Final

San Luis Valley Field Office

Geothermal Leasing RMP Amendment

October 2012

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

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

San Luis Valley Resource Area
Geothermal Leasing Resource Management Plan Amendment
DOI-BLM-CO-140-2010-14-EA

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

Background

In 2008, the United States (US) Department of the Interior (DOI), Bureau of Land Management (BLM) recommended, and the Assistant Secretary–Land and Minerals Management approved, the Record of Decision (ROD) associated with the *Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States*. The 2008 Geothermal PEIS and ROD were prepared pursuant to the planning requirements of the Federal Land Policy and Management Act of 1976, as amended (FLPMA), and its implementing regulations at 43 Code of Federal Regulations (CFR) Part 1600, as well as the National Environmental Policy Act of 1969 (NEPA), and its implementing regulations at 40 CFR Parts 1500 through 1508.

Decisions in the 2008 Geothermal ROD allocated BLM-administered lands as available for geothermal leasing and development and provided stipulations, best management practices (BMPs), and procedures for geothermal leasing and development. While the 2008 Geothermal ROD amended 14 BLM Resource Management Plans (RMPs) in the State of Colorado, it did not amend the San Luis Valley Resource Area (SLRA) RMP. Therefore, the BLM is considering an amendment to the SLRA RMP that would incorporate the 2008 Geothermal ROD.

FINDING OF NO SIGNIFICANT IMPACT DETERMINATION

Based on review of the San Luis Valley Resource Area (SLRA) Geothermal Resource Management Plan Amendment and Environmental Assessment (EA), I have determined that the Proposed Action to allocate BLM administered lands for geothermal leasing as defined and analyzed in Alternative B is not a major federal action and will not have a significant effect on the quality of the human environment, individually or cumulatively with other actions in the general area. No environmental effects from any alternative assessed or evaluated meet the definition of significance in context or intensity, as defined by 43 CFR 1508.27. Therefore, an environmental impact statement is not required. This finding is based on the context and intensity of the project, proposed action, or action alternative.

Context:

The 1991 San Luis Resource Area RMP (SLRA RMP) allocated the majority of BLM administered lands as open with timing limitations with limited areas closed to geothermal leasing (EA Alternative A-No Action). The purpose of amending the SLRA RMP is to better facilitate environmentally responsible geothermal leasing and potential geothermal development

projects in BLM-administered portions of the San Luis Basin, a region along the upper Rio Grande Rift that is recognized for high resource potential by the USGS and Colorado Geological Survey. A BLM planning-level decision consistent with agency policy including best management practices as leasing procedures, defined in the December 17, 2008 Geothermal ROD provides that opportunity.

In addition, the SLRA RMP amendment proposal is needed to protect sensitive species, other resource values, and analyze additional information that was not available at the time the SLRA RMP was approved in 1991. This proposed amendment will inform BLM decision-making regarding appropriate means to reduce adverse impacts from possible geothermal leasing and development on resource values while advancing national and state renewable energy generation goals.

Decisions to be made include:

- Allocation of those BLM-administered surface lands and subsurface mineral estate with geothermal resource potential as closed, open with standard stipulations, or open with major or moderate constraints to geothermal leasing;
- Identification of appropriate stipulations and BMPs; and
- Possible exceptions, waivers, and modifications to lease stipulations; terms and conditions; and conditions of approval (COAs).

To support decision-making, the BLM consulted with the US Fish and Wildlife Service under Section 7 of the Endangered Species Act of 1973 (ESA) and the Colorado State Historic Preservation Office under Section 106 of the National Historic Preservation Act of 1966 (NHPA). Further, the BLM consulted with Indian Tribes throughout the plan amendment process and will continue to do so during plan implementation.

Intensity:

The following discussion is organized around significance criteria described at 40 CFR 1508.27. The following have been considered in evaluating intensity for this proposal:

Degree of effect on public health and safety:

The Proposed Action (Alternative B) and Alternative C, would allocate lands for geothermal leasing and define resource protective stipulations to guide leasing and potential future development of subsurface heat flow. Planning-level allocation of lands for geothermal leasing is not a surface disturbing activity. However, it is reasonable to expect resource exploration and potential development, which could affect public health or safety, to occur after a lease is issued and during the 10-year period of a standard lease term. There are several stages of decision making necessary following land use allocation to approve geothermal resource development, each with its own site-specific environmental analysis under NEPA. At each stage, the BLM can issue site specific conditions of approval to protect resource values and health and safety. Geothermal exploration and production on Federal land conducted through leases is subject to terms and stipulations to comply with all applicable Federal and state laws pertaining to various considerations for water quality and quantify, sanitation, tribal interests, sanitation, wildlife, safety, cultural resources, and reclamation.

Unique Characteristics of the Geographic Area:

The SLRA RMP planning-analysis area includes three wilderness study areas (San Luis Hills, Papa Keel, Black Canyon) where leasing is precluded 43CFR 3201.11(h)(1), eight BLM Areas of Critical Environmental Concern (Trickle Mountain, Elephant Rocks, Blanca Wetlands, Ra Jadero Canyon, Los Mogotes, Cumbres and Toltec Railroad, Rio Grande Outstanding Natural Area), three National Wildlife Refuges (Baca, Monte Vista, Alamosa), three State Wildlife Areas (Russell Lakes, Hot Creek-Poso, Hot Creek), one National Park (Great Sand Dunes), one National Historic Trail (Old Spanish), and one State Park (San Luis Lakes).

The planning area also includes known cultural resources which would be protected by a No Surface Occupancy (NSO) lease stipulation, as well as by site-specific conditions of approval applied to any subsequent permitted surface-disturbing activities. Wetlands in the area would be similarly protected by closure under Blanca Wetlands ACEC and McIntyre Springs and in other areas by NSO and Controlled Surface Use (CSU) lease stipulations and site-specific conditions of approval. There are no identified federal prime or unique farmlands, designated wild or scenic rivers or designated wilderness in the planning and analysis area.

Degree to which effects are likely to be highly controversial:

There are essentially no direct effects on the human or natural environment from planning-level allocation of BLM administered lands for geothermal leasing as defined in the Proposed Action (Alternative B) or Alternative C. Any subsequent proposals for surface-disturbing activities are presently speculative, and would be subject to site-specific environmental analysis. The BLM conducted public involvement in a manner that allowed agency staff to gauge public sentiment and concerns. Scoping identified issues included potential adverse effects to economically important direct geothermal users at Valley View Hot Springs, Joyful Journey Hot Springs, and the San Luis Valley Alligator Farm, water quality and quantity, wildlife habitat, sensitive species, wetlands, State Wildlife Areas, cultural resource protection, and maintenance of high quality views.

The lack of direct effects due to allocating lands for leasing geothermal resources under the Proposed Action (Alternative B) or Alternative C is certain. The degree to which direct, indirect, and cumulative effects are uncertain or involve unique or unknown risks depends on the location of any future geothermal lease, proposal for exploration, or energy development project. Generally, the effects of geothermal exploration and development of geothermal electricity generation through binary closed-loop technologies are not highly uncertain, nor are they characterized by unique or unknown risks. Geothermal development has been occurring in other areas of the western United States for decades. The potential effects of any subsequent proposals for surface-disturbing activities would be subject to site-specific environmental analysis, and based on such information and the BLM's knowledge of the local resource, would be reasonably predictable.

Consideration of whether the action may establish a precedent for future actions with significant impacts:

The allocation of lands for geothermal energy, as defined under the Proposed Action (Alternative B) represents a decision in principle about a future consideration of lands proposed for leasing.

However, the allocation of lands for geothermal leasing under Alternative B and action Alternative C both incorporate best management practices, leasing procedures, and environmental protection stipulations for resource protection. Neither the proposed action nor action alternative will create a precedent for future actions with significant impacts without further opportunity to identify issues and reduce or avoid impacts based on site-specific environmental review.

The BLM San Luis Resource Area Resource Management Plan (1991) allocated the vast majority of the San Luis Valley Field Office federal and split-estate as open for geothermal leasing, subject to existing laws, regulations, formal orders, stipulations attached to the lease form, and the terms and conditions of the standard lease form (see Alternative A-No Action in the EA-RMPA). The issuance of a lease, following the allocation of lands for geothermal leasing as defined in the Proposed Action (Alternative B) or Alternative C, does not authorize any ground disturbing activities to explore for or develop geothermal resources without further application, environmental review, and approval by the BLM.

Consideration of whether the action is related to other actions with cumulatively significant impacts:

There are essentially no cumulative effects of allocating lands as open or closed to geothermal leasing and this action is not connected or related to other actions with cumulatively significant impacts. Anticipated future actions related to geothermal leasing and development are not considered to have significant impacts given the application of protective stipulations and conditions of approval for subsequent ground-disturbing activities. Each stage of development requires additional site-specific environmental analysis prior to issuance of a permit from the BLM.

Scientific, cultural, or historical resources, including those listed in or eligible for listing in the National Register of Historic Places:

As described in section 3.7.2 of the EA, the proposed action will not adversely affect districts, sites, highways, structures, or other objects listed in or eligible for listing in the National Register of Historic Places, nor will it cause loss or destruction of significant scientific, cultural, or historical resources. Per existing stipulations, all eligible and listed cultural resources would be avoided within the proposed lease area.

Threatened or endangered species and their critical habitat:

The allocation of lands for geothermal leasing does not directly affect threatened or endangered species or habitat. These resources would be affected only by development of specific geothermal projects. As described in the EA, the only threatened or endangered species or habitat that could potentially be impacted in the analysis area is Canada lynx. Lynx habitat on BLM administered lands would be protected under Alternatives B or C. Alternatives B and C include lease stipulations and a lease notice for the protection of Gunnison sage-grouse (currently a candidate species) and habitat. A no surface occupancy for Gunnision's Sage Grouse habitat in the northern portion of the planning area is defined in Alternative B. Additionally, threatened or endangered species and habitat would be evaluated on a project-specific basis, as environmental

analyses would be conducted for each of the potential phases of geothermal development activity.

The Proposed Action (Alternative B), as well as Alternative C, includes a lease stipulation in accordance with the Endangered Species Act, Section 7 consultation. In addition, they include a Lease Notice specific to Canada lynx informing a potential lessee of the presence of Canada lynx habitat on the private surface portion of the analysis area. BMP's would be applied as Conditions of Approval to any exploration and/or development permits to avoid, minimize, or mitigate impacts to lynx habitat. It is expected that these measures would effectively minimize impacts on lynx by maintaining habitats and minimizing human caused habitat destruction, degradation, and fragmentation. The lease stipulations and lease notice, in addition to best management practices applied as Conditions of Approval to any subsequent permitting would help to avoid, minimize, or mitigate impacts to Gunnison sage-grouse.

Any effects that threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment:

As described in the EA, neither the Proposed Action (Alternative B) nor Alternative C, violate any known Federal, State, or local law or requirement imposed for protection of the environment. Specialists from BLM San Luis Valley Field Office, as well as representatives from various cooperating federal, state, and local agencies/governments, were involved in preparation of the EA. Officials from Saguache, Alamosa, Rio Grande, and Conejoes Counties were notified of the proposal.

The proposed action conforms with the provisions of NEPA (U.S.C. 4321-4346) and FLPMA (43 U.S.C. 1701 et seq.) and is compliant with the Clean Water Act and The Clean Air Act, the National Historic Preservation Act, Migratory Bird Treaty Act (MBTA) and the Endangered Species Act.

SIGNATURE OF AUTHORIZED OFFICIAL: _____

Andrew Archuleta, Field Manager

DATE SIGNED: _____

This page intentionally left blank.

TABLE OF CONTENTS

Chapter Page

1. INTRODUCTION 1-1

1.1 Purpose and Need 1-1
1.2 Description of the Planning Area 1-2
1.3 Geothermal Leasing Process 1-5
1.4 Colorado Geothermal Potential 1-6
1.4.1 Resource Geography 1-8
1.4.2 Technical Capabilities 1-9
1.4.3 State of Colorado Water Laws and Regulations 1-12
1.5 Decisions to be Made 1-14
1.6 Relationship to Policies, Plans, and Programs 1-15
1.6.1 San Luis Valley Field Office Resource Management Plan 1-15
1.6.2 Programmatic Environmental Impact Statement for Geothermal Leasing Exploration and Development 1-15
1.6.3 State of Colorado Water Laws and Regulations 1-17
1.7 The Geothermal Programmatic Environmental Impact Statement and the San Luis Valley Field Office Resource Management Plan Amendment 1-19
1.8 Public Involvement 1-20
1.8.1 Scoping 1-20
1.8.2 Public Comments on the Draft RMP Amendment/EA 1-22
1.8.3 Protest Period and Governor's Consistency Review 1-23

2. ALTERNATIVES 2-1

2.1 Alternatives Development 2-1
2.1.1 Developing Alternatives for the San Luis Valley Field Office Resource Management Plan Amendment 2-2
2.2 Alternatives Considered for Detailed Analysis 2-2
2.2.1 Alternative A (No Action Alternative) 2-3
2.2.2 Decisions Common to Both Action Alternatives (B and C) 2-4
2.2.3 Alternative B (Proposed action) 2-10
2.2.4 Alternative C 2-13
2.3 Alternatives Considered but Eliminated from Detailed Study 2-15
2.3.1 No Leasing or Development of Geothermal Resources on BLM Lands 2-15
2.3.2 Identify priority low-conflict, high potential zones for geothermal leasing 2-15
2.3.3 Create a comprehensive energy plan that incorporates geothermal, solar, and oil and gas 2-15
2.3.4 Expand the Closed to Leasing Lands to a two to five mile buffer around private hot springs resorts (Valley View and Joyful Journey) 2-15
2.4 Management Guidance for Alternatives A, B, and C 2-16
2.4.1 How to Read Table 2-1 2-16

3. AFFECTED ENVIRONMENT 3-1

3.1 Air Quality 3-1
3.2 Greenhouse Gases and Climate Change 3-2
3.3 Cultural Resources and Tribal Interests 3-3
3.3.1 Prehistory 3-4

TABLE OF CONTENTS *(continued)*

Chapter Page

3.3.2 Ethnohistory....3-5
3.3.3 History....3-6
3.3.4 Trails and Rails....3-7
3.3.5 National Register of Historic Places....3-8
3.3.6 Traditional Cultural Properties....3-10
3.4 Fish and Wildlife Habitat and Special Status Species....3-10
3.4.1 Big Game Species....3-10
3.4.2 Small Mammals and Carnivores....3-11
3.4.3 Reptiles/Amphibians....3-11
3.4.4 Migratory Birds....3-12
3.4.5 Federal Threatened, Endangered, and Proposed Wildlife Species....3-15
3.4.6 BLM Sensitive Species....3-17
3.4.7 Federal Threatened, Endangered, and Proposed Plant Species....3-22
3.4.8 BLM Sensitive Plant Species....3-22
3.5 Fluid Minerals....3-23
3.6 Geology and Seismicity....3-24
3.7 Health and Safety....3-25
3.8 Land Uses....3-26
3.9 Lands with Wilderness Characteristics....3-27
3.10 Livestock Grazing....3-28
3.11 Noise....3-28
3.12 Paleontological Resources....3-28
3.13 Recreation....3-30
3.14 Renewable Energy....3-31
3.14.1 Solar Energy Resources....3-31
3.14.2 Wind Energy Resources....3-31
3.14.3 Biomass Resources....3-32
3.15 Socioeconomics and Environmental Justice....3-32
3.16 Soils....3-36
3.17 Special Designated Areas....3-37
3.17.1 Wilderness Study Areas....3-37
3.17.2 Areas of Critical Environmental Concern....3-37
3.17.3 Wild and Scenic Rivers....3-40
3.17.4 National Scenic Byways....3-41
3.17.5 National Heritage Areas....3-41
3.17.6 National Scenic and Historic Trails....3-41
3.17.7 National Parks and Preserves....3-41
3.17.8 National Wildlife Refuges....3-42
3.18 Vegetation....3-43
3.18.1 Plant Communities....3-43
3.18.2 Riparian Resources....3-47
3.19 Visual Resource Management and Night Sky....3-50
3.20 Water Resources....3-52
3.20.1 Rio Grande Hydrologic Region....3-52
3.20.2 Surface Water....3-53
3.20.3 Groundwater....3-55
3.20.4 Water Use and Water Rights Management....3-57

TABLE OF CONTENTS *(continued)*

Chapter Page

4. ENVIRONMENTAL EFFECTS 4-1

4.1 Introduction 4-1
4.2 Methods of Impact Analysis 4-1
4.2.1 Determining Significance 4-3
4.2.2 Incomplete or Unavailable Information 4-3
4.3 Reasonably Foreseeable Development Scenario for the San Luis Valley Field Office 4-4
4.4 Air Quality 4-5
4.4.1 Scoping Comments on the Resource 4-5
4.4.2 How Resource Impacts were Evaluated 4-5
4.4.3 Common Impacts Associated with Geothermal Development 4-6
4.4.4 Potential Impacts Associated with Preferred Action and Alternatives 4-9
4.5 Greenhouse Gases and Climate Change 4-10
4.5.1 Scoping Comments on the Resource 4-10
4.5.2 How Resource Impacts were Evaluated 4-10
4.5.3 Common Impacts Associated with Geothermal Development 4-11
4.5.4 Potential Impacts Associated with Preferred Action and Alternatives 4-12
4.6 Cultural Resources 4-13
4.6.1 Scoping Comments on the Resource 4-13
4.6.2 How Resource Impacts were Evaluated 4-13
4.6.3 Common Impacts Associated with Geothermal Development 4-16
4.6.4 Potential Impacts Associated with Preferred Action and Alternatives 4-17
4.7 Tribal Interests 4-19
4.7.1 Scoping Comments on the Resource 4-19
4.7.2 How Resource Impacts were Evaluated 4-20
4.7.3 Common Impacts Associated with Geothermal Development 4-21
4.7.4 Potential Impacts Associated with Preferred Action and Alternatives 4-22
4.8 Fish and Wildlife Habitat 4-23
4.8.1 Scoping Comments on the Resource 4-23
4.8.2 How Resource Impacts were Evaluated 4-23
4.8.3 Common Impacts Associated with Geothermal Development 4-25
4.8.4 Potential Impacts Associated with Preferred Action and Alternatives 4-30
4.9 Special Status Species 4-33
4.9.1 Scoping Comments on the Resource 4-33
4.9.2 How Resource Impacts were Evaluated 4-33
4.9.3 Common Impacts Associated with Geothermal Development 4-36
4.9.4 Potential Impacts Associated with Preferred Action and Alternatives 4-38
4.10 Geology and Seismicity 4-45
4.10.1 Scoping Comments on the Resource 4-45
4.10.2 How Resource Impacts were Evaluated 4-46
4.10.3 Common Impacts Associated with Geothermal Development 4-46
4.10.4 Potential Impacts Associated with Preferred Action and Alternatives 4-49
4.11 Health and Safety 4-50
4.11.1 Scoping Comments on the Resource 4-50
4.11.2 How Resource Impacts were Evaluated 4-50
4.11.3 Common Impacts Associated with Geothermal Development 4-50

4.11.4 Potential Impacts Associated with Preferred Action and Alternatives....4-51
4.12 Land Uses 4-52
4.12.1 Scoping Comments on the Resource 4-52
4.12.2 How Resource Impacts were Evaluated 4-52
4.12.3 Common Impacts Associated with Geothermal Development 4-53
4.12.4 Potential Impacts Associated with Preferred Action and Alternatives....4-53
4.13 Lands with Wilderness Characteristics 4-54
4.13.1 Scoping Comments on the Resource 4-54
4.13.2 How Resource Impacts were Evaluated 4-54
4.13.3 Common Impacts Associated with Geothermal Development 4-55
4.14 Livestock Grazing 4-55
4.14.1 Scoping Comments on the Resource 4-55
4.14.2 How Resource Impacts were Evaluated 4-56
4.14.3 Common Impacts Associated with Geothermal Development 4-56
4.14.4 Potential Impacts Associated with Preferred Action and Alternatives....4-57
4.15 Minerals and Energy 4-58
4.15.1 Scoping Comments on the Resource 4-58
4.15.2 How Resource Impacts were Evaluated 4-58
4.15.3 Common Impacts Associated with Geothermal Development 4-59
4.15.4 Potential Impacts Associated with Preferred Action and Alternatives....4-59
4.16 Noise 4-60
4.16.1 Scoping Comments on the Resource 4-60
4.16.2 How Resource Impacts were Evaluated 4-60
4.16.3 Common Impacts Associated with Geothermal Development 4-61
4.16.4 Potential Impacts Associated with Preferred Action and Alternatives....4-62
4.17 Paleontological Resources 4-62
4.17.1 Scoping Comments on the Resource 4-62
4.17.2 How Resource Impacts were Evaluated 4-62
4.17.3 Common Impacts Associated with Geothermal Development 4-64
4.17.4 Potential Impacts Associated with Preferred Action and Alternatives....4-64
4.18 Recreation 4-65
4.18.1 Scoping Comments on the Resource 4-65
4.18.2 How Resource Impacts were Evaluated 4-65
4.18.3 Common Impacts Associated with Geothermal Development 4-66
4.18.4 Potential Impacts Associated with Preferred Action and Alternatives....4-67
4.19 Socioeconomics and Environmental Justice 4-68
4.19.1 Scoping Comments on the Resource 4-68
4.19.2 How Resource Impacts were Evaluated 4-68
4.19.3 Common Impacts Associated with Geothermal Development 4-69
4.19.4 Potential Impacts Associated with Preferred Action and Alternatives....4-71
4.20 Soils 4-72
4.20.1 Scoping Comments on the Resource 4-72
4.20.2 How Resource Impacts were Evaluated 4-72
4.20.3 Common Impacts Associated with Geothermal Development 4-72
4.20.4 Potential Impacts Associated with Preferred Action and Alternatives....4-73
4.21 Special Designated Areas 4-75
4.21.1 Scoping Comments on the Resource 4-75

TABLE OF CONTENTS *(continued)*

Chapter Page

4.21.2 How Resource Impacts were Evaluated 4-75
4.21.3 Common Impacts Associated with Geothermal Development 4-76
4.21.4 Potential Impacts Associated with Preferred Action and Alternatives....4-78
4.22 Vegetation....4-81
4.22.1 Scoping Comments on the Resource 4-81
4.22.2 How Resource Impacts were Evaluated 4-81
4.22.3 Common Impacts Associated with Geothermal Development 4-83
4.22.4 Potential Impacts Associated with Preferred Action and Alternatives....4-87
4.23 Visual Resource Management and Night Sky 4-89
4.23.1 Scoping Comments on the Resource 4-89
4.23.2 How Resource Impacts were Evaluated 4-89
4.23.3 Common Impacts Associated with Geothermal Development 4-90
4.23.4 Potential Impacts Associated with Preferred Action and Alternatives....4-92
4.24 Water Resources....4-94
4.24.1 Scoping Comments on the Resource 4-94
4.24.2 How Resource Impacts were Evaluated 4-94
4.24.3 Common Impacts Associated with Geothermal Development 4-96
4.24.4 Potential Impacts Associated with Preferred Action and Alternatives.... 4-101
4.25 Cumulative Impacts 4-104
4.25.1 Methodology 4-104
4.25.2 Geographic Extent and Time Frame 4-108
4.25.3 Cumulative Impacts by Resource.... 4-108

5. CONSULTATION, COORDINATION, AND RESPONSES TO COMMENTS.... 5-1

5.1 Consultation....5-1
5.1.1 Native American Tribes 5-2
5.1.2 Colorado State Historic Preservation Officer....5-3
5.1.3 United States Fish and Wildlife Service....5-3
5.1.4 Other Agencies 5-3
5.2 Public Involvement....5-4
5.2.1 Scoping Process....5-4
5.3 Public Review of the RMP Amendment/EA....5-5
5.4 Responses to Comments....5-7

6. LIST OF PREPARERS.... 6-1

7. GLOSSARY AND REFERENCES 7-1

7.1 Glossary 7-1
7.2 References....7-13

FIGURES

Page

1-1 San Luis Valley Field Office....1-3
1-2 Geothermal Potential 1-7
2-1 Geothermal Leasing Allocations 2-41
2-2 Open to Geothermal Leasing Subject to Controlled Surface Use 2-43

FIGURES *(continued)* Page

2-3 Open to Geothermal Leasing Subject to Timing Limitations 2-45
2-4 Open to Geothermal Leasing Subject to No Surface Occupancy 2-47
2-5 Closed to Geothermal Leasing 2-49
2-6 Sage-Grouse Stipulations 2-51
3-1 Historic Trails and Byways 3-9
3-2 Areas of Critical Environmental Concern 3-39
3-3 Colorado Vegetation Classification Project – Habitat Types in the San Luis Valley Field Office 3-45
3-4 National Wetlands Inventory (NWI) 3-49
3-5 Visual Resource Management Classes 3-51
3-6 Location and Extent of the Rio Grande Basin Showing Distribution of Mapped Quaternary Alluvium and Permitted Water Wells 3-54
3-7 Hydrogeologic Units of the San Luis Valley 3-56

TABLES Page

1-1 Land Status within the Planning Area 1-4
1-2 Federal Mineral Estate in the Planning Area 1-4
1-3 Earthquake Magnitude Scale 1-11
2-1 Description of Alternatives A, B, and C 2-17
2-2 NSO, Timing Limitations, and CSU Constraints for Alternatives B and C 2-24
2-3 Impacts Analysis Summary Table 2-33
3-1 USFWS Birds of Conservation Concern for Bird Conservation Region 16 and their Occurrence in the SLVFO 3-14
3-2 Federally Threatened, Endangered, and Proposed Species within the SLVFO 3-16
3-3 Planning Area Population Between 2000 and 2010 3-32
3-4 Planning Area Income/Employment 3-33
3-5 Planning Area Employment Sectors 3-34
3-6 BLM-administered Riparian Zones in San Luis Valley, Colorado 3-48
4-1 Typical Disturbances by Phase of Geothermal Resource Development 4-4
4-2 Activities and Related Pollutants from Geothermal Project Phases 4-6
4-3 Hourly Carbon Dioxide Emissions Rates 4-9
4-4 Special Status Species Habitats 4-35
4-5 Direct Economic Impacts of Geothermal Electricity Generation in Colorado 4-69
4-6 Cumulative Projects 4-105

APPENDICES

A Geothermal Resources, Technology, Leasing, and Development
B Geothermal Leasing Procedures
C Best Management Practices
D Waivers, Exceptions, and Modifications
E Scoping Report
F United States Geological Survey Report
G San Luis Valley Field Office Wilderness Characteristics Inventory: 2012 Update

ACRONYMS AND ABBREVIATIONS

	Full Phrase
ACEC	Area of Critical Environmental Concern
BLM	United States Department of the Interior, Bureau of Land Management
BMP	best management practice
˚C	Celsius
CEQ	Council on Environmental Quality
CDPHE	Colorado Department of Public Health and the Environment
CDWR	Colorado Division of Water Resources
CFR	Code of Federal Regulations
CO	Colorado
CO2	Carbon Dioxide
COA	condition of approval
CPW	Colorado Parks and Wildlife
CSU	controlled surface use
dBA	A-weighted decibel
DNA	Documentation of NEPA Adequacy
DOE	United States Department of Energy
DOI	United States Department of the Interior
EA	environmental assessment
EGS	enhanced geothermal system
EIS	environmental impact statement
EPA	United States Environmental Protection Agency
ERMA	Extensive Recreation Management Area
ESA	Endangered Species Act of 1973
˚F	Fahrenheit
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
GIS	Geographic Information Systems
IM	Instruction Memorandum
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
MW	megawatt
NA	Natural Area
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NOI	Notice of Intent
NRHP	National Register of Historic Places
NSO	no surface occupancy
NWR	National Wildlife Refuge

ACRONYMS AND ABBREVIATIONS *(continued)*

	Full Phrase
ONA	Outstanding Natural Area
PEIS	programmatic environmental impact statement
R&PPA	Recreation & Public Purposes Act
RFDS	reasonably foreseeable development scenario
RMP	resource management plan
ROD	record of decision
SLVFO	San Luis Valley Field Office
SRMA	Special Recreation Management Area
SWA	State Wildlife Area
TL	timing limitations
US	United States
USC	United States Code
USDA	United States Department of Agriculture
USFS	United States Department of Agriculture, United States Forest Service
USFWS	United States Department of the Interior, Fish and Wildlife Service
USGS	United States Geological Survey
VRM	Visual Resource Management
WSA	Wilderness Study Area
WSR	Wild and Scenic River

CHAPTER 1
INTRODUCTION

In 2008, the United States (US) Department of the Interior (DOI), Bureau of Land Management (BLM) recommended, and the Assistant Secretary–Land and Minerals Management approved, the Record of Decision (ROD) associated with the *Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States*. The 2008 Geothermal PEIS and ROD were prepared pursuant to the planning requirements of the Federal Land Policy and Management Act of 1976, as amended (FLPMA), and its implementing regulations at 43 Code of Federal Regulations (CFR) Part 1600, as well as the National Environmental Policy Act of 1969 (NEPA), and its implementing regulations at 40 CFR Parts 1500 through 1508. Decisions in the 2008 Geothermal ROD allocated BLM-administered lands as available for geothermal leasing and development and provided stipulations, best management practices (BMPs), and procedures for geothermal leasing and development. While the 2008 Geothermal ROD amended 14 BLM Resource Management Plans (RMPs) in the State of Colorado, it did not amend the San Luis Valley Field Office (SLVFO) RMP. Therefore, the BLM is considering an amendment to the SLVFO RMP that would incorporate the 2008 Geothermal ROD.

This chapter discusses the purpose and need for the proposed action, the action's objectives, the planning and decision areas, the decisions to be made after analysis, the relationship of the proposed action to existing policies and plans, issues to be addressed based on internal and external scoping, and a brief reasonably foreseeable development scenario (RFDS) for geothermal resources in Colorado.

1.1 PURPOSE AND NEED

The purpose of amending the SLVFO RMP is to better facilitate geothermal leasing decision-making and eventual geothermal development projects in an environmentally responsible way. This proposed action is needed because the SLVFO has geothermal resources that could be made available for development

but lacks planning decisions to support future development consistent with BLM policy as reflected in the December 17, 2008 Geothermal ROD. In addition, the proposal to amend the SLVFO RMP provides the opportunity to consider new information regarding sensitive species that was not available at the time the SLVFO RMP was approved (December 1991). This information will inform BLM decision-making regarding appropriate means of reducing impacts from possible geothermal leasing and development on such species.

