted Owl (*Strix occidentalis lucida*), and 2) the Red-faced Warbler (*Cardellian rubrifrons*).

There are an additional 135 species of birds recorded on the Water Canyon Summer Bird Count. It is probable that most of these birds are likely breeding species.
Andrew Rominger

Response:

Potential impact to birds is evaluated in Section 3.3.2 of the EIS.

Subcategory: Big Game Species

Comment:

It is also important to consider all of the other organisms that inhabit Water Canyon—Cougars and Black Bears, all the way to the microscopic decomposers.
Andrew Rominger

Response:

The EIS addresses the existing environment and impacts to vegetation in Section 3.3.1, and to Wildlife in Section 3.3.2.

Subcategory: Effects of Noise/Human Activity

Comment:

Impacts to T&E wildlife species from increased noise and construction along both the access route and the project site.

Impacts to wildlife due to increased traffic after construction due to improvement in the access route and due to increased use of the facilities on the mountaintop.
David Heft

Response:

Potential impacts to T&E species are evaluated in the Biological Assessment/Biological Evaluation prepared for this proposal. Impacts to wildlife are presented in Section 3.3.2 of the EIS.

Subcategory: Effects of Development

Comment:

The perimeter fence mentioned in the MRO Project Description will protect the site from cattle and larger wildlife from wandering amongst the buildings and equipment, but certainly an increase of 13,000 truck trips over four years will increase the amount of road kill. A septic system

or leach field may harm groundwater quality, ultimately poisoning nearby streams or ponds (if any), thereby affecting the wildlife on the mountain. Although no one has attributed or proven the effect to NPOI, there has been a catastrophic decline in the antelope population on Anderson Mesa, AZ (the site of NPOI) since the project started.
William Ketzeback

Response:

Septic systems and leach fields are permitted by the New Mexico Environment Department and must be designed to meet the demands on the system and according to other site specific physical parameters (including soil type and leachability). The standards are designed to prevent contamination of ground and surface water.

Comment:

Since there are a variety of eagles, hawks, and other birds in the area, they may “use” some of the facility for perches, nests, etc. Perhaps this should be assessed and provisions be made for such birds, perches, etc., that would be more attractive than say, antennae and so forth.
Anthony & Joy Trennel

Response:

Comment noted. Effects on raptors are evaluated in Section 3.3.2 of the EIS.

Subcategory: Sensitive/Protected Species

Comment:

When will road and utility line construction be done? If road and utility line work, as well as the blasting for the buildings, can be done between the months of mid-August to late April, it will SIGNIFICANTLY reduce effects on breeding birds.

A utility line is projected to go through Mexican spotted owl habitat. What measures are to be taken to mitigate against disturbance to habitat or the owls themselves? How will the three pumping stations affect the owl? How loud will they be, and how might it affect the *Neotoma* (sp.) or other prey base?

Note that a Summer Bird Count has been conducted in Water Canyon for at least 12 years. Species of concern based on that data include: (1) Northern Goshawk; (2) Spotted Owl; (3) Acorn Woodpecker; (4) Violet-green Swallow; (5) Red-faced Warbler; and (6) Olive Warbler.

Note further that on South Baldy, there is a population of Clark's Nutcracker. This population could be greatly harmed with activity in the area due to the isolation of South Baldy and its environs from other such habitats. The population is relatively small and may, for that reason, be unable to recover as easily as larger populations linked to other nearby birds.
Jeffrey Myers, Central New Mexico Audubon Society

Response:

Measures have been identified and proposed to avoid construction during sensitive times for Mexican spotted owl. The EIS draws on several sources for information on birds in the project area. Section 3.3.2 provides information and analysis of impact on avian species. A Neotropical Migratory Bird Analysis was prepared to support his analysis.

Comment:

There has been documentation of a Mexican Spotted Owl individual or pair during several of the bird count times: 1992, 1994, and 2001. It is my understanding that the pair found in 2001 was studied using conventional Spotted Owl protocol for determining if the pair is nesting or using the area in some other capacity. I would be interested to know the answers to the following questions in the Final EIS: What was the result of the study on the Mexican Spotted Owl? Are the Owls still in the Magdalenas? Where exactly is the owls' territory? And, of course, How will road traffic and construction on South Baldy affect the success of the owls, including issues with noise disturbance and abundance of prey-base? It is my understanding that the existing road does bisect, near the perimeter, the current territory of the owl and that the planned transmission line would do the same. An additional question would be: Is the construction of a transmission line necessary? And: Is there a transmission line already constructed that traverses the western slope that could be used instead?

The Red-faced Warbler is documented every year on the Water Canyon Breeding Bird Count. The arrival time of this bird is within the last week of April and the departure date is unknown although it is expected to be sometime in August or September. As you probably know, the Red-faced Warbler is a ground nester and prefers areas with a large collection, if not a noticeable dominance, of Gambel oak (*Quercus gambelii*) surrounded by and mixed in with coniferous trees, particularly firs (*Abies* sp.). Not only would road traffic and possible construction potentially damage this *Quequs-Abies* habitat where it is closest to the road, but would also potentially make the remaining stands of trees (the ground they shade and the water which flows over their roots) nearly uninhabitable for Red-faced Warblers. There is, unfortunately, no information that I am aware of which documents the effect of roads on nesting Red-faced Warblers. Disturbance to Red-faced Warblers in Water Canyon could be reduced, but not eliminated, if road construction were to be done from September or late August to late March or early April, which would also be beneficial for all other breeding birds, including the Mexican Spotted Owl.

It is understood that the Red-faced Warbler is not threatened or endangered in the State of New Mexico or in the United States. However, this bird is ranked on the PIF New Mexico Breeding Bird Priority Scores database as having a 27 total score, which is one point less than the Mexican Spotted Owl (a listed species in New Mexico) and three points GREATER than the Peregrine Falcon (another listed species in New Mexico).

It would be very important to carefully consider the effects of five years of construction on this unique, pioneer, and sensitive population of Olive Warblers. Olive Warblers were first documented on the Water Canyon/Magdalena Mountain Summer Bird Count in 1999.

It is important that the Mexican Spotted Owl, Red-faced Warbler, Olive Warbler, and all other bird species be protected in the Magdalena Mountains in order to preserve the full spectrum of adaptation within each species.

Andrew Rominger

Response:

Special measures have been incorporated to minimize impacts on Mexican spotted owl, some of which may also reduce impacts on other bird species. Potential impacts on avian species are addressed in Section 3.3.2 of the EIS.

APPENDIX B. DRAFT EIS COMMENTS AND RESPONSES

Introduction

Nine reviewers submitted comments on the Draft EIS for the proposed Magdalena Ridge Observatory during the 45-day public comment period. Comments were received via email (1), conventional mail (7), and hand delivered (1). The submittals were indexed by author, and individual comments were categorized by topic. The comments were then reviewed by the Cibola National Forest Supervisor to determine whether they are substantive, clarification, or other types of comments, defined as follows:

- Substantive comments are defined as those comments that are eligible for appeal.
- Clarification comments are comments or questions concerning information or analysis that was included in the Draft EIS, and additional information has been provided in the Final EIS, either in the response provided in this appendix or in the document itself.
- Other comments include comments that are: concurrence, opinion, correction, and/or outside the scope of this EIS.

Subcategories identify the specific resource area(s) the comment addresses. **Table B-1** lists the individual comments by category and subcategories. There were two comments determined to be substantive. All remaining comments concerned topics that were addressed in the Draft EIS, although additional clarification is provided in some cases, or they were beyond the scope of the EIS. Following the table, each categorized comment is summarized and a response is provided. All of the comments are included as submitted at the end of this Appendix.

Table B-1. List of Categories and Subcategories for Draft EIS Comments and Responses

Comment Category	Comment Subcategory	Index Identifier	Comment/ Response Page No.	Comment Letter Page No.
Substantive	WaterResources/Wildlife	Myers-C	B-3	B-25
	Water Resources/Wildlife	Rominger-B	B-3	B-28
Clarification	Wildlife	Kreiner-A	B-5	B-21
	Water Resources	Kreiner-B	B-5	B-21
	Transportation	Lane	B-6	B-22
	Wildlife	Myers-A	B-6	B-23
	Wildlife	Myers-B	B-8	B-25
	Rangelands	Myers-D	B-8	B-25
	Water Resoureces	Myers-E	B-8	B-26
	Wildlife	Rominger-A	B-9	B-27
	Rangelands/Transportation	Rominger-C	B-11	B-29
	Wildlife	Spencer	B-11	B-34
Other	Water Resources/Air Quality	Curry	B-13	B-16
	NEPA	Houghten	B-14	B-19
	Recreation	Jackson	B-15	B-20
	General	Vigil	B-15	B-36

Category: Substantive

Comment: Myers-C:

Because Sawmill Canyon provides excellent habitat for birds and other wildlife, the Society is strongly opposed to operations it its watershed. For example, it has been confirmed by Carol Davis and Andrew Rominger that Painted Redstarts, a PIF Priority Bird Species, are breeding in Sawmill Canyon. Sawmill Canyon is in part unique due to its south-facing orientation, much like Three Gun Spring Canyon is a unique habitat within the Sandia Ranger District.

Accordingly, the Society believes that Option 1 for the water supply should be proposed and adopted. Hardy Spring is on the west face of the Magdalenas, which has a lower wildlife quantity and diversity. Furthermore, the proposal is to drill down to the aquifer hydrologically below Hardy Spring, and so the spring itself should not be affected.

Response:

This comment was considered substantive for the following reasons: It provided new information concerning painted redstarts breeding in East Sawmill Canyon Creek. The watershed referred to in the comment already contains "operations" designated by Congress (P.L. 96-550) for the purpose of scientific research. The water drawn out of East Sawmill Canyon Creek would not exceed the state authorized 84,375 gallons per year (see pages 2-10 and 3-46). Additional water required above the state authorized limit would be supplemented through water hauling. Water flows and use in East Fork of Sawmill Canyon Creek would be monitored. Additional clarification was added to the Final EIS regarding painted redstarts (see page 3-114). This information does not change the analysis or conclusion of the Draft EIS.

Comment: Rominger-B:

On page 3-44 under Option 2 of the water source for the MRO, the East Fork of Sawmill Canyon Creek is sighted as a possible water source. It is understood that this is the source for Langmuir Laboratory. From the perspective of avian diversity this would not be an advantageous source for water as increased use may alter the down stream ecosystem. This canyon and its lush vegetation - made possible by the perennial water source--has produced many unique species. Most notable among them is the Painted Redstart (Myioborus pictus), a species usually found farther south. This summer (June/July, 2003) was the first time Painted Redstart has been confirmed breeding in the Magdalenas; confirmation was made by Hart Schwarz as well as Andrew Rominger and Carol Davis. Because of its unique bird life and vegetation, we object to taking water from Sawmill Canyon Creek and support, instead, water being taken from Hardy Spring.

Response:

This comment was considered substantive for the following reasons: It provided new information concerning painted redstarts breeding in East Sawmill Canyon Creek. The water drawn out of East Sawmill Canyon Creek would not exceed the state authorized 84,375 gallons per year (see pages 2-10 and 3-46). Additional water required above the state authorized limit would be supplemented through water hauling. Water flows and use in East Fork of Sawmill Canyon Creek would be monitored. Additional clarification was added to the Final EIS regarding painted redstarts (see page 3-114). This information does not change the analysis or conclusion of the Draft EIS.

Category: Clarification

Comment: Kreiner-A:

On page 3-112 there is no mention of wild turkeys being present in the Magdalena Mountains. We understand that there is a population of Merriam's wild turkeys on the mountain that ranges from 30-40 birds. We suggest that the impacts to these birds be addressed.

Response:

This comment was not considered substantive for the following reasons: Merriam’s wild turkeys are considered a Management Indicator Species by the Cibola National Forest and thus were discussed under the MIS section on page 3-115 of the Draft EIS. An analysis was conducted of impacts from the proposed MRO on MIS, including Merriam’s turkey. The findings are summarized in the EIS, and the detailed report is in the project record. Additional clarification on the impacts to Merriam’s turkey was added to page 3-122 of the Final EIS. This information does not change the analysis or conclusion of the Draft EIS.

Comment: Kreiner-B:

My principle concern about the proposed project has to do with its affect on the existing water resources that wildlife utilize. On page A-26 your own team member; Dave Heft, raised this concern and it was dismissed without adequately addressing this issue. The quantification of existing water resources and the net affect this project would have on the local wildlife populations is sloppy, at best. On page 3-33 you state that "There is little to no flow or water quality data available for the canyon creeks." and that "No flowing water was observed in these creeks during a field trip on November 20, 2001.", and yet you go on to state that "in the East Fork of Sawmill Canyon Creek, the surface water flow in the drainage is probably perennial". Also, at the top of page 3-34 you state "According to information from NMIMT personnel on a recent field trip (SAIC 2003b), water flows in this area all year round." Clearly this information is misleading. Best I can tell from the information provided is that all of the creeks in the vicinity of the ridge are intermittent and that the only location you can state as being perennial is a portion of Hardy Canyon. The true affect of this proposed project would nearly double the current water demand that already exists and the impacts on the already drought susceptible water resources in the area are clearly not addressed in this document.

It is my opinion that any increase in water use by the proposed project will have a negative impact on the water resources currently available to the existing wildlife community and that these impacts should be mitigated by the construction/development of additional water sources in this area.

Response:

This comment was not considered substantive for the following reasons: The water demand for the proposed MRO would not double the amount of water extracted from the current source, East Sawmill Canyon Creek. Withdrawals would not exceed the existing state authorization of 84,375 gallons per year. Additional water required above the state authorized limit would be supplemented through water hauling. Additional clarification was added to the Final EIS to clarify the current surface water conditions in the vicinity of the Proposed MRO (see page 3-33). With the implementation of water hauling mitigation, negative impacts to wildlife are not expected.

Comment: Lane:

Please note that a portion of the access route off U.S. 60, commonly referred to as the Water Canyon Road, crosses a portion of public land in T. 3 S., R. 2 W., Section 7, Lots 1 and 2. The road is authorized to the County of Socorro under RS 2477. The right-of-way case file is NMNM 82589; the authorized road right-of-way is 50-feet in width.

The subsection entitled Road Access and Maintenance, on page 7 of the summary section of the draft document, states that any required repairs would be performed in accordance with an agreement developed among New Mexico Institute of Mining and Technology (NMIMT), the United States Forest Service and Socorro County. Please be advised that any work on that portion of the road that crosses public land would require authorization and should be coordinated with the BLM Socorro Field Office.

Response:

This comment was not considered substantive for the following reason(s): The expressed concern can be addressed through inter-agency coordination between NMIMT, the U.S. Forest Service, Socorro County, and the BLM for maintenance on Water Canyon Road. Additional clarification was added in the Final EIS; see page 3-99.

Comment: Myers-A:

On page 3-112 Gray Jay (*Perisoreus canadensis*) is sighted (*sic*) as a common species in the coniferous forests of the Magdalenas as well as along Water Canyon Road. Black-capped Chickadee (*Poeile atricapilla*) is also sighted (*sic*) as common along the road. These two claims are highly unlikely as Gray Jays have not been reported south of the Sangre de Cristo and San Juan Mountains in New Mexico. Black-capped Chickadee is also very unlikely to stray into higher elevations during winter and does not breed as far south as the Magdalenas. Andrew Rominger and Christopher Rustay confirm the absence of these two species.

While these birds would not be common, or even present, in the Project Area, there are 24 common species present during the breeding season that were not included in the Draft EIS. These species have been found in high numbers in all thirteen years of the Magdalena Mountain Summer Bird Count. (The Magdalena Mountain summer Bird

Count was initiated in 1988 by James Black and has been compiled by Andrew Rominger since 2001; it is conducted during the first Friday and Saturday in the month of June.)

In the coniferous forests of the ridge, the common species excluded from the Draft EIS are Ruby-crowned Kinglet *(Regulus calendula)* and "dorsalis" Dark-eyed Junco *(Junco hyemalis dorsalis).* Additional surveys conducted by Andrew Rominger show that Townsend's Warbler *(Dendroica townsendi)* and Wilson's Warbler *(Wilsonia* pusilla) are common fall migrants to the ridge.Those species excluded from the list of common birds along Water Canyon Road (p. 3-112) include: Turkey Vulture *(Cathartes aura)* Morning Dove *(Zenaida macroura)* White-throated *Swift (Aeronautes saxatalis)* Broad-tailed Hummingbird *(Selasphorus platycercus)* Acorn Woodpecker *(Melanerpes formicivorus)* Northern Flicker *(Colaptes auratus)*Western Wood-Pewee *(Contopus sordidulus)* Cordilleran Flycatcher *(Empidonax occidentalis)* Ash-throated Flycatcher *(Myiarchus cinerascens)* Plumbeous Vireo *(Vireo plumbeus)*Warbling Vireo *(Vireo gilvus)*Western Scrub-Jay *(Aphelocoma californica)*Violet-green Swallow *(Tachycineta thalassina)* Bushtit *(Psaltriparus minimus)*White-breasted Nuthatch *(Sitta carolinensis)*American Robin *(Turdus migratorius)* Virginia's Warbler *(Vermivora virginiae)* Grace's Warbler *(Dendroica graciae)* Western Tanager *(Piranga ludoviciana)* Spotted Towhee (Pipilo *maculatus)*Chipping Sparrow *(Spizella passerina)* Black-headed Grosbeak *(Pheucticus melanocephalus)*

In addition, on page 3-114, Table 3-23 seems to be lacking certain species of PIF Priority Bird Species. There are an additional seventeen PIF Priority Bird Species which the Magdalena Mountain Summer Bird Count has confirmed in the Project Area, namely: Spotted *Owl (Strix occidentalis lucida)* Peregrine Falcon *(Falco peregrinus)* Hammond's Flycatcher *(Empidonax hammondii)* Whip-poor-will *(Caprimulgus vociferous)* Cordilleran Flycatcher *(Empidonax occidentalis),* Plumbeous Vireo *(Vireo plumbeus),*Western Bluebird *(Sialia mexicana),* Townsend's Solitaire *(Myadestes townsendi),* Scott's Oriole *(Icterus parisorum),* Northern Goshawk *(Accipiter gentils),* Zone-tailed Hawk *(Buteo albonotatus),* Pinon Jay *(Gymnorhinus cyanocephalus)*Clark's Nutcracker *(Nucifraga columbiana)* Pygmy Nuthatch *Sitta pygmaea)* Mountain Bluebird *(Sialia currucoides)* MacGillivray's Warbler (Oporonis *tolmiei)* Green-tailed Towhee *(Pipilo chlorurus)*

Response:

This comment was not considered substantive for the following reasons: The information in the Draft EIS is adequate to meet the requirements of NEPA. The list of common species in the Draft EIS is representative of the bird species observed in the project area. It is not intended to be a comprehensive listing of all species that may occur in the area. The text cites the source documents used in the analyses. The best available literature, as identified in Chapter 5, was used to derive species lists for habitat types and occurrence in the project area. The additional information does not alter the analysis or conclusions in the Draft EIS. The commenter’s information was added to the project record.

Comment: Myers-B:

On page 3-116, Table 3-24 states that Hairy Woodpecker *(Dendrocopos villosus)* and Pygmy Nuthatch *(Sitta pymaea)*, both Management Indicator Species, have stable population trends. However, based on thirteen years of data from the Magdalena Summer Bird Count, both species are in decline.