Decisions to be made include:

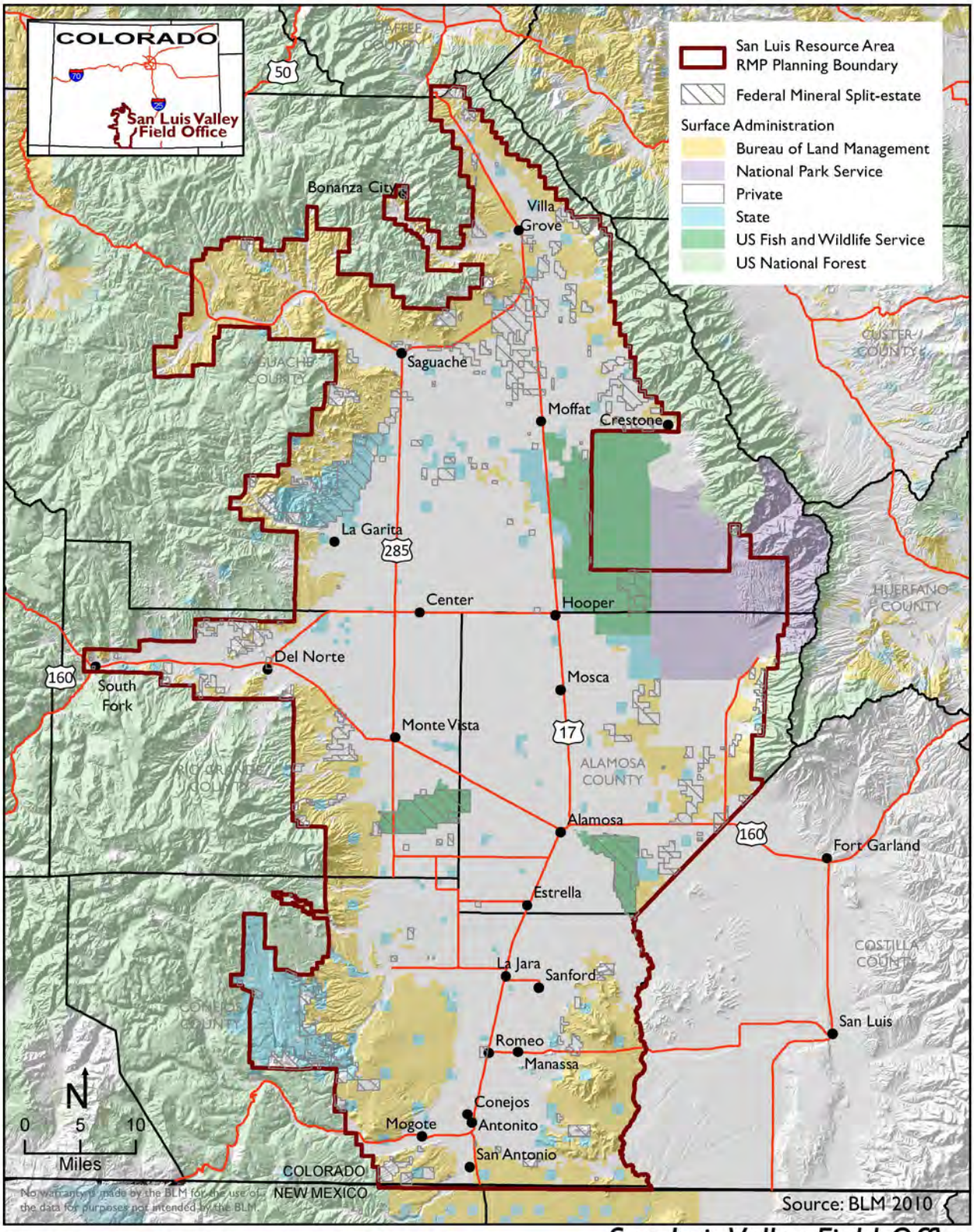
- Allocation of those BLM-administered surface lands and subsurface mineral estate as closed, open with standard stipulations, or open with major or moderate constraints to geothermal leasing;
- Identification of appropriate stipulations and BMPs; and
- Possible exceptions, waivers, and modifications to lease stipulations; terms and conditions; and conditions of approval (COAs).

1.2 DESCRIPTION OF THE PLANNING AREA

***Planning Area*:** BLM, State, Private, and other Federal lands within the San Luis Valley Public Land Center.

***Decision Area*:** Lands and federal minerals in planning area for which BLM has administrative responsibility.

The planning area for the SLVFO Geothermal Leasing RMP Amendment/Environmental Assessment (EA) is bordered on three sides by the Rio Grande National Forest and is within or part of Saguache, Alamosa, Rio Grande, Conejos, and Costilla Counties. Of the total 1,979,900 acres in the planning area, approximately 59 percent is privately owned. The DOI, Fish and Wildlife Service (USFWS) manages approximately four percent; approximately seven percent is administered by various state agencies (i.e., Colorado Parks and Wildlife [CPW], Colorado Land Board Commission, etc.); approximately four percent is managed by other federal agencies; and 25 percent is managed by BLM (**Table 1-1**, Land Status within the Planning Area, and **Figure 1-1**, San Luis Valley Field Office). In addition, the BLM manages an additional 155,000 acres of subsurface federal mineral estate that underlies state, private, and other federal lands (known as split estate). There are also approximately 10,800 acres of BLM-administered surface lands that overlay non-federal mineral estate. In this case, BLM, as the surface landowner, would apply any applicable surface use stipulations on lands proposed for development (**Table 1-2**, Mineral Status in the Planning Area, and **Figure 1-1**).



The decision area for the San Luis Valley Field Office includes only BLM surface estate and split estate within the planning area.

San Luis Valley Field Office

Figure 1-1

Table 1-1
Land Status within the Planning Area

Land Managing Agency	Acres	Percent
BLM	500,200	25
National Park Service	77,200	4
USFWS	74,600	4
CPW	8,000	<1
State of Colorado	138,000	7
Private	1,177,300	59
Total	**1,975,300**	**100**

Source: BLM 2011

Table 1-2
Federal Mineral Estate in the Planning Area[1]

Mineral Status	Acres
BLM surface/federal minerals	500,200
National Park Service surface/federal minerals	0
USFWS surface/federal minerals	29,100
CPW surface/federal minerals	2,600
State of Colorado/federal minerals	23,400
Private surface/federal minerals	95,400
Total	**650,700**
BLM-administered surface lands/non-federal mineral estate	*10,800*

Source: BLM 2011
[1]Federal mineral estate acreages are based on the best available GIS data but do not represent a legal description. Legal descriptions of federal mineral estate are stored in Master Title Plats.

The decision area for the SLVFO RMP Amendment/EA includes all lands under jurisdiction of the San Luis Valley Resource Area at the time the Decision Record is signed. BLM management authority on lands with a split estate is limited to activities (both surface and subsurface) related to exploration and development of the minerals. The BLM considers and may adopt the leasing requirements determined by other surface-managing agencies when leasing the mineral estate under those lands with a split estate. Lands administered by the US Department of Agriculture (USDA), US Forest Service (USFS) are not included as part of the planning or decision area, and are not considered in this EA. The BLM will continue with current policies to not lease geothermal resources underlying USFS-administered lands without the review and consent of the USFS. Therefore, any nominations or applications for geothermal development on USFS lands will require additional environmental and NEPA analysis separate from this process.

1.3 GEOTHERMAL LEASING PROCESS

The BLM has the delegated authority to issue geothermal leases on federal lands. It is the policy of the federal government, consistent with Section 2 of the Mining and Mineral Policy Act of 1970 and Sections 102(a)(7), (8), and (12) of the FLPMA (43 United States Code [USC] 1701 *et seq.*), to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 (30 USC Section 1001, *et seq.*), which was amended and supplemented by the Energy Policy Act of 2005, provides statutory guidance for geothermal leasing by the BLM. New federal geothermal development regulations (43 CFR Parts 3000, 3200, and 3280 – Geothermal Resource Leasing and Geothermal Resources Unit Agreements) were made effective June 1, 2007 (72 Federal Register 24358, May 2, 2007). These statutes and regulations delineate lands that are available and unavailable for leasing. This first step includes allocating BLM-administered lands and federal mineral estate with geothermal potential as closed, open with standard lease terms and conditions, or open with major to moderate constraints to geothermal leasing.

Geothermal Leasing Process

1. Allocate BLM-administered lands and federal mineral estate with geothermal potential as closed, open with standard terms and conditions, or open with major or moderate constraints to geothermal leasing. ***(Considered in this document)***
2. Lands and federal mineral estate open to leasing are made available for leasing through bidding process.
3. For pre-leasing testing, a 2920 permit would allow for temperature-gradient hole drilling or non-production testing. The permit application would be analyzed under NEPA, and appropriate mitigations would be applied as needed. If the testing program revealed commercial potential, then a parcel or parcels could be nominated for leasing.
4. BLM receives lease nominations and conducts site-specific environmental analysis on the proposed parcels.
5. Leases issued for a primary term of 10 years and may be extended for two five-year periods. Lease owner has the right to develop in accordance with lease terms and stipulations.
6. Geothermal resource development stages may follow if the lessee chooses to develop the lease.

The BLM grants access to geothermal resources on BLM-administered lands and federal mineral estate designated as open to leasing through a formalized leasing process based on the end use. For direct uses, an applicant can apply noncompetitively for a lease. For indirect use, such as commercial electrical generation, the BLM awards leases through a competitive bidding process.

When the BLM receives a lease nomination through the bidding process, it is adjudicated, and configured into lease parcels by the respective BLM state office. Lease parcels are then forwarded to the appropriate field office where the appropriate environmental analysis and review is conducted.

The stages of geothermal resource development within a lease are exploration, drilling operations, utilization, and reclamation and abandonment. Each stage requires a permit from the BLM. Leasing of geothermal resources by the BLM vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area, subject to existing laws; regulations; formal orders; and the terms, conditions, and stipulations in or attached to the lease form or included as COAs to permits.

Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site-specific approval for the intended operation. Such approval could include additional environmental reviews and permits. Also at each stage, the BLM can issue site-specific COAs to protect resource values. The specific activities associated with each phase are detailed in **Appendix A**, Geothermal Resources, Technology, Leasing, and Development.

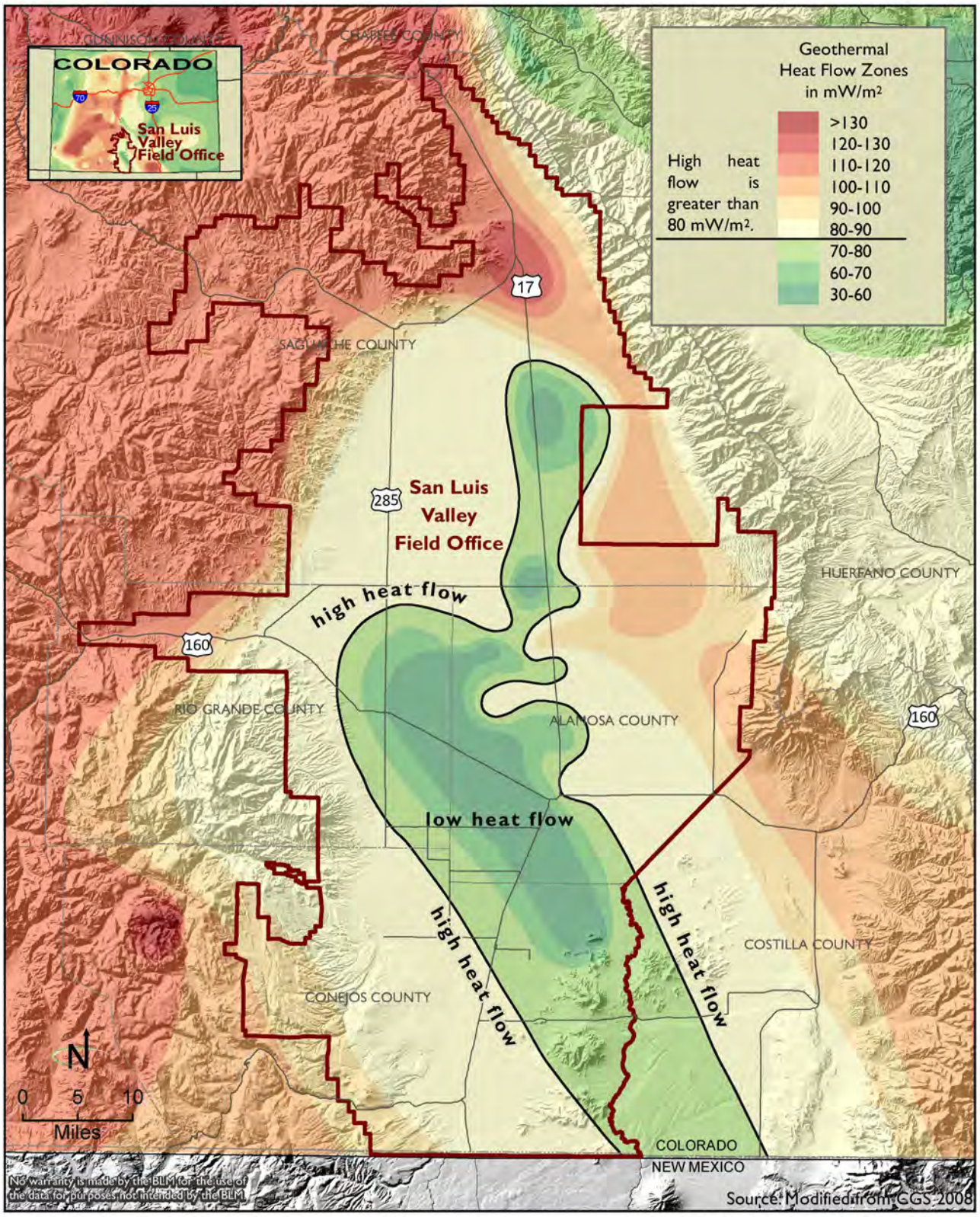
A lease is issued for a primary term of 10 years and may be extended for two five-year periods. Each of these extensions is available provided the lessee meets the work commitment requirements or made payment in lieu of minimum work requirements each year. At any time a lease may receive a five-year drilling extension. Once commercial production is established, the lease may receive a production extension of up to 35 years and a renewal period of up to 55 years. The lease must continue to produce to remain in effect. BLM may grant a suspension of operations and production on a lease when justified by the operator (see 43 CFR 3207).

Geothermal exploration and production on federal land conducted through leases is subject to terms and stipulations to comply with all applicable federal and state laws pertaining to various considerations for tribal interests, sanitation, water quality, wildlife, safety, cultural resources, and reclamation.

1.4 COLORADO GEOTHERMAL POTENTIAL

In order to assess where geothermal development could occur, the BLM, in partnership with the USFS, US Department of Energy (DOE), and US Geological Survey (USGS) conducted a detailed evaluation of the literature and state of the science to create a geothermal potential map for the 2008 Geothermal PEIS. **Figure 1-2**, Geothermal Potential, illustrates the geothermal potential area, focusing on areas where there may be underground reservoirs of hot water or steam created by heat from the earth, or that have subsurface areas of dry hot rock in Colorado. Based on this information, BLM assumed that these were the most likely areas where the BLM would receive geothermal lease nominations and applications (BLM and USFS 2008).

Primary data sources for assessing geothermal potential are scientific literature, government, academic, and industry sources, and consultations with the United States Geological Survey and Colorado Geological Survey. The BLM initially reviewed geothermal potential maps from various sources and then identified the assessments most commonly accepted by government agencies involved in geothermal research and development and the geothermal industry (BLM and USFS 2008).



Geothermal potential is present in areas where there are underground reservoirs of hot water or steam created by heat from the earth, or that have subsurface areas of dry hot rock.

Geothermal Potential

Figure 1-2

The lack of significant volcanic activity in the San Luis Valley in the past 500,000 years and the lack of chemical indicators in the thermal springs of Colorado symptomatic of interaction with volcanic gases and other volcanic products strongly suggest that none of the thermal waters in Colorado are derived from high-temperature (> 350°F) geothermal reservoirs. The data suggest that water is heated by deep circulation to a depth of a mile or two, with maximum temperatures of about 300°F or less. This is the maximum temperature that is indicated by geothermometry at a number of the thermal springs in the state (J. K. Barrett and R. H. Pearl, 1976, An appraisal of Colorado's geothermal resources, CGS, Denver, CO, Bull. 39, 224 pp.; and CGS data submitted to the National Geothermal Data Center, 2012).

1.4.1 Resource Geography

Expert opinion suggests Colorado has a large geothermal resource base, although development in the state has been limited to direct-use applications (BLM and USFS 2008; DOE 2007a). When last inventoried in 1992-1993, Colorado had 59 sites with water temperatures above 95 degrees Fahrenheit (°F) (35 degrees Celsius [°C]) and 34 geothermal wells (Colorado Geological Survey 2007). High-temperature resources exist at greater depth beneath most of the mountainous regions of the state (Cappa and Hemborg 1995; CSWG 2007; DOE 2007a). From preliminary heat flow and geothermal gradient maps, several areas can be identified that have potential for geothermal power generation. These locations include the Mt. Princeton area near Buena Vista, the Waunita Hot Springs area in southeast Gunnison County, the San Luis Basin (especially along its margins), the San Juan Mountains near Ouray and Rico, Pagosa Springs, the Raton Basin west of Trinidad, and possibly an area near Somerset.

In response to comments from the Colorado Geological Survey and the public, the BLM requested the United States Geological Survey to review conflicting interpretations of the geology and hydrogeology for the San Luis Basin comments. In their expert opinion, the USGS noted that the lack of data and differing models used by the commenters highlights the high degree of uncertainty in the area. Numerous models have been proposed to explain the hydrogeology and geothermal systems in areas of the San Luis Valley (such as Joyful Journey Hot Springs and Valley View Hot Springs). Past geothermal and geochemistry studies at hot springs in the Steamboat Springs area indicate geothermal resources at depth may have temperatures above 250°F (121°C). Oil and gas development has also indicated geothermal resource potential in both the Denver and San Juan Basins (CSWG 2007).The USGS findings are presented in **Appendix F**, United States Geological Survey Report.

Utilizing geothermal electric power has not historically been considered competitive, given low energy prices in the state. Thus, further exploration and analysis is needed to characterize known geothermal prospects and determine what would be needed for development. As suggested above, some resources

may require deep drilling, while small power units similar to the plant at Chena Hot Springs in Alaska may be applicable in some locations (Fleischmann 2007). Current plans for development continue to focus on direct-use, particularly for recreation, therapeutic properties, and aquaculture. Several unique aquaculture-related projects are currently in operation, such as alligator farms (Clutter 2001).

1.4.2 Technical Capabilities

Colorado universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Colorado Geological Survey has conducted and published various assessments of the state's geothermal resource base, while the National Renewable Energy Laboratory in Golden, Colorado, is the nation's leading institution for the research and development of renewable energy technologies, including geothermal energy (DOE 2007a). Currently the Colorado Geological Survey is compiling a Colorado-specific geothermal database that will be used to create an updated and more detailed state-wide heat flow map and geothermal gradient map (CSWG 2007).

Data from geographic information systems (GIS) have been used in developing acreage calculations and for generating many of the figures. Most calculations in this EA are rounded to the nearest one hundred acres. Calculations depend on the quality and availability of data. (All calculations are approximate and are for comparison and analytic purposes only. Likewise, the figures are provided for illustrative purposes and are subject to the limitations discussed above. The BLM may receive additional GIS data, so the acreages may be recalculated and revised at a later date.)Electrical Power Generation and Capacity

No geothermal power plants are currently proposed for Colorado, but literature cites a short-term (to 2015) geothermal potential of 20 MW with a long-term (to 2025) potential of 50 MW (WGA 2006a). The USGS report titled Assessment of Moderate- and High-Temperature Geothermal Resources of the United States estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Colorado during the next 30 years at 30 MW, with a total low to high range of 8 MW to 67 MW (USGS 2008). From what is known about the geothermal resources in the San Luis Valley (SLV), individual power plants in the SLV are likely to be smaller than 5 to 10 MW. Future developments in technology are difficult to predict, but currently there are no indications of a single geothermal resource sustaining generation of more than 10 MW (Paul Morgan, Colorado Geological Survey, personal communication 2012).

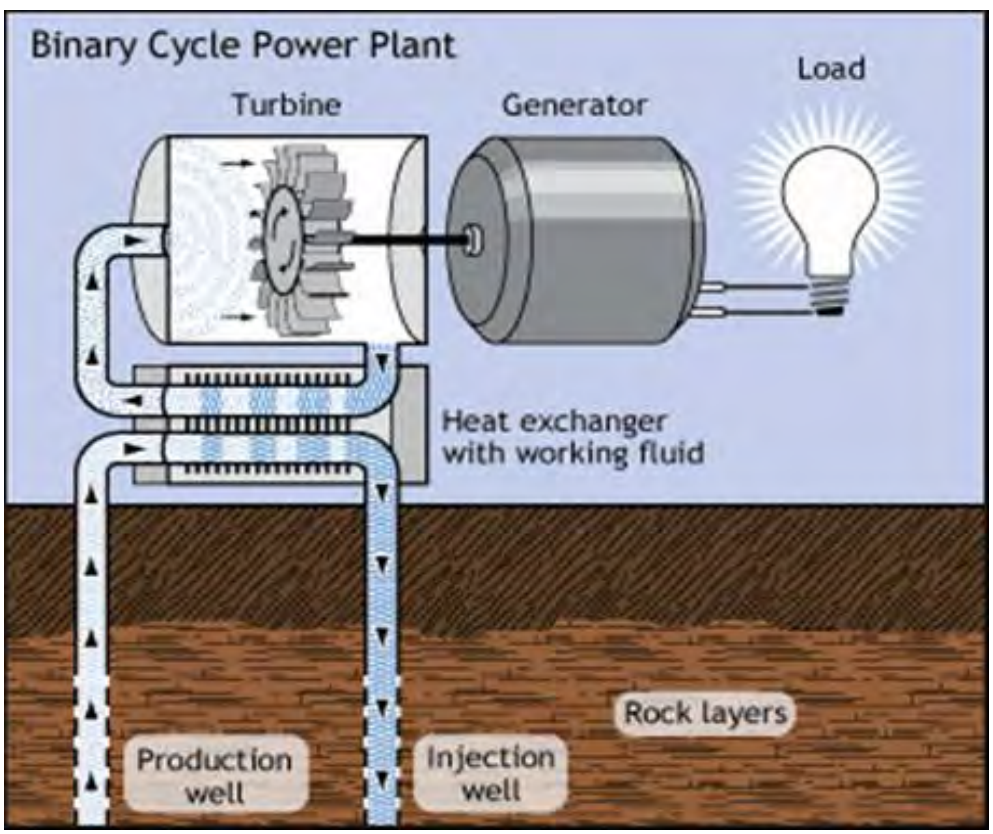
Additionally, geothermal power plants have a small footprint for the amount of actual power they generate over 30 years. They have a high capacity factor (percentage of time they are generating power) and base-load power (generate power 24 hours a day, 365 days a year). A number of different technologies

exist for capturing geothermal energy (described below). Some systems use recyclable water for cooling and are operated completely within closed buildings. Other systems, which are still under development, have minimal equipment aboveground since the turbine and generator are down-hole (Paul Morgan, Colorado Geological Survey, personal communication 2012). Based on the current knowledge, information, and data available for the planning area, a binary-cycle power plant is assumed to be the most likely form of development.

Binary-Cycle Power Plants

Binary-cycle power plants typically use cooler fluids in the range from 165-360°F [74 to 182°C]. The hot fluid from geothermal reservoirs is passed through a heat exchanger, which transfers heat to a separate pipe containing fluids with a much lower boiling point. These fluids, usually iso-butane or iso-pentane, are vaporized to power the turbine (see **Figure 1-3**, Binary-cycle Power Plant). The advantage of binary-cycle power plants is their lower cost and increased efficiency. These plants also do not emit any excess gas and, because they use fluids with a lower boiling point than water, are able to use lower temperature geothermal reservoirs. Most geothermal power plants planned for construction in the US are binary-cycle (DOE 2007a).

Figure 1-3
Binary-Cycle Power Plant



Enhanced Geothermal Systems

The Colorado Geological Survey reports that Colorado displays a number of criteria for geothermal power potential and that Colorado may have some of the best high-temperature resources in the country for extraction via "enhanced geothermal system" (EGS) or "hot dry rock" technology (Colorado Geological Survey 2007). A hot dry-rock resource is deep, hot crystalline rock that can be used to generate geothermal energy by pumping water down to the rock and thus heating it before it returns to the surface (Battocletti 2005). EGS technology is relatively new in the geothermal field and has been found to have great potential for providing electrical power; one study found the potential for 100 gigawatts of power (DOE 2006). Lack of research and development funding, government policies, and lack of incentives have not favored the growth of EGS within the US, and most development has occurred outside of the US (DOE 2006). It is anticipated that there may be applications for research and development drilling on BLM-administered lands and split estate in the future; however, until EGS becomes a technically and economically proven technology, it is unlikely that it will be applied at a large scale in the western US within the next 20 years.

One potential concern with EGS is its potential impact on seismic activity. Seismic data has been collected from five EGS sites located in France, Germany, Switzerland, Australia, and the United Kingdom. The maximum magnitude seismic events at these EGS sites have been in the range of 2.9 to 3.7, with the German location having had no recorded seismic events. Even where seismic events have been observed, it is not certain whether the events over 3.0 were induced from the EGS projects or were of tectonic origin inherent to the area (Bromley and Mongillo 2008). **Table 1-3**, Earthquake Magnitude Scale, shows the relationship between earthquake magnitudes, their effects on people and structures at the surface, and their frequency of occurrence across the planet in any given year.

Table 1-3
Earthquake Magnitude Scale

Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 years

Colorado Water Law Summary

- Colorado water law is based on the Prior Appropriation Doctrine: first in time; first in right.
- The Office of the State Engineer, a division of the Colorado Department of Natural Resources, administers water rights and issues well permits, including those for geothermal resources (Colorado Resources Act, Section 37-90.5-101, CRS)
- Water rights are required for the use of surface water or groundwater that is tributary (hydraulically connected) to a surface water system.
- Water must be put to a beneficial use in order for it to be rightfully appropriated.
- Where a geothermal resource is found in conjunction with groundwater that is tributary, use of the water is considered a beneficial use.
- For the State Engineer to issue a new well permit, adequate water rights must be available and it must be demonstrated that no material injury (e.g. change in quantity, quality, or temperature) to existing water rights will occur. Or, if there will be an injury, the user is able to offset the injury or offer replacement water (Section 37-90.5-107, CRS).

1.4.3 State of Colorado Water Laws and Regulations

As outlined in **Appendix A**, Geothermal Resources, Technology, Leasing, and Development, the State of Colorado has its own definition of and approach to management of geothermal resources. The Colorado Division of Water Resources (CDWR; also known as the Office of the State Engineer) is the lead state agency for promulgating rules and regulations from state statutes for the regulation and administration of geothermal activities on private land, including overseeing the permitting of injection wells on private lands. Before construction of a geothermal resource well, a permit to construct a well must be granted by the State Engineer or by the Colorado Ground Water Commission. The State Engineer has the authority to adopt rules to protect the public health, safety, and welfare and the environment (Section 37-90.5-106, Colorado Revised Statutes) as part of the permitting process. Colorado law also states that the development of geothermal resources should be undertaken in such a manner as to safeguard life, health, property, public welfare, and the environment; to encourage the maximum economic recovery of the resource; and to prevent its waste (Section 37-90.5-103, Colorado Revised Statute).

Geothermal resource is defined in Colorado law as the energy that may be extracted from the natural heat of the earth and the naturally occurring ground water, brines, vapor, and steam associated with the geothermal resource (§ 37-90.5-103, Colorado Revised Statute). Under state law, where a geothermal resource is associated with geothermal fluid that is tributary groundwater, the geothermal resource is a public resource, and the use of water as a material medium for geothermal heat is recognized as a beneficial use of such water. If the geothermal resource is on or under federal land then the State of Colorado only has jurisdiction over the water aspects of the resource, in terms of permitting wells and apportioning any water use (Section 37-90, Colorado Revised Statute). The BLM would be responsible for withdrawal of heat, subject to the observation of State of Colorado geothermal rights on adjacent non-federal lands.

The Colorado Department of Public Health and Environment's Water Quality Control Division administers surface disposal of wastewater, including geothermal fluids (Battocletti 2005). Colorado has established a Geothermal State Working Group and is bringing together state and regional energy professionals to promote the increased use of the state's geothermal resources (DOE 2007a). Colorado has a renewable portfolio standard of 20 percent by

2020 for investor-owned utilities and ten percent for rural co-ops and municipal utilities (Richter 2007). Outside of the renewable portfolio standard, the state offers no incentives for geothermal development, and no funding is available at the state level for development (DOE 2007a). However, at the municipal level, if the municipality has the authority to acquire public utilities, financing may be by way of public bonds, chargeable solely or in part against the income of such utility (CRS 31-32-101; 31-32-201). Presently, Colorado has no greenhouse gas laws or legislation pending, but it does participate in the National Climate Registry (Camp 2007).

As part of the construction permit process, and before geothermal fluid is produced, the State Engineer or, in designated basins, the Colorado Ground Water Commission must evaluate the use of the geothermal resource and the potential to cause material injury to other water rights and geothermal rights holders. "Material injury" in this context means any reduction or alteration in quantity or quality of a valid prior water right, and, in the case of a geothermal right, any reduction in the temperature to an extent that adversely affects a valid prior geothermal right (§ 37-90.5-107, Colorado Revised Statutes; CDWR 2010).

Before it appropriates any water, the CDWR conducts an extensive study to determine whether the new appropriation will have any impact on existing water resources. In the San Luis Valley the interaction among subsurface and surface waters is particularly important, and any new appropriations would include studies of impacts on both subsurface and surface waters. A new appropriation may not be granted that may materially injure a previous water or geothermal right; injury includes "any diminution or alteration in the quantity, temperature, or quality of any valid, prior water or geothermal right; except that, with regard to a geothermal right, 'materially injure' and 'material injury' include a diminution or alteration in the temperature of water only if the diminution or alteration adversely affects the valid, prior geothermal right" (Colorado Revised State Statutes 37-90.5-107 [3] and [8]). The grant of a federal lease for geothermal resources does warrant the right to an appropriation of heat energy (i.e., such heat as the lessee may develop and use) but does not establish, warrant, or guarantee a right to appropriate, under Colorado law, fluids associated with the geothermal resource.

The BLM Colorado State Office and the State of Colorado Department of Natural Resources have developed a memorandum of understanding (MOU) to facilitate the process of leasing, permitting, and administering geothermal resources in the state. The BLM-Colorado Department of Natural Resources MOU sets out a series of common understandings regarding the nature of geothermal resources and ownership under federal and state statutes, provides for consultation between federal and state officials, and includes a standard lease stipulation and notice that will require geothermal lessees and operators to comply with applicable portions of Colorado water appropriations law.

As stated and agreed to in the BLM-Colorado Department of Natural Resources MOU, the State Engineer (for small capacity wells) or the Colorado Ground Water Commission (for large capacity wells) in designated basins administers the appropriative rights of water for development of geothermal resources regardless of whether the lease is private, state, or federal. This means that prior to and during all lease operations, including exploration, drilling operations, and utilization of a geothermal resource, a federal geothermal resource lessee must comply with Colorado appropriations law for the administration of the geothermal fluid as well as other water that may be necessary for operations (e.g., using surface water or groundwater as cooling water during geothermal operations).

For federally permitted geothermal development, the BLM would conduct an environmental analysis (either an EA or an EIS) for any site-specific lease nominations or geothermal project development proposals, as required by NEPA. The EA or EIS would provide a detailed examination of potential impacts on groundwater aquifers and any nearby hot springs or cold springs.

1.5 DECISIONS TO BE MADE

The BLM will determine whether or not to amend the SLVFO RMP to allocate BLM-administered lands and federal mineral estate with geothermal resource potential as closed, open with standard terms and conditions, or open with major or moderate constraints to geothermal leasing. This may include considering and incorporating decisions from the 2008 Geothermal Programmatic ROD. This would include identifying appropriate stipulations; BMPs; procedures to protect other resource values and uses; possible exceptions, waivers, and modifications to lease stipulations, terms, and conditions; and COAs. If the SLVFO RMP is amended, the BLM can make decisions on whether or not to issue geothermal leases. Following this amendment process, it is the intent of the BLM that, upon receipt of future nominations or applications for geothermal leasing, the BLM will conduct a NEPA evaluation to make lease sale decisions without further plan amendments.

This EA provides the necessary analysis to support the amendment of the San Luis Valley Field Office land use plan for the planning level decisions discussed above. This EA will not eliminate the need for site-specific environmental review for future site-specific geothermal leasing and development proposals. The BLM will make individual decisions on a case-by-case basis whether or not to authorize specific geothermal projects in conformance with the amended land use plan on the basis of this EA. When the BLM considers an application, the BLM decision maker must determine if it would conform to the applicable land use plan (43 CFR, 1610.5-3, 516 BM 11.5) and what level or type of environmental documentation is required. Analysis of proposed geothermal leases and/or projects must comply with NEPA, CEQ NEPA regulations (40 CFR, Parts 1500-1508) and the DOI NEPA manual. The public would have opportunities to participate and comment during the NEPA process.

The BLM would retain the discretion to deny geothermal lease nominations and sales based on site-specific issues and concerns, even in areas identified as open for leasing in existing land use plans.

1.6 Relationship to Policies, Plans, and Programs

1.6.1 San Luis Valley Field Office Resource Management Plan

Under the SLVFO RMP, approximately 617,400 acres of the mineral estate within the SLVFO were identified as having potential for geothermal resources; approximately 487,600 acres, or 99.7 percent, of BLM-administered lands or federal mineral estate are open to leasing (BLM 1991). Federal geothermal mineral estate, on both federal and split-estate lands, is open to leasing, except for the following closed areas:

- 320 acres within the town of Del Norte;
- 3,300 acres designated as BLM wilderness; and
- 16,800 acres within BLM Wilderness Study Areas (WSAs).