Response:

This comment was not considered substantive for the following reasons: Population trends for these species were addressing population trends on a national (Nature Serve 2001 database) and Forest (USFS 2002e, USFS 2003g) wide level. Additional text to clarify the population trends was incorporated in the Final EIS on page 3-118. This comment does not change the analysis or conclusions contained in the Draft EIS.

Comment: Myers-D:

However, road usage harm is another matter. Oddly, the Draft EIS on pages 3-123 to 3-124 states that "the noise from large, construction-related vehicles on Water Canyon Road may have a negative affect on priority bird species during the first year of construction" and yet does not propose any mitigation measures.

There are certainly mitigation measures that can be taken, and the Forest Service should further investigate the possibilities of keeping road noise to a minimum. (Note that paving the road would lead to even greater road noise due to greater speeds and the lessened noise absorbance of the road surface.)

Examples of mitigation measures that should be investigated and/or required are: (1) adherence to speed limits; (2) high quality mufflers in good working order; (3) brakes and brake pads in good working order and not overly worn; and (4) no loose materials in truck beds.

Response:

This comment was not considered substantive for the following reasons: The Draft EIS addresses noise impacts during construction (see the Noise Section 3.2.4) and included timing restrictions to reduce potential impacts on birds during sensitive periods (see page 2-44 in the Final EIS). There are no plans to pave any unpaved portions of Water Canyon Road in connection with the Proposed MRO. Other mitigation measures for wildlife are referred to in Chapter 2 (Table 2-6) and Section 3.3.2.4 of the Final EIS, the BA/BE (USFS 2003a), the MIS Report (USFS 2003g), and the Migratory Bird Report (USFS 2003h).

Comment: Myers-E:

Subalpine meadow habitat is rare in New Mexico in comparison to the total surface area of the state. Furthermore, mountain tops have also been shown to be very important stop-over points during migration, particularly fall migration. A great deal of that habitat in the construction area will be lost.

Accordingly, mitigation of loss of that habitat should be accomplished by excluding grazing from the remaining portion of that habitat in the project area. This will help that habitat to return to its natural state and species diversity and also help to reduce the impact from humans on the habitat.

If this exclosure is deemed to have an adverse impact on an existing grazing leaseholder, this impact should be mitigated to the extent possible, whether by direct financial compensation or by lowering the leaseholder's cost of the lease.

Response:

This comment was not considered substantive for the following reasons: The loss of wildlife habitat due to the proposed MRO is not sufficient to warrant a grazing exclosure as a mitigation measure. The long-term loss of 7 acres of habitat (approximately 3 percent of the project area) is not considered significant. (USFS 2003a, USFS 2003g, and USFS 2003h). The current grazing conditions and authorized usage for the proposed MRO are outlined on pages 3-133 through 3-135. Authorized grazing (for the Baldy allotment) would be reduced by 3 AUMs in the short term, due to staging areas and fencing to protect the construction site, and 2 AUMs in the long term, due to permanent loss of grazing lands (see page 3-136). Slight increases in competition may occur with wildlife and livestock species due to the reduction in habitat. However, this would likely be minimal due to the upward trend the mountain meadow habitat displays (see Section 3.3.3 Rangelands).

Comment: Rominger-A:

According to the Sullivan and Knight surveys of 1992-1993 both Gray Jay (*Perisoreus canadensis*) and Black-capped Chickadee (*Poecile atricapilla*) are sighted as "common" bird species on the ridge (Gray Jay) and along Water Canyon Road (Gray Jay and Black-capped Chickadee). (3-112) This is extremely unlikely given that in all 13 years of the Magdalena Summer Bird Count (currently compiled by Andrew Rominger) never has there been a report of either species. Granted winter is the most probable time to find either species in the Magdalenas this possibility is equally unlikely given that there has been no personal observation, by local bird watchers, of either species during the winter. The Magdalenas are very poplar with birding groups so the absence of reports for Gray Jay or Mountain Chickadee has not resulted from lack of coverage. Additionally, Gray Jays are limited in range--in New Mexico--to the Sangre de Cristos and San Juans of far Northern New Mexico. They have not even been reported from the Sandia Mountains. Observations of supposed Gray Jays most likely were misidentifications of the relatively abundant Clark's Nutcracker (*Nucifraga columbiana*). Black-capped Chickadees do not regularly stray into the higher elevations during winter; they usually reside along the Rio Grande in Central New Mexico. The absence of these two species can also be validated by Hart Schwarz and Christopher Rustay. The Draft EIS's claim that both Gray Jay and Black-capped Chickadee are common in the Magdalenas detracts from the credibility of the report.

In addition to those bird species said to be common in coniferous forests, (p.3-112) Ruby-crowned Kinglet (*Regulus calendula*) is well represented in the Sub-alpine Forests on Magdalena Ridge during the breeding season. "Dorsalis" Dark-eyed Junco *(Junco hyemalis dorsalis*) is also an abundant breeder in the forests along the ridge and in the meadow areas. In addition, during fall migration, while doing informal surveys for Hart Schwarz, I commonly encountered Townsend's Warbler (*Dendroica townsendi*) and Wilson's Warbler (*Wilsonia pusilla*). In addition to the 13 "common" bird species found along Water Canyon Road by Sullivan and Knight (p. 3-112), some 22 birds are found in good numbers along the road during the breeding season. In Table 1, these species are listed along with the maximum number of individuals of the species recorded between 1988 to 2003.

Partners in Flight Priority Species and Important Bird Areas

There have been 33 PIF priority species recorded on the Magdalena Summer Bird Count. Of these, 17 (in addition to the 15 listed in Table 3-23 of the DEIS) have a potential to be found in the Project Area. These are listed in Table 2.

The Magdalena Mountains, while not currently designated as an Important Bird Area, have been nominated for IBA status by Central New Mexico Audubon.

A Note on the Olive Warbler (*Peucedramus taeniatus*) in the Magdalena Mountains The Olive Warbler first appeared in the Magdalena Mountains in 1999. Since then there have been reports of up to six individuals. It seems very likely that the Olive Warbler is a breeding species in the Magdalenas although no nest has been found. Due to the relatively recent entry of the Olive Warbler into the Magdalenas, its population here may be fragile and not strongly established enough to tolerate disturbance from construction and/or traffic. While it cannot be definitively stated if the Olive Warbler will be adversely effected, it can be stated with certainty that to lose or alter such a bird's population would be a regrettable loss to the ever evolving diversity of the Magdalena Mountain ecosystem. Suggested mitigation is to focus construction in the non-breeding season (August-March) and actively monitor the population of Olive Warblers, along with all other neotropical bird species, throughout construction in order to detect any adverse impacts in time to take remedial action.

Indicator Species

In table 3-24, five Management Indicator Species of birds are listed as having stable population trends. Over all this is the case; however, both Hairy Woodpecker and Pygmy Nuthatch show decreases in population based on the Magdalena Mountain Summer Bird Count. Included is a set of graphs showing the trend of each indicator species from 1988 to 2003 (See Graphs 1-4). (Merriam's Turkey is not included as it has not been recorded on the count)

Response:

This comment was not considered substantive for the following reasons: It does not affect the EIS analysis. Impacts on migratory birds were analyzed in a Neotropical Migratory

Bird Report (USFS 2003h) prepared for this project. The report meets the requirements of The Migratory Bird Treaty Act of 1918 (16 United States Code [U.S.C.] §§ 701-715s, as amended) and Executive Order 13186 of January 10, 2001. The report, which was review by the USFWS, does not identify any requirements for mitigation or monitoring. Because noise levels decline rapidly with distance from construction sites, a mitigation restricting construction during breeding season is not necessary. The additional information does not alter the analysis or conclusion in the Draft EIS.

Comment: Rominger-C:

To reiterate, grazing exclosures are recommended as mitigation measures both on the ridge and in Water Canyon's riparian habitat; the natural surface of the road should be left unpaved; and Hardy spring (Option 1) is preferred to Sawmill Canyon Creek Spring (Option 2).

Response:

This comment was not considered substantive for the following reasons: The loss of wildlife habitat due to the proposed MRO is not sufficient to warrant a grazing exclosure as a mitigation measure. The long-term loss of 7 acres of habitat (approximately 3 percent of the project area) is not considered significant. (USFS 2003a, USFS 2003g, and USFS 2003h). The current grazing conditions and authorized usage for the proposed MRO are outlined on pages 3-133 through 3-135. Authorized grazing (for the Baldy allotment) would be reduced by 3 AUMs in the short term,due to staging areas and fencing to protect the construction site and 2 AUMs in the long term, due to permanent loss of grazing lands (see page 3-136). Slight increases in competition may occur with wildlife and livestock species due to the reduction in habitat. However, this would likely be minimal due to the upward trend the mountain meadow habitat displays (see Section 3.3.3 Rangelands). There are no plans to pave unpaved portions of Water Canyon Road in connection with the Proposed MRO.

Comment: Spencer:

On July 25, 2003, the U.S. Forest Service (Forest Service), provided a Biological, Assessment and Biological Evaluation (BA&BE) to the U.S. Fish and Wildlife Service (FWS) for the Magdalena Ridge Observatory Project (MRO). The BA&BE analyzed the effects of a proposed action (construction and operation of the MRO) on federally endangered and threatened species. In their BA&BE, the Forest Service made a determination of "may affect, not likely to adversely affect" for the Mexican spotted owl *(Strix occidentalis lucida).*

On August 19, 2003, the FWS concurred with the Forest Service's determination. The concurrence was based on: 1) the proposed action as described, analyzed, and evaluated in the BA&BE; 2) impacts to the Mexican spotted owl associated with implementation of the proposed action; and 3) other information. However, on September 11, 2003, the Forest Service sent a Draft FIS for the MRO to the FWS for comment. The EIS evaluated three actions and a no action alternative.