The following areas are open to leasing with a no surface occupancy (NSO) stipulation:

- 560 acres of eligible National Register of Historic Places (NRHP) sites (5SH1065 La Garita Wagon Ruts, 5SH1063 Poncha Pass Pail-line, 5SH1053 Villa Grove-Orient Railroad Bed, 5CN560 King Turquoise Mine, 5SH1066 Ute Pass Road);
- 40 acres within the town of South Fork;
- 360 acres under Recreation & Public Purposes Act (R&PPA) lease to the City of Monte Vista for a city park; and
- 840 acres within the Pike Stockade Historic Site.

The decisions made in this action may modify or retain some or all of these decisions.

1.6.2 Programmatic Environmental Impact Statement for Geothermal Leasing Exploration and Development

The 2008 Geothermal PEIS was prepared by the BLM and USFS to assess environmental impacts associated with the development and implementation of a geothermal program that would facilitate environmentally responsible utility-scale geothermal energy development in the following Western states: Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming. Additionally, the 2008 Geothermal PEIS allocated BLM lands as open to be considered for geothermal leasing or closed for geothermal leasing, and adopted stipulations and BMPs, and explained the procedures for geothermal leasing and development.

BLM decisions resulting from the 2008 Geothermal PEIS included amendments to 114 BLM land use plans adopting the allocations, stipulations, BMPs, and leasing procedures presented in the 2008 Geothermal ROD on the basis of the analysis in the 2008 Geothermal PEIS that was prepared in light of the RFDS. Specifically, the 2008 Geothermal ROD:

- Identified about 143 million acres of BLM-administered public lands as having geothermal resources with potential for indirect or direct applications;
- Designated about 111 million acres BLM-administered public lands with geothermal potential as open to geothermal leasing subject to existing laws, regulations, formal orders, stipulations attached to the lease form, and the terms and conditions of the standard lease form;
- Adopted a comprehensive list of stipulations and procedures to serve as consistent guidance for future geothermal leasing;
- Provided a list of recommended BMPs that may be applied for subsequent exploration, drilling, development, and reclamation activities (specifically, the BMPs can be incorporated, as appropriate, into the permit application by the lessee or can be included in the approved use authorization by the BLM as COAs); and
- Recognized that prior to making a leasing decision on lands in proximity to a National Park System unit, the BLM or other surface management agency must determine if there would be any impacts on thermal or hydrological features within the unit, in accordance with the Geothermal Steam Act Amendments (30 USC Section 1026).

The 2008 Geothermal PEIS noted that designating lands for geothermal leasing potential and amending a land use plan, in and of itself, does not cause any direct impacts as defined by the Council on Environmental Quality (CEQ) regulations (40 CFR 1508.8(a)). However, it is reasonable to foresee that on-the-ground impacts would occur if the BLM were to issue geothermal leases but that the impacts would not occur until sometime in the future. Therefore, the 2008 Geothermal PEIS addressed both direct and indirect impacts based on the foreseeable on-the-ground actions, including exploration, drilling, and utilization. These impacts were not analyzed site-specifically, but generically and programmatically, for the 2008 Geothermal PEIS planning area based on the RFDS. To inform assessment of the likely impacts from development following leasing in the planning area, the 2008 Geothermal PEIS analyzed the broad impacts associated with allocation of geothermal resources for leasing along with impacts of the adoption of stipulations and BMPs based on the assumptions presented in the RFDS. The 2008 Geothermal PEIS also provided the necessary

Colorado Water Law Summary

- Colorado water law is based on the Prior Appropriation Doctrine: first in time; first in right.
- The Office of the State Engineer, a division of the Colorado Department of Natural Resources, administers water rights and issues well permits, including those for geothermal resources (Colorado Resources Act, Section 37-90.5-101, CRS)
- Water rights are required for the use of surface water or groundwater that is tributary (hydraulically connected) to a surface water system.
- Water must be put to a beneficial use in order for it to be rightfully appropriated.
- Where a geothermal resource is found in conjunction with groundwater that is tributary, use of the water is considered a beneficial use.
- For the State Engineer to issue a new well permit, adequate water rights must be available and it must be demonstrated that no material injury (e.g. change in quantity, quality, or temperature) to existing water rights will occur. Or, if there will be an injury, the user is able to offset the injury or offer replacement water (Section 37-90.5-107, CRS).

information to support the amendment of land use plans covering those lands where leasing may eventually be proposed. Beyond some general and programmatic discussion of the possible effects, the 2008 Geothermal PEIS did not include evaluations for site-specific issues associated with on-the-ground actions of geothermal exploration, drilling, utilization, or reclamation and abandonment.

The decisions made in this action may adopt some or all of the Geothermal Leasing ROD decisions.

1.6.3 State of Colorado Water Laws and Regulations

As outlined in **Appendix A**, Geothermal Resources, Technology, Leasing, and Development, the State of Colorado has its own definition of and approach to management of geothermal resources. The Colorado Division of Water Resources (CDWR; also known as the Office of the State Engineer) is the lead state agency for promulgating rules and regulations from state statutes for the regulation and administration of geothermal activities on private land, including overseeing the permitting of injection wells on private lands. Before construction of a geothermal resource well, a permit to construct a well must be granted by the State Engineer or by the Colorado Ground Water Commission. The State Engineer has the authority to adopt rules to protect the public health, safety, and welfare and the environment (Section 37-90.5-106, Colorado Revised Statutes) as part of the permitting process. Colorado law also states that the development of geothermal resources should be undertaken in such a manner as to safeguard life, health, property, public welfare, and the environment; to encourage the maximum economic recovery of the resource; and to prevent its waste (Section 37-90.5-103, Colorado Revised Statute).

Geothermal resource is defined in Colorado law as the energy that may be extracted from the natural heat of the earth and the naturally occurring ground water, brines, vapor, and steam associated with the geothermal resource (§ 37-90.5-103, Colorado Revised Statute). Under state law, where a geothermal resource is associated with geothermal fluid that is tributary groundwater, the geothermal resource is a public resource, and the use of water as a material medium for geothermal heat is recognized as a beneficial use of such water. If the geothermal resource is on or under federal land then the State of Colorado only has jurisdiction over the water aspects of the resource, in terms of permitting wells and apportioning any water use (Section 37-90, Colorado Revised Statute). The BLM would be responsible for withdrawal of heat, subject

to the observation of State of Colorado geothermal rights on adjacent non-federal lands.

The Colorado Department of Public Health and Environment's Water Quality Control Division administers surface disposal of wastewater, including geothermal fluids (Battocletti 2005). Colorado has established a Geothermal State Working Group and is bringing together state and regional energy professionals to promote the increased use of the state's geothermal resources (DOE 2007a). Colorado has a renewable portfolio standard of 20 percent by 2020 for investor-owned utilities and ten percent for rural co-ops and municipal utilities (Richter 2007). Outside of the renewable portfolio standard, the state offers no incentives for geothermal development, and no funding is available at the state level for development (DOE 2007a). However, at the municipal level, if the municipality has the authority to acquire public utilities, financing may be by way of public bonds, chargeable solely or in part against the income of such utility (CRS 31-32-101; 31-32-201). Presently, Colorado has no greenhouse gas laws or legislation pending, but it does participate in the National Climate Registry (Camp 2007).

As part of the construction permit process, and before geothermal fluid is produced, the State Engineer or, in designated basins, the Colorado Ground Water Commission must evaluate the use of the geothermal resource and the potential to cause material injury to other water rights and geothermal rights holders. "Material injury" in this context means any reduction or alteration in quantity or quality of a valid prior water right, and, in the case of a geothermal right, any reduction in the temperature to an extent that adversely affects a valid prior geothermal right (§ 37-90.5-107, Colorado Revised Statutes; CDWR 2010).

Before it appropriates any water, the CDWR conducts an extensive study to determine whether the new appropriation will have any impact on existing water resources. In the San Luis Valley the interaction among subsurface and surface waters is particularly important, and any new appropriations would include studies of impacts on both subsurface and surface waters. A new appropriation may not be granted that may materially injure a previous water or geothermal right; injury includes "any diminution or alteration in the quantity, temperature, or quality of any valid, prior water or geothermal right; except that, with regard to a geothermal right, 'materially injure' and 'material injury' include a diminution or alteration in the temperature of water only if the diminution or alteration adversely affects the valid, prior geothermal right" (Colorado Revised State Statutes 37-90.5-107 [3] and [8]). The grant of a federal lease for geothermal resources does warrant the right to an appropriation of heat energy (i.e., such heat as the lessee may develop and use) but does not establish, warrant, or guarantee a right to appropriate, under Colorado law, fluids associated with the geothermal resource.

The BLM Colorado State Office and the State of Colorado Department of Natural Resources have developed a memorandum of understanding (MOU) to facilitate the process of leasing, permitting, and administering geothermal resources in the state. The BLM-Colorado Department of Natural Resources MOU sets out a series of common understandings regarding the nature of geothermal resources and ownership under federal and state statutes, provides for consultation between federal and state officials, and includes a standard lease stipulation and notice that will require geothermal lessees and operators to comply with applicable portions of Colorado water appropriations law.

As stated and agreed to in the BLM-Colorado Department of Natural Resources MOU, the State Engineer (for small capacity wells) or the Colorado Ground Water Commission (for large capacity wells) in designated basins administers the appropriative rights of water for development of geothermal resources regardless of whether the lease is private, state, or federal. This means that prior to and during all lease operations, including exploration, drilling operations, and utilization of a geothermal resource, a federal geothermal resource lessee must comply with Colorado appropriations law for the administration of the geothermal fluid as well as other water that may be necessary for operations (e.g., using surface water or groundwater as cooling water during geothermal operations).

For federally permitted geothermal development, the BLM would conduct an environmental analysis (either an EA or an EIS) for any site-specific lease nominations or geothermal project development proposals, as required by NEPA. The EA or EIS would provide a detailed examination of potential impacts on groundwater aquifers and any nearby hot springs or cold springs.

1.7 THE GEOTHERMAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT AND THE SAN LUIS VALLEY FIELD OFFICE RESOURCE MANAGEMENT PLAN AMENDMENT

The 2008 Geothermal PEIS included an in-depth analysis of the potential effects of utility-scale geothermal energy development on public lands. This analysis was designed to identify environmental consequences, pursuant to NEPA, to support the amendment of land use plans; however, in some cases, that analysis may support, at least in part, the making of additional decisions regarding geothermal leasing and development. For instance, in many cases, BLM field offices considering proposed geothermal leases in the areas located within the study area covered by the 2008 Geothermal PEIS analysis will be able to "tier" to the PEIS, using it as part of any environmental impact studies for site-specific projects required under NEPA. Tiering refers to the coverage of general matters in a broader environmental impact statement (EIS), such as the 2008 Geothermal PEIS, with subsequent narrower EISs or EAs, such as this one, incorporating by reference the general discussions and concentrating solely on the issues specific to the EIS or EA subsequently prepared (40 CFR 1508.28). Tiering typically results in a more efficient environmental analysis process for future development proposals. The determination of the necessary level of

additional NEPA analysis is made on a case-by-case basis at the time a project is proposed.

This EA will tier to and incorporate by reference those elements of the 2008 Geothermal PEIS that are appropriate for such use (e.g., resource impact analysis, stipulations, leasing procedures, and BMPs). As the SLVFO presents slightly different issues than those addressed in the 2008 Geothermal PEIS, the analysis for this EA has been refined and may include other, more site-specific protective provisions.

1.8 PUBLIC INVOLVEMENT

1.8.1 Scoping

Public scoping began with solicitation of public input and public scoping meetings in June and July 2010. Public scoping meetings were held on July 7th and 8th in Saguache and Alamosa, Colorado, respectively. These meetings provided an opportunity for members of the public, local government, Native American tribes, and other interest groups to learn about the SLVFO RMP Amendment/EA, to provide input into the development of the SLVFO RMP Amendment/EA, and to voice their concerns related to potential environmental impacts so that they could be addressed in the SLVFO RMP Amendment/EA.

Public comments were accepted starting in June 2010. The formal public scoping comment period, as required by NEPA, began on September 13, 2010, with the publication of the Notice of Intent (NOI) in the Federal Register and continued through October 13, 2010. The scoping report is available in Appendix E.

Planning decision issues have been identified based on internal (within the BLM) and external (public) scoping comments. A planning decision guides future land management actions and subsequent site-specific implementation decisions; in this case, the planning decision is to determine where geothermal leasing will be open or closed on BLM-administered surface lands and federal mineral estate. Issues are points of disagreement, debate, or dispute with the planning decisions; issues point to environmental effects and can help shape the proposal, alternatives, and mitigation measures. The BLM used the planning issues to guide the development of a reasonable range of alternatives for the SLVFO RMP Amendment/EA. Based on the analysis of public scoping comments; the following planning issues were identified:

- What are the water resource impacts that could result from geothermal leasing? What are the BMPs that can be applied to minimize these impacts? (Water resource impacts are discussed in Section 4.8; best management practices for water resources are discussed in Section 4.8.3.)
- How could threatened, endangered, or sensitive species be affected by leasing decisions? What stipulations will be needed in

order to conserve suitable sensitive habitat to ensure and maintain healthy local populations of listed and sensitive plant and animal species? (Special status species impacts and stipulations to address these impacts are discussed in Section 4.15.)

- What impacts on critical big game winter range, wetlands, sage-grouse leks, and other wildlife habitats can be expected as a result of geothermal leasing decisions? What stipulations would be needed to minimize any impacts? (Impacts on habitat for fish and wildlife and stipulations to address these impacts are discussed in Section 4.14.)
- What cultural resource impacts can be anticipated from geothermal leasing, and what stipulations or COAs are needed to prevent impacts on eligible sites? (Impacts on cultural resources and stipulations to address these impacts are discussed in Section 4.21.)
- Will leasing decisions impact areas of Native American concern or sensitivity? (Tribal interests and potential impacts are addressed in Section 4.22.)
- To what extent could geothermal resources and features in and near the lease area(s) be affected if lands are open to leasing? What stipulations should be included in order to lessen impacts on the geothermal resources and features? (Stipulations are addressed in Section 2.2, Alternatives Considered for Detailed Analysis and Table 2-1, and impacts are addressed in Section 4.24)
- What are the cumulative impacts from renewable energy projects in the project area? (Cumulative impacts are addressed in section 4.25.)
- How should other land uses and special designation areas be addressed, and what areas should be automatically closed to geothermal leasing? Specific concerns included, but were not limited to: Colorado State Wildlife Areas (SWAs), state trust lands, Special Recreation Management Areas (SRMAs), Areas of Critical Environmental Concern (ACECs), Wilderness and WSAs, National Historic and National Scenic Trail Corridors, National Landscape Conservation System units, Wild and Scenic Rivers (WSRs), Scenic Byways and Backcountry Byways, National Historic landmarks, Interpretive Sites, Visual Resource Management (VRM) Class 1 or 2 lands. (The relationship of land uses and special designated areas are addressed in Section 4.16 and Section 4.19, respectively.)

The analysis in the SLVFO RMP Amendment/EA focuses on the environmental consequences of future geothermal leasing and development decisions that may be made, consistent with the selection of the proposed action or one of the

alternatives analyzed in the SLVFO RMP Amendment/EA. Development decisions could relate to exploration, drilling, utilization, or reclamation and abandonment. Issues identified included:

- How much demand is there for renewable energy and specifically geothermal energy? How would local economies be affected? (Demand for renewable energy is addressed in Section1.6.2 and geothermal energy is discussed in Section 3.8. Impacts on local economies are discussed in Section 4.23.)
- How would potential development of the leases impact visual resources? Are there ways to mitigate visual impacts? (Impacts to visual resources and mitigation measures are discussed in Section 4.20.)
- How would the SLVFO RMP Amendment/EA address issues related to water quantity and quality change during development, including, but not limited to: aquifer depletion, contamination of ground and surface waters, decrease in temperature at hot springs, and induced seismicity? (Measures to address impacts on water quality, quantity, and other water resource issues are discussed in Section 4.
- How can geothermal development be sited to limit impacts on sensitive resources and use existing infrastructure and transmission lines? (Siting of geothermal development is addressed in impacts under the individual resource topics and impacts from siting on that particular resource.)

1.8.2 Public Comments on the Draft RMP Amendment/EA

The BLM announced a public review and comment period for the EA on March 13, 2012. The BLM distributed the EA to individuals, agencies, and organizations via the BLM's Web site and mailings. Two public meetings were held, one in Saguache and one in Alamosa, in March to provide an opportunity to comment on the EA. These public meetings were structured in an open house format with BLM specialists available to provide information on the EA in general, the alternatives, analysis, specific resources of concern, or on the planning process. The public was also provided information on how to submit comments on the EA. Prior to the end of the comment period, the BLM extended it for two additional weeks to April 24, 2012, then extended it again for an another 30-day period to May 24, 2012.

In total, the BLM received 22 comment letters from individuals, organizations, and agencies. Although each comment letter was diligently considered, the comment analysis process involved determining whether a comment was substantive or nonsubstantive in nature. In performing this analysis, BLM relied on the CEQ's regulations to determine what constituted a substantive comment.

Additional detail on the public comment process, including changes made in response to public comments on the SLVFO RMP Amendment/EA can be found in **Chapter 5**, Consultation, Coordination, and Responses to Comments.

1.8.3 Protest Period and Governor's Consistency Review

As this action is a planning amendment, the BLM will submit the final RMP Amendment EA/FONSI to the Colorado Governor for a 60-day Governor's Consistency Review and announce a 30-day protest period on the planning action.

Pursuant to BLM's planning regulations at 43 CFR 1610.5-2, any person who participated in the planning process for the RMP Amendment/EA and has an interest which is or may be adversely affected by the planning decisions may protest approval of the planning decisions in writing to the BLM Washington Office Division of Decision Support, Planning & NEPA within 30 days from publication of the final RMP Amendment/EA.

Emailed and faxed protests will not be accepted as valid protests unless the protesting party also provides the original letter by either regular or overnight mail postmarked by the close of the protest period. Under these conditions, the BLM will consider the emailed or faxed protest as an advance copy and will afford it full consideration. Detailed protest filing instructions are available on the BLM's national website at: http://www.blm.gov/wo/st/en/prog/planning/planning_overview/protest_resolution/filinginstructions.html.

The regulations specify the required elements of your protest, and protesting parties should take care to document all relevant facts. Valid protest issues are limited to allegations that finalizing the RMP amendment would violate an applicable statute, regulation, or BLM policy. Comments include concerns that have not been raised previously in the planning process, concerns that are not germane to the planning process, and/or statements that merely reflect disagreement, express opinions, or make demands or allegations without the support of a concise statement on why the State Director's decision is in error. Although they will be identified during the protest resolution process, comments will not result in any changes to the plan, nor will they be further analyzed as part of the protest resolution process. See BLM's website for additional information: http://www.blm.gov/wo/st/en/prog/planning/planning_overview/protest_resolution.html.

The BLM Director will make every attempt to promptly render a decision on each protest. The decision will be in writing and will be sent to the protesting party by certified mail, return receipt requested. The decision of the BLM Director shall be the final decision of the Department of the Interior. Responses to protest issues will be complied and formalized in a Director's Protest Decision Report made available following issuance of the decisions.

In addition to a 30-day protest period, the BLM must also provide a 60-day review period to the Governor's Office to ensure consistency with state and local plans, policies, and programs. Any responses from the Governor on consistency must be resolved before the BLM issues the Decision Record.

If the Governor does not respond by the end of the review period, the BLM will assume that the proposed land use plan amendment decisions are consistent with state policies and plans (43 CFR 1610.3-2(e)). If the Governor recommends changes in the proposed plan amendment that were not raised during the public participation process, the State Director shall provide the public with an opportunity to comment on the recommendations (43 CFR 1610.3-2(e)). This public comment opportunity will be offered for 30 days and may coincide with the 30-day comment period for the notice of significant change (see Section III(A)(13) below). If the State Director does not accept the Governor's recommendations, the Governor has 30 days to appeal in writing to the BLM Director (43 CFR 1610.3-2(e)).

Upon resolution of all land use plan protests and the Governor's consistency review, the BLM will issue the FONSI/Decision Record. The approved RMP Amendment and Decision Record will be available electronically on the BLM's website or by mail upon request.

CHAPTER 2
ALTERNATIVES

This chapter describes in detail the Alternatives A through C considered in the SLVFO RMP Amendment/EA and provides maps to illustrate where actions are applicable. The alternatives only address geothermal mineral leasing allocations and are directed towards meeting the purpose and need for the amendment and responding to identified issues and concerns. Each alternative is a complete RMP amendment for geothermal leasing allocation decisions with associated stipulations and waivers, exceptions, and modifications.

In the SLVFO, BLM-administered federal mineral estate totals approximately 644,400 acres. The federal mineral estate acres are greater than BLM surface acres as BLM manages federal mineral estate underlying some split-estate lands. Stipulations apply to all areas of federal mineral ownership, including federal minerals underlying privately owned or state-owned lands. Acreages in Chapter 2 reflect federal mineral estate overlain by BLM, private, and other federal and state-owned land. Acreages for stipulations are calculated based on current information and may be adjusted in the future through plan maintenance as conditions warrant.

2.1 ALTERNATIVES DEVELOPMENT

The NEPA requires the BLM to develop a reasonable range of alternatives that must be rigorously explored and objectively evaluated and to identify those other alternatives which are eliminated from detailed study. If a large number of possible reasonable alternatives exist, only a reasonable number covering the full spectrum of alternatives must be analyzed and compared in the analysis (see Questions 1a and 1b, CEQ, *Forty Most Asked Questions Concerning CEQ's NEPA Regulations*, March 16, 1981). The goal of developing alternatives is to prepare different possible management scenarios that:

- Meet the purpose and need;
- Address the identified issues; and

- Resolve conflicts among resources and resource uses.

Achievement of this goal helps the BLM and the public understand the various ways of addressing conflicts concerning alternative uses of the geothermal resource and provides the BLM decision maker a reasonable range of alternatives with which to make an informed decision. The components of the alternatives are discussed below.

2.1.1 Developing Alternatives for the San Luis Valley Field Office Resource Management Plan Amendment

The SLVFO conducted internal and external scoping, developed planning criteria, identified issues, and reviewed and analyzed current management direction and resource data in order to develop the range of alternatives. Issue identification and current management assessment began with an extensive review of current geothermal management decisions and direction from the SLVFO RMP (BLM 1991) and the 2008 Geothermal Leasing PEIS (BLM and USFS 2008). From this, the BLM identified preliminary planning issues that could be addressed in the geothermal RMP amendment. Planning issues express concerns, conflicts, and problems with the existing and potential allowable land and resource uses, levels of resource use, and related management practices. Frequently, issues are based on how land uses affect resources, or how the protection of resources affects land uses.

Preliminary planning issues were included in the NOI at the start of the public scoping process along with a request for the public to identify additional issues. Based on scoping and public participation efforts, the SLVFO identified 13 planning issues, which are detailed in **Section 1.9**, Issues.

2.2 ALTERNATIVES CONSIDERED FOR DETAILED ANALYSIS

Following the close of the public scoping period in October 2010, the BLM began developing alternatives. The BLM also coordinated with partnering agencies (see **Section 5.1.4**, Other Agencies) beginning in December 2010; this coordination has continued throughout the planning process.

Based on the public input, the interdisciplinary team's analysis of the current management situation and resource data, and the defined purpose and need for the project, the BLM developed three alternatives: the No Action alternative (Alternative A) and two action alternatives (Alternatives B and C). Each action alternative stands alone as a potential RMP amendment and provides geothermal leasing allocation decisions; possible stipulations; and waivers, exceptions, and modifications. All of the alternatives denote areas that are open and closed to geothermal leasing; differences between alternatives are expressed by varying the amount of closed or open lands and the degree of stipulation constraints applied to the open areas. Specifically, the alternatives identify:

- Areas open to leasing, subject to existing laws, regulations, and formal orders and standard lease terms and conditions;

- Areas open to leasing, subject to moderate constraints such as seasonal timing limitations (TLs) and/or controlled surface use (CSU) stipulations. These are areas where it has been determined that moderately restrictive lease stipulations may be required to mitigate impacts on other land uses or resource values;
- Areas open to leasing subject to major constraints, such as NSO, on an area more than 40 acres in size or more than 0.25 mile in width. These are areas where it has been determined that highly restrictive lease stipulations are required to mitigate impacts on other lands or resource values;
- Areas closed to leasing. These are areas where it has been determined that other land uses or resource values cannot be adequately protected with even the most restrictive lease stipulations; appropriate protection can be ensured only by closing the lands to leasing. The closed areas are also identified for either discretionary or nondiscretionary reasons.

Alternatives B and C incorporate the decisions from the 2008 Geothermal ROD as well as additional stipulations and constraints in response to issues and concerns identified during public and internal scoping. Some of these additional stipulations/constraints are applied as additional protections for resource areas already identified for at least some protection; other stipulations/constraints are applied to identify areas for which a higher level of protection beyond the standard stipulations is appropriate. Additionally, both action alternatives have been designed to respond to the identified planning issues differently, providing a range of possible allocation decisions that the BLM could implement.

2.2.1 Alternative A (No Action Alternative)

NEPA regulations require an agency conducting an environmental impact assessment to "include the alternative of no action" (40 CFR Part 1502.14). The "No Action" alternative means continuing with the present course of management based on the existing SLVFO RMP (BLM 1991) and other existing policies; it would not amend the SLVFO RMP with the decisions in the 2008 Geothermal ROD. Goals and objectives for BLM geothermal leasing would be based on the existing SLVFO RMP, RMP amendments, and activity, or implementation-level plans. Direction contained in laws, regulations, and BLM policies superseding provisions of the existing RMP and amendments would be implemented.

Based on the current SLVFO RMP, Alternative A allocates the following to the federal mineral estate in the planning area:

Geothermal Leasing Allocation	Acreage
Open with standard lease terms and conditions	106,500
Open with Controlled Surface Use	0
Open with Timing Limitations	528,700
Open with No Surface Occupancy	26,800
Closed to leasing	17,100

Illustrations of these allocations are shown in **Figure 2-1**, Leasing Allocations; **Figure 2-2**, Open to Geothermal Leasing Subject to Controlled Surface Use; **Figure 2-3**, Open to Geothermal Leasing Subject to Timing Limitations; **Figure 2-4**, Open to Geothermal Leasing Subject to No Surface Occupancy; **Figure 2-5**, Closed to Lease; and **Figure 2-6**, Sage-Grouse Stipulations; at the end of this chapter. This alternative neither meets the purpose and need nor addresses the planning issues.

2.2.2 Decisions Common to Both Action Alternatives (B and C)

Alternatives B and C use the decisions from the 2008 Geothermal Leasing ROD as their baseline for geothermal leasing decisions, then add additional site specific stipulations to supplement decisions made in the PEIS and tailor the decisions to the identified planning and resource issues and objectives. Detailed below are the lands available and unavailable for geothermal leasing, geothermal program policies, management procedures, BMPs, and applicable stipulations that would apply for all alternatives.

Identified Lands Available for Geothermal Leasing

The geothermal leasing regulations (43 CFR 3201, Available Lands) describe the types of lands available and unavailable for geothermal leasing. The BLM may issue geothermal leases on all BLM-administered lands and subsurface mineral estate (split estate) that are allocated as open in the land use planning process. Exceptions to this are identified as lands closed to geothermal leasing; this denotes an area that is not available for geothermal leasing, exploration, or development for nondiscretionary or discretionary reasons. The 2008 Geothermal Program Record of Decision (ROD) identified certain classifications of lands as closed to geothermal leasing based on non-discretionary or discretionary basis. Non-discretionary closures include lands that are excluded based on existing laws, regulations (43 CFR 3201.11), and Executive Orders (see Geothermal Program ROD, Section 2.2.1, Closed Lands, p. 2-2 and 2-3). For the SLVFO, under both action alternatives, non-discretionary closed lands include:

- Black Canyon, Papa Keel, and San Luis Hills WSAs; and
- All National Wildlife Refuges

Additionally, the BLM has the administrative authority to issue discretionary closures to protect special resource values. The following areas are proposed BLM discretionary closures for geothermal leasing within the SLVFO in both action alternatives:

- ACECs where the BLM determines that geothermal leasing and development would be incompatible with the purposes for which the ACEC was designated, or those whose management plans expressly preclude new leasing or development for oil and gas or geothermal resources:
  - Blanca ACEC and SRMA[1]
- National Landscape Conservation System lands, e.g., National Historic and Scenic Trails:
  - Rio Grande Natural Area
  - Old Spanish National Historic Trail
- National Landmarks and Research Natural Areas:
  - Pike's Stockade National Historic Landmark
- Areas previously closed to fluid minerals development in the 1991 SLVFO RMP:
  - 320 acres within the incorporated town of Del Norte, Colorado
- Other areas with discretionary closure to protect resource values:
  - McIntire/Simpson wetland and homestead area

Management Procedures for Geothermal Leasing

To ensure compliance with regulations and federal laws, the procedures detailed in **Appendix B**, Geothermal Leasing Procedures, would be implemented prior to any lands being included in a competitive lease sale. Stipulations would also be used to help achieve resource protection in accordance with laws and regulations and the SLVFO RMP.

Best Management Practices for Geothermal Leasing

The recommended BMPs detailed in **Appendix C**, Best Management Practices, would be incorporated as appropriate into the permit application by the lessee or would be included in the approved use authorization by the BLM as COAs. When implementing the BMPs, SLVFO would work with an affected lessee early in the process to explain how BMPs may fit into their development proposals and how BMPs can be implemented with the least economic impact on the lessee. The SLVFO would discuss potential resource impacts with the lessee and

[1] If BLM were to decide to expand the ACEC boundary, any closure made as part of the Decision Record for this Geothermal Leasing EA would apply to the expanded Blanca ACEC, resulting in a further reduction to the amount of acreage available for geothermal development.

seek the operator's recommended solutions. The SLVFO would also encourage the lessee to incorporate necessary and effective BMPs into the lessee's project proposal as determined to be appropriate during site-specific project level environmental analysis. BMPs not incorporated into the permit application by the lessee may be considered and evaluated through the environmental review process and incorporated into the use authorization as COAs or rights-of-way stipulations.

Lease Stipulations

Geothermal leasing stipulations are applied to leases prior to the lease being issued and apply to any subsequent applications for activities on those leases. As not every stipulation from the 2008 Geothermal PEIS is applicable to the SLVFO planning area (e.g., stipulations related to Alaskan resources), only those stipulations that could be applied are included below. The individual stipulations would be applied as appropriate by the BLM authorized officer to any new leases for lands that would be made available for geothermal leasing, to leases that are reissued, or on BLM-administered surface lands that overlay non-federal mineral estate. Where the SLVFO determines that particular stipulations may be inappropriate, the procedures for waivers, exceptions, and modifications would be followed as discussed in **Appendix D**, Waivers, Exceptions, and Modifications.

The following stipulations serve as the minimal level of protection. The authorized officer retains the discretion to issue stipulations in order to mitigate the impacts on other land uses or resource objectives as defined in SLVFO RMP or other authorities. One such additional authority applicable in Colorado is the BLM-Colorado Department of Natural Resources MOU designed to assist geothermal energy development on state and federal lands and mineral holdings (BLM and Colorado Department of Natural Resources 2011) and discussed in Section 1.4.5. When offering a federal geothermal lease, the BLM will include the following two stipulations in the Sale Notice:

- Any future lessee is required to comply with Colorado law. A similar notice will be applied to a State Land Board geothermal lease requiring the lessee to comply with BLM rights-of-way rules and regulations where BLM administers the surface estate;
- The lessee is on notice that the BLM may require the lessee to conduct monitoring to ensure lessee activities do not cause material injury to senior water or geothermal rights.

No Surface Occupancy Lease Stipulations

NSO stipulations are considered a major constraint, as they do not allow for surface development. A NSO may be appropriate when the standard terms and conditions, other less restrictive lease stipulations, and BMPs for permit approval are determined to be insufficient to achieve the resource protection objectives. The following areas should be considered for NSO:

- Designated or proposed critical habitat for listed or proposed species under the ESA (as amended) if surface occupancy would adversely modify the habitat. For listed or proposed species without designated habitat, NSO would be implemented to the extent necessary to avoid jeopardy.
- Areas within the boundary of properties designated or eligible for the NRHP, including National Landmarks and National Register Districts and Sites, and additional lands outside the designated boundaries to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility.
- Areas with important cultural and archaeological resources, such as Traditional Cultural Properties and Native American sacred sites, as identified through consultation.
- Water bodies, riparian areas, wetlands, playas, and 100-year floodplains.
- Developed recreational facilities, special-use permit recreation sites, and areas with significant recreational use with which geothermal development is deemed incompatible, excluding direct use applications.
- Designated important viewsheds, including public lands designated as VRM Class I.
- Slopes in excess of 40 percent and soils with high erosion potential.

Timing Limitations and Controlled Surface Use Lease Stipulations

Where standard lease terms and permit-level decisions are deemed insufficient to protect sensitive resources, but where an NSO is deemed overly restrictive, the BLM could apply seasonal or timing limitation (TL) stipulations or controlled surface use (CSU) stipulations to leases.

The CSU stipulations allow the BLM to require that any future activity or development be modified or relocated from the proposed location if necessary to achieve resource protection. The project applicant would be required to submit a plan to meet the resource management objectives through special design, construction, operation, mitigation, or reclamation measures, and/or relocation. Unless the plan is approved, the lease would proceed with the NSO stipulation. The CSU stipulations noted below would be applied by the authorizing officer as appropriate for the specific area and site conditions.

- Protection of Riparian and Wetland Habitat. This stipulation would be applied within 500 feet of riparian or wetland vegetation to protect the values and functions of these areas. Measures required will be based on the nature, extent, and value of the area potentially affected.

- Protection of Visual Resources. This stipulation would be applied to BLM VRM Class II areas (VRM Class III management objectives would be met through COAs applied during the permit approval process, and may be referenced in a lease notice) and other sensitive viewsheds such as within the visual settings of the Great Sand Dunes National Park or National Scenic and Historic Trails or near residential areas.
- Protection of Recreational Areas. This stipulation would be applied to minimize the potential for adverse impacts on recreational values, both motorized and non-motorized, and the natural settings associated with the recreational activity.
- Compatibility with Urban Interface. This stipulation would be applied to minimize the potential for adverse impacts on residential areas, schools, or other adjacent urban land uses.
- Protection of Erosive Soils and Soils on Slopes Greater than 30 Percent. This stipulation would be applied to minimize the potential for adverse impacts on erosive soils as defined as severe or very severe erosion classes based on Natural Resources Conservation Service mapping.
- Protection of Important Habitat and Migration Corridors. This stipulation would be applied to protect the continuity of migration corridors and important habitat.

TL stipulations would be applied by the authorizing officer as appropriate for the specific lease areas. The BLM has consulted with the USFWS and CPW in establishing the periods and extent of area for TLs. **Table 2-2**, Timing Limitations for Alternatives B and C, lists wildlife timing limitations that apply to both Alternatives B and C.

Other Lease Stipulations

Protection of Geothermal Features. Under the following situations, the BLM would apply stipulations to protect the integrity of geothermal resource features, such as springs and geysers. If it is determined that geothermal operations are reasonably likely to result in a significant adverse effect on such a feature, then BLM would decline to issue the lease.

- The BLM would include stipulations to protect any significant thermal features of a National Park System unit that could be adversely affected by geothermal development. These stipulations will be added, if necessary, when the lease or permit is issued, extended, renewed, or modified (43 CFR 3201.10(b)).
- Any leases that contain thermal features (e.g., springs or surface expressions) would have a stipulation requiring monitoring of the

> thermal features during any exploration, development, and production of the lease to ensure that there are no impacts on DWR permitted water quality or quantity or BLM permitted temperature change.

Endangered Species Act Stipulation. In accordance with BLM IM No. 2002-174, the BLM will apply the following stipulation on any leases where threatened, endangered, or other special status species or critical habitat is known or strongly suspected. Additionally, the BLM will provide a separate notification through a lease notice to prospective lessees identifying the particular special status species that are present on the lease parcel offered. As stated in the IM:

> The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the ESA, as amended, 16 USC 1531 et seq., including completion of any required procedure for conference or consultation.

Sensitive Species Stipulation. For agency-designated sensitive species (e.g., Gunnison sage-grouse), a lease stipulation (NSO, CSU, or TL) would be imposed for those portions of high value/key/crucial species habitat where other existing measures are inadequate to meet agency management objectives.

Cultural Resources Stipulation. In accordance with BLM IM No. 2005-003, the BLM will apply the following stipulation to protect cultural resources:

> This lease may be found to contain historic properties and/or resources protected under the NHPA, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders. The BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated.

Coordination with County Highway Department. Proponents will coordinate transportation planning with the appropriate highway department(s) during planning for projects.

Waivers, Exceptions, and Modifications

Appendix D outlines the procedures, criteria, and guidelines when considering any changes to lease stipulations under 43 CFR 3101.1-4. All of the guidance presented in **Appendix D** would be applied across all action alternatives and incorporated into the SLVFO RMP for future application, as necessary.

2.2.3 Alternative B (Proposed action)

Alternative B, BLM's Proposed action, incorporates all of the 2008 Geothermal Leasing ROD program procedures, BMPs, and stipulations and tailors them to critical identified resource issues and locations. It meets the SLVFO RMP Amendment/EA objective to facilitate orderly, economic, and environmentally sound exploration and development of geothermal resources, using the best available technology. Alternative B allocates the following to the federal mineral estate in the planning area:

Geothermal Leasing Allocation	Acreage
Open with standard lease terms and conditions	188,100
Open with Controlled Surface Use[2]	244,000
Open with Timing Limitations[3]	238,900
Open with No Surface Occupancy	67,300
Closed to leasing	63,700

Specifically, this alternative:

- Closes:
  - Old Spanish National Historic Trail corridor
  - Pike's Stockade National Historic Landmark
  - All WSAs
  - All National Wildlife Refuges
  - Rio Grande Natural Area (NA)
  - 320 acres within the incorporated town of Del Norte, Colorado
  - Blanca ACEC and SRMA[4]

[2] This number only includes SRMAs. Additional CSU stipulations would be applied as needed based on a specific lease nomination's or geothermal development's NEPA analysis.

[3] Acreage amounts for TLs, CSUs, and NSOs are not mutually exclusive and not intended to add up to the total of mineral estate acreage; instead, the acreage amounts indicate that there is overlap in the areas that cover both stipulations.

– McIntire–Simpson wetland complex and homestead

- Applies NSO to:

– 40 acres within unincorporated town of South Fork, Colorado[5]

– 360 acres within park site under R&PPA lease to the city of Monte Vista, Colorado[6]

– 840 acres within the Pike Stockade State Historic Park[7]

– 5 NRHP sites (5SH1065 La Garita Wagon Ruts, 5SH1063 Poncha Pass Pail-line, 5SH1053 Villa Grove-Orient Railroad Bed, 5CN560 King Turquoise Mine, 5SH1066 Ute Pass Road)

– All SWAs

– Gunnison sage-grouse leks and occupied habitat

- Applies TLs for the following specific species (see **Table 2-2**, Timing Limitations for Alternatives B and C):

- Bighorn Sheep

- Ungulates (Mule Deer, Elk, Moose, and Pronghorn Antelope)

- Black Footed Ferret

[4] Blanca ACEC acreage is calculated at current size. If the ACEC boundary were later to be expanded, any closure made as part of the Decision Record for this Geothermal Leasing EA would apply to the expanded Blanca ACEC, resulting in a further reduction to the amount of acreage available for geothermal development.

[5] This area of federal minerals lies under a privately owned subdivision that is completely developed. There is likely not enough room to do exploration or production with proper setbacks for public safety and convenience. The tract is surrounded by private surface and private minerals, which would likely allow access by directional drilling. If an RMP waiver is applied, the lands will be open with CSU or TL or open with standard stipulations.

[6] A total of 360 acres are under an R&PP lease to the City of Monte Vista for a city park for the purpose of protecting the scenic and recreational value as well as the physical improvements of the Monte Vista Park. This is reflected in the SLVFO RMP (decision LUA I-2). An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts on the scenic, recreational, and physical improvement values. This stipulation may be waived by the Authorized Officer only upon a determination that the Monte Vista Park is no longer utilized for recreational purposes. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. If NSO is waived, the lands may be open with CSU or TL or open with standard stipulations.

[7] The Pike Stockade Historic Site (surface) is now owned by the Colorado Historical Society. The BLM owns the sub-surface right but the SLVFO RMP of 1991 applied an NSO stipulation to 840 acres within the Pike Stockade State Historic site for the purpose of protecting the historic, scenic and recreational values as well as the physical improvements of the Pike Stockade Historic Site. This is reflected in the SLVFO RMP (decision LUA I-2). The surface rights of these lands were patented to the State of Colorado through the R&PP Act in 1949 with minerals reserved to the US. An exception to this stipulation may be approved if it can be demonstrated to the satisfaction of the Authorized Officer that operations can be conducted without causing unacceptable impacts on the historic, scenic, recreational and physical improvement values. This stipulation may be waived by the Authorized Officer only upon a determination that Pike Stockade Historic Site no longer exists. If RMP waiver is applied, the lands will be open with CSU or TL or open with standard stipulations. If the state fails to use the area as a park for five consecutive years or uses the lands for another purpose, the lands will revert back to the US.

- Gunnison's Prairie Dogs
- Gunnison Sage-grouse
- Raptors and Owls (Bald and Golden Eagles, Ferruginous and Swainson's Hawks, Northern Goshawk, Osprey, Peregrine and Prairie Falcons, and Mexican Spotted and Burrowing Owls)
- Southwestern Willow Flycatcher
- Piping Plover
- Least Tern
- Waterfowl
- Cutthroat Trout

- Applies CSU stipulations as needed based on the specific undertaking's NEPA analysis and to SWAs (except Russell Lakes SWA and Hot Creek SWA) and SRMAs.
- Applies the standard stipulations to all leases.

See **Figures 2-1** through **2-6** at the end of this chapter for illustrations of these allocations. This alternative meets the purpose and need, addresses the planning issues and objectives, and resolves conflicts between resources and geothermal leasing.

The BLM has identified Alternative B as the agency's proposed action because it best meets the following criteria:

- Satisfies statutory requirements (true for all alternatives).
- Reflects what the BLM believes to be the best combination of actions to achieve the stated goals.
- Represents the best solution for the purpose and need as described in Chapter 1.
- Provides the best approach to address the key resource and planning issues.
- Provides resource protection and a viable footprint for geothermal leasing.
- Includes input from cooperating agencies, collaborating partners, stakeholders, the public, and BLM specialists.

The proposed action is the BLM's preliminary preference and does not represent a final BLM decision. The proposed action could change based on public comments on the draft document; new information; or changes in laws, regulations, or BLM policies. The BLM invites comment on the choice of proposed action.

2.2.4 Alternative C

Alternative C incorporates all of the 2008 Geothermal Leasing ROD program procedures, BMPs, and stipulation language, then tailors them further to conserve more areas or resources; it meets the SLVFO RMP Amendment/EA objectives to provide for special management to protect and enhance wildlife values, significant natural values, cultural resources values, recreational experiences, and special status plant values in the planning area. Alternative C allocates the following to the federal mineral estate in the planning area:

Geothermal Leasing Allocation	Acreage
Open with standard lease terms and conditions	130,100
Open with Controlled Surface Use	99,500
Open with Timing Limitations	165,600
Open with No Surface Occupancy	186,200
Closed to leasing	179,700

Specifically, this alternative:

Closes:

- Old Spanish National Historic Trail corridor
  - Pike's Historic Trail
  - Pike's Stockade National Historic Landmark
  - All WSAs
  - All National Wildlife Refuges
  - All ACECs
  - Rio Grande NA
  - 320 acres within the incorporated town of Del Norte, Colorado
  - Small parcel of BLM land adjacent to Great Sand Dunes National Park
  - McIntire–Simpson wetland complex and homestead
  - All SWAs

Applies NSO to:

- 40 acres within unincorporated town of South Fork, Colorado
- 360 acres within park site under R&PPA lease to the city of Monte Vista, Colorado
- Split estate lands adjacent to McIntire–Simpson wetland complex and homestead

– All split estate surrounding the Blanca ACEC and SRMA within the boundaries of:

  - County Road 6 to the South
  - State Highway 150 to the West
  - State Highway 60 to the North
  - State Highway 17 to the East

– Federal mineral estate within 0.5 mile buffer surrounding the Orient Land Trust lands (Valley View Hot Springs) and Joyful Journey Hot Springs lands.

– All SRMAs

– West Branch Old Spanish Trail corridor

– 5 NRHP sites (5SH1065 La Garita Wagon Ruts, 5SH1063 Poncha Pass Rail-line, 5SH1053 Villa Grove-Orient Railroad Bed, 5CN560 King Turquoise Mine, 5SH1066 Ute Pass Road)

– 840 acres within the Pike Stockade State Historic Park

- Applies TLs for the following specific species (see **Table 2-2**, NSO, Timing Limitations, and CSU Constraints for Alternatives B and C):

- Bighorn Sheep

- Ungulates (Mule Deer, Elk, Moose, and Pronghorn Antelope)

- Black Footed Ferret

- Gunnison's Prairie Dogs

- Gunnison sage-grouse leks and occupied habitat

- Raptors and Owls (Bald and Golden Eagles, Ferruginous and Swainson's Hawks, Northern Goshawk, Osprey, Peregrine and Prairie Falcons, and Mexican Spotted and Burrowing Owls)

- Southwestern Willow Flycatcher

- Piping Plover

- Least Tern

- Waterfowl

- Cutthroat Trout

- Applies CSU stipulations as needed based on NEPA analysis. Additionally, the following areas would have CSU:

- Los Caminos Antiguos National Scenic and Historic Byway corridor

– Other Scenic Byway & Backcountry Byway corridors

- Applies the standard stipulations to all leases.

See **Figures 2-1** through **2-6** for illustrations of these allocations. Similar to Alternative B, this alternative meets the purpose and need, addresses the planning issues and objectives, and resolves conflicts between resources and geothermal leasing.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

2.3.1 No Leasing or Development of Geothermal Resources on BLM Lands

The No Lease Alternative would not allow leasing of any geothermal resources. Under this alternative, all pending and future geothermal lease applications and nominations would not be approved so as to preclude any and all environmental consequences. This alternative was considered but eliminated from detailed analysis because it is not consistent with the multiple-use mandate of FLPMA, the President's National Energy Policy (Public Law 109-58), the Energy Policy Act of 2005, or Executive Order 13212 (Actions To Expedite Energy-Related Projects). Consequently, the No Lease Alternative was not carried forward for detailed analysis.

2.3.2 Identify priority low-conflict, high potential zones for geothermal leasing

Under this alternative, lands with high geothermal potential and low resource conflict would be identified for geothermal leasing in the EA. This alternative was considered but eliminated from detailed analysis due to lack of consistent and reliable, site-specific, geothermal knowledge making these decisions highly speculative.

2.3.3 Create a comprehensive energy plan that incorporates geothermal, solar, and oil and gas

Under this alternative, all forms of energy production would be considered under the EA in order to more accurately manage any simultaneous energy production. This alternative was considered but eliminated from detailed analysis due to the lack of consistent and reliable, site-specific, geothermal knowledge. Additionally, this alternative does not meet the purpose and need and is outside of the specific scope of this project.

2.3.4 Expand the Closed to Leasing Lands to a two to five mile buffer around private hot springs resorts (Valley View and Joyful Journey)

Public commenters requested that BLM include closing BLM lands to geothermal leasing within a two to five mile buffer zone around the Valley View Hot Springs and Joyful Journey Hot Springs resorts to protect the springs' quantity, quality, temperature, and flow. The BLM did not consider this option in detail as State law currently offers the protections commenters requested (see discussion in Section 1.6.3, State of Colorado Water Laws and Regulations). Additionally, at this date and time, the hydro-geologic data is inconclusive and does not indicate that buffers are needed; more research is need and continues in the area.

2.4 MANAGEMENT GUIDANCE FOR ALTERNATIVES A, B, AND C

Table 2-1, Descriptions of Alternatives A, B, and C, is a description of all decisions proposed for each alternative for geothermal leasing. All decisions in **Table 2-1** are land use plan-level decisions. **Table 2-2**, NSO, Timing Limitations, and CSU Constraints for Alternatives B and C gives specific information for species timing limitations in geothermal development areas.

2.4.1 How to Read Table 2-1

Table 2-1 is written and formatted to show the decisions proposed for each alternative, including the geothermal leasing goal, objective, and management actions, and allowable uses.

- In general, only those resources and uses that have been identified as planning issues have notable differences between the alternatives.
- Actions that are applicable to all alternatives are shown in one cell across a row. These particular objectives and actions would be implemented regardless of which alternative is ultimately selected.
- Actions that are applicable to more than one but not all alternatives are indicated by either combining cells for the same alternatives, or by denoting those actions as the "same as Alternative B," for example.

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
Geothermal Leasing		
GOAL: Provide opportunities for environmentally responsible exploration and development of geothermal resources subject to appropriate BLM policies, laws, and regulations. Establish conditions of use to protect other resource values.		
Objective: Facilitate orderly, economic, and environmentally sound exploration and development of geothermal resources, using the best available technology.		
Action: No similar action in current RMP.	Action: Include all management procedures from the 2008 Geothermal ROD (**Appendix B**).	
Action: No similar action in current RMP.	Action: Include all BMPs from the 2008 Geothermal ROD (**Appendix C**).	
Action: Apply lease stipulations to all geothermal leases.	Action: Apply lease stipulations to all new geothermal leases and to expired leases that are reissued.	
Action: Develop and apply COAs for authorizations such as, but not limited to, applications for Plans of Development, Plans of Operations, permit to drill and sundry notices to supplement regulations and policy, provided the COAs are consistent with lease rights granted.		
Action: In areas being actively developed, the operator must submit a Master Development Plan that describes a minimum of two to three years activity for operator-controlled federal leases within a reasonable geographic area (to be determined jointly with BLM). Use the Master Development Plan to plan development of federal leases within the area to account for well locations, roads, and pipelines, and to identify cumulative environmental effects and appropriate mitigation. The extent of the analysis would be dependent on the extent of surface ownership, extent of lease holdings, topography, access, and resource concerns. This requirement for a Master Development Plan may be waived for individual or small groups of exploratory wells, for directional wells drilled on previously developed well pads.		
Allowable Use: Approximately 627,300 acres of federal mineral estate are open to geothermal leasing.	Allowable Use: Approximately 591,400 acres of federal mineral estate are open to geothermal leasing subject to existing laws, regulations, formal orders, stipulations attached to lease form, and the terms and conditions of the standard lease form.	Allowable Use: Approximately 475,500 acres of federal mineral estate are open to geothermal leasing subject to existing laws, regulations, formal orders, stipulations attached to lease form, and the terms and conditions of the standard lease form.

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
Allowable Use: Manage 17,100 acres of the federal mineral estate as closed to geothermal leasing. ONAs: • Rio Grande NA WSAs: • Black Canyon, Papa Keel, San Luis Hills Other areas: • 320 acres within the incorporated town of Del Norte, Colorado.	Allowable Use: Manage 63,700 acres of the federal mineral estate as closed to geothermal leasing. Same as Alternative A, plus the following: National Historic & Scenic Trails: • Old Spanish National Historic Trail National Historic Landmarks: • Pike's Stockade National Historic Landmark ACECs: • Blanca ACEC Other Areas: • McIntire-Simpson wetland complex and homestead	Allowable Use: Manage 179,700 acres of the federal mineral estate as closed to geothermal leasing. Same as Alternative A, plus the following: National Historic & Scenic Trails: • Old Spanish National Historic Trail • Pike Historic Trail National Historic Landmarks: • Pike's Stockade National Historic Landmark ACECs: • All ACECs Other Areas: • McIntire-Simpson wetland complex and homestead • Small parcel of BLM land adjacent to Great Sand Dunes National Park • All SWAs
Allowable Use: **STIPULATION** NSO: Prohibit surface occupancy and other surface-disturbing activities in the following areas: • 40 acres within unincorporated town of South Fork, Colorado • 360 acres within park site under R&PPA lease to the city of Monte Vista, Colorado • 840 acres within the Pike Stockade State Historic Park • 5 bighorn sheep lambing ranges and special status values in the Trickle	Allowable Use: **STIPULATION** NSO: Prohibit surface occupancy and other surface-disturbing activities in the following areas: • 40 acres within unincorporated town of South Fork, Colorado • 360 acres within park site under R&PPA lease to the city of Monte Vista, Colorado • All SWAs	Allowable Use: **STIPULATION** NSO: Prohibit surface occupancy and other surface-disturbing activities in the following areas: • 40 acres within unincorporated town of South Fork, Colorado • 360 acres within park site under R&PPA lease to the city of Monte Vista, Colorado • Split estate lands adjacent to McIntire/Simpson wetland complex and homestead • All split estate surrounding the

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
Mountain ACEC • 2,000 acres Semi-primitive Nonmotorized area of Flat Top Mountain in the San Luis Hills ACEC • Cumbres and Toltec Railroad Scenic Corridor ACEC		Blanca ACEC and SRMA within the boundaries of: o County Road 6 to South o State Highway 150 to West o State Highway 60 to North o State Highway 17 to East • All SRMAs • The area that extends west from the town of Saguache to Gunnison, along Highway 114 • Federal mineral estate within 0.5 mile buffer surrounding Orient Land Trust lands (Valley View Hot Springs) and Joyful Journey Hot Springs lands.
Allowable Use: **STIPULATION** Cultural Resource NSO: Prohibit surface occupancy and other surface-disturbing activities in the following areas for protection of cultural resources: • 5 NRHP sites (5SH1065 La Garita Wagon Ruts, 5SH1063 Poncha Pass Pail-line, 5SH1053 Villa Grove-Orient Railroad Bed, 5CN560 King Turquoise Mine, 5SH1066 Ute Pass Road)	Allowable Use: **STIPULATION** Cultural Resource NSO: NSO stipulation would be applied within the boundary of properties designated or eligible for the NRHP and additional lands outside the designated boundaries to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility. Specifically, prohibit surface occupancy and other surface-disturbing activities in the following areas for protection of cultural resources: • 5 NRHP sites • 840 acres within the Pike Stockade State Historic Park	Allowable Use: **STIPULATION** Cultural Resource NSO: Same as Alternative B, plus the following: • West Branch Old Spanish Trail corridor

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** ESA Critical Habitat NSO: Prohibit surface occupancy and other surface-disturbing activities in designated or proposed critical habitat for listed/proposed species under ESA if it would adversely modify the habitat. For listed/proposed species without designated habitat, NSO would be implemented to the extent necessary to avoid jeopardy.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Traditional Cultural Properties and Native American Sacred Sites NSO: Prohibit surface occupancy and other surface-disturbing activities in areas with important cultural and archaeology resources, e.g., Traditional Cultural Properties and Native American sacred sites as identified through consultation.	
Allowable Use: **STIPULATION** Water Bodies/Riparian Areas/Wetlands/Floodplains NSO: Prohibit surface occupancy and other surface-disturbing activities in the following water bodies, riparian areas, wetlands: • Flat Top Mesa wetlands • Blanca wetlands • Rio Grande River Corridor	Allowable Use: **STIPULATION** Water Bodies/Riparian Areas/Wetlands/Floodplains/Fens NSO: Prohibit surface occupancy and other surface-disturbing activities in water bodies, riparian areas, wetlands, playas, 100-year floodplains, and fens including the associated hydrological source, in the SLVFO.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Recreation NSO: Prohibit surface occupancy and other surface-disturbing activities in developed recreation facilities, special-use permit recreation sites, and areas with significant recreational use with which geothermal development is deemed incompatible, excluding direct use application.	Allowable Use: **STIPULATION** Recreation NSO: Same as Alternative B, and specifically the following: • Lands adjacent to Valley View Hot Springs and Joyful Journey Hot Springs
Allowable Use:, No similar action in current RMP.	Allowable Use: **STIPULATION** Wilds and Scenic Rivers NSO: Prohibit surface occupancy and other surface-disturbing activities in designated National Scenic & Recreational Rivers under the	

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	WSR Act, and segments of rivers determined to be potentially eligible for WSR status by virtue of a WSR inventory, including a corridor of 0.25 mile from the high water mark.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** VRM NSO: Prohibit surface occupancy and other surface-disturbing activities in designated important viewsheds, including public lands designated as VRM Class I.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Slopes and Soils NSO: Prohibit surface occupancy and other surface-disturbing activities on areas that have both (1) slopes in excess of 40 percent; and (2) soils with high erosion potential.	Allowable Use: **STIPULATION** Slopes and Soils NSO: Prohibit surface occupancy and other surface-disturbing activities on areas that have either (1) slopes in excess of 40 percent; or (2) soils with high erosion potential.
Allowable Use: **STIPULATION** TL: Apply the following timing limitations on leases as needed in order to protect the noted resources: • Big game crucial winter range and eagle wintering areas would be closed to surface disturbing activity (January 1 through March 31) • Antelope birthing areas would be closed to surface disturbing activity (May 15 through July 15) • Waterfowl nesting areas (seasonal limitations) • Water bird nesting habitat associated with wetlands (seasonal use limitations, varies year to year) • Other crucial wildlife habitat (seasonal limitations) • Waterfowl nesting and water bird	Allowable Use: **STIPULATION** TL: Timing limitations for the following species will be applied to leases (see **Table 2-2**, NSO, Timing Limitations and CSU Constraints for Alternatives B and C): • Bighorn Sheep • Ungulates (Mule Deer, Elk, Moose, and Pronghorn Antelope) • Black Footed Ferret • Gunnison's Prairie Dogs • Gunnison sage-grouse (applicable on BLM-managed and split-estate lands) • Raptors and Owls (Bald and Golden Eagles, Ferruginous and Swainson's Hawks, Northern Goshawk, Osprey, Peregrine and Prairie Falcons, and Mexican Spotted and Burrowing Owls) • Southwestern Willow Flycatcher • Piping Plover • Least Tern • Waterfowl • Cutthroat Trout	

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
nesting habitat in the Blanca ACEC and SRMA (Feb. 15 - July 15)		
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** CSU: Apply CSU restrictions as needed based on NEPA analysis, to all SRMAs, and the area that extends west from the town of Saguache to Gunnison, along highway 114.	Allowable Use: **STIPULATION** CSU: Apply CSU restrictions as needed based on NEPA analysis. Additionally, CSU restrictions would be applied to the following specific areas: • Los Caminos Antiguos National Scenic and Historic Byway • Scenic Byways & Backcountry Byways
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Riparian/Wetland Habitat CSU: Apply CSU restrictions within 500 feet of riparian or wetland vegetation; measures required would be based on the nature, extent, and value of the area potentially affected.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Visual Resources CSU: Apply CSU restrictions to BLM VRM Class II areas and other sensitive viewsheds such as within the visual settings of Great Sand Dunes National Park or National Scenic and Historic Trails or near residential areas.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Recreation CSU: Apply CSU restrictions to minimize potential for adverse impacts on recreational values, both motorized and non-motorized, and the natural settings associated with the recreational activity.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Urban Interface CSU: Apply CSU restrictions to minimize the potential for adverse impacts on residential areas, schools, other adjacent urban land uses, or wildland-urban interface.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Soils and Slopes Greater than 30 Percent CSU: Apply CSU restrictions to minimize potential for adverse impacts on erosive soils as defined as severe or very	

Table 2-1
Description of Alternatives A, B, and C

Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	severe erosion based on Natural Resources Conservation Service mapping.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Important Habitat and Migration Corridors CSU: Apply CSU restrictions to protect the continuity of migration corridors and important habitat.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STIPULATION** Coordination with County Highway Departments: Proponents will coordinate transportation planning with the appropriate highway departments during project planning.	
Allowable Use: **STANDARD STIPULATIONS**: Apply standard stipulations in the following areas: • Elephant Rocks Area #5 • Ra Jadero Area #6 • Los Mogotes Area #7	Allowable Use: **STANDARD STIPULATIONS**: Apply standard stipulations to all leases.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STANDARD STIPULATIONS** Geothermal Resources: Apply standard lease stipulation for the protection of geothermal features to all geothermal leases.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STANDARD STIPULATIONS** ESA: Apply standard lease stipulation for the ESA to all geothermal leases.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STANDARD STIPULATIONS** Sensitive Species: Apply standard lease stipulation for sensitive species to all geothermal leases.	
Allowable Use: No similar action in current RMP.	Allowable Use: **STANDARD STIPULATIONS** Cultural Resources: Apply standard lease stipulation for cultural resources to all geothermal leases.	
Allowable Use: Operations might be allowed in seasonally limited areas during defined timing limitations if no more than minimal disturbance to wildlife would occur.	Allowable Use: See **Appendix D**, Waivers, Exceptions and Modifications	

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
Bats (Brazilian Free-tailed, Townsend's Big-eared, Fringed Myotis)	Roost Sites	Alternative B: NSO within 0.25 mile of roost site	N/A	A bat inventory may be required prior to approval of operations within historic mining complexes. These are areas where bats are suspected or the habitat is deemed suitable but no bats have been documented. The inventory data will be used to apply conservation measures to reduce the impacts of surface disturbance on bat habitat.
		Alternative C: NSO within 2.0 miles of roost site		
Bighorn Sheep	Production Areas	Entire mapped production area	No human activities in occupied production areas, including overflights: April 15 – June 30	N/A
	Winter Range	Entire mapped winter range area	No human activities in occupied winter range: November 1 – April 15	
Black Footed Ferret	Release Areas	N/A	No human encroachment in occupied habitat (Prairie dog colonies): March 1 – July 15	N/A
Cutthroat Trout	Designated Cutthroat habitat	Alternative B: NSO on 500 feet from the ordinary high water mark	Alternative B: N/A	Surface Density Limitation of one pad per section
		Alternative C: NSO on .5 mile from the ordinary high water mark	Alternative C: No human activities in designated habitat May 1 through June 30.	
	Designated Cutthroat Habitat	Alternative B: NSO on 500 feet buffer	N/A	

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
	Watershed	from centerline of stream		
		Alternative C: NSO on .5 mile buffer from centerline of stream		
Mule Deer	Crucial Winter Ranges (Severe Winter Range & Winter Concentration Areas)	N/A	No human encroachment in occupied crucial winter ranges December 15 – March 31	Surface Density Limitation of one pad per section or consider off site mitigation
Elk and Moose	Crucial Winter Ranges (Severe Winter Range & Winter Concentration Areas)	N/A	No human encroachment in occupied crucial winter ranges December 15 – March 31	Surface Density Limitation of one pad per section or consider off site mitigation actions
	Production Areas	N/A	No human encroachment in occupied production areas May 15 – June 30	
Gunnison Sage-grouse	Leks	Alternative B: NSO on all occupied habitat within 4 miles of lek sites and extending to include the top of Poncha Pass on all BLM-managed mineral estate north of the	No human encroachment in mapped occupied habitat March 1 – August 15	Alternative B: N/A

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
		4-mile buffer on both sides of Highway 285		
		Alternative C: NSO within 0.6 mile of lek sites		Alternative C: CSU within 4 miles of lek sites
	Core Areas (Occupied Habitat = Core Area for Gunnison sage-grouse)	Alternative B: NSO within mapped areas	No human encroachment in mapped occupied habitat March 1 – August 15	Surface Density Limitation of one pad per section; Relocate compressors > 4 miles from lek; Limit noise not to exceed 49 dB measured 30 feet from source.
		Alternative C: N/A		Alternative C: CSU for all occupied habitat in the Poncha Pass area

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
	Winter Range	Alternative B: NSO within mapped areas Alternative C: N/A	No human encroachment in mapped winter range December 1 – March 15	Surface Density Limitation of one pad per section; Relocate compressors > 4 miles from lek; Limit noise not to exceed 49 dB measured 30 feet from source.
	Production Areas (Breeding & Nesting Habitat)	Alternative B: Within 4 miles of lek sites and on split estate within mapped occupied areas Alternative C: Within 4 miles of lek sites	No human encroachment in mapped occupied production areas March 1—August 15	Surface Density Limitation of one pad per section; Relocate compressors > 4 miles from lek; Limit noise not to exceed 49 dB measured 30 feet from source. Alternative C: CSU for all production areas in the Poncha Pass area
Waterfowl	Wetlands, playas, riparian zones, and water bodies	NSO within 500 feet of the ordinary high water mark	No human encroachment in occupied habitat February 15 – July 15	A waterfowl preconstruction inventory would be required before approval of operations. The inventory data would be used to apply conservation measures to reduce the impacts of surface disturbance on waterfowl habitat. Follow-up monitoring of mitigation measures would also be required.