The FWS's concurrence with the Forest Service's "may affect, not likely to adversely affect" determination was for the action as proposed in the BA&BE. If the proposed action, as described in the BA&BE is modified or changed as a result of the National Environmental Policy Act (NEPA) process, then the Forest Service should reinitiate consultation with the FWS pursuant to the Endangered Species Act of 1973, as amended (ESA).

The DOI supports early consultation and streamlining of the ESA consultation process. However, ESA consultation should be completed concurrent with, rather than prior to, the NEPA process.

Response:

This comment was not considered substantive for the following reasons: The NEPA process requires consideration of alternatives. The BA and BE was submitted to the USFWS as part of the consultation under the ESA. It was consistent with the preferred alternative in the Draft EIS. If another alternative is selected after completion of the NEPA process, consultation will be reopened and completed prior to implementation (USFS 2003a).

Category: Other

Comment: Curry:

Surface Water Quality

The DEIS presents Alternatives 1-4, with #2 being "No Action", #3 (page 15) being the Preferred scenario, and with #4 responding to public comments, to date. Our surface water quality issues review focused on examination of potential water quality impacts of the project, especially any impacts upon listed waters for which State standards would have to be maintained and protected. Following this review, we find no objection to the work described in either Alternatives 3 or 4.

LAMED has not identified any surface water bodies with impaired water quality on the MRD. No perennial or intermittent streams are present at the primary construction site. The project occurs on a high ridge that straddles the local headwater supply and source areas. There is local spring discharge at the head of Water Canyon Creek and the East and West Forks of Sawmill Canyon Creek. Both of these drainages are continuous enough to eventually deliver runoff to the Middle Rio Grande, above and below Socorro, but dominantly only under storm runoff conditions. Other minor drainages in the area include Hardy Creek and Bear Creek.

Potential Direct Impacts:

We are satisfied that potential impacts to surface water and riparian vegetation, and erosion of local soils are adequately addressed within the DEIS. The proposed Alternatives include commitments to develop a Surface Water Pollution Prevention Plan (if needed, as part of the application for a National Pollutant Discharge and Elimination System [NPDES] permit), a Stormwater/Erosion Control Plan, a Noxious Weed Management Plan, a Revegetation Plan, and a Dust Abatement Plan.

During the construction and road building activities, the project will provide methods of soil erosion reduction such as properly placed culverts, cross drains, water bars, dips, energy dissipaters, aprons, downspouts, gabions, and/or debris racks, along with armoring of ditches, drain inlets and outlets. If flow in stream courses is ever diverted, the contractors will restore such diverted flow to natural stream course as soon as practicable and prior to the summer monsoon storm season. They generally state that they will incorporate mitigating measures into project plans and designs to maintain the hydrologic and biologic function of any wetlands that may be encountered, and implement a Noxious Weed Management Plan consistent with Forest Service guidance and standards. Soil and water control measures would be adapted and designed for specific construction activities at specific locations prior to initiating road improvements on Water Canyon Road and prior to construction and operation of the proposed MRO facilities.

Indirect Impacts

They note how indirect effects to water quality may be caused by earthmoving, which might result in sedimentation entering drainage ways and then being transported to perennial water bodies. Also, disruption of topsoil can reduce the potential to successfully reseed disturbed areas, causing effects on vegetation.

Conclusion:

Overall, the DEIS is proposed for an area with minor potential impact on live surface water bodies. The plans that were provided acknowledge the full range of potential impacts this Bureau would want to see considered. All the involved agency staffs and contractors are hereby referred to the complete list of standards that apply to the drainages in the project area (from Standards for Interstate & Intrastate Surface Waters, New Mexico Water Quality Control Commission, 20.6.4.8, 20.6.4.12, 20.6.4.900 NMAC (as amended through December 16, 2001)). They can be found on-line at: http://www.mnenv.state.mn.us/NMED_regs/swgb/20_6_4_mnac.pdf)

Air Quality

The proposed construction of the Magdalena Ridge Observatory does not conflict with New Mexico's laws and regulations pertaining to air quality. As stated in the DEIS, the facility and surrounding area is currently considered to be in attainment with all state and national ambient air quality standards.

The document addresses short-term high concentrations of total suspended particulates during construction and subsequent reclamation of the project area to stabilize the soil disturbed by the building sites to minimize long-term dust impacts. Potential impacts of air emissions on visibility in the nearby Bosque del Apache National Wildlife Refuge, a Class I area, should be kept to a minimum using the reclamation techniques described.

Permits must be obtained for generators used for this project that have a potential to emit greater than 10 pounds per hour or 25 tons per year of any regulated air containment for which there is a National or New Mexico Ambient Air Quality Standard. If a back up generator is used, be advised that records should be kept of the hours of operation of the generator. An application for a construction permit must be submitted for standby generators used 500 hours per year or more. In addition, contractors supplying asphalt for the project must have current air quality permits.

Response:

This comment was not considered substantive for the following reason: The comment concurs with the Draft EIS findings and does not identify any issues or deficiencies.

Comment: Houghten:

Thank you for providing the Mescalero Apache Tribe with the Magdalena Ridge Observatory Project Draft EIS. We are pleased to see that our concerns were addressed and would like to continue reviewing and commenting on this and other Cibola National Forest projects.

Response:

This comment was not considered substantive for the following reason: The Tribe acknowledges that its concerns had been addressed and no new concerns were raised.

Comment: Jackson:

I have reviewed the EIS and feel that it provides the necessary information. I agree that the preferred alternative is the best one for the project. My only concern is that access to hiking on the Magdalena's be maintained and that a trail across the Magdalena Ridge be accessible to hikers when the project is far enough along to make this safe.

Response:

This comment was not considered substantive for the following reason: The comment expressed concerns that are addressed in the Draft EIS on page 3-175. Additional trail enhancements would be provided through additional parking, a visitor kiosk, and trail maintenance as identified on page 3-168 in the Final EIS.

Comment: Vigil:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement recently released for the proposed Magdalena Ridge Observatory Project in the Cibola National Forest. Since this facility will be located approximately 75 miles from Albuquerque and Bernalillo County it does not appear that there will be an impact on County residents or facilities. The County has no adverse comment on this project.

Response:

The comment was not considered substantive for the following reasons: It does not raise any concerns on the content of the Draft EIS.

State of New Mexico
ENVIRONMENT DEPARTMENT
Office of the Secretary
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone (505) 827-2855
Fax (505) 827-2836

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

October 20, 2003

Susan Goodan
2109 Air Park Road SE
Albuquerque, N.M. 87106

Dear Ms. Goodan:

RE: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED MAGDALENA RIDGE OBSERVATORY, CIBOLA NATIONAL FOREST, SOCORRO COUNTY, NEW MEXICO, SEPTEMBER 2003

This transmits New Mexico Environment Department (LAMED) comments concerning the above - referenced Draft Environmental Impact Statement (DEIS).

Surface Water Quality

This DEIS evaluates the potential impacts from the proposal by the New Mexico Institute of Mining and Technology (NMIMT) to construct and operate an astronomical observatory project, called the Magdalena Ridge Observatory (MRO), located on the Magdalena Ranger District (MRD) of the CNF. It is located at the crest of the Magdalena Mountains, in Socorro County. The proposed construction project represents an expansion of the existing 31,000-acre Langmuir Research Site, presently operated by NMIMT. New development totaling 980 acres is proposed at the existing site and along Water Canyon Road, beyond the paved portion that links US Highway 60 with the USFS Water Canyon Campground.

The DEIS presents Alternatives 1-4, with #2 being "No Action", #3 (page 15) being the Preferred scenario, and with #4 responding to public comments, to date. Our surface water quality issues review focused on examination of potential water quality impacts of the project, especially any impacts upon listed waters for which State standards would have to be maintained and protected. Following this review, we find no objection to the work described in either Alternatives 3 or 4.

LAMED has not identified any surface water bodies with impaired water quality on the MRD. No perennial or intermittent streams are present at the primary construction site. The project occurs on a high ridge that straddles the local headwater supply and source areas. There is local spring discharge at the head of Water Canyon Creek and the East and West Forks of Sawmill Canyon Creek. Both of these drainages are continuous enough to eventually deliver runoff to the Middle Rio Grande, above

Susan Goodan
October 20, 2003
Page 2

and below Socorro, but dominantly only under storm runoff conditions. Other minor drainages in the area include Hardy Creek and Bear Creek.

Potential Direct Impacts:

We are satisfied that potential impacts to surface water and riparian vegetation, and erosion of local soils are adequately addressed within the DEIS. The proposed Alternatives include commitments to develop a Surface Water Pollution Prevention Plan (if needed, as part of the application for a National Pollutant Discharge and Elimination System [NPDES] permit), a Stormwater/Erosion Control Plan, a Noxious Weed Management Plan, a Revegetation Plan, and a Dust Abatement Plan.

During the construction and road building activities, the project will provide methods of soil erosion reduction such as properly placed culverts, cross drains, water bars, dips, energy dissipaters, aprons, downspouts, gabions, and/or debris racks, along with armoring of ditches, drain inlets and outlets. If flow in stream courses is ever diverted, the contractors will restore such diverted flow to natural stream course as soon as practicable and prior to the summer monsoon storm season. They generally state that they will incorporate mitigating measures into project plans and designs to maintain the hydrologic and biologic function of any wetlands that may be encountered, and implement a Noxious Weed Management Plan consistent with Forest Service guidance and standards. Soil and water control measures would be adapted and designed for specific construction activities at specific locations prior to initiating road improvements on Water Canyon Road and prior to construction and operation of the proposed MRO facilities.

Indirect Impacts

They note how indirect effects to water quality may be caused by earthmoving, which might result in sedimentation entering drainage ways and then being transported to perennial water bodies. Also, disruption of topsoil can reduce the potential to successfully reseed disturbed areas, causing effects on vegetation.