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
Least Tern	Production Areas (Breeding & Nesting habitat)	NSO within 500 feet of the ordinary high water mark	0.5 mile – No human encroachment in occupied production areas April 1 – July 31	N/A
Lynx	Suitable habitat	Alternative B: NSO with waivers, exemptions, and modifications within mapped areas	No human encroachment in mapped suitable habitat April 15 – June 30	Alternative B: N/A
		Alternative C: N/A		Alternative C: CSU within mapped areas
	Linkage Area	Alternative B: NSO with waivers, exemptions, and modifications within mapped areas	No human encroachment in mapped linkage zone April 15 – June 30	Alternative B: N/A
		Alternative C: N/A		Alternative C: CSU within mapped areas Surface Density Limitation of one pad per section; Limit noise to below 49 dB, measured 30 feet from source
Mountain Plover	Active nest site	NSO within 300 feet of active nest	No surface disturbing activities in active nest sites: March 15-July 15	Pre-construction survey for nest sites may be required.
Piping Plover	Production areas (Breeding & Nesting Habitat)	NSO within 500 feet of the ordinary high water mark	No human encroachment within 0.5 mile of occupied production areas April 1 – July 31	N/A

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
Prairie Dogs (Gunnison's)	Colonies	N/A	No human encroachment within active or historic colonies March 1 – June 15	Pre-construction survey for active colonies may be required; avoid direct disturbance to active colonies when possible.
New Mexico Meadow Jumping Mouse	Known and Potential Occupied Habitat	NSO within 500 feet of stream centerline	N/A	N/A
Pronghorn Antelope	Winter concentration areas	N/A	No human encroachment within occupied winter concentration areas December 15 – March 31	N/A
	Fawning Season		No human encroachment within occupied birthing areas May 15-June 30	
Bald Eagle	Active Nest Site[8]	NSO within 0.25 mile of nest site	No human encroachment within 0.5 mile of active nest site November 15 – July 31	Preconstruction nest surveys may be required.
	Active Winter Night Roost Site[9]	NSO within 0.25 mile of roost site	No human encroachment within 0.5 mile of active nest site November 15 – March 15	Preconstruction roost surveys may be required.

[8] Active Nest Site = Any nest that is frequented or occupied by a raptor during the breeding season, or which has been frequented or occupied in any of the five previous breeding seasons.
[9] Active Bald Eagle Winter Night Roost = Areas where bald eagles gather and perch overnight, and sometimes during the day in the event of inclement weather.

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
Ferruginous Hawk	Active Nest Site[1]	NSO within 0.5 mile of nest site	No human encroachment within 0.5 mile of active nest site February 1 – July 15	Preconstruction nest surveys may be required.
Golden Eagle	Active Nest Site[1]	NSO within 0.25 mile of nest site	No human encroachment within 0.5 mile of active nest site December 15 – July 15	Preconstruction nest surveys may be required.
Mexican Spotted Owl	Protected Activity Center (PAC)	NSO on the entire PAC	N/A	Preconstruction nest surveys may be required.
	Active Nest Site[1]	N/A	No human encroachment on adjacent PAC Areas March 1 – August 31	
Northern Goshawk	Active Nest Site[1]	NSO within 0.5 mile of nest site	No human encroachment within 0.5 mile of active nest site March 1 – September 15	Preconstruction nest surveys may be required.
Osprey	Active Nest Site[1]	NSO within 0.25 mile of nest site	No human encroachment within 0.25 mile of active nest site April 1 – August 15	Preconstruction nest surveys may be required.
Peregrine Falcon	Active Nest Site[1]	NSO within 0.5 mile of nest site	No human encroachment within 0.5 mile of active nest site March 15 – July 31	Preconstruction nest surveys may be required.

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
Prairie Falcon	Active Nest Site[1]	NSO within 0.5 mile of nest site	No human encroachment within 0.5 mile of active nest site March 15 – July 15	Preconstruction nest surveys may be required.
Swainson's Hawk	Active Nest Site[1]	NSO within 0.25 mile of nest site	No human encroachment within 0.25 mile of active nest site April 1 – July 15	Preconstruction nest surveys may be required.
Other Raptors not listed above	Nesting Habitat	N/A	No human encroachment within nesting habitats January 1 – July 15	Preconstruction nest surveys may be required.
	Roost Sites	N/A	No human encroachment within roost sites November 15 – April 1	
Burrowing Owl	Active Nest Site	N/A	300 feet No human encroachment March 1 – August 15	N/A
Southwestern Willow Flycatcher	Active Nest Site	NSO within 500 feet of nest site	No human encroachment within 500 feet of active nest site: May 1 – August 30	Preconstruction nest surveys may be required.
	Suitable habitat (USFWS minimum patch size definition)	NSO within floodplain and riparian zone	Restrict activities in suitable habitat between May 15 – August 1 Restrict activities within suitable habitat between May 1 – August 30 in occupied habitat	Preconstruction nest surveys may be required. CSU within 500 feet of suitable riparian vegetation

Table 2-2
NSO, Timing Limitations, and CSU Constraints for Alternatives B and C

Wildlife Species	Habitat Types	Area or Buffer for NSO stipulations	TL Stipulations	Potential relocation or other Operational Constraint for CSU stipulations
Yellow Billed Cuckoo	Active Nest Site	NSO within 500 feet of nest site	No human encroachment within 500 feet of active nest site: May 1 – August 30	Preconstruction nest surveys may be required.
	Suitable habitat (USFWS minimum patch size definition)	NSO within 500 feet of riparian area	Restrict activities within suitable habitat between May 15 – August 1	Preconstruction nest surveys may be required.
River Otter	Breeding sites	NSO within 300 feet of riparian area	N/A	Minimize disturbance of riparian vegetation and road development within 500 feet of occupied habitat
Northern Leopard Frog	Breeding sites	NSO within 0.25 mile of breeding site	N/A	N/A
Western Boreal Frog	Breeding sites	NSO within 0.5 mile of breeding site	N/A	N/A

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
Air Quality	Short-term emissions associated with exploration, drilling, utilization, and reclamation and abandonment would be less but could occur over a longer period of time. COAs would be applied on a case-by-case basis.	Decision measures would minimize impacts on air quality and atmospheric values by reducing sources of air quality degradation including particulates and hydrocarbons.	Same as B, however with more area closed, development would be slowed and results would likely take longer to realize.
Greenhouse Gases and Climate Change	Least beneficial effect on reducing greenhouse gas emissions and the least amount of new, clean energy being brought online.	Greatest amount of geothermal development, the greatest amount of new, clean energy being brought online, and the greatest potential for reducing greenhouse gas emissions because of the greater potential for greenhouse gas offsets.	Due to the least amount of open lands, Alternative C would likely result in the least amount of new, clean energy coming online and potential reductions in greenhouse gases.
Cultural Resources	Leasing closed around five eligible NRHP sites (5SH1065 La Garita Wagon Ruts, 5SH1063 Poncha Pass Pail-line, 5SH1053 Villa Grove-Orient Railroad Bed, 5CN560 King Turquoise Mine, 5SH1066 Ute Pass Road), thereby protecting the cultural resources in those areas. In areas identified as open to leasing with stipulations, direct and indirect impacts on cultural resources would likely occur.	Areas allocated as closed to geothermal leasing would protect cultural resources in those areas. Stipulations and BMPs would minimize impacts on cultural resources designated or eligible for the NRHP to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility.	Impacts would be the same as those described under Alternative B, except that more areas would be closed to leasing and protected with stipulations which would result in protecting all the known and unknown sites within those areas from direct and indirect impacts.
Tribal Interests	No specific protections applied to areas of tribal interest or significance. Areas of importance that did not have surface protections could be protected or impacts mitigated on a case-by-case basis as a result of tribal	Impacts on areas of tribal interest or significance would be minimized or avoided through consistent application of the geothermal leasing program procedures and BMPs, including closures, any required consultations,	Impacts would be the same as those described under Alternative B, except that more areas would be closed to leasing and protected with stipulations which would result in protecting all the known and unknown areas of tribal significance

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	consultation at the time of leasing and/or development.	environmental reviews, and stipulations. Indirect impacts may still occur under any of the open allocation decisions.	within those areas from direct impacts. Indirect impacts may still occur under any of the open allocation decisions.
Fish and Wildlife Habitat	Least amount of acres closed to geothermal leasing and fewer stipulations would result in more direct and indirect impacts on fish and wildlife from geothermal development compared to other alternatives. COAs could be applied on a case-by-case basis.	More acres closed to geothermal leasing, more stipulations, and BMPs would reduce the likelihood for direct and indirect impacts on fish and wildlife compared to Alternative A.	Same as Alternative B, however more area closed or under geothermal leasing restrictions would protect fish and wildlife and prevent disturbance to habitats.
Special Status Species	Least amount of acres closed to geothermal leasing and fewer stipulations would result in more direct and indirect impacts on special status species from geothermal development compared to other alternatives. COAs could be applied on a case-by-case basis.	More acres closed to geothermal leasing, more stipulations, and BMPs would reduce the likelihood for direct and indirect impacts on special status species from geothermal development compared to Alternative A.	Same as Alternative B, however more area closed or under geothermal leasing restrictions would protect special status species and prevent disturbance to habitats.
Geology and Seismicity	Moderate likelihood for impacts on sensitive geologic resources due to large area of open lands, but no comprehensive list of stipulations, BMPs, or procedures related to geology and seismicity are available. Such measures would be considered and applied on a case-by-case basis.	More area is closed to leasing and open with NSO, thereby restricting development and protecting sensitive geologic resources. The Elephant Rocks ACEC, noted for special geologic features, is open for leasing with standard lease terms and conditions; however, under this alternative CSU stipulations could be applied to protect the specific, unique geologic features.	Same as Alternative B. However, there is less likelihood for impacts on sensitive geologic resources as more area is closed to leasing and open with NSO stipulation. The Elephant Rocks ACEC is closed thereby protecting the unique geologic features.
Health and Safety	With no specific requirements or procedures related to protection of	Impacts would be similar to Alternative A; however, BLM would	Same as Alternative B.

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	human health and safety, impacts on human health and safety from geothermal resource development are possible. COAs could be applied on a case-by-case basis.	apply stipulations, BMPs, and procedures to protect health and safety.	
Land Uses	Absence of allocating areas as open or closed to geothermal leasing, lease nominations, and project development would likely result in fragmented and segregated land uses. Could be increased unanticipated environmental impacts from the lack of planning for appropriate land uses.	Comprehensive list of stipulations, BMPs, and procedures implemented to serve as consistent guidance for future geothermal leasing is expected to effectively avoid or minimize impacts over the long term on land uses.	Same as Alternative B, however lower potential to impact lands due to the smaller acreage of lands available for leasing.
Lands with Wilderness Characteristics	A loss of wilderness characteristics would occur from the development of new facilities and access roads on or near lands with wilderness characteristics. Indirect impacts include a decrease in opportunities for solitude and a perceived loss of natural and undeveloped characteristics to recreationists. Other potential impacts would include aural or visual intrusions and degradation of scenic values.	BLM completed an inventory for lands with wilderness characteristics in the planning area, and the only area found to have lands with wilderness characteristics was the San Luis Hills WSA. The San Luis Hills WSA is allocated as closed to geothermal leasing; therefore, there will be no impacts on lands with wilderness characteristics.	Same as Alternative B.
Livestock Grazing	As 96.8percent of grazing acreage is open to geothermal leasing, there is a high likelihood that any subsequent proposed development would impact grazing permittees. Without standard procedures, stipulations, or BMPs, mitigation	As 94.8 percent of grazing acreage is open to geothermal leasing, there is a high likelihood that any subsequent proposed development would impact grazing permittees. Stipulations and BMPs developed specifically for geothermal leasing	Same as Alternative B, however only 74 percent of acres available for grazing would be open to geothermal leasing, thereby lessening the degree of impact on permittees.

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	measures would be applied on a case-by-case basis.	would be applied to all geothermal leases in the project area and would reduce the potential for impacts.	
Minerals and Energy	In general, any infrastructure improvements (e.g., roads, transmission lines, pipelines) associated with the exploration and development of geothermal resources would provide access and possibly new routes for pipelines or transmission for the exploration and development of other energy and mineral resources within the immediate area. Any land being used for exploration and development activities would become unavailable for developing other mineral resources (e.g., aggregates, solid minerals). Geothermal plants and infrastructure development could be compatible with other forms of renewable energy, such as solar, wind, and biomass. There would likely be negligible impacts on energy and mineral resources. Utilization of the geothermal resources would have minor or no impact on other energy or mineral resources.	Alternative B would decrease the areas available for geothermal leasing; the reduction in land base is unlikely to impact oil and gas development as areas under leasing agreements would still be available for oil and/or gas development. The reduced land base may increase competition for areas that could also be proposed for solar or wind energy development.	Magnitude would be similar to Alternative B. However, with the further reduction in land base open to geothermal leasing, there could be a greater increase in competition for lands that may be permitted for wind or solar energy development.
Noise	Geothermal projects can be expected to continue to come online and generate noise at the	A slightly smaller area (as compared to Alternative A) would be open to geothermal leasing, which could	Same as Alternative B, however smaller area would be open for geothermal leasing under this

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	existing pace of development which is currently none, and therefore will have negligible effect.	decrease the potential for noise impacts near developed land uses. Additionally, BMPs and noise reduction measures as noted in the BMPs would be implemented to reduce project impacts as determined during site-specific analysis at the various stages of development.	alternative, which could result in a lesser potential for noise-related impacts.
Paleontological Resources	Moderate risk to paleontological resources as a large area is open to leasing with only the existing policy protections for paleontological resources. Paleontological resources would only be protected as per current management policy.	More area is closed to leasing or open with NSO thereby possibly protecting paleontological resources. It is expected that required BMPs would effectively mitigate impacts on paleontological resources by protecting and conserving resources where they are known to exist or are discovered on public lands.	Same as Alternative B, however with more area closed or open with NSO, paleontological resources would be more likely to be protected.
Recreation	All SRMAs open to geothermal leasing would result in the most impacts on recreation. No specific stipulations to minimize impacts on visitor experiences. COAs could be applied on a case-by-case basis.	Applying a CSU stipulation and BMPs to all SRMAs, would likely lessen impacts on recreation and visitor experiences of remoteness and solitude values would be better preserved.	Applying an NSO stipulation and BMPs to all SRMAs would likely lessen the severity and intensity of these indirect effects, resulting in the least amount of impacts on recreation activities.
Socioeconomics and Environmental Justice	Issuing leases under current regulations is not expected to affect socioeconomics or environmental justice. Measures to protect area communities from impacts would be determined on a case-by-case basis. Alternative A would provide the least defined protection for	Alternative B would limit the impacts on area resources and other existing land uses thereby decreasing the impacts on economic and social benefits. Potential for impacts on local adjacent communities, including minority populations, are likely reduced	Impacts under Alternative C similar to Alternative B. Potential for impacts on local adjacent communities, including minority populations, are likely to be the lowest under Alternative C due to program procedures, BMPs, and stipulations.

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	socioeconomics and environmental justice of any alternative.	under B.	
Soils	With more area with severe or very severe erosion hazard open and no specific stipulations related to these types of soils, there is the likelihood for increased erosion risk on these lands. COAs could be applied on a case-by-case basis.	Lands identified as open to geothermal leasing would include minor to moderate constraints to reduce impacts on soil resources based on site-specific environmental conditions. Stipulations and BMPs would avoid or minimize the impacts on soil resources by protecting sensitive soil resources, thus minimizing erosion and secondary impacts on air quality associated with erosion.	Same as Alternative B. However, as more area is closed to leasing, there is less acreage with severe or very severe erosion hazard classification available for geothermal development, thereby reducing the erosion risk further.
Special Designation Areas	No specific stipulations, BMPs, or procedures would be applied to any issued leases; resulting in indirect impacts on WSAs. All ACECs open to leasing would result in direct impacts. No specific stipulations to minimize impacts on ACECS, NWRs, and NPS units. Least amount of protection to special designated areas.	Blanca ACEC and SRMA closed to leasing; therefore, there would be no direct effects on the resources within the ACEC and SRMA. Less area open to leasing than Alternative A, however more flexibility with siting development and mitigation measures to reduce the intensity of the indirect impacts on WSAs and ACECs. Impacts on NWRs and NPS units would be the same as Alternative A; however, geothermal procedures, stipulations, and BMPs would add further protections.	Same impacts on WSAs as Alternative B. All ACECs are closed to geothermal leasing; there would be no direct impacts on the resources values within the ACECs. Impacts on NWRs and NPS units would be the same as Alternative B; however, there would be more lands closed to leasing and the remaining areas covered with stipulations adding further protections to these resource values.
Vegetation	General Vegetation: The greatest amount and intensity of impacts are likely in the semi-desert shrubland, grassland, piñon-juniper, and	General Vegetation: Alternative B would lessen the direct and indirect impacts on the vegetation resources as more areas are closed or have	General Vegetation: Same as Alternative B; however, more acreage is closed to leasing or protected with NSO stipulations,

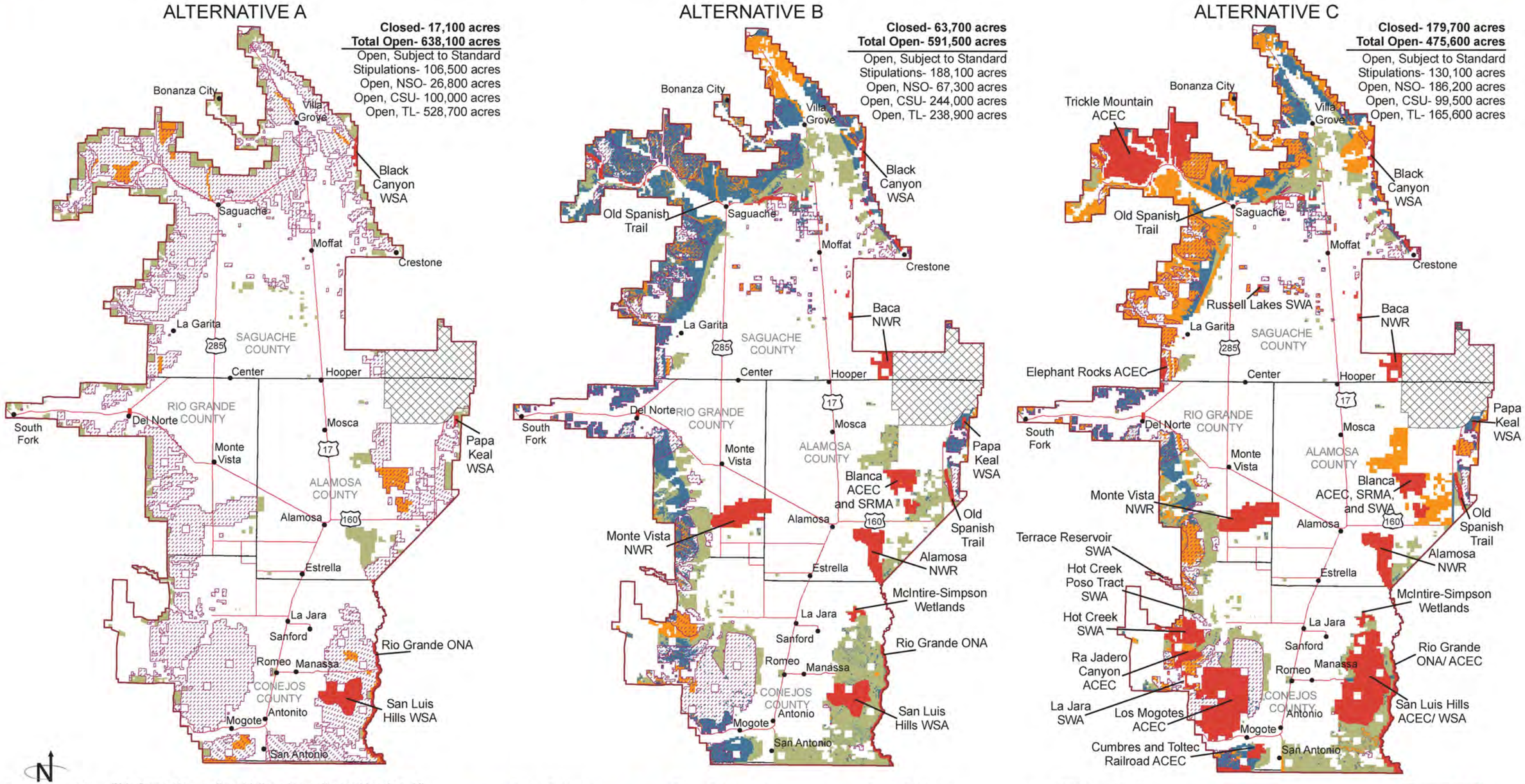
Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
	ponderosa pine vegetation communities since these communities have the greatest acreage open to leasing. COAs would be applied on a case-by-case basis, creating inconsistent application of protective stipulations. Riparian/Wetland Areas: Flat Top Mesa wetlands, the Blanca wetlands area and Rio Grande River Corridor would be protected, however other sensitive wetland and riparian areas would be available for development. Any additional protective measures would be applied on a case-by-case basis.	NSO stipulations. Grasslands and semi-desert shrubland are more likely to experience impacts as more acreage in these habitats is open. Most of the anticipated impacts from geothermal development would be mitigated with application of the BMPs included as part of this alternative. Riparian/Wetland Areas: The majority of wetland and riparian habitat would have NSO stipulation or be closed to geothermal leasing, thereby protecting these areas from direct and indirect development impacts. As BLM could apply a CSU stipulation within 500 feet of riparian areas and wetlands, more protection for this sensitive and critical resource would be available, and application of the BMPs would further reduce impacts.	therefore more area in vegetation communities would be protected from direct and indirect development impacts. Riparian/Wetland Areas: Same as Alternative B, but Alternative C would protect more riparian areas and wetlands from direct and indirect development impacts than any other alternative due to closing areas or applying NSO stipulations.
Visual Resource Management and Night Sky	Least defined protection to visual resources in regards to geothermal development. Scenic features such as the Old Spanish National Historic Trail and Pike's Stockade National Historic Landmark could potentially be affected.	Areas closed to leasing, including Blanca ACEC and SRMA, the Old Spanish National Historic Trail, and the McIntire/Simpson wetland and homestead area, would be protected from direct impacts on visual resources. Manage visual resources and meet VRM Class objectives by providing clear direction for potential geothermal development. More defined	The amount and degree of impacts would be less than under Alternative A and slightly less than under Alternative B since more areas would be closed and contain stipulations directly and indirectly protecting visual resources. However, high amount of closed and NSO areas would limit siting options which could result in more indirect impacts by siting projects

Table 2-3
Impacts Analysis Summary Table

Resource or Use	Alternative A (No Action)	Alternative B (BLM's Proposed action)	Alternative C
		protection for visual resources than Alternative A.	within viewsheds adjacent to these closed or NSO areas.
Water Resources	Moderate likelihood for impacts on sensitive water resources due to large area of open lands, but no comprehensive list of stipulations, BMPs, or procedures available to protect water resources. Such measures would be considered and applied by DWR.	Less likelihood for impacts on sensitive water resources due to more area closed to leasing, comprehensive NSO and CSU stipulations to protect water, riparian, and wetland resources, as well as additional stipulations and BMPs available to mitigate potential development impacts applied by DWR.	Same as Alternative B, however with even less likelihood for impacts due to much greater area closed to leasing and open with NSO stipulation.

Geothermal Leasing Allocations

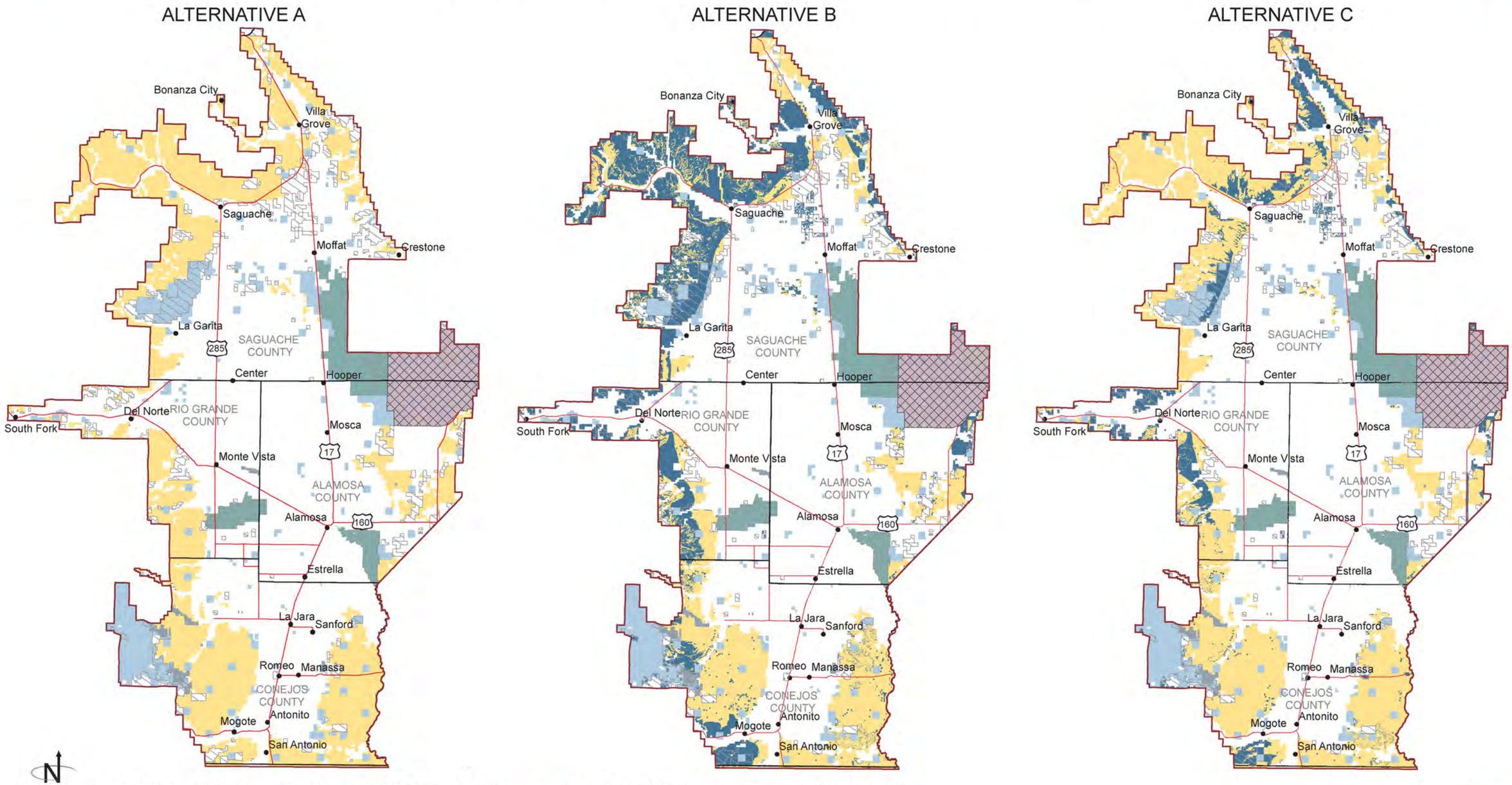


No warranty is made by the BLM for the use of the data for purposes not intended by the BLM.

Figure 2-1

This page intentionally left blank.

Open to Geothermal Leasing Subject to Controlled Surface Use



N

0 5 10
Miles

No warranty is made by the BLM for the use of the data for purposes not intended by the BLM.

A Controlled Surface Use stipulation allows BLM to require that a proposed facility or activity be relocated by more than 200 meters from the proposed location if necessary to achieve the desired level of protection.
All leasing allocations are on BLM land or Federal Mineral Estate.

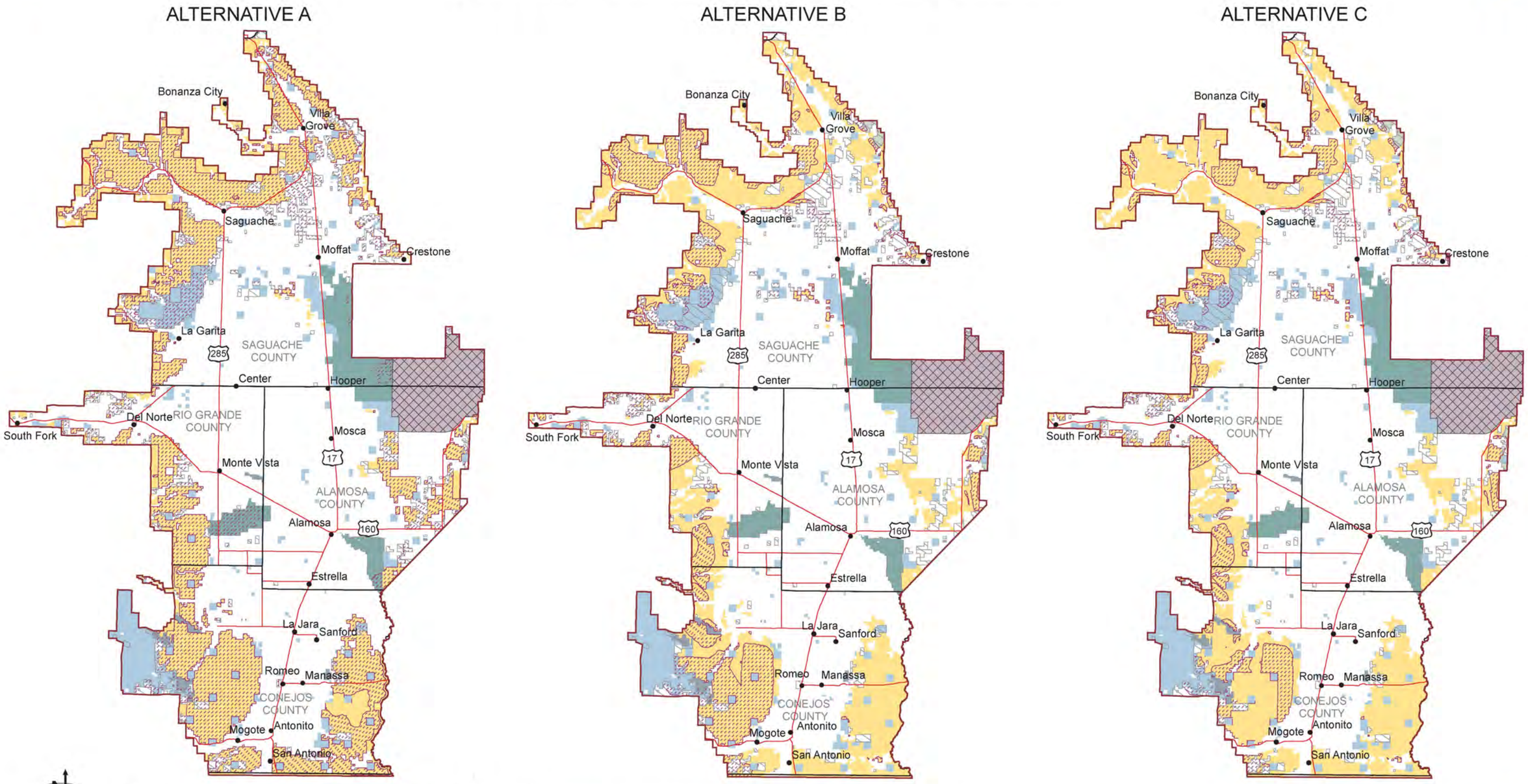
Open, Subject to Controlled Surface Use (CSU)
San Luis Valley Field Office RMP Planning Boundary
Federal Mineral Split-estate

Surface Ownership
Bureau of Land Management
Colorado Parks and Wildlife
National Park Service (Withdrawn from Geothermal Leasing)
Private
State
US Fish and Wildlife Service

Figure 2-2

This page intentionally left blank.

Open to Geothermal Leasing Subject to Timing Limitations



N

0 5 10

Miles

No warranty is made by the BLM for the use of the data for purposes not intended by the BLM.

Timing Limitations protect resources that are sensitive to disturbance during certain time periods and are generally applicable to specific areas, seasons, and resources and commonly applied to wildlife activities and habitat. Buffer zones specific to species and location are also used to further mitigate impacts from any human activities.

All leasing allocations are on BLM land or Federal Mineral Estate.