Conclusion:

Overall, the DEIS is proposed for an area with minor potential impact on live surface water bodies. The plans that were provided acknowledge the full range of potential impacts this Bureau would want to see considered. All the involved agency staffs and contractors are hereby referred to the complete list of standards that apply to the drainages in the project area (from Standards for Interstate & Intrastate Surface Waters, New Mexico Water Quality Control Commission, 20.6.4.8, 20.6.4.12, 20.6.4.900 NMAC (as amended through December 16, 2001)). They can be found on-line at: http://www.mnenv.state.mn.us/NMED_regs/swgb/20_6_4_mnac.pdf)

Air Quality

The proposed construction of the Magdalena Ridge Observatory does not conflict with New Mexico's laws and regulations pertaining to air quality. As stated in the DEIS, the facility and surrounding area is currently considered to be in attainment with all state and national ambient air quality standards.

Susan Goodan
October 20, 2003
Page 3

The document addresses short-term high concentrations of total suspended particulates during construction and subsequent reclamation of the project area to stabilize the soil disturbed by the building sites to minimize long-term dust impacts. Potential impacts of air emissions on visibility in the nearby Bosque del Apache National Wildlife Refuge, a Class I area, should be kept to a minimum using the reclamation techniques described.

Permits must be obtained for generators used for this project that have a potential to emit greater than 10 pounds per hour or 25 tons per year of any regulated air containment for which there is a National or New Mexico Ambient Air Quality Standard. If a back up generator is used, be advised that records should be kept of the hours of operation of the generator. An application for a construction permit must be submitted for standby generators used 500 hours per year or more. In addition, contractors supplying asphalt for the project must have current air quality permits.

Please let us know if you have any questions. We appreciate the opportunity to comment on this document.

Sincerely,

Ron Curry
Secretary

NMED File No. 1776ER

MESCALERO APACHE TRIBAL HISTORIC PRESERVATION OFFICE
P.O. Box 227
Mescalero, New Mexico 88340
Phone: 505/464-4711
Fax: 505/464-4637

September 29, 2003
Ms. Liz Agpaoa
Forest Supervisor
Cibola National Forest
2113 Osuna Rd., NE
Albuquerque, New Mexico
87113-1001

Dear Ms. Agpaoa:
Thank you for providing the Mescalero Apache Tribe with the Magdalena Ridge Observatory Project Draft EIS. We are pleased to see that our concerns were addressed and would like to continue reviewing and commenting on this and other Cibola National Forest projects. If you have any questions please contact me at 5051464-4711.
Sincerely,

Holly Houghten

Tribal Historic Preservation Officer
Cc: President Sara Misquez, MAT

"David Jackson" <zxac2r@concentric.net>

To: <comments-southwestern-cibola-magdalena@fs.fed.us>

cc: Subject: comments on Magadelina Ridge Observatory EIS

09/30/2003 04:34PM

I have reviewed the EIS and feel that it provides the necessary information. I agree that the preferred alternative is the best one for the project. My only concern is that access to hiking on the Magdalena's be maintained and that a trail across the Magdalena Ridge be accessible to hikers when the project is far enough along to make this safe.

David G. Jackson
11500 Herman Roser SE
Albuquerque, New Mexico, 87123

505/299-2430

SAIC
Attn: Susan Goodan
2109 Air Park Road SE
Albuquerque, NM 87106

October 20, 2003

Dear Ms. Goodan:

A

I am writing you to provide comments on the Proposed Magdalena Ridge Observatory DEIS on behalf of the Middle Rio Grande Chapter of the National Wild Turkey Federation. To begin I would like to point out that on page 3-112 there is no mention of wild turkeys being present in the Magdalena Mountains. We understand that there is a population of Merriam's wild turkeys on the mountain that ranges from 30-40 birds. We suggest that the impacts to these birds be addressed.

B

My principle concern about the proposed project has to do with its affect on the existing water resources that wildlife utilize. On page A-26 your own team member; Dave Heft, raised this concern and it was dismissed without adequately addressing this issue. The quantification of existing water resources and the net affect this project would have on the local wildlife populations is sloppy, at best. On page 3-33 you state that "There is little to no flow or water quality data available for the canyon creeks." and that "No flowing water was observed in these creeks during a field trip on November 20, 2001.", and yet you go on to state that "in the East Fork of Sawmill Canyon Creek, the surface water flow in the drainage is probably perennial". Also, at the top of page 3-34 you state "According to information from NMIMT personnel on a recent field trip (SAIC 2003b), water flows in this area all year round." Clearly this information is misleading. Best I can tell from the information provided is that all of the creeks in the vicinity of the ridge are intermittent and that the only location you can state as being perennial is a portion of Hardy Canyon. The true affect of this proposed project would nearly double the current water demand that already exists and the impacts on the already drought susceptible water resources in the area are clearly not addressed in this document.

It is my opinion that any increase in water use by the proposed project will have a negative impact on the water resources currently available to the existing wildlife community and that these impacts should be mitigated by the construction/development of additional water sources in this area.

Thank you for the opportunity to comment in the DEIS. Feel free to contact me at 342-3383 if clarification or additional information is needed.

Sincerely,

Dick Kreiner
President
Middle Rio Grande Chapter
National Wild Turkey Federation:

cc: Liz Agpaca
Dennis Aldridge

United States Department of the Interior

BUREAU OF LAND MANAGEMENT Socorro Field Office
198 Neel Avenue NW Socorro, New Mexico 87801 www.nm.blm.gov

IN REPLY REFER TO: NMNM 82589 1610 (050)
October 21, 2003
Ms. Susan Goodan 2109 Air Park Road SE Albuquerque, NM 87106

Dear Ms. Goodan:

The Bureau of Land Management (BLM) Socorro Field Office has reviewed the draft environmental impact statement for the proposed Magdalena Ridge Observatory. Please note that a portion of the access route off U.S. 60, commonly referred to as the Water Canyon Road, crosses a portion of public land in T. 3 S., R. 2 W., Section 7, Lots 1 and 2. The road is authorized to the County of Socorro under RS 2477. The right-of-way case file is NMNM 82589; the authorized road right-of-way is 50-feet in width.
The subsection entitled *Road Access and Maintenance,* on page 7 of the summary section of the draft document, states that any required repairs would be performed in accordance with an agreement developed among New Mexico Institute of Mining and Technology (NMIMT), the United States Forest Service and Socorro County. Please be advised that any work on that portion of the road that crosses public land would require authorization and should be coordinated with the BLM Socorro Field Office.
Thank you for providing us an opportunity to review the draft document. If we can be of assistance feel free to contact Lois Bell, of my staff, at 505-838-1272.
Enclosure

cc: Socorro County
Sincerely,

Mark A. Lane

Field Manager (Acting)

November 3, 2003

SAIC

Attn: Susan Goodan 2109 Air Park Road SE Albuquerque, New Mexico 87106 (goodansC saic.com) (comments-southwestern-cibola-magdalenaC fs.fed.us)

Re: Comments on Draft EIS for Magdalena Ridge Observatory

Dear Ms. Goodan:

This letter responds to the Notice regarding the above published in the Federal Register on September 19 2003. The Central New Mexico Audubon Society (the "Society") requests that Draft Alternative 3 be made the preferred alternative and that Option 1 (Hardy Spring) be employed as a water source. Furthermore, the Society requests that its further comments below be considered, particularly with respect to certain mitigation measures beyond those propsed in the Draft EIS.

1. Affected Bird Species Errors in Draft EIS

A

On page 3-112 Gray Jay *(Perisoreus canadensis)* is sighted as a common species in the coniferous forests of the Magdalenas as well as along Water Canyon Road. Blackcapped Chickadee (Poeile atricapilla) is also sighted as common along the road. These two claims are highly unlikely as Gray Jays have not been reported south of the Sangre de Cristo and San Juan Mountains in New Mexico. Black-capped Chickadee is also very unlikely to stray into higher elevations during winter and does not breed as far south as the Magdalenas. Andrew Rominger and Christopher Rustay confirm the absence of these two species.

While these birds would not be common, or even present, in the Project Area, there are 24 common species present during the breeding season that were not included in the Draft EIS. These species have been found in high numbers in all thirteen years of the Magdalena Mountain Summer Bird Count. (The Magdalena Mountain summer Bird Count was initiated in 1988 by James Black and has been compiled by Andrew Rominger since 2001; it is conducted during the first Friday and Saturday in the month of June.)

In the coniferous forests of the ridge, the common species excluded from the Draft EIS are Ruby-crowned Kinglet *(Regulus calendula)* and "dorsalis" Dark-eyed Junco *(Junco hyemalis dorsalis).* Additional surveys conducted by Andrew Rominger show that Townsend's Warbler *(Dendroica townsendi)* and Wilson's Warbler *(Wilsonia* pusilla) are common fall migrants to the ridge.

SAIC
November 3, 2003
Page 2 of 5

A

Those species excluded from the list of common birds along Water Canyon Road (p. 3-112) include:

Turkey Vulture *(Cathartes aura)* Morning Dove *(Zenaida macroura)* White-throated *Swift (Aeronautes saxatalis)* Broad-tailed Hummingbird *(Selasphorus platycercus)* Acorn Woodpecker *(Melanerpes formicivorus)* Northern Flicker *(Colaptes auratus)*
Western Wood-Pewee *(Contopus sordidulus)*
Cordilleran Flycatcher *(Empidonax occidentalis)* Ash-throated Flycatcher *(Myiarchus cinerascens)* Plumbeous Vireo *(Vireo plumbeus)*
Warbling Vireo *(Vireo gilvus)*

Western Scrub-Jay *(Aphelocoma californica)* Violet-green Swallow *(Tachycineta thalassina)* Bushtit *(Psaltriparus minimus)* White-breasted Nuthatch *(Sitta carolinensis)* American Robin *(Turdus migratorius)* Virginia's Warbler *(Vermivora virginiae)* Grace's Warbler *(Dendroica graciae)* Western Tanager *(Piranga ludoviciana)* Spotted Towhee (Pipilo *maculatus)*
Chipping Sparrow *(Spizella passerina)*

Black-headed Grosbeak *(Pheucticus melanocephalus)*

In addition, on page 3-114, Table 3-23 seems to be lacking certain species of PIF Priority Bird Species. There are an additional seventeen PIF Priority Bird Species which the Magdalena Mountain Summer Bird Count has confirmed in the Project Area, namely:

Spotted *Owl (Strix occidentalis lucida)* Peregrine Falcon *(Falco peregrinus)* Hammond's Flycatcher *(Empidonax hammondii)* Whip-poor-will *(Caprimulgus vociferous)*
Cordilleran Flycatcher *(Empidonax occidentalis),*
Plumbeous Vireo *(Vireo plumbeus),*
Western Bluebird *(Sialia mexicana),* Townsend's Solitaire *(Myadestes townsendi),* Scott's Oriole *(Icterus parisorum),* Northern Goshawk *(Accipiter gentils),* Zone-tailed Hawk *(Buteo albonotatus),*
Pinon Jay *(Gymnorhinus cyanocephalus)*
Clark's Nutcracker *(Nucifraga columbiana)* Pygmy Nuthatch *Sitta pygmaea)* Mountain Bluebird *(Sialia currucoides)* MacGillivray's Warbler (Oporonis *tolmiei)* Green-tailed Towhee *(Pipilo chlorurus)*

SAIC
November 3, 2003
Page 3 of 5

B

On page 3-116, Table 3-24 states that Hairy Woodpecker *(Dendrocopos villosus)* and Pygmy Nuthatch *(Sitta pymaea)*, both Management Indicator Species, have stable population trends. However, based on thirteen years of data from the Magdalena Summer Bird Count, both species are in decline.

2. Preferred Alternative and Preferred Water Source

Because of the extreme scarcity of subalpine meadow habitat in New Mexico, Alternative 3 is preferred by the Society because of its lesser impact on this habitat. However, note the grazing exclosure mitigation measure proposed below.

C

Because Sawmill Canyon provides excellent habitat for birds and other wildlife, the Society is strongly opposed to operations it its watershed. For example, it has been confirmed by Carol Davis and Andrew Rominger that Painted Redstarts, a PIF Priority Bird Species, are breeding in Sawmill Canyon. Sawmill Canyon is in part unique due to its south-facing orientation, much like Three Gun Spring Canyon is a unique habitat within the Sandia Ranger District.

Accordingly, the Society believes that Option 1 for the water supply should be proposed and adopted. Hardy Spring is on the west face of the Magdalenas, which has a lower wildlife quantity and diversity. Furthermore, the proposal is to drill down to the aquifer hydrologically below Hardy Spring, and so the spring itself should not be affected.

3. Road Noise Mitigation

First, the Society applauds the proposal to mitigate road construction harm to wildlife by doing construction only during non-breeding season. The Forest Service should work to ensure that this is indeed the case during the project.

D

However, road usage harm is another matter. Oddly, the Draft EIS on pages 3123 to 3-124 states that "the noise from large, construction-related vehicles on Water Canyon Road may have a negative affect on priority bird species during the first year of construction" and yet does not propose any mitigation measures.

There are certainly mitigation measures that can be taken, and the Forest Service should further investigate the possibilities of keeping road noise to a minimum. (Note that paving the road would lead to even greater road noise due to greater speeds and the lessened noise absorbance of the road surface.)

Examples of mitigation measures that should be investigated and/or required are: (1) adherence to speed limits; (2) high quality mufflers in good working order; (3) brakes and brake pads in good working order and not overly worn; and (4) no loose materials in truck beds.

SAIC
November 3, 2003
Page 4 of 5

E

4. Subalpine Meadow Grazing Exclosure

Subalpine meadow habitat is rare in New Mexico in comparison to the total surface area of the state. Furthermore, mountain tops have also been shown to be very important stop-over points during mirgration, particularly fall migration. A great deal of that habitat in the construction area will be lost.

Accordingly, mitigation of loss of that habitat should be accomplished by excluding grazing from the remaining portion of that habitat in the project area. This will help that habitat to return to its natural state and species diversity and also help to reduce the impact from humans on the habitat.

If this exclosure is deemed to have an adverse impact on an existing grazing leaseholder, this impact should be mitigated to the extent possible, whether by direct financial compensation or by lowering the leaseholder's cost of the lease.

In conclusion, the Final EIS should include the following: (1) Present Alternative 3 should be the preferred alternative and proposed action; (2) Option 1 (Hardy Spring) should be employed as the preferred water source; (3) Construction road noise mitigation measures must be employed; and (4) the remaining post-construction subalpine meadow should be protected from grazing.

Thank you for your consideration of these comments.

It is believed that this document provides sufficient basis for appeal eligibility. In that this document is being submitted electronically, the undersigned is willing to provide whatever verification of identity that may be reasonably requested.

SAIC

November 3, 2003
Page 5 of 5

Thank you for the opportunity to provide input in the EIS process.

Best regards,

Jeffrey D. Myers, Conservation Chair Direct line: (505) 998-1502

cc: Laura Hudnell

Forest Service MRO Liaison P.O. Box
45
Magdalena, New Mexico 87825
(LHudnell@fs.fed.us)

G:IIDM\CNMAS\Magdalena\MRO_EIS ltr.doc

Andrew J. Rominger
915 Roma NW
Albuquerque, New Mexico 87102
ecopiranga@cybermesa.com

SAIC
Attn: Susan Goodan
2109 Air Park Road SE
Albuquerque, New Mexico 87106

(googdans@saic.com)

(comments-southwestern-cibola-magdalena@fs.fed.us)

Re: Comments on Draft EIS for Magdalena Ridge Observatory

Dear Ms. Goodan:

This letter is in response to the Draft EIS on the purposed Magdalena Ridge Observatory issued September 19, 2003. The following discussion focuses on the information in the DEIS regarding birdlife in the Magdalenas. I strongly support and contributed to the suggested mitigation proposed by The Central New Mexico Audubon Society including a grazing exclosure on the ridge's subalpine meadows with financial reimbursement to the lease holder in some capacity and a similar exclosure in the riparian valley of Water Canyon with similar reimbursement. Leaving the natural surface on the road is wholeheartedly preferred over paving the road for two reasons: 1.) the natural surface would absorb noise more effectively and 2.) the natural surface would mandate slower travel along the road leading to less noise and disturbance.

Presence or Absence of Bird Species

A

According to the Sullivan and Knight surveys of 1992-1993 both Gray Jay *(Perisoreus canadensis)* and Black-capped Chickadee *(Poecile atricapilla)* are sighted as "common" bird species on the ridge (Gray Jay) and along Water Canyon Road (Gray Jay and Black-capped Chickadee). (3-112) This is extremely unlikely given that in all 13 years of the Magdalena Summer Bird Count (currently compiled by Andrew Rominger) never has there been a report of either species. Granted winter is the most probable time to find either species in the Magdalenas this possibility is equally unlikely given that there has been no personal observation, by local bird watchers, of either species during the winter. The Magdalenas are very poplar with birding groups so the absence of reports for Gray Jay or Mountain Chickadee has not resulted from lack of coverage. Additionally, Gray Jays are limited in range--in New Mexico--to the Sangre de Cristos and San Juans of far Northern New Mexico. They have not even been reported from the Sandia Mountains. Observations of supposed Gray Jays most likely were misidentifications of the relatively abundant Clark's Nutcracker *(Nucifraga columbiana).* Black-capped Chickadees do not regularly stray into the higher elevations during winter; they usually reside along the Rio Grande in Central New Mexico. The absence of these two species can also be validated by Hart Schwarz and Christopher

Rustay. The Draft EIS's claim that both Gray Jay and Black-capped Chickadee are common in the Magdalenas detracts from the credibility of the report.

In addition to those bird species said to be common in coniferous forests, (p. 3-112) Ruby-crowned Kinglet *(Regulus calendula) is* well represented in the Sub-alpine Forests on Magdalena Ridge during the breeding season. "Dorsalis" Dark-eyed Junco (Junco *hyemalis dorsalis) is* also an abundant breeder in the forests along the ridge and in the meadow areas. In addition, during fall migration, while doing informal surveys for Hart Schwarz, I commonly encountered Townsend's Warbler (Dendroica townsendi) and Wilson's Warbler (Wilsonia pusilla). In addition to the 13 "common" bird species found along Water Canyon Road by Sullivan and Knight (p. 3-112), some 22 birds are found in good numbers along the road during the breeding season. In Table 1, these species are listed along with the maximum number of individuals of the species recorded between 1988 to 2003.

A

Partners in Flight Priority Species and Important Bird Areas

There have been 33 PIF priority species recorded on the Magdalena Summer Bird Count. Of these, 17 (in addition to the 15 listed in Table 3-23 of the DEIS) have a potential to be found in the Project Area. These are listed in Table 2.

The Magdalena Mountains, while not currently designated as an Important Bird Area, have been nominated for IBA status by Central New Mexico Audubon.

A Note on the Olive Warbler *(Peucedramus taeniatus)* in the Magdalena Mountains The Olive Warbler first appeared in the Magdalena Mountains in 1999. Since then there have been reports of up to six individuals. It seems very likely that the Olive Warbler is a breeding species in the Magdalenas although no nest has been found. Due to the relatively recent entry of the Olive Warbler into the Magdalenas, its population here may be fragile and not strongly established enough to tolerate disturbance from construction and/or traffic. While it cannot be definitively stated if the Olive Warbler will be adversely effected, it can be stated with certainty that to lose or alter such a bird's population would be a regrettable loss to the ever evolving diversity of the Magdalena Mountain ecosystem. Suggested mitigation is to focus construction in the non-breeding season (August-March) and actively monitor the population of Olive Warblers, along with all other neotropical bird species, throughout construction in order to detect any adverse impacts in time to take remedial action.