Timing Limitations

San Luis Valley Field Office RMP Planning Boundary

Federal Mineral Split-estate

Surface Administration

Bureau of Land Management

Colorado Parks and Wildlife

National Park Service (Withdrawn from Geothermal Leasing)

Private

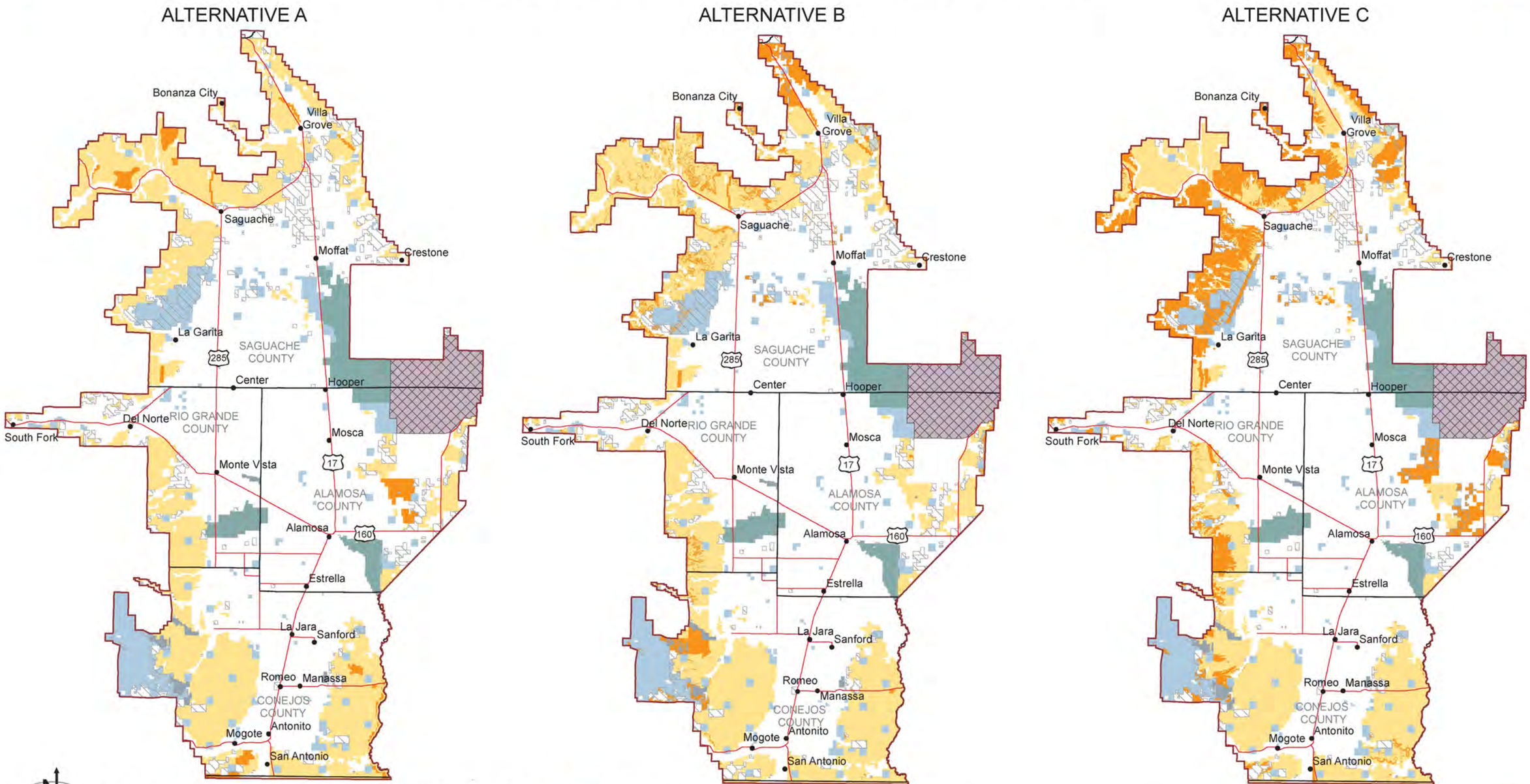
State

US Fish and Wildlife Service

Figure 2-3

This page intentionally left blank.

Open to Geothermal Leasing Subject to No Surface Occupancy

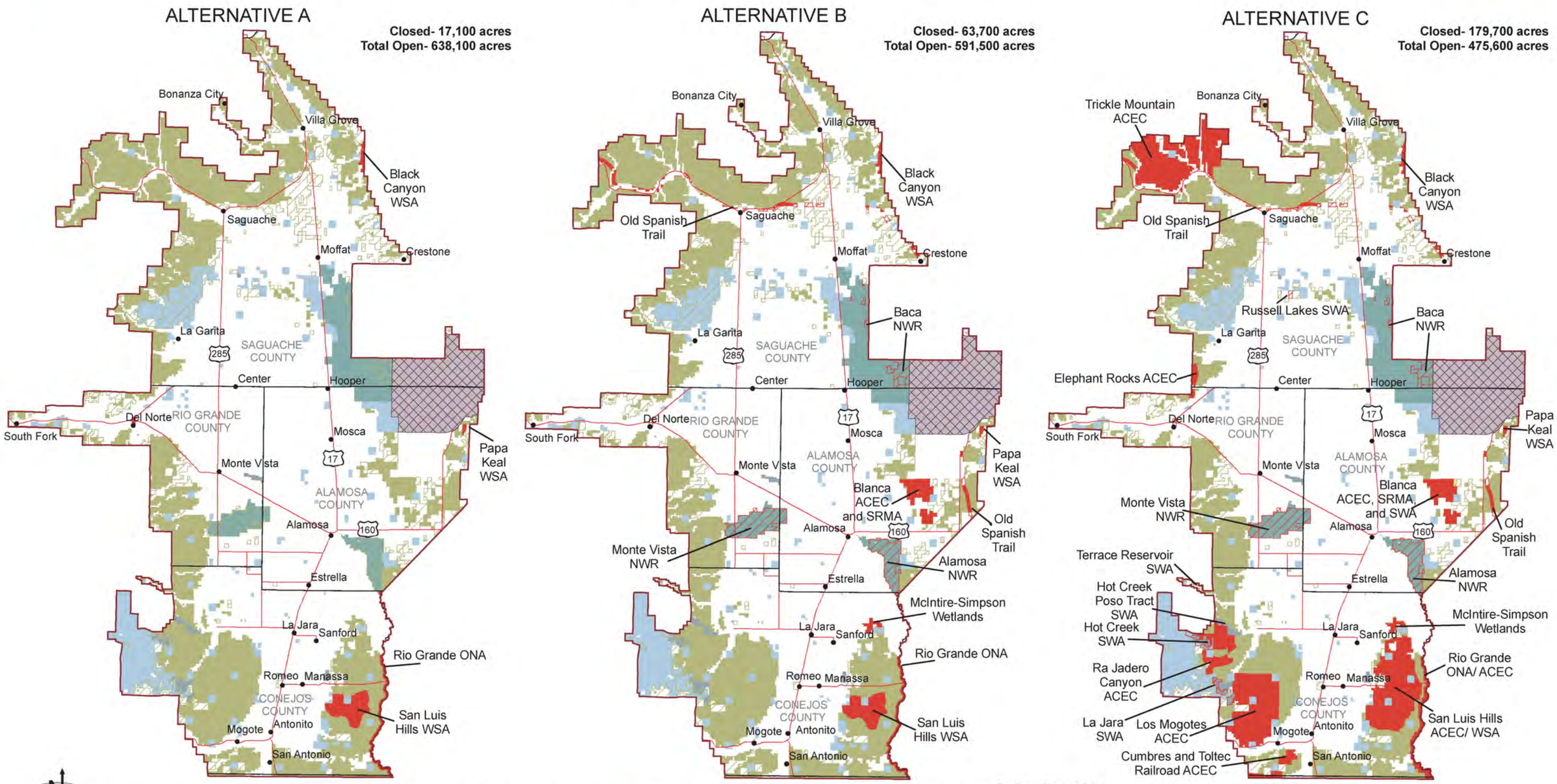


A No Surface Occupancy stipulation prohibits occupancy or disturbance on all or part of the lease surface to protect values or uses. Lessees may exploit the fluid mineral resources under the leases restricted by this constraint through use of directional drilling from sites outside of the No Surface Occupancy area.
All leasing allocations are on BLM land or Federal Mineral Estate.

Figure 2-4

This page intentionally left blank.

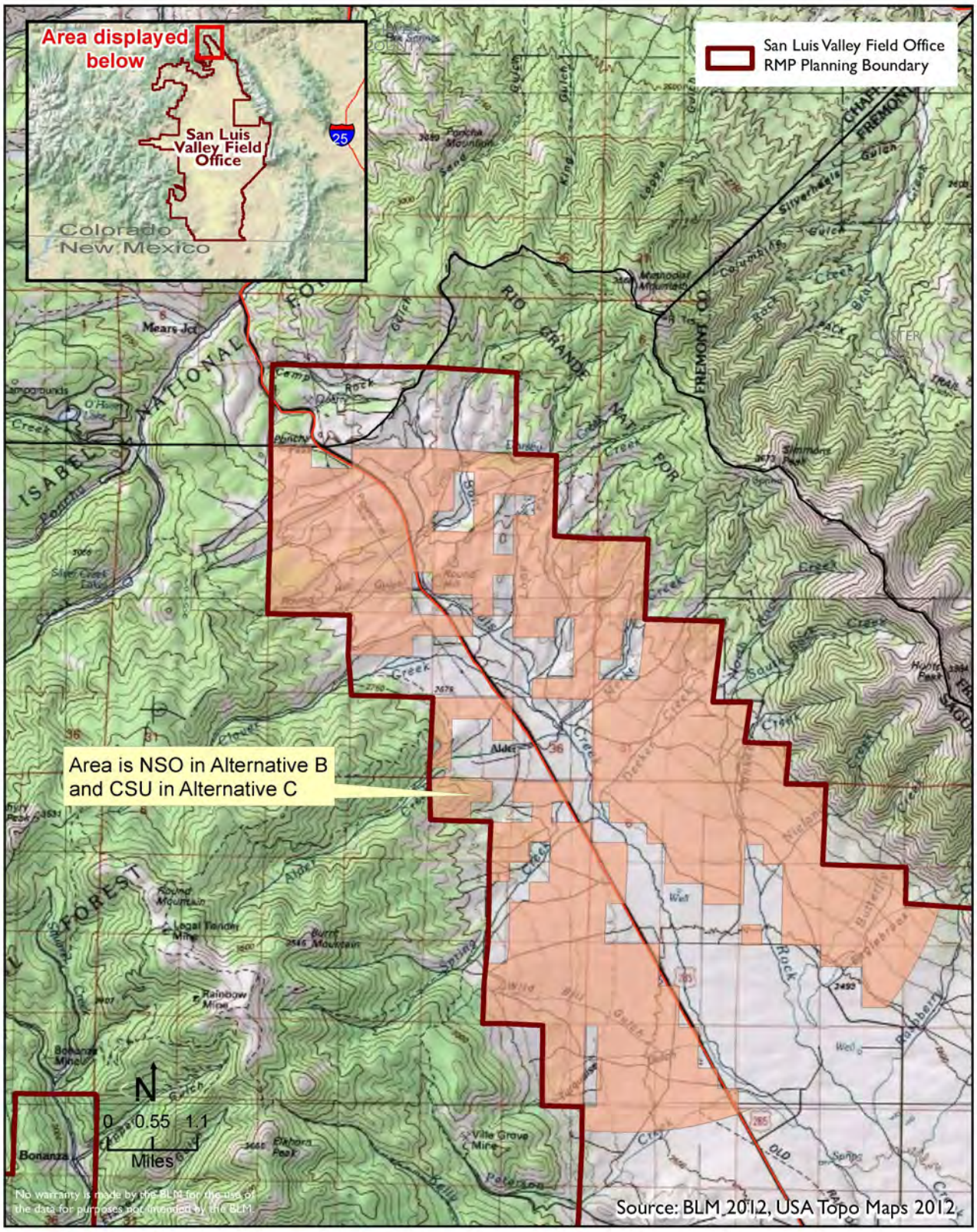
Closed to Geothermal Leasing



Areas Closed to Leasing denotes an area that is not available for fluid mineral leasing, exploration, or development. The BLM has determined that other land uses or resource values cannot be adequately protected with even the most restrictive lease stipulations; appropriate protection can be ensured only by closing the lands to leasing. All leasing allocations are on BLM land and Federal Mineral Estate.

Figure 2-5

This page intentionally left blank.



Sage-Grouse Stipulations

Gunnison sage-grouse is protected as a NSO in Alternative B. The area is protected as a CSU in Alternative C although the majority of the area is NSO due to erosive soils. This stipulation is applicable on BLM-managed lands and split-estate lands.

Current Gunnison sage-grouse habitat, range, and lek with 4 mile buffer

Figure 2-6

This page intentionally left blank.

CHAPTER 3
AFFECTED ENVIRONMENT

This chapter describes the existing condition and trend of issue-related elements of the human environment, which include the biological, physical, social, and economic, that may be affected by implementing the proposed action or an alternative.

The description of the affected environment provides the basis for identifying and interpreting potential impacts in a concise manner. This section describes the present condition of the affected resources within the identified geographic scope and provides a baseline for the effects analysis. When possible, any regulatory, biological, or physical thresholds and known stresses affecting the resources are characterized.

The affected environment descriptions are no more detailed than what is necessary to understand the effects of the alternatives. Data and analyses are commensurate with the importance of the impact; less important material has been summarized, consolidated, or simply referenced (40 CFR 1502.15). Data and other information were also gathered from cooperating agency partners such as the USFWS and CPW. If any information is unavailable or incomplete at the time of writing, a statement to that effect is included in the section.

This chapter focuses on those resources potentially affected by the proposed action or an alternative. The chapter is divided into sections for each resource topic.

3.1 AIR QUALITY

Air quality and atmospheric values are protected under the Clean Air Act of 1970, as amended, which falls under the authority of the EPA-Region 8 (which includes Colorado) and is managed in the State of Colorado by the Department of Public Health and the Environment. EPA authority under the federal Clean Air Act and Colorado law frames all air quality protection requirements on federally administered lands in the SLVFO.

In Colorado, the National Ambient Air Quality Standards are measured and monitored by the state. The SLVFO encompasses two Colorado Department of Public Health and Environment air quality monitoring areas: Mountain Counties and Southern Front Range Counties. The State of Colorado reports emissions for several criteria and non-criteria pollutants for four counties in the SLVFO.

A local public health concern and a source of visibility impairment in the SLVFO is seasonal windblown dust (particulate matter less than ten micrometers in diameter [PM_{10}]). Quite severe dust events occur annually. These events, combined with high elevation (greater than 7,200 feet above sea level), commonly lead to an increase in incidences of acute and chronic respiratory conditions in the local population. Alamosa County Department of Public Health issues public health PM_{10} advisories on average six times each year (Geisner 2010).

Seasonally high wind-blown dust (PM_{10}) also results in measurable visibility impairment both within and looking toward the Great Sand Dunes National Park, a Clean Air Act Class I air quality protection area (IMPROVE 2011). Dust-impaired air quality in the SLVFO also influences local hydrology. Colorado Department of Natural Resources, Division III, accounts for spring "dust-on" events in the Sangre de Cristo Mountains and USFS Wilderness Area; the darker-colored dust particles coat the snow during dust-on events and increase the melting rate of the snow pack. Thus, the measureable dust-on phenomena accelerate snowpack melt in those watersheds and affect both the timing of surface runoff and the aquifer recharge in the closed-basin system.

While PM_{10} levels are by far the greatest seasonal air quality concern in the planning area, ozone levels and human and ecological exposure to the criteria pollutant in the SLVFO are an increasing environmental and public health concern. Natural and human-caused sources of chemical precursors to ozone generation occur in the SLVFO. The nexus of these sources is an air basin that experiences atmospheric conditions such as inversions and nationally significant solar exposure. These are potential existing conditions that could foster photochemical generation of ozone depending on season. Perhaps of greater near- and long-term concern, however, is the SLVFO planning area's location downwind of larger ozone sources, particularly the Four Corners Power Plant in northwestern New Mexico and oil and gas infrastructure in the San Juan Basin of the same region and in La Plata County, Colorado.

3.2 GREENHOUSE GASES AND CLIMATE CHANGE

Greenhouse gases are chemical compounds in the Earth's atmosphere that allow incoming short-wave solar radiation but absorb long-wave infrared radiation re-emitted from the Earth's surface, trapping heat. Most studies indicate that the Earth's climate has warmed over the past century due to increased emissions of greenhouse gases, and that human activities affecting emissions to the atmosphere are likely an important contributing factor. In the

US, most greenhouse gas emissions are attributed to energy use. Such emissions result from combustion of fossil fuels used for electricity generation, transportation, industry, heating, and other needs. Energy-related carbon dioxide emissions represent 82 percent of total manmade greenhouse gas emissions in the US (US Energy Information Administration 2009).

Climate in the SLVFO is arid and characterized by cold winters, moderate summers, light precipitation, and a high rate of evaporation, as well as intense and abundant sunshine. Within the SLVFO, topography and location relative to the surrounding San Juan, La Garita, and Sangre de Cristo mountain ranges influence the temperature of any particular location. Elevations in the SLVFO average 7,500 feet and generally result in overall cooler summer and winter temperatures than would occur at lower altitude. January is the coldest month of the year—average minimum temperature is 3.6°F, and average maximum temperature is 35.1°F. Subzero temperatures are common in January and December. Temperatures for July, the hottest month of the year, range from 48.5°F (average minimum) to 80.5°F (average maximum). Precipitation in the SLVFO ranges from 7.14 to 11.2 inches annually. Most precipitation occurs during summer months during the Southwest Monsoon.

Change in climate, and specifically temperature, in the SLVFO represents an existing condition that will likely continue throughout the 21st century. During the 30-year period between 1977 and 2006, temperatures in the San Luis Valley have increased by approximately 2.4°F (Ray et al. 2008). Climate models run by the National Oceanographic and Atmospheric Administration project that temperatures in Colorado will increase 2.5°F by 2025 and 4°F by 2050 relative to the 1950-to-1999 baseline (Ray et al. 2008). However, no consistent long-term precipitation trends in Colorado are present. Changes in Colorado's water cycle are projected to be the source of many climate change impacts. Rising late-winter and early-spring temperatures would shift the timing of spring runoff, surface water flow, and water recharge. Projected stream flow declines in the Rio Grande Basin, including the SLVFO, as a result of climate change have been estimated at negative 3 percent to negative 14 percent by 2030, and negative 8 to negative 29 percent by 2080 (Hurd and Coonrod 2007).

3.3 CULTURAL RESOURCES AND TRIBAL INTERESTS

The San Luis Valley is rich in cultural history, with documented evidence of human occupation extending as far back as 12,000 years. Various geographic features located in the valley or seen from the valley have cultural significance. Blanca Peak (also called Mount Blanca, Sierra Blanca, and White Shell Mountain) is thought to be a sacred mountain and could be the place the Navajo refer to as Sisnaajini, or the Sacred Mountain of the East, one of the four sacred mountains of the Navajo (Simmons 1999; BLM 2009a).

The Great Sand Dunes, located at the base of the Sangre de Cristo Mountains are also considered sacred by a number of different Tribes. Languages of both

the Ute and Jicarilla Apache Tribes have words referring to these dunes near where the tribes historically camped and hunted (NPS 2009). Water features in the valley, consisting of several streams, a shallow water table producing marshy areas and shallow ponds, and natural springs, played a significant role in human use of the area despite the low annual rainfall it receives (Simmons 1999).

The San Luis Lakes could also be the location of a mythical emergence place based on Upper Rio Grande Pueblo (Tewa) oral histories (Simmons 1999), such as that of the Santa Clara Pueblo in New Mexico; their creation story begins near sand dunes to the north. These and other topographic features of the valley, along with an elaborate prehistorically established trail system and various natural resources, such as mineral resources (gold, turquoise), flora, and fauna, would be important factors for prehistoric and historic settlement in the valley.

3.3.1 Prehistory

The earliest peoples known to have used resources present in the San Luis Valley are from the Paleo-Indian Era, dating from roughly 12,000 years before present to 7,500 years before present. The archaeological data suggest that Paleo-Indian groups were mobile hunter gatherers moving seasonally to exploit available natural resources. Although these groups initially hunted large animals (megafauna), such as mammoth and mastodon, they adapted to hunting bison and relatively smaller game animals and continued their reliance on wild plant foods as the larger megafauna became extinct. The San Luis Valley has the highest density of Paleo-Indian finds in Colorado. Distinctive Paleo-Indian projectile points from the Clovis, Folsom, and Plano periods have been found in the valley (Guthrie et al. 1984; Martorano et al. 1999). Additionally, bison kill sites have been recorded in the San Luis Valley. Folsom points in association with ancient bison remains are present at some of the more significant sites in the valley, such as those recorded in the northeast portion of Alamosa County (Guthrie et al. 1984; Martorano et al. 1999). In addition to bison, other animals of interest to Paleo-Indian hunters as well as later populations in the valley and surrounding mountains included elk, mountain sheep, and mule deer. It is postulated that proximity to Pleistocene water sources and animal migration routes were primary factors in site location for camps and activity areas during this time (Guthrie et al. 1984; Martorano et al. 1999).

The Archaic Era began about 7,500 years before present, characterized by changing subsistence patterns and tool production. Archaic Era projectile points are stemmed or notched varieties, rather than the large, lanceolate points of the Paleo-Indian Era, indicating a reliance on smaller game. Early Archaic (7,500 to 5,000 years before present) sites are present in the San Luis Valley. Many of these sites are located near the Rio Grande and contain characteristic tools made of local basalt (Guthrie et al. 1984). Continued use of the valley is documented by Middle Archaic (5,000 to 3,000 years before present) sites in Saguache County and in the northern portion of the valley. Late Archaic Period

(3,000 to 1,500 years before present) sites have been recorded throughout the valley as indicated in results from several surface surveys (Wells 2008). It is unclear based on the archaeological evidence when the Archaic Period classification should end as the lifestyle appears to continue throughout the Late Prehistoric Period.

The period between AD 500 and 1300 has been referred to as the Formative Era, which in most cases includes the presence of agriculture and sedentary villages. In the San Luis Valley, an archaic lifestyle of hunting and gathering probably continued during this time, also known as the Late Prehistoric Period. However, although sufficient evidence of agriculture and village life does not appear in San Luis Valley, some influences from Formative groups in the surrounding areas did occur. Several sites dating to this time period are known in the San Luis Valley as evidenced by the presence of ceramics, corn, and smaller projectile point sizes suggesting use of the bow and arrow (Martorano et al. 1999). Specifically, Pueblo ceramics, Northern Rio Grande ceramics, and Woodland ceramics characterize sites from this period within the valley, as well as diagnostic corner-notched points. Two rockshelters recorded in the region contained remnants of corn (Guthrie et al. 1984). The majority of known sites in the region dating to this period have been recorded near the San Luis Lakes and Great Sand Dunes in Alamosa and Saguache counties. Fewer sites have been identified in Conejos County; those that have been found are located along drainages or the bases of the San Juan Mountains or the Sangre de Cristo Range (Martorano et al. 1999).

3.3.2 Ethnohistory

Inhabitants of the valley during a transitional time between the Late Prehistoric Period and the beginning of Spanish contact (AD 1300 to 1600) would primarily have been the Utes, nomadic bands of hunters and gatherers traveling in small groups foraging for food. Similar to the Formative or Late Prehistoric period, diagnostic artifacts include corner-notched points and some ceramics. Other Native American groups that likely visited the area during this time are the Navajo, Apache, Kiowa, Comanche, Arapaho, Pueblo people (BLM 2009a) (mostly northern Pueblo groups), and Cheyenne (Martorano et al. 1999). Seasonal hunting was likely the predominant use of the valley. The Apache also claimed portions of the valley as their territory. Once the Ute and Apache started interacting with the Spanish, they obtained horses to help them hunt buffalo, trade goods, and fight. Artifacts indicative of this period in the Rio Grande Basin include Euro-American trade goods, such as guns, metal projectile points and knives, and metal cooking pots; projectile points for use with a bow and arrow; glass artifacts, such as flaked glass and beads; wickiups; and brown ware ceramics. Other features of archaeological interest include culturally peeled trees and rock art depicting horses (Martorano et al. 1999).

Native American human skeletal remains have been found in the San Luis Valley, including several burial sites in Saguache and Alamosa Counties (Martorano et al. 1999).

3.3.3 History

In 1598, Don Juan de Oñate took possession of New Mexico, including the San Luis Valley, for King Phillip II of Spain. The process by which the Spanish expanded across the frontier was through the issuance of land grants by the Spanish government. The San Luis Valley was initially administered by Spaniards in New Mexico but was designated La Tierra de los Indios (i.e., Indian Lands), so it was not initially authorized for Spanish settlement. Nevertheless, exploration, hunting, prospecting, and trading were conducted in the valley. Interactions between the Utes and the Spaniards/New Mexicans varied in outcome: friendly encounters resulted in trade of horses, food, material goods, and access to Indian trails; less-than-friendly encounters, in raids, thefts, and enslavements. Various raids and attacks were also occurring during this time among the various Native American tribes.

Lieutenant Zebulon Pike can probably be credited as the first American explorer of the valley. He traversed the area in 1807 in search of the Red River, the perceived boundary between the US and Spanish territories. He and his men built a fort along the Conejos River (mistaking it for the Red River) and raised a US flag on land that he later found to be within Spanish territory (as he was escorted by Spanish soldiers to Spain's capital city, Santa Fe) (Church et al 2007). Pike's Stockade, the first official fort in the region, is listed on the NRHP.

Numerous trading forts emerged to support the fur-trapping industry in the 1830s and 1840s. Utes were given guns and whiskey in exchange for livestock they had stolen from the New Mexicans; resistance to settlement continued. Three land grants were approved by the Mexican government for the San Luis Valley between 1821 and 1845. Numerous attempts at settlement between 1840 and 1850 failed, and resistance from Ute Indians forced settlers out of the area on several occasions. In 1846, the Mexican-American War broke out, and no attempts at settlement in the region were made. At the close of the war, the land was purchased by the US, and the New Mexicans became American citizens under the 1848 Treaty of Guadalupe Hidalgo. The first official non-Indian permanent settlement in Colorado, San Luis de la Culebra, was not established until 1851. San Luis is considered the oldest town in Colorado and is located in the southeast corner of the San Luis Valley. Hispanic farmers and ranchers continued settling in the region throughout the 1850s.

The US military established Fort Massachusetts in 1852 to help the new settlements survive. This fort was poorly located at the foot of Mt. Lindsey and was not in use for very long (BLM 2009a). A second fort, Fort Garland, was built further to the south and served the area for 25 years in support of westward expansion. A notable resident was Kit Carson, who served as commander of

the fort near the end of his career. Carson was instrumental in working with Ute Chief Ouray to ensure nonviolent settlement in the area. Men from Fort Garland also served in the only Civil War battle to take place in the West, at Glorietta Pass, to drive back Texas confederates. Buffalo Soldiers, African-American soldiers named as such by the Cheyenne, also served at Fort Garland between 1876 and 1879 (BLM 2009a).

In 1861, the area became part of the Colorado Territory, and Colorado achieved statehood in 1876. The ethnic and religious diversity of the valley continued to expand. Anglo settlers moved in under the Homestead Act of 1862. After 1870, Mormons also began settling in the valley. Cattle ranching on large tracts of land became the trend in the 1880s. Railroads established during the same decade brought waves of immigrants to the West. The next wave of settlement was in the 1920s with the arrival of Japanese-American tenant farmers in the valley (BLM 2009a).

3.3.4 Trails and Rails

Trails used by the early inhabitants of the valley did not go unnoticed by later visitors. It is likely that some trails started as migration routes used by large animals, including natural travel corridors along streams (Martorano et al. 1999). Not surprisingly, early hunters used the paths to track game for food and hides. Later, the same paths became conduits for trade. One trail system used throughout the history of the San Luis Valley, known as the Old Spanish Trail, was part of a much larger system of trails extending across several western states. Additional local paths through the area were also utilized for a long time by prehistoric peoples, Native Americans, explorers, trappers, military scouts, miners, and settlers.

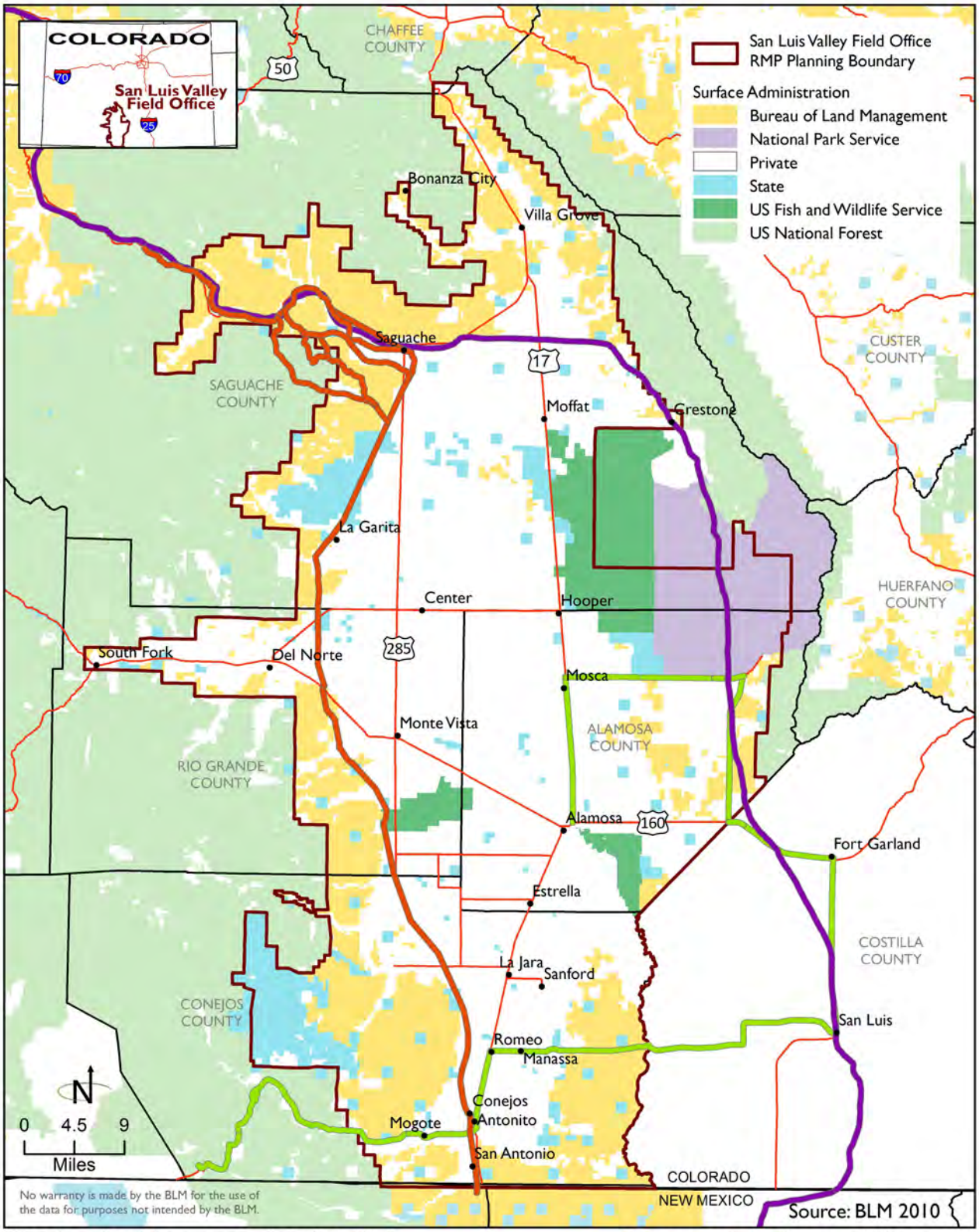
Two forks of the North Branch of the Old Spanish National Historic TrailOld Spanish Trail are present in the San Luis Valley. The East Fork straddles the base of the Sangre de Cristo Mountains before cutting west across the valley to head through a pass west of Saguache. The West Fork follows the base of the San Juan Mountains from New Mexico through Antonito and north to Saguache. The wetlands in the valley restricted movement through the interior. By the time of European exploration, many of the paths were well established and continued to be used. The Old Spanish Trail was likely used by Don Diego de Vargas in 1694, Juan Batista de Anza in 1779, Lieutenant Zebulon Pike in 1807, fur trapper Jacob Fowler in 1822, trapper Kit Carson throughout the 1830s and 1840s, several government expeditions between 1849 and1853 by John C. Fremont and Captain John Gunnison, and sheep herders in the 1850s to get sheep to the California Gold Rush camps. By the 1870s many of the trails had turned into well-worn wagon roads (Church et al., 2007). The East Fork has been congressionally designated as part of the National Historic Trail system under the National Trail System Act. The West Fork is not currently part of the National Historic Trail system but is undergoing evaluation for possible

inclusion. Trails and byways are shown in **Figure 3-7**, Historic Trails and Byways.

During the late nineteenth century, the Denver and Rio Grande Railroad heavily affected the cultural landscape of the valley. It was established in the 1870s when General William Jackson Palmer decided to try narrow-gauge tracks in the West to maneuver through the Rocky Mountains and steep passes in the Colorado Territory. His idea was very successful and spurred tremendous expansion and economic growth. Railroad towns, like Alamosa and Antonito, emerged in the San Luis Valley with a whole host of businesses to support them (restaurants, saloons, gambling establishments, bordellos, and so on). Mining, ranching, and agricultural markets expanded because of the new accessibility. The San Juan extension of the Denver and Rio Grande Railroad became known as the Cumbres & Toltec Scenic Railroad and was important for aiding in the establishment of the major Colorado towns of Durango and Silverton. The line, which runs to Chama, New Mexico, was taken out of regular passenger service in 1951. The Cumbres & Toltec Scenic Railroad is listed on the NRHP and is a tourist attraction for the area. Portions of the line near Antonito have also been designated as an ACEC to be managed by the BLM to protect its historical and scenic values.

3.3.5 National Register of Historic Places

Within Alamosa, Conejos, and Saguache Counties, 29 properties are listed on the NRHP. The majority of these properties are related to town (churches, courthouses, schools, stores, banks) and railroad (railcars, depots, tracks) development. Other property types include bridges, homesteads/ranches, forts, and archaeological sites. The Superintendent's Residence for the Great Sand Dunes National Park is also listed. The NRHP-listed Cumbres and Toltec Scenic Railroad is being nominated for National Historic Landmark status. Also related to the cultural heritage of the region, the Sangre de Cristo National Heritage Area was created in 2009. The heritage area encompasses Alamosa, Conejos, and Costilla Counties; management implications of the heritage area are not yet clear.



Historic trails with a quarter mile buffer. Pike's National Historic Trail (Proposed) not shown.

- West Branch Old Spanish Trail
- Old Spanish Trail National Historic Trail
- Los Caminos Antiguos Scenic Historic Byway

Historic Trails and Byways

Figure 3-1

3.3.6 Traditional Cultural Properties

Traditional cultural properties of significance to the Ute, Apache, Navajo, Kiowa, Arapaho, Comanche, Cheyenne, and Pueblo ancestral groups could be present in the valley. Government-to-government consultation is ongoing with these Native American Tribes, so that their concerns, including any potential impacts on traditional cultural properties, can be adequately addressed.

The Navajo may consider natural features, such as mountains; canyons; springs; areas containing significant plant species, clay sources, or minerals; and archaeological sites, such as battlefields, quarries, hunting traps, and other site types containing rock art, various types of cairns or stone caches, and certain artifacts, as culturally significant places. Blanca Peak has been identified as an important mountain of the Navajo, and protection of gathering rights for plants, soil, and spring water for ceremonies is an important concern. The Southern Ute have previously identified Great Sand Dunes National Park and the Baca Land Grant, near Crestone, as culturally significant areas. In addition, stone circles, stone structures and alignments, wickiups, platform burials and other burial sites, quarries, caves, cairns, rock art, rockshelters, and battle or massacre sites are all types of sites and features that could be of cultural significance to the Southern Ute. The Pueblo people have previously identified the San Luis Valley as a place of emergence for the Tewa peoples. Various researchers have suggested different locations within the valley as that emergence place, such as the Dry Lakes area and Great Sand Dunes National Park. The Taos Pueblo also have an emergence myth that suggests a location near Blanca Peak.

3.4 FISH AND WILDLIFE HABITAT AND SPECIAL STATUS SPECIES

3.4.1 Big Game Species

Rocky Mountain bighorn sheep (*Ovis canadensis*), pronghorn antelope (*Antilocarpa americana*), mule deer (*Odocoileus virginianus*), and elk (*Cervus canadensis*) occur frequently throughout the project area and are considered big game focal species. Hunting permits can also be purchased for both black bear (*Ursa americanus*) and mountain lion (*Felis concolor*).

Bighorn Sheep

Rocky Mountain bighorn sheep are associated with high mountains and steep canyons. They typically dwell on steep, precipitous terrain, in part because of human impacts. Bighorn sheep prefer high-visibility habitat dominated by grass, low shrubs, and rock cover. The bulk of their diet is grasses and grass-like plants, browse, and some forbs. Bighorn sheep are gregarious social mammals that have a high degree of site fidelity. This keeps a herd close to areas that are familiar and results in slow rates of territorial expansion rendering them vulnerable to increased stress levels when a disturbance occurs. Bighorn sheep are common near Trickle Mountain, Natural Arch/Eagle Rock, La Garita Canyon (Hells Gate), Alamosa Canyon, La Jara Canyon, Conejos Canyon, and the Sangre De Cristo Mountain Range.

Pronghorn Antelope

Pronghorn antelope occupy shrubland habitats and grasslands. Pronghorn have been observed in the foothills within moderately dense piñon/juniper woodland, ponderosa pine woodland, and in areas not noted previously in historical records. Although pronghorn herds within the SLVFO are generally significantly smaller than the large winter elk herds, this year-round resident tends to need extensive areas for both summer and winter browse.

Mule Deer

Mule deer occupy all habitat types from grasslands to alpine tundra. They reach their greatest densities in shrublands on rough, broken terrain that provides abundant browse and cover. There are relatively large numbers of mule deer in the SLVFO with corresponding sensitive mule deer habitat, such as fawning areas and severe winter habitat.

Rocky Mountain Elk

Elk can be found in most habitat types and elevations at least on a seasonal basis. They have large localized numbers in the SLVFO, occupy a relatively wide-spread distribution, use specific calving areas, and need broad areas of undisturbed severe winter habitat during harsh winters.

Black Bear

In Colorado, black bear is most common in montane forests and shrublands and in subalpine forests at moderate elevations. Bears are relatively adaptable and mobile animals. Bears do not tend to spend much time in the open, exposed, semi-desert shrub of the valley floor.

Mountain Lion

Mountain lions in Colorado primarily inhabit rough, broken foothills and canyon country, often in association with montane forests, shrublands, and piñon/juniper woodlands. Mountain lions are agile, highly mobile animals that do not spend a great amount of time in the open, exposed, semi-desert shrub of the valley floor. This species tends to avoid human habitation unless potential prey items, such as small livestock or pets, are readily present and available.

3.4.2 Small Mammals and Carnivores

Small mammals and carnivores are found in every habitat type. Small mammals in the San Luis Valley include several species of voles, shrews, mice, squirrels, chipmunks, rabbits, and hares. Orient Mine hosts a continentally-unique Mexican-Brazilian Free-tailed Bat summer roost. Other unique local species include pika and Gunnison's prairie dog (*Cynomys gunnisoni*), a federal candidate and BLM sensitive species. Examples of small carnivores include skunks, foxes, bobcats, coyotes, and badgers.

3.4.3 Reptiles/Amphibians

Reptiles may frequent habitats near water but are most commonly found in arid grasslands, shrublands, and areas of rocky outcrops. Some local species have

rather broad distributions and occur in a wide variety of habitats at low to moderate elevations. Examples include tiger salamander (*Ambystoma tigrinum*), short-horned lizard (*Phrynosoma hernandesi*), plateau lizard (*Sceloporus undulatus*), western rattlesnake (*Crotalus viridis*), bull snake (*Pituophis catenifer*), western chorus frog (*Pseudacris triseriata*), Great Plains toad (*Bufo cognatus*), Plains spadefoot (*Spea bombifrons*), Northern leopard frog (*Rana pipiens*) and western terrestrial garter snake (*Thamnophis elegans*). A variety of reptile and amphibian species are found in dry upland habitats and rocky canyons near areas where water is present (Hammerson 1999).

3.4.4 Migratory Birds

The Migratory Bird Treaty Act of 1918 (MBTA) protects all migratory birds and their parts (including eggs, nests, and feathers). The MBTA is a domestic law that enforces treaties between the US, Mexico, and Canada for the protection of a shared migratory bird resource. Executive Order 13186, enacted in 2001, directs federal agencies to take actions to implement migratory bird conventions, the MBTA, the Bald and Golden Eagle Protection Act, and other pertinent statutes. Subsequent to Executive Order 13186, an MOU was signed between the BLM and USFWS on April 12, 2010. This MOU identifies specific activities where cooperation between the two agencies will contribute to the conservation of migratory birds and their habitat.

Bald and Golden Eagle Protection Act and Avian Protection Plans for Renewable Energy

On July 9, 2010, the BLM issued IM No. 2010-156 titled "Bald and Golden Eagle Protection Act–Golden Eagle National Environmental Policy Act and Avian Protection Plan guidance for Renewable Energy." In this IM, the BLM gives direction for complying with the Bald and Golden Eagle Protection Act and identifies steps that may be necessary for projects that occur within the habitat of golden eagles to ensure environmentally responsible authorization and development of renewable energy resources. This IM primarily addresses golden eagles because a process to acquire take permits for bald eagles already exists. Consideration of golden eagles and their habitat must be incorporated into the NEPA analysis for all renewable energy projects.

Neotropical Migrants

Neotropical migrants are not covered in the current BLM SLVFO RMP (BLM 1991). Pursuant to the MBTA and the recent MOU signed between the BLM and USFWS in April 2010, the BLM will address the Birds of Conservation Concern list to determine potential effects of any proposed projects on bird species on the list that have potential to occur within the SLVFO. The SLVFO falls within Bird Conservation Region 16 (BCR 16), which includes parts of Colorado, New Mexico, Arizona, and Utah. Of the 27 species listed in BCR 16, five species (gray vireo [*Vireo vicinior*], veery [*Catharus fuscescens*], Grace's warbler [*Dendroica graciae*], chestnut-collared longspur [*Calcarius ornatus*], and black rosy finch [*Leucosticte atrata*]) do not occur or only have very rare

occurrence in the SLVFO. A sixth species, Bendire's thrasher (*Toxostoma bendirei*), is only present as a rare migrant. A total of 21 species from BCR 16 have nesting, foraging, and stopover habitat within the SLVFO. **Table 3-1**, USFWS Birds of Conservation Concern for Bird Conservation Region 16 and their Occurrence in the SLVFO, lists the names of the species that occur in BCR 16, describes their primary habitat, and indicates the species potential to occur within the SLVFO.

Most migratory bird use is limited to the summer period due to the harsh fall, winter, and spring months in the San Luis Valley. Birds generally arrive during late spring (April/May) and migrate from the area in early fall (August/September). The species present during summer are most likely breeding and rearing young. They leave as the weather changes in late summer. Most species on the BCR 16 list follow this migration pattern, although some species are present during the winter.

Waterfowl/Shorebirds

Wetland habitats are critically important as stopover, breeding, and roosting sites for migratory shorebirds and waterfowl in the central flyway. These occur in six primary wetland complexes and in numerous small tracts that occur throughout the SLVFO planning area. Common waterfowl species include mallards (*Anas platyrhynchos*), coots (*Fulica americana*), widgeon (*A. americana*), blue-winged teal (*A. discors*), green-winged teal (*A. crecca*), cinnamon teal (*A. cyanoptera*), bufflehead (*Bucephala albeola*), canvasback (*Aythya valisineria*), double-crested cormorants (*Phalacrocorax auritus*), gadwall (*A. strepera*), northern pintail (*A. acuta*), northern shoveler (*A. clypeata*), redhead (*Aythya americana*), ruddy duck (*Oxyura jamaicensis*), and Canada goose (*Branta canadensis*). Many priority species and species of concern use these habitats. For example, the only nesting site of snowy plovers in the San Luis Valley and one of the few in Colorado occurs on the Blanca ACEC and SRMA.

Nearly 140 plovers are counted annually at the Blanca wetlands nesting on alkali flats. Other nesting species include the white-faced ibis (*Plegadis chihi*) and black tern (*Chlidonias niger*). The white pelican (*Pelecanus erythrorhynchos*) is frequently observed during the summer months using the Blanca wetlands and the Rio Grande corridor. Long-billed curlew (*Numenius americanus*) is considered an occasional migrant, and has been well documented using the wetlands, particularly Blanca wetlands. Barrow's goldeneye (*Bucephala islandica*) is an uncommon migrant, with only scattered sightings.

Table 3-1
USFWS Birds of Conservation Concern for Bird Conservation Region 16 and their Occurrence in the SLVFO

Species Name	Associated Habitat Types(s)	Occurs in SLVFO?
Gunnison's sage-grouse (*Centrocercus minimus*)	Mountain Shrub, Sagebrush Shrubland, Low Elevation Riparian	Yes
American Bittern (*Botaurus lentiginosus*)	Wetlands	Yes
Bald Eagle (*Haliaeetus leucocephalus*)	Lakes and rivers	Yes
Ferruginous Hawk (*Buteo regalis*)	Grassland, Mountain Shrub, Semi-Desert Shrubland, Sagebrush Shrublands	Yes
Golden Eagle (*Aquila chrysaetos*)	Agricultural, Grassland, Cliff/Rock/Talus	Yes
Peregrine Falcon (*Falco peregrinus*)	Agricultural, Piñon-Juniper, Spruce-Fir, Ponderosa Pine, Cliff/Rock/Talus, Wetlands	Yes
Prairie Falcon (*Falco mexicanus*)	Agricultural, Grassland, Semi-Desert Shrubland, Cliff/Rock/Talus	Yes
Snowy Plover (*Charadrius alexandrines nivosus*)	Wetlands	Yes
Mountain Plover (*Charadrius montanus*)	Agricultural, Grassland, Semi-Desert Shrubland, Sagebrush Shrubland	Yes
Long-billed Curlew (*Numenius americanus*)	Shorelines	Yes
Yellow-billed Cuckoo (*Coccyzus americanus*)	Low Elevation Riparian, Wetlands	Yes
Flammulated Owl (*Otus flammeolus*)	Aspen, Ponderosa Pine, Mixed-Conifer, Spruce-Fir	Yes
Burrowing Owl (*Athene cunicularia*)	Grassland, Semi-Desert Shrubland, Sagebrush Shrubland	Yes
Lewis's Woodpecker (*Melanerpes lewis*)	Ponderosa Pine, Low Elevation Riparian	Yes
Southwestern Willow Flycatcher (*Empidonax traillii extimus*)	Willow-Riparian	Yes
Gray Vireo (*Vireo vicinior*)	Oak woodlands/scrub	No*
Piñon Jay (*Gymnorhinus cyanocephalus*)	Piñon-Juniper, Ponderosa Pine	Yes

Table 3-1
USFWS Birds of Conservation Concern for Bird Conservation Region 16 and their Occurrence in the SLVFO

Species Name	Associated Habitat Types(s)	Occurs in SLVFO?
Juniper Titmouse (*Baeolophus griseus*)	Piñon-Juniper Woodlands	Yes
Veery (*Catharus fuscescens*)	Dense riparian thickets, willow-riparian	No*
Bendire's Thrasher (*Toxostoma bendirei*)	Semi-Desert Shrubland	Rare; likely only present as migrant
Grace's warbler (*Dendroica graciae*)	Ponderosa pine	No*
Brewer's sparrow (*Spizella breweri*)	Sagebrush Shrubland	Yes
Grasshopper Sparrow (*Ammodramus savannarum*)	Grasslands	Yes
Chestnut-collared longspur (*Calcarius ornatus*)	Shortgrass Prairie	No*
Black Rosy Finch (*Leucosticte atrata*)	Spruce-fir forest; alpine	No*
Brown-capped Rosy Finch (*Leucosticte arctoa australis*)	Nests above timberline in alpine zone in cliffs, crevices; also utilizes spruce-fir forest	Yes
Cassin's Finch (*Carpodacus cassinii*)	Primarily spruce-fir, but also mixed-conifer forest	Yes

* Excluded from analysis because the species does not occur or has very rare migratory occurrence in the SLVFO.
Source: BLM 2011

3.4.5 Federal Threatened, Endangered, and Proposed Wildlife Species

Table 3-3, Federally Threatened, Endangered, and Proposed Species within the SLVFO, describes the list of federally listed and proposed species within the SLVFO. Three federally listed species, Canada lynx, Mexican spotted owl (*Strix occidentalis*), and southwestern willow flycatcher (*Empidonax traillii extimus*), as well as one species proposed for listing, the mountain plover (*Charadrius montanus*), will be evaluated further in this analysis due to known occurrence and/or potential suitable habitat within the project area. In their August 4, 2011 species list concurrence letter for the San Luis Valley Public Lands Center, which applies to both the SLVFO and the Rio Grande National Forest, the USFWS stated that no habitat exists within the SLVFO for the Uncompahgre fritillary butterfly. As such, this species will not be evaluated further.

Table 3-2
Federally Threatened, Endangered, and Proposed Species within the SLVFO

Species	Status[1]	Critical Habitat	Species Occurrence
		Mammals	
Canada lynx *Lynx canadensis*	T	No	Known occurrence, denning, winter foraging, summer foraging habitat available.
		Birds	
Mexican spotted owl *Strix occidentalis*	T	No	No known occurrence. Suitable habitat in steep canyons.
Mountain Plover *Charadrius montanus*	P	No	Known occurrence. Suitable habitat within grassland, desert-scrub habitat, and barren agricultural fields. Often associated with presence of prairie dog colonies.
Southwestern willow flycatcher *Empidonax traillii extimus*	E	No	Known occurrence; suitable habitat in riparian systems.
		Insects	
Uncompahgre fritillary butterfly *Boloria acrocnema*	E	No	No known occurrence; No suitable habitat in SLVFO on BLM lands.

1 T: federally threatened; E: federally endangered; P: proposed for listing
Source: BLM 2011

Canada Lynx

Canada lynx (Federal Threatened) are found at higher elevation early-successional and late mixed conifer forests. Aspen/willow/shrub-steppe is used for foraging. Late-successional forests are used for denning, as well as winter foraging. Lynx are typically associated with large tracts of higher elevation boreal or coniferous forest that is often interspersed with rock outcrops, bogs, and thickets. Lynx habitat in Colorado is found within the subalpine and upper montane forest zones, typically between 8,000 and 12,000 feet. Lynx habitat is not abundant within the SLVFO and represents only 7,658 acres (0.4 percent) of the total mapped lynx habitat (all ownerships) in the San Luis Valley.

Mexican Spotted Owl

Mexican spotted owls (Federal Threatened) do not occur uniformly throughout their range, but rather in disjointed localities that correspond to isolated mountain systems and canyons. All known Mexican spotted owl pairs in Colorado use canyon habitats for nesting. Mexican spotted owls have not been found in the San Luis Valley, but suitable habitat is available in steep canyon habitat with ponderosa/pine, Douglas fir, and piñon/juniper forest types (USFWS 1995; USFS 1993).

Mountain Plover

The mountain plover (Federal Proposed) is a small terrestrial shorebird inhabiting open flat lands with sparse vegetation. The mountain plover is found on xeric (extremely dry) shrublands, shortgrass prairie, barren agricultural fields, and other sparsely vegetated areas. Mountain plovers breed in the

western Great Plains and Rocky Mountain States from the Canadian border to northern Mexico. Most breeding occurs in Montana, Wyoming, and Colorado. They winter in similar habitat in California, southern Arizona, Texas, and Mexico.

Within the SLVFO, Mountain Plover are documented in the southwest part of the valley with a single data point in the far southeastern part of the San Luis Valley (Colorado Natural Heritage Program 2006). Another three locations have been recorded north of the town of Saguache.

Southwestern Willow Flycatcher

Southwestern willow flycatchers (Federal Endangered) breed in relatively dense riparian tree and shrub communities with a co-occurring dense understory. The habitat is generally located near slow-moving or standing water. Suitable habitat occurs within riparian areas along rivers, streams or other wetlands, where dense growths of willows or other shrub and medium sized trees are present, often with a scattered overstory of cottonwood (USFWS 2002).

3.4.6 BLM Sensitive Species

The BLM sensitive species addressed in this analysis are derived from the Colorado State Director's Sensitive Species List, last revised November 20, 2009. The North American wolverine (*Gulo gulo*), designated as a candidate species on December 14, 2010, and the Yuma myotis (*Myotis yumanensis*), which had been included in the previous State Director's list, but was inadvertently omitted from the revision, have both been included in this section.

Gunnison's Prairie Dog

Gunnison's prairie dog is listed as a Federal Candidate species and is therefore included in the BLM sensitive species list. Gunnison's is the only species of prairie dogs found within the SLVFO planning area. There are several areas within the SLVFO where Gunnison's prairie dog is locally abundant.

New Mexico Meadow Jumping Mouse

The New Mexico meadow jumping mouse (jumping mouse) is a Federal Candidate species and is endemic to New Mexico, Arizona, and a small area of southern Colorado (Hafner et al. 1981; Jones 1999). The elevation limit for this species is approximately 8,000 feet. It is possible that the San Luis Valley is not populated with the New Mexico meadow jumping mouse due to the elevation. Until sufficient jumping mouse-focused surveys are completed, this species will be treated as having potential suitable habitat in the San Luis Valley.

Yellow-billed Cuckoo

The yellow-billed cuckoo (cuckoo) is listed as a Federal Candidate species and BLM sensitive species. The only known cuckoo populations in the SLVFO are in the low elevation riparian woodlands in cottonwood galleries and willow thickets on the McIntire-Simpson property complex in Conejos County along the Conejos River. However, additional sightings have been recorded in the

SLVFO. Major threats to cuckoo abundance include habitat loss and fragmentation, pesticides, alteration of hydrological features such as water diversions and dams, and grazing degradation of habitat (especially impacts on understory vegetation).

Rio Grande Cutthroat Trout, Rio Grande Chub, Rio Grande Sucker

All three of these species of fish have similar clean, cool-water habitat requirements. Rio Grande cutthroat trout (Federal Candidate) has the greatest distribution while the Rio Grande chub has the most limited (documented in only a single creek within the SLVFO). Core habitat exists in creeks that feed into the Saguache Creek, Carnero and La Garita Creeks, and San Francisco Creek.

The Rio Grande sucker has been documented in a single feeder creek downstream of Browns Creek on USFS lands (upstream of BLM), in two branches of Carnero Creek, in San Francisco Creek, in Hot Creek and in two feeder creeks to the Conejos River on the southwestern side of the San Luis Valley. The Rio Grande chub is documented in Hot Creek and a feeder creek to the Conejos River on the southwestern side of the valley. Rio Grande cutthroat trout occurs in Tuttle Creek and has limited occurrences in the Carnero Creek drainage.

A Conservation Agreement for Rio Grande Cutthroat Trout has been developed to expedite implementation of conservation measures for Rio Grande Cutthroat Trout (RGCT) in Colorado and New Mexico. The overall goal of this agreement is to assure the long-term viability of RGCT throughout their historic range. Areas that currently support RGCT will be maintained, while other areas will be managed for increased abundance. The agreement's goals and objectives will be reached by implementing specific management actions detailed in existing Conservation Plans for Rio Grande Cutthroat Trout in Colorado and New Mexico and in existing and future conservation agreements/ strategies and management plans. The conservation plans would be considered in future site specific analysis for leases or projects that fall within the RGCT habitat.

Milk Snake

While habitat for this species is not well understood, it generally occurs below 8,000 feet in prairies, shrubby hillsides, canyons, ponderosa pine, piñon-juniper, and river valleys (CPW 2011). There is a historical occurrence of milk snake in agricultural habitat within the SLVFO.

Northern Leopard Frog

This frog generally inhabits permanent water with rooted aquatic vegetation and may travel far from water during wet, mild weather (NatureServe 2011, CPW 2011). Wintering sites are usually underwater, though some frogs possibly overwinter underground (NatureServe 2011). This species is known to occur

within the SLVFO and suitable habitat exists along healthy riparian systems, wetlands, and in the backwaters of the Rio Grande River.

Big Free-tailed Bat

This bat occurs at lower elevations and frequents rocky or canyon country where it roosts in crevices (CPW 2011). Maternity colonies may occupy the same crevice in successive years (NatureServe 2011). The species is rare in Colorado and there is no known occurrence within the SLVFO.

North American Wolverine

Wolverines inhabit a wide variety of arctic, subarctic and alpine habitats, including coniferous forests. They require large areas of suitable, high-elevation habitat, and it is estimated that there are fewer than 400 individuals in the contiguous US (CPW 2011). In 2009, a wolverine was tracked from Utah into north-central Colorado (CPW 2011). The species was historically documented on the Rio Grande National Forest, and a small amount of potential habitat exists within the SLVFO.

Yuma Myotis

Yuma myotis is found in a variety of upland and lowland habitats but is usually found near open water. Nursery colonies are usually in buildings, caves and mines, and under bridges (NatureServe 2011). The species is known to occur in the SLVFO. Suitable habitat is present in semi-arid canyonlands and mesas at lower elevations.

Townsend's Big-eared Bat

This bat inhabits mines, caves, and structures in woodlands and forests to elevations above 9,500 feet. The species is generally solitary or gathers in small groups, although females may gather in larger maternity colonies in summer (CPW 2011). Townsend's big-eared bat is known to occur in the SLVFO. Suitable habitat is present in caves, abandoned mines, and cliffs; and the species forages over water, along vegetation edges, and over sagebrush.

American White Pelican

Habitat for this species includes rivers, lakes, reservoirs, and open marshes. Pelicans nest and roost on islands and peninsulas (NatureServe 2011). American white pelican is known to occur in the SLVFO and suitable habitat exists in the Blanca wetlands, McIntire-Simpson complex, and in the Rio Grande corridor.

Bald Eagle

The bald eagle was originally listed as endangered on February 14, 1978 (USFWS 1978). The bald eagle population in Colorado has gradually increased since then, with up to 1,000 wintering bald eagles documented in Colorado in 1995 (Gross 1998). On August 9, 2007 the bald eagle was delisted, but protection is still afforded by the Bald and Golden Eagle Protection Act of 1940. Breeding and wintering bald eagles are known to use the San Luis Valley floor. Bald eagles have been documented nesting on private lands at high elevations

and using winter roosting sites on public lands. The Rio Grande and Conejos River both have large expanses of bald eagle habitat and provide significant winter roosting sites. Wintering and breeding sites also exist in natural and managed wetland areas on the floor of the Valley, with roosting sites existing in the Blanca wetlands and McIntire-Simpson property.

Bald eagles are found from November to April along rivers, lakes, reservoirs, and stream corridors with open branched trees such as cottonwoods, pine, and spruce-fir stands.

Ferruginous Hawk

This hawk utilizes open country, sagebrush, semi-desert shrubland, and the periphery of woodlands. It nests in a variety of habitat types including grasslands, tall trees or willows along streams, and cliff ledges (NatureServe 2011). Ferruginous hawk is known to occur in the SLVFO and a nest site has been documented in the Mogotes Flat Allotment. The species likely uses the SLVFO for foraging and nesting.

Gunnison Sage-grouse

Historically, the Gunnison sage-grouse occupied suitable habitats in several portions of the San Luis Valley (Rogers 1964). All sage-grouse in the valley were thought to be extirpated by the 1950s. The CPW and BLM reintroduced 30 to 32 birds in the Poncha Pass area from the larger population in the Gunnison Basin in 1971 and 1972 (Gionfriddo 2002). There may have been more than 100 birds present by the mid-1980s (Gionfriddo 2002). A sharp decline in sage-grouse numbers in the Poncha Pass area occurred between 1992 and 1999, with 1999 surveys indicating that the population was critically low and in danger of disappearing (Gionfriddo 2002). Additional transplants occurred between 2000 and 2003 to augment the population. Only three Gunnison sage-grouse individuals were detected in the Poncha Pass area in the 2010 surveys. All sage-grouse populations are closely associated with sagebrush for their needs. This relationship is the strongest with varieties of big sagebrush. Use of different sagebrush habitats occurs between seasons although this pattern generally involves dense stands of mature sagebrush for nesting and wintering sites, open areas for breeding displays (leks), and semi-open grassy riparian areas for rearing and/or foraging habitat for young chicks. Sage-grouse prefer extensive open sagebrush areas with few if any trees (Connelly et al. 2000).

Suitable nesting habitat for the Gunnison sage-grouse has been characterized as big sagebrush stands within two miles of leks that have at canopy closure of at least 20 percent and an average height of 16 inches (Gunnison Sage-grouse Working Group 1997). An estimated 80% percent of the Gunnison sage-grouse nesting occurs within 4 miles of a lek (Gunnison Sage-grouse Rangewide Steering Committee 2005). Brood-rearing habitat for Gunnison sage-grouse has been defined as riparian plant communities associated with intermittent and perennial streams, springs, seeps, and meadows that are within upland areas or

along the edge of agricultural hay meadows (Gunnison Sage-grouse Working Group 1997). Gunnison sage-grouse are basically non-migratory and use similar brood-rearing habitat throughout the summer and fall (Gunnison Sage-grouse Working Group 1997).

Sage-grouse feed during winter almost exclusively on the leaves of sagebrush. Diet and winter cover needs prompt them to select sagebrush stands with greater canopy closures and taller shrubs, where they will primarily remain until the next nesting season.

Northern Goshawk

This species nests in a wide variety of forest types, including deciduous, coniferous, and mixed forests. Typically, it uses mature or old-growth forests for nesting and generally occurs in remote, undisturbed habitats (NatureServe 2011). While limited nesting habitat occurs in the SLVFO, the species has been documented and is likely to use the area for foraging.

Burrowing Owl

This owl uses generally open areas, such as grassland and semi-desert shrub habitats, and is sometimes found near disturbed areas, such as airports. It nests in abandoned burrows that have been dug out by prairie dogs, squirrels, or other small mammals, and is generally found on the ground or on low perches (NatureServe 2011). Burrowing owl has been documented within the SLVFO and is found near prairie dog towns within shrub-steppe habitat.

Western Snowy Plover

This bird species is an uncommon spring and fall migrant and summer resident in Colorado. Breeding birds occur on alkali flats around reservoirs and migrants occur on mudflats and sandy shorelines (CPW 2011). Western snowy plover has been documented nesting and foraging in the Blanca wetlands within the SLVFO.

Brewer's Sparrow

This species is strongly associated with sagebrush in areas with scattered shrubs and short grass. However, it can also be found to a lesser extent in other shrublands, grasslands with shrubs, and in large openings in piñon-juniper (NatureServe 2011). This species is known to occur within the SLVFO.

White-faced Ibis

This bird is found in freshwater habitats such as marshes, swamps, ponds, and rivers. It nests in marshes, low trees, on the ground in bulrushes or reeds, or on a floating mat (NatureServe 2011). White-faced ibis is known to occur within the SLVFO and suitable habitat occurs in the Blanca wetlands, McIntire-Simpson wetland complex, and along the Rio Grande corridor.

Black Swift

This generally aerial species forages over forests and in open areas. It nests behind or next to waterfalls and wet cliffs, often in dark inaccessible sites. This species is known to occur within the SLVFO.

American Peregrine Falcon

Peregrine falcons use various open habitats, especially where there are nearby nesting cliffs, as well as open forested areas and human population centers. The species forages over farmlands, marshes, river valleys, and in human disturbed areas (NatureServe 2011). This species is known to occur within the SLVFO.

3.4.7 Federal Threatened, Endangered, and Proposed Plant Species

There are no federally threatened, endangered or proposed plants or any designated critical habitat for such plants in or near the project area. Therefore, there are no federally threatened, endangered or proposed plants species that will be affected during implementation of the SLVFO RMP Amendment/EA.

3.4.8 BLM Sensitive Plant Species

The BLM sensitive plant species addressed in this analysis are derived from the November 20, 2009 list, which is the most current revision. There are five BLM sensitive Species plants known to occur or have potential to occur within the SLVFO. Those include Ripley's milkvetch (*Astragalus ripleyi*), slender spiderflower (*Cleome multicaulis*), fragile rockbrake, rock-loving neoparrya, and pale blue-eyed grass (*Sisyrinchium pallidum*).