Indicator Species

In table 3-24, five Management Indicator Species of birds are listed as having stable population trends. Over all this is the case; however, both Hairy Woodpecker and Pygmy Nuthatch show decreases in population based on the Magdalena Mountain Summer Bird Count. Included is a set of graphs showing the trend of each indicator species from 1988 to 2003 (See Graphs 1-4). (Merriam's Turkey is not included as it has not been recorded on the count)

Sawmill Canyon

On page 3-44 under Option 2 of the water source for the MRO, the East Fork of Sawmill Canyon Creek is sighted as a possible water source. It is understood that this is the source for Langmuir Laboratory. From the perspective of avian diversity this would not be an advantageous source for water as increased use may alter the down stream ecosystem. This canyon and its lush vegetation—made

B

possible by the perennial water source--has produced many unique species. Most notable among them is the Painted Redstart *(Myioborus pictus)*, a species usually found farther south. This summer (June/July, 2003) was the first time Painted Redstart has been confirmed breeding in the Magdalenas; confirmation was made by Hart Schwarz as well as Andrew Rominger and Carol Davis. Because of its unique bird life and vegetation, we object to taking water from Sawmill Canyon Creek and support, instead, water being taken from Hardy Spring. **B**

To reiterate, grazing exclosures are recommended as mitigation measures both on the ridge and in Water Canyon's riparian habitat; the natural surface of the road should be left unpaved; and Hardy spring (Option 1) is preferred to Sawmill Canyon Creek **C**
Spring (Option 2). In regard to bird life: Gray Jay and Black-capped Chickadee are not members of the avifauna of the Magdalenas; there are additional common species and priority species of birds not mentioned in the DEIS; the presence of Olive Warbler in the Magdalenas is very unique, mitigation measures for other neotropical species, such as natural road surface, would likely also reduce impact on this species; and the population trend of two MISS is down rather than stable. It is not my intent to out right criticizes the DEIS, and I apologize if this is the impression I have given, instead I mean only to give my input based on my intimate observations and long-term field studies in the Magdalena Mountains. Thank you for your consideration.

Andrew J. Rominger

COMPILER OF THE MAGDALENA MOUNTAIN SUMMER BIRD COUNT

(505) 243-7-355

cc: Lauri Hudnell Forest Service MRO Liaison
P.O. Box 45
Magdalena, New Mexico 87825
(LHudaell@ s.fed.us)

Table 1: Common Species along Water Canyon Road

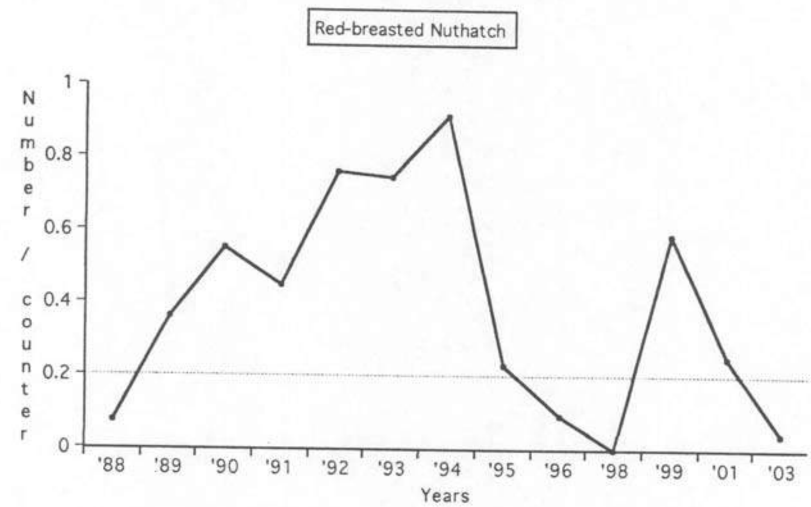
Species	Highest Number	Year(s) of Highest Number
Turkey Vulture *(Cathartes aura)*	89	1993
Morning Dove *(Zenaida macroura)*	81	1998
White-throated Swift *(Aeronautes saxatalis)*	62	1991
Broad-tailed Hummingbird *(Selasphorus platycercus)*	71	1993
Acorn Woodpecker *(Melanerpes formicivorus)*	25	1991
Northern Flicker *(Colaptes auratus)*	35	1994
Western Wood-Pewee *(Contopus sordidulus)*	57	1993
Cordilleran Flycatcher *(Empidonax occidentalis)*	35	1993
Ash-throated Flycatcher *(Myiarchus cinerascens)*	29	1991 & 1992
Plumbeous Vireo *(Vireo plumbeus)*	52	1991
Warbling Vireo *(Vireo gilvus)*	58	1993
Western Scrub-Jay *(Aphelocoma californica)*	25	1993
Violet-green Swallow *(Tachycineta thalassina)*	355	1991
Bushtit *(Psaltriparus minimus)*	53	1991
White-breasted Nuthatch *(Sitta carolinensis)*	27	1991, 1993 & 1994
American Robin *(Turdus migratorius)*	47	1992
Virginia's Warbler *(Vermivora virginiae)*	34	1991
Grace's Warbler *(Dendroica graciae)*	54	1988
Western Tanager *(Piranga ludoviciana)*	50	1993
Spotted Towhee *(Pipilo maculatus)*	61	1993
Chipping Sparrow *(Spizella passerina)*	62	1993
Black-headed Grosbeak *(Pheucticus melanocephalus)*	54	1993

Table 2: Additional PIF Priority Species Confirmed in the Project Area

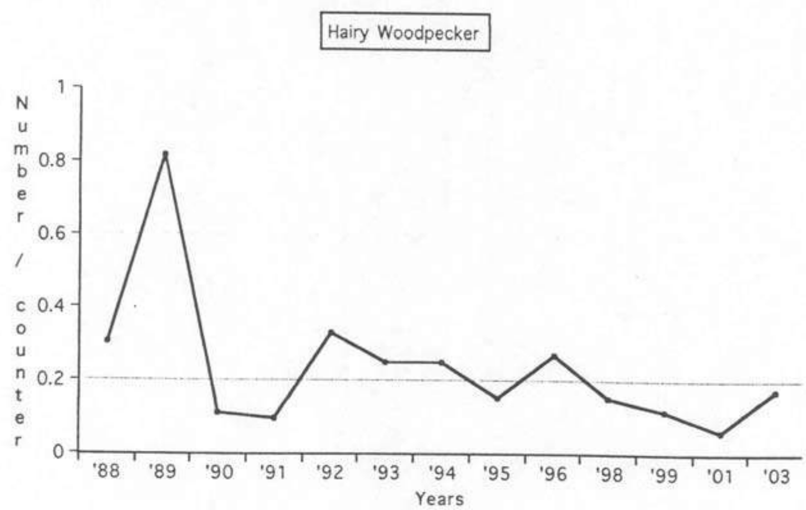
Species	Pinyon-Juniper	Ponderosa Pine	Mixed Conifer	Spruce-Fir
Spotted Owl *(Strix occidentalis lucida)*		X	X	X
Peregrine Falcon *(Falco peregrinus)*	X	X		
Hammond's Flycatcher *(Empidonax hammondii)*	X	X	X	X
Whip-poor-will *(Caprimulgus vociferus)*		X	X	
Cordilleran Flycatcher *(Empidonax occidentalis)*	X	X	X	X
Plumbeous Vireo *(Vireo plumbeus)*		X	X	
Western Bluebird *(Sialia mexicana)*	X	X		
Townsend's Solitaire *(Myadestes townsendi)*	X	X	X	X
Scott's Oriole *(Icterus parisorum)*	X			
Northern Goshawk *(Accipiter gentils)*		X	X	
Zone-tailed Hawk *(Buteo albonotatus)*	X	X		
Pinon Jay *(Gymnorhinus cyanocephalus)*	X			
Clark's Nutcracker *(Nucifraga columbiana)*				X
Pygmy Nuthatch *(Sitta pygmaea)*		X		
Mountain Bluebird *(Sialia currucoides)*				X*
MacGillivray's Warbler *(Oporonis tolmiei)*			X	X
Green-tailed Towhee *(Pipilo chlorurus)*				X*
TOTAL	**8**	**11**	**8**	**8**

* indicates these species utilize subalpine meadow habitat adjacent to the spruce-fir forest

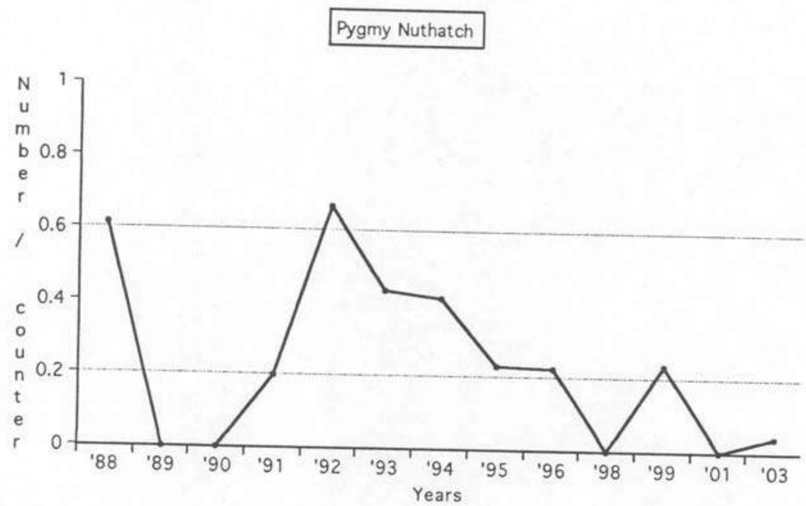
Graph 1: Subalpine Conifer forest MIS Population Trend