Ripley's Milkvetch

Ripley's milkvetch occurs in canyons and mesa top woodlands at the southwestern perimeter of the San Luis Valley. It is known to occur in limited areas straddling the Colorado-New Mexico border in the Rio Grande and Conejos River valleys. This species is found in grassy ponderosa pine or aspen savannas and in sagebrush and rabbitbrush flats adjacent to watercourses. It grows mainly in soils derived from the volcanic rocks of the San Juan Mountains. Ripley's milkvetch blooms late June to July (Colorado Native Plant Society 1997).

The northern-most documented extent of Ripley's milkvetch is in the Bishop Rock area, southwest of Monte Vista, Colorado. There are numerous documented locations for this species along the western edge of BLM/USFS interface lands on the southwest side of the valley.

Slender Spiderflower

Slender spiderflower occurs around margins of moist, slightly saline depressions, old lakebeds, and greasewood and creosote bush stands. In Colorado, slender spiderflower occurs in the San Luis Valley, where it typically grows in narrow bands about a foot wide in moist soil just outside stands of the rush *Juncus ater*. In other settings, large clusters or even sizeable patches of slender spiderflower

occur, always in very wet, alkaline soils. This species blooms between mid-July and mid-August (Colorado Native Plant Society 1997).

The known SLVFO locations (BLM 2006) for this species are mostly clustered on the east-central part of the valley and across the Blanca wetlands. There is an additional, non-clustered data point for slender spiderflower southeast of the USFWS Alamosa Refuge.

Fragile Rockbrake, Slender Cliffbrake

Fragile rockbrake can be found in moist, shaded ledges, usually on limestone cliffs. This plant belongs to the Pteridaceae family. Fragile rockbrade grows to about 2 to 4 inches. It is a deciduous plant, disappearing by late summer. The spores of this plant are found at the edges of fertile fronds, partially covered by rolled edges of the leaves. The leaf stalk is green above, brown at base, and has a smooth appearance. The fertile (spore-bearing) fronds have a different shape from the sterile fronds. The fertile fronds have narrower leaflets, and the overall frond size is usually larger. Species identification period for this non-flowering plant is June through August (Kershaw et al. 1998). There are no known occurrences of fragile rockbrake on BLM-administered lands in the SLVFO.

Rock-loving Neoparrya, Bill's Neoparrya

Several small populations of rock-loving neoparrya have been found in Chaffee, Saguache, Rio Grande, Conejos, and Huerfano counties. They generally occur on volcanic rocks. This species occurs in the northeast, west-central, southwest, and southeast parts of the San Luis Valley, primarily on BLM lands. Additional populations have been documented north of Poncha Pass, just outside of BLM lands. Rock-loving neoparrya blooms from May through early July (Colorado Native Plant Society 1997).

Pale Blue-eyed Grass

Pale blue-eyed grass is found in only a few scattered populations in Saguache, Park, Jackson, and Larimer counties in Colorado and in Albany County in Wyoming. Pale blue-eyed grass has one known data point in the very northern part of the San Luis Valley, not far from Poncha Pass. A second data point for this species appears north Poncha Pass and north of the Sangre de Cristo Mountains. It occurs in fens and poorly drained meadows at about 7,000 to 10,000 feet in elevation and blooms from late June to July (Colorado Native Plant Society 1997). Although this species has a very limited distribution within the SLVFO, it does occur in the northern part of the valley.

3.5 FLUID MINERALS

The San Luis Basin is a known oil- and natural gas-producing region (Burnell et al. 2008). Although the whole San Luis Basin area has been identified in the BLM's SLVFO RMP (BLM 1991) as an area of low potential for oil and gas development, most of the area is open for discretionary mineral leasing, including leasing for oil and gas and for other fluid minerals (e.g., geothermal resources). Although much of the SLVFO was leased for oil and gas at one time,

at present there is only one oil and gas lease, south of Del Norte, being considered for drilling and possible production.

There are 17 authorized oil and gas leases (10,133 acres) in the SLVFO and one geophysical project (40 acres). The leases include 7 competitive (5,518 acres) and 10 non-competitive leases (4,615 acres). There are no current BLM geothermal leases or authorized uses in the SLVFO (LR 2000). There are, however, at least four private commercial users of geothermal resources in the San Luis Valley.

Areas of the eastern San Luis Valley have higher geothermal potential than the western portion of the valley. Currently all geothermal development within the San Luis Valley has been in the form of direct use applications completed on private landholdings. The developments have included aquaculture, spa/recreation facilities, and indirect direct under-floor heating of businesses, domestic hot water use and space heating, and greenhouse heating. There are currently no proposals for geothermal development on federal lands in the San Luis Valley. There are no BLM geothermal leases or authorized uses in the SLVFO.

3.6 GEOLOGY AND SEISMICITY

The San Luis Valley is in the Southern Rocky Mountains physiographic province, which extends from central New Mexico north through Colorado to the Wyoming state line. The defining feature of this physiographic province is mountains formed by compression approximately 70 to 40 million years ago. In Colorado this compression was followed by the eruption of a 9,000-square-mile volcanic field, the San Juan volcanic field; peak volcanism was about 33 million years ago. Lavas and ash spread from this field into the surrounding areas, including what was to become the San Luis Valley, and volcanism continued into the early development of the structure that forms the valley. Starting about 28 million years ago extensional forces started to pull the mountains apart in the region of the Southern Rocky Mountains, forming a system of roughly north-south elongated valleys or basins. These basins are known as rift basins and are collectively known as the Rio Grande rift. As a system they extend from Leadville, Colorado, to Big Bend National Park in Texas. They are characterized by high heat flow, which contributes to the geothermal resources in New Mexico and Colorado. The San Luis Valley is the largest and deepest of these basins (Morgan 2012).

Volcanism associated with the San Juan volcanic field continued through much of the early development of the San Luis rift basin; much of the western side of the basin is filled with lava flows and volcanic ash. The San Juan Mountains are the erosional remnant of volcanism in the San Juan volcanic field. After about 30 million years ago, volcanic activity became more widespread in Colorado. About 23 million years ago (early Miocene) the frequency and magnitude of volcanism

decreased with more common basaltic eruptions, which continue to the present (Morgan 2012).

The San Luis Valley is an alluvium-filled basin within the Southern Rocky Mountain physiographic province in south-central Colorado. The San Luis Valley is part of the San Luis Basin, an intermountain structural depression within the Rio Grande Rift zone (Burroughs 1974, 1981; Emery 1979). This depression is filled with 5,000 to 7,000 feet of alluvial fan gravel, volcanic debris, and interbedded basaltic flows of the Pliocene and Pleistocene undifferentiated Santa Fe and Alamosa formations. Quaternary stream deposits, pediment gravels, and alluvial fan materials mantle most of the valley floor, while a smaller part of the floor is overlain by dune deposits that are younger than most of the alluvium.

The Sangre de Cristo Range is a structurally complex area that includes extensive outcrops of Precambrian crystalline rocks, Paleozoic clastic sedimentary rocks, and rare Tertiary intrusives. Mineralization occurs primarily in veins and fissures in the Precambrian rocks and as replacements and veins in the sedimentary rocks. No mineralization occurs in the valley-fill sediments. Large volumes of aggregate occur in recent alluvial activity.

Seismic activity associated with earthquakes in Colorado is considered to be low to moderate, with a slightly higher risk in and around the Rio Grande Rift zone (Kirkham and Rogers 1981). The Rio Grande Rift is considered to be an area where the peak horizontal 7 acceleration with a 10 percent probability of exceedance in 50 years is very low (between 0.05 and 0.06 gravity). The rift zone is an extensional stress regime and consists of a series of grabens (fault-bounded basins) that extend along the northeast-oriented rift axis. It is currently dormant; however, earthquakes could occur as a result of movement along existing normal faults within and along the boundaries of the San Luis Basin (Blume and Sheehan 2002).

Downward displacement is to the west of the fault line, thereby creating prominent topographic scarps along the west side of the San Luis Basin (Kelson et al. 2004; Personius and Machette 1984). The Southern Sangre de Cristo fault system occurs 4 to 9 miles to the east of the Mesita fault and forms the border between the Sangre de Cristo Mountains and the San Luis Valley. Slip along this fault system uplifted the Sangre de Cristo Mountains to elevations greater than 14,000 feet. Although this fault system has been historically inactive, large fault scarps suggest late Pleistocene and Holocene movement (as recent as 5,000 years ago) along much of its length and past earthquakes of magnitude 7.0 to 7.3. The trace of the Southern Sangre de Cristo fault system is buried by landslide debris (Crone et al. 2006; Blume and Sheehan 2002; McCalpin 1986).

3.7 HEALTH AND SAFETY

Given the lack of public access to the majority of lands within geothermal exploration and production areas, health and safety risks to the public due to activities related to geothermal resource are typically low. Occupational hazards

would be limited to project employees and contractors, rather than the general public. The potential for impacts related to the use of hazardous materials would be reduced by implementing a Hazard Communication Program, Spill Prevention Control and Countermeasure Plan, and other mitigation measures. Although a heightened risk of wildfire would occur in some areas, the risk to the public would be minimal.

Hazardous materials present in geothermal exploration, development, production and abandonment include many of those used and produced in association with all fluid mineral drilling, completion, and production. Hazardous materials anticipated to be used geothermal exploration or production well projects generally could include drilling materials, cementing and plugging materials, fracturing materials, production products, fuels, pipeline materials, emissions, compressor/pump station materials, and other miscellaneous materials.

The BLM, Colorado Department of Public Health and Environment, EPA, Occupational Health and Safety Administration, US Department of Transportation, Colorado Oil and Gas Conservation Commission, CPW, CDWR, and possibly other state, federal or local government agencies may each regulate certain safety aspects of fluid mineral development. The primary federal regulations related to health and safety requirements for fluid mineral operations are specified under 43 CFR Ch. II, subpart 3162.5. These regulations require the prior BLM approval of a drilling and operations plan that addresses the procedures to be employed for protection of environmental quality, including safety precautions, control and removal of waste, spill prevention, fire prevention, and firefighting procedures.

Potential health and safety impacts associated with geothermal projects are similar to those associated with other existing fluid mineral development. Risk of certain types of impacts would increase as the amount of geothermal development increases. Potential health and safety impacts include occupational hazards associated with geothermal exploration and development, risk associated with vehicular travel on improved and unimproved roads, and range fires.

3.8 LAND USES

BLM public lands are used for a variety of purposes. Major focus areas for the lands and realty program include land ownership adjustments, mineral estate, rights-of-way, other leases or permits, utility corridors, and communication sites. Wind and solar renewable resource production is also permitted by rights-of-way through the lands and realty program.

The goals of the lands and realty program are to manage public lands to support the goals and objectives of other resource programs, provide for uses of public lands in accordance with regulations and compatibility with other resources, and improve management of public lands through land ownership adjustments. The

lands and realty program is a support program to all other resources to help ensure that BLM-administered public lands are managed to benefit the public.

BLM land use authorizations consist mostly of rights-of-way pursuant to 43 CFR 2800. The uses authorized include, but are not limited to, roads and highways, utility lines for both electrical and telephone service, fiber optic lines, communication sites, water pipelines, and irrigation ditch facilities. Road rights-of-way include authorizations for four-wheel drive two-track routes that provide access to electrical transmission lines, small single-lane "driveways" for individual landowners, more highly developed double-lane access routes for subdivisions, and the federal, state, and county road systems. Power line rights-of-way range from authorizations for small kilovolt service lines for single or multiple residences to large kilovolt double wood-pole transmission lines to the very large steel structured Western Area Power Administration transmission facility constructed through the middle of the planning area. Telephone and fiber optic rights-of-way include aerial and buried systems. There are two communication sites in the planning area: the Zapata site and the Saguache Limited Partnership in the Limekiln Travel Management Area.

Three major highways traverse the San Luis Valley. Colorado State Highway 17 (CO 17) runs north to south through the communities of Villa Grove, Alamosa, and Conejos. US Highway 285 (US 285) runs parallel to CO 17 through the community of Saguache. The primary west to east highway travel route through the valley is US Highway 160 (US 160), which intersects CO 17 at Alamosa. The Colorado Department of Transportation (CDOT) is responsible for maintaining the highway system.

3.9 LANDS WITH WILDERNESS CHARACTERISTICS

The BLM Washington Office Instruction Memorandum 2011-154, "Requirement to Conduct and Maintain Inventory Information for Wilderness Characteristics and to Consider Lands with Wilderness Characteristics in Land Use Plans," requires BLM part to maintain an updated inventory of Lands with Wilderness Characteristics (LWCs) (BLM 2011b). As directed by the IM, the San Luis Valley Field Office (Field Office) assessed public lands within the Field Office in 2012 to determine whether wilderness characteristics are present outside of existing wilderness study areas (WSAs), and within the congressionally-designated Rio Grande Natural Area. The BLM reviewed original 1980 wilderness inventories, lands identified by BLM staff, and lands proposed by the public in order to identify lands with potential wilderness characteristics. Of the eleven areas identified through the review, only the San Luis Hills WSA was found to possess wilderness characteristics. The complete inventory is included in **Appendix G**, San Luis Valley Field Office Wilderness Characteristics Inventory: 2012 Update for reference.

3.10 LIVESTOCK GRAZING

The SLVFO includes 132 livestock grazing allotments. Many of these allotments contain interspersed state and private lands. Allotments cover a total of 487,700 acres of BLM surface or BLM split estate lands. BLM grazing permits allow specific ranchers or permittees to utilize these allotments for livestock grazing. These permits contain specific guidelines for use, such as livestock numbers and livestock type, authorized seasons/periods of use, and alternating rotational schedules. Grazing use is managed in accordance with specific Guidelines for Livestock Grazing in Colorado (BLM 1997).

In accordance with the conditions listed on BLM allotment permits, permittees are required to be given a two-year notice prior to any permit changes that would affect their grazing operation. Examples would include land use changes within their allotments, boundary alterations, land exchanges, or other changes to the permit that would affect the number of animal unit months permitted for their allotment.

3.11 NOISE

The federal law that directly affects noise control is the Noise Control Act of 1972, as amended by the Quiet Communities Act of 1978 (42 USC 4901-4918). This Act delegates to the states the authority to regulate environmental noise. It also directs government agencies to comply with local community noise statutes and regulations and to conduct their programs to promote an environment free of any noise that could jeopardize public health or welfare. More specifically, BLM regulations mandate that noise at one-half mile—or at the lease boundary, if closer—from a major geothermal operation shall not exceed 65 A-weighted decibels (dBA) (43 CFR 3200.4[b]).

Background noise is the noise from all other sources than the source of interest (e.g., geothermal operations). The background noise level can vary considerably depending on the location. Some areas within the San Louis Valley are exceptionally quiet. The NPS National Sounds Program collected noise data at Great Sand Dunes National Park in 2008 and 2009. Recent analysis of the data indicated a daytime natural ambient of 20.5 dBA and a nighttime natural ambient of 10 dBA. This represents the lowest level ever recorded in a national park. Manmade background noises in the planning area include agricultural activities, recreation activities (including mechanized and motorized uses), oil and gas development, and aircraft over-flights.

The San Luis Valley experiences noise from vehicle traffic, agricultural production, household noise (such as lawn maintenance, vehicle repair, house repair), and general day-to-day activities of the population.

3.12 PALEONTOLOGICAL RESOURCES

Some surveying for paleontological resources has been conducted in the SLVFO. The potential for paleontological resources to occur in the larger SLVFO has been updated in the last several years for planning purposes (Harley Armstrong,

BLM Regional Paleontologist - personal communication). The current "Potential Fossil Yield Classification" (PFYC) is based on updated reports of fossil finds after the initial assessment in 1983 by K. Don Lindsey, then the Curator of Paleontology at the Denver Museum of Nature and Science. Although several geological formations in the SLVFO have produced fossils elsewhere in the region, such fossils have not always been found to be as abundant in the SLVFO; this finding could possibly be due to a lack of sufficient sampling, or a relative lack of access to exposed geologic unit outcrop. Most SLVFO fossils have been Paleozoic marine invertebrates and Tertiary vertebrates consistent with the types of sedimentary rocks found in the area (Lindsey 1983; Harley Armstrong, personal communication). The western part of the valley is tertiary volcanic tuffs, flows, and breccias. These igneous and metamorphic deposits are not expected to contain significant paleontological resources (Lindsey 1983; BLM Colorado PFYC spreadsheet and map - Harley Armstrong, personal communication).

Occurrences of paleontological resources are closely related to the geologic units that contain them, and the potential for finding important paleontological resources can be broadly predicted by the presence of the pertinent geologic units at or near the surface. Therefore, geologic mapping can be used as a proxy for assessing the potential occurrence of important paleontological resources. The acreage of BLM surface ownership has been calculated by geologic class. Approximately 36 percent of BLM surface land falls within either PFYC Class 3 or 5. Class 3 areas may be subject to paleontological inventory, and Class 5 requires a paleontological inventory of any geological exposures devoid of thick vegetation or well- developed soils, or steep unsafe cliffs.

The Santa Fe Formation (Miocene and Pleistocene eras) has Class 3 paleontological potential in the SLVFO, meaning that the potential for significant fossil resources is currently unknown and needs to be investigated further.

The Alamosa Formation has yielded Pleistocene-Pliocene mammal species, as well as a number of reptiles and amphibians, birds, fish, mollusks, ostracods, and bryozoans. There are only a few outcrops of the Alamosa Formation in the San Luis Valley. One such outcrop is at Hansen's Bluff in Alamosa County and is classified as Potential Fossil Yield Classification 4/5 (Harley Armstrong, personal communication). A recent report by the USFS indicates that exposures of the Alamosa Formation may also occur in the San Luis Hills (Dyer 2009).

Quaternary deposits (alluvial fans, terrace gravels, and loess) overlie the Alamosa Formation extensively throughout the valley. Vertebrate fossils are possible, especially in any areas of deeper ground disturbance. When found, fossils may range in size from fragmentary to whole bones. Recent finds indicate that radiometric dating of these Late Pleistocene fossils and their deposits may be possible and useful as based on carbon in the soil and collagen in these more recent fossil bones (Harley Armstrong, personal communication). Several

mammoth sites, mixed with other Late Pleistocene fauna, have been reported in the valley (Martorano et al. 1999; Harley Armstrong, personal communication). These sites have been of great interest to archaeologists due to potential associations with Paleo-Indian artifacts, and to paleontologists for the Late Pleistocene fauna and associated paleoenvironmental information. The bones found to date have been either highly fragmented and badly deteriorated (Martorano et al. 1999), or fragmented to whole bones showing a diverse Late Pleistocene faunal assemblage (Harley Armstrong, personal communication). These fossils are usually deeply buried and only sporadically found, so their host geologic alluvium units are for now categorized by the BLM as Class 3 (unknown), with the joint categorization of Class 4/5 because of the potential for significant resources in the underlying Alamosa Formation.

3.13 RECREATION

Recreational use of public lands in the San Luis Valley can be significant but variable according to season and location. Numerous activities occur on public lands in the valley, including but not limited to driving for pleasure, sightseeing, rock climbing, hiking, horseback riding, mountain biking, hunting, and fishing.

The BLM manages for a variety of recreation opportunities on public lands. The vast majority of public lands in the SLVFO planning area are managed for dispersed recreation opportunities, where recreationists have the freedom of recreational choice with a minimum of regulatory constraints. There are few recreation facilities or supervisory efforts on these lands, with the exceptions of some trailhead, informational and/or directional signs; and picnic tables at popular use sites such as off-highway vehicle areas, dispersed camping areas, hunting areas, swimming holes, fishing access sites, etc.

Other types of recreational opportunities are provided within SRMAs, of which there are four in the SLVFO. These include the Blanca SRMA (9,100 acres); Zapata Falls SRMA (3,700 acres); Rio Grande SRMA (3,400 acres); and Penitente Canyon SRMA (4,200 acres). Each SRMA is managed for unique recreational opportunities. The Blanca Wetlands SRMA is managed to enhance opportunities for fishing, viewing wildlife, waterfowl hunting, and upland game hunting, as well as for non-motorized recreational activities such as mountain biking, climbing, horseback riding, and hiking. The Zapata Falls SRMA is a destination SRMA whose primary attraction is the falls itself. The Rio Grande SRMA (3,400 acres) is managed as 29 miles of river corridor and features intensive management of recreation to enhance float boating, fishing, and other recreational opportunities. The Penitente Canyon SRMA (4,200 acres) is a destination SRMA whose primary focus is rock climbing.

Recreational uses throughout most of the remaining portions of the planning area consist of a mixture of motorized, mechanized, and non-motorized uses. Motorized activities dominate, while non-motorized activities dominate the more remote and rugged areas.

3.14 RENEWABLE ENERGY

The U.S. Department of the Interior and the BLM are working with local communities, state regulators, industry, and other federal agencies in building a clean energy future by providing sites for environmentally sound development of renewable energy on public lands. Renewable energy projects on BLM-managed lands include wind, solar, geothermal, and biomass projects and the siting of transmission facilities needed to deliver this power to the consumer (BLM Renewable Energy Program website, http://www.blm.gov/wo/st/en/prog/energy/renewable_energy.html, last accessed 1/23/2012).

There are numerous laws, regulations and policies the BLM is required to follow for their renewable energy programs, including the regulations for managing the geothermal leasing program and numerous instruction memoranda. One critical instruction memorandum (IM) applicable to the oil, gas, geothermal and rights-of-way authorizations is Washington Office IM 2008-204, Offsite Mitigation (http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/20080/IM_2008-204.html). This IM outlines policy for the use of offsite mitigation for authorizations issued by the BLM. Offsite mitigation consists of compensating for resource impacts by replacing or providing substitute resources or habitat at a different location than the project area. Offsite mitigation is supplemental to onsite mitigation and is used to enhance the BLM's ability to fulfill its mission of providing multiple uses on the public lands, while ensuring its resource management objectives are met.

The policy allows BLM to consider offsite mitigation should it be offered voluntarily by a project proponent, or for BLM to incorporate it into the project proposal, and approve it as a condition of the permit authorization.

3.14.1 Solar Energy Resources

There are two existing solar energy facilities (SunEdison [8.4 MW] and SunPower [20 MW]) and two solar energy facilities under construction (Iberdrola [30 MW] and CoGentrix [30 MW]) in the San Luis Valley. Several facilities (Tessera [150 MW], Solar Reserve [101 MW], NextEra Energy [30 MW], and Lincoln Renewables [37.4 MW]) have been proposed and are under public review or permitting. All of these facilities are or would be located on private lands in Alamosa and Saguache Counties. The BLM is in the process of completing a National Solar Energy PEIS (DOE and BLM 2010) regarding solar energy development on public lands. The draft Solar PEIS is considering land available for solar energy development and an alternative that would create Solar Energy Zones to be used strictly for solar energy development. There are four Solar Energy Zones located within the San Luis Valley.

3.14.2 Wind Energy Resources

Wind energy is a renewable energy resource that has excellent potential for generating electricity. The Final PEIS on Wind Energy Development on BLM-administered Lands in the Western United States (BLM 2005a) determined

which areas on public lands have high, medium, or low potential for wind energy development based on the typical wind speed measured at a location. Ninety percent of the wind potential in the San Luis Valley falls within the poor to marginal power classification. The parcels available have not been analyzed with regard to other resource values that may limit their suitability for wind energy development. There are currently no wind development proposals in the San Luis Valley.

3.14.3 Biomass Resources

Biomass power is power obtained from the energy in plants and plant-derived materials, such as food crops, grassy and woody plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes. Biomass can be used for direct heating such as burning wood in a fireplace or wood stove, for generating electricity, or can be converted directly into liquid fuels to meet transportation energy needs (DOI 2007).

3.15 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Socioeconomics:

The area examined for social and economic analysis consists of Alamosa, Conejos, Rio Grande, Costilla, and Saguache Counties. Since economic data is available only in county units, this analysis is defined in terms of these counties.

Population for the five-county area is presented in **Table 3-3**, Planning Area Population. Between 2000 and 2010, the population in the five-county area increased by approximately 0.2 percent, with the highest increase in Alamosa County (3.6 percent) and the largest decrease in Costilla County (-3.8 percent). Saguache County was the only other county to experience an increase in population (3.54 percent), while both Conejos and Rio Grande Counties experienced a decrease in population of -1.3 percent and -3.4 percent. The population is anticipated to increase by almost 14 percent by 2020 and by almost 50 percent by 2040 (Colorado State Demography Office 2012).

Table 3-3
Planning Area Population Between 2000 and 2010

	Alamosa County	Conejos County	Rio Grande County	Saguache County	Costilla County	Five-County Area	Colorado
Population 2000	14,954	8,401	12,445	5,939	3,675	45,414	4,326,921
Population 2010	15,496	8,291	12,023	6,138	3,536	45,484	5,047,692
Population change	542	-110	-422	199	-139	70	720,771

Table 3-3
Planning Area Population Between 2000 and 2010

	Alamosa County	Conejos County	Rio Grande County	Saguache County	Costilla County	Five-County Area	Colorado
Percent population change	3.6%	-1.3%	-3.4%	3.4%	-3.8%	0.2%	16.7%

Source: Headwaters Institute 2012

In 2010, the per capita income and median household income for each of the five counties was substantially lower than the Colorado average. The per capita income ranged between $16,252 in Costilla County and $18,820 in Alamosa County, while the state average was $30,151. The median household income ranged between $30,430 in Saguache County and $39,871 in Rio Grande County, which is much lower than the state average of $56,456. In addition, the unemployment rate for 2010 was much higher, with approximately 10.8 percent of the work force unemployed in the planning area, compared to 6.8 percent for the rest of Colorado (US Census Bureau 2010).

Table 3-4
Planning Area Income/Employment[1]

	Alamosa County	Conejos County	Rio Grande County	Saguache County	Costilla County	Five-County Area	Colorado
Per capita income 2010	$18,820	$17,541	$17,199	$18,686	$16,525	$17,754	$30,151
Median household income 2010	$35,935	$33,627	$39,871	$30,430	$33,627	$34,698	$56,456
Annual unemployment rate 2010	10.0%	8.9%	11.9%	10.5%	11.4%	10.5%	6.8%

Source: US Census Bureau 2010
1American Community Survey estimates are based on data collected over five years. The estimates represent the average characteristics of population and housing between January 2006 and December 2010 and do not represent a single point in time.

The San Luis Valley has historically been centered around ranching and agriculture. The five-county area is defined by a Hispanic population that is significantly larger than that of Colorado as a whole. In 2010, the planning area was approximately 50 percent Hispanic or Latino, compared to the state average of 20.7 percent. Saguache County had the lowest percentage of

Hispanic or Latino persons, at 40.1 percent, while Costilla County had the highest, at 66.0 percent (US Census Bureau 2010).

Recreation and tourism on public lands contributes to the local economy. Travel and tourism-related jobs are estimated to have contributed approximately 15.5 percent of jobs in the five-county area in 2009, with the largest contribution in Costilla County (25.1percent) and the lowest in Saguache County (10.8 percent). Employment sectors are shown in **Table 3-5**, Planning Area Employment Sectors. Activities on public lands include hiking, camping, rock climbing, mountain biking, hunting, and rafting. While exact employment and economic contributions are difficult to determine, some important sites are the Sangre de Cristo Mountains, the Great Sand Dunes National Park, the Alamosa, Monte Vista, and Baca National Wildlife Refuges, the Rio Grande, Penitente Canyon, and the Cumbres & Toltec Scenic Narrow Gauge Railroad.

Table 3-5
Planning Area Employment Sectors[1]

	Alamosa County	Conejos County	Rio Grande County	Saguache County	Costilla County	Five-County Area	Colorado
Agriculture, forestry, fishing and hunting, mining	6.5%	10.7%	8.9%	18.2%	15.6%	12.0%	2.2%
Construction	8.2%	12.3%	9.5%	11.0%	15.6%	11.3%	8.9%
Manufacturing	2.2%	3.3%	4.1%	5.6%	6.8%	4.4%	7.3%
Wholesale trade	1.7%	1.5%	3.3%	6.2%	0.4%	2.6%	2.9%
Retail trade	14.5%	12.1%	11.7%	11.5%	7.8%	11.5%	11.2%
Transportation, warehousing, and utilities	4.7%	4.3%	7.3%	7.0%	3.5%	5.4%	4.7%
Information	1.9%	1.4%	2.0%	0.6%	0.9%	1.4%	3.4%
Finance, insurance, and real estate	3.1%	5.3%	5.7%	1.6%	5.4%	4.2%	7.7%
Prof., scientific, mgmt., admin., and waste mgmt.	5.3%	4.9%	9.3%	4.2%	1.8%	5.1%	12.9%

Table 3-5
Planning Area Employment Sectors[1]

	Alamosa County	Conejos County	Rio Grande County	Saguache County	Costilla County	Five-County Area	Colorado
Education, health care, and social assistance	35.6%	28.8%	17.6%	14.9%	25.0%	24.4%	19.0%
Arts, entertain., recreation, accommodation, and food	6.7%	4.8%	9.4%	7.1%	10.3%	7.7%	10.1%
Other services, except public administration	4.2%	5.0%	6.3%	7.2%	4.0%	5.3%	5.1%
Public administration	5.5%	5.6%	5.0%	5.1%	2.9%	4.8%	4.7%

Source: US Census Bureau 2010

[1]American Community Survey estimates are based on data collected over five years. The estimates represent the average characteristics of population and housing between January 2006 and December 2010 and do not represent a single point in time.

Local businesses using geothermal resources are agriculture, The Colorado Alligator Farm, and area hot springs, notably Valley View and Joyful Journeys Hot Springs, which are in Saguache County. The two hot springs employ 17 and 25 people and have approximately 46,000 visitors per year (combined information from both locations; information self-reported by Valley View Hot Springs and Joyful Journey Hot Springs).

Environmental Justice:

Executive Order 12898 formally requires federal agencies to incorporate environmental justice as part of their missions. Specifically, it directs them to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

Persons are included in the minority category if they identify themselves as belonging to any of the following racial groups: (1) Hispanic, (2) Black (not of Hispanic origin) or African American, (3) American Indian or Alaska Native, (4) Asian, or (5) Native Hawaiian or Other Pacific Islander. The CEQ guidance proposes that minority populations should be identified where either (1) the minority population of the affected area exceeds 50 percent, or (2) the minority population percentage of the affected area is meaningfully greater than the

minority population percentage in the general population or other appropriate unit of geographic analysis.

The State of Colorado has a total minority population of 1,437,078 people, which comprises 29 percent of the state. The San Luis Valley has a total minority population of 20,796 people, or 47.6 percent of the population of the San Luis Valley. Although the number of minority individuals does not exceed 50 percent of the total population in the area, the number of minority individuals exceeds the state average by 15 percentage points or more, meaning that there is a minority population in the planning area.

Low-income populations are those individuals and families who fall below the poverty line. The poverty line takes into account family size and age of individuals in the family. In 1999, for example, the poverty line for a family of five with three children younger than 18 was $19,882.

The State of Colorado has a population of 562,772, or 11.2 percent of the state, that is at or below poverty level. The San Luis Valley has a population of 9,024 people that is at or below poverty level, or 20.7 percent of the state total. The number of low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50 percent of the total population in the area, which means that there are no low-income populations in the planning area.

3.16 SOILS

Soil resources on BLM-administered lands in the SLVFO, including physical groupings (soil orders), biological soil crusts, micro- and macro-organisms, soil erosion, and soil compaction, are described in the Geothermal PEIS (BLM and USFS 2008). Finer-scale mapping and characterization of soils on BLM-administered lands has been completed by the USDA Natural Resources Conservation Service.

Soils in the SLVFO are more broadly represented by Aridisols, Mollisols, and Alfisols than soils on BLM-administered lands in western states as a whole. Soil properties vary geographically in the planning area dependent upon complex combinations of the San Luis Valley's arid and frigid climate, the forces of water and wind, the region's montane-basin topography, and geologic parent material ranging from volcanic uplift to eolian sands to granitic substrate. Soils in the planning area range widely from fine-textured clays and loams along the flanks of the San Juan, La Garita, and Saguache mountain ranges to coarse-textured soils along the Sangre de Cristo range.

Soils within the SLVFO are highly variable. Site-specific soil conditions determine livestock stocking rates, types of plant communities, quality of wildlife habitat, and risk to water and wind erosion. Flash summer rain events annually move thousands of tons of sediment through the region's watersheds and extensive road network. Equally characteristic