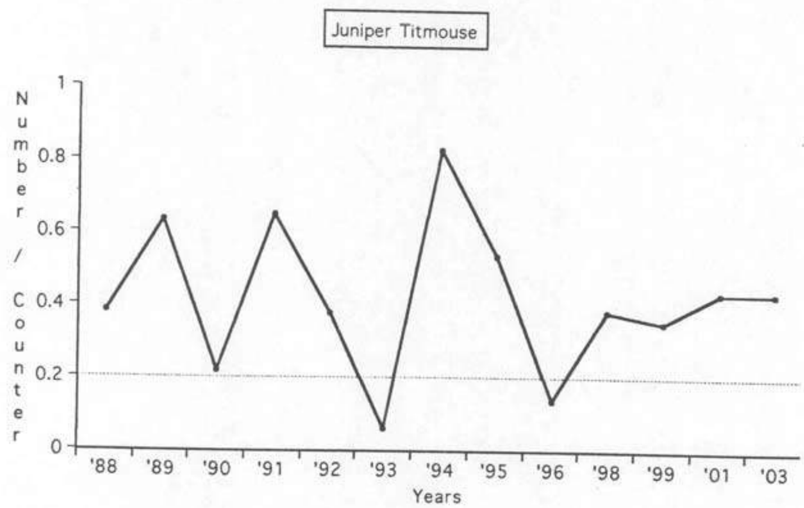
Graph 2: Mixed Conifer MIS Population Trend



Graph 3: Ponderosa Pine MIS Population Trend



Graph 4: Pinyon-Juniper MIS Population Trend



United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Post Office Box 649
Albuquerque, New Mexico 87103

IN REPLY REFER TO:

October 28, 2003

ER 03/760

Susan Goodan

Science Application International Corporation 2109 Air Park Road, SE
Albuquerque, NM 87106

Dear Ms. Goodan,

The U. S. Department of the Interior (DOI) has reviewed the Draft Environmental Impact Statement (EIS) for Proposed Magdalena Ridge Observatory, Cibola National Forest, Socorro County, New Mexico. The following comments are provided for your consideration during preparation of the final EIS on this proposed action.

On July 25, 2003, the U.S. Forest Service (Forest Service), provided a Biological, Assessment and Biological Evaluation (BA&BE) to the U.S. Fish and Wildlife Service (FWS) for the Magdalena Ridge Observatory Project (MRO). The BA&BE analyzed the effects of a proposed action (construction and operation of the MRO) on federally endangered and threatened species. In their BA&BE, the Forest Service made a determination of "may affect, not likely to adversely affect" for the Mexican spotted owl *(Strix occidentalis lucida).*

On August 19, 2003, the FWS concurred with the Forest Service's determination. The concurrence was based on: 1) the proposed action as described, analyzed, and evaluated in the BA&BE; 2) impacts to the Mexican spotted owl associated with implementation of the proposed action; and 3) other information. However, on September 11, 2003, the Forest Service sent a Draft FIS for the MRO to the FWS for comment. The EIS evaluated three actions and a no action alternative.

The FWS's concurrence with the Forest Service's "may affect, not likely to adversely affect" determination was for the action as proposed in the BA&BE. If the proposed action, as described in the BA&BE is modified or changed as a result of the National Environmental Policy Act (NEPA) process, then the Forest Service should reinitiate consultation with the FWS pursuant to the Endangered Species Act of 1973, as amended (ESA).

The DOI supports early consultation and streamlining of the ESA consultation process.

However, ESA consultation should be completed concurrent with, rather than prior to, the NEPA process

2

We appreciate the cooperation of the Forest Service during our investigation of the project and the opportunity to review the Draft EIS and provide comments concerning the proposed project. We trust our comments will be of use during completion of the final document.

Sincerely,

Stephen R. Spencer

Acting Regional Environmental Officer

County of Bernalillo

State of New Mexico

BOARD OF COUNTY COMMISSIONERS
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JUAN R. VIGIL, COUNTY MANAGER

ONE CIVIC PLAZA, N.W.
ALBUQUERQUE, NEW MEXICO 87102
ADMINISTRATION (505) 768-4000
COMMISSION (505) 768-4217
FAX (505) 768-4329

MARK J. CARRILLO, ASSESSOR
MARY HERRERA, CLERK
MERRI RUDD, PROBATE JUDGE
DARREN P. WHITE, SHERIFF
ALEX A. ABEYTA, JR., TREASURER

September 18, 2003 SAIC

Attn: Susan
Goodan 2109 Air
Park Road SE
Albuquerque, NM
87106

Re: Magdalena Ridge Observatory

Project Dear Ms. Goodan:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement recently released for the proposed Magdalena Ridge Observatory Project in the Cibola National Forest. Since this facility will be located approximately 75 miles from Albuquerque and Bernalillo County it does not appear that there will be an impact on County residents or facilities. The County has no adverse comment on this project.

Very truly yours,

Juan R. Vigil County Manager

ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
AAM	Annual Arithmetic Mean
AAQS	Ambient Air Quality Standards
AGM	Annual Geometric Mean
AMS	Analysis of the Management Situation
APE	Area of Potential Effect
AQCR	Air Quality Control Region
AUM	Animal Unit Month
ATV	All-Terrain Vehicle
BA/BE	Biological Assessment/Biological Evaluation
BLM	Bureau of Land Management
BMP	Best Management Practice
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CNF	Cibola National Forest
CO	Carbon Monoxide
CWA	Clean Water Act
EIS	Environmental Impact Statement
EO	Executive Order
FAA	Federal Aviation Administration
FHA	Federal Highway Administration
FSH	Forest Service Handbook
FR	Forest Road
GIS	Geographic Information System
HAP	Hazardous Air Pollutant
H_2S	Hydrogen Sulfide
HUD	U.S. Department of Housing and Urban Development
I-25	Interstate 25
IBA	Important Bird Area
ID	Interdisciplinary
IMPROVE	Interagency Monitoring of Protected Visual Environments
JOCR	Joint Observatory for Cometary Research
LRMP	Land and Resource Management Plan
MIS	Management Indicator Species
MRD	Magdalena Ranger District
MRO	Magdalena Ridge Observatory
MSL	Mean Sea Level
MSO	Mexican Spotted Owl
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEON	National Ecological Observatory Network
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMAC	New Mexico Administrative Code
NMAQB	New Mexico Air Quality Bureau
NMARMS	New Mexico Archaeological Records Management Section
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMED	New Mexico Environment Department
NMEIB	New Mexico Environmental Improvement Board
NMGF	New Mexico Department of Game and Fish
NMSBM&MR	New Mexico State Bureau of Mines and Mineral Resources
NMSHTD	New Mexico State Highway and Transportation Department
NMIMT	New Mexico Institute of Mining and Technology
NMWQCC	New Mexico Water Quality Control Commission
NOx	Nitrogen Oxide(s)
NO_2	Nitrogen Dioxide
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge and Elimination System
NPOI	Navy Prototype Optical Interferometer
NPR	No Permit Required
NRAO	National Radio Astronomy Observatory
NRHP	National Register of Historic Places
NRL	Naval Research Laboratory
NSR	New Source Review
O_3	Ozone
ORV	Off-Road Vehicle
OSE	Office of the State Engineer
OSHA	Occupational Safety and Health Administration
P	Primitive
PAC	Protected Activity Center
Pb	Lead
PCB	Polychlorinated Biphenyl
PIC	Public Information and Communication
PIF	Partners in Flight
P.L.	Public Law
$PM_{2.5}$	particulate matter 2.5 microns or less
PM_{10}	particulate matter 10 microns or less
PRF	Principle Research Facility
PSD	Prevention of Significant Deterioration
R	Rural
RN	Roaded Natural
RNA	Research Natural Area
ROI	Region of Influence
ROS	Recreation Opportunity Spectrum

SCAQMD	South Coast Air Quality Management District	THPO	Tribal Historic Preservation Officer
SEL	Sound Exposure Level	TSP	Total Suspended Particulates
SHPO	State Historic Preservation Office	U	Urban
SIC	Standard Industrial Code	U.S.	United States
SIP	State Implementation Plan	US 60	U.S. Highway 60
SLAMS	State and Local Air Monitoring Station	USACE	U.S. Army Corps of Engineers
SMS	Scenery Management System	USC	United States Code
SOx	Sulfur Dioxide	USDA	U.S. Department of Agriculture
SOPA	Schedule of Proposed Action	USDOL	U.S. Department of Labor
SPM	Semi-Primitive, Motorized	USDOT	U.S. Department of Transportation
SPNM	Semi-Primitive, Non-Motorized	USEPA	U.S. Environmental Protection Agency
STIP	Statewide Transportation Improvement Program	USFWS	U.S. Fish and Wildlife Service
SUP	Special Use Permit	USGS	U.S. Geological Survey
SWQB	Surface Water Quality Bureau	VA	Department of Veterans Affairs
SWPPP	Stormwater Pollution Prevention Plan	VLA	Very Large Array
TCP	Traditional Cultural Property	VMS	Visual Management System
TDS	Total Dissolved Solids	VOC	Volatile Organic Compound
TES	Terrestrial Ecosystem Survey	VQO	Visual Quality Objective
		WA	Wilderness Area
		WSMR	White Sands Missile Range

MEASUREMENTS

° F	degrees Fahrenheit	kW	kilowatt
cm	centimeter	L_{eq}	Equivalent Sound Level
dBA	A-weighted decibels	L_{dn}	Day-Night Average Sound Level
dbh	diameter at breast height	L_{max}	Maximum Sound Level$\mu g/m^3$
gpd	gallons per day		micrograms per cubic meter
gpm	gallons per minute	m	meter
gpy	gallons per year	mi^2	square mile
HP	horsepower	mph	miles per hour
Hz	Hertz	mpy	miles per year
kg	kilogram	ppm	parts per million
km	kilometer	sf	square foot
km^2	square kilometer	sm	square meter
kmph	kilometers per hour	TPY	tons per year
kpy	kilometers per year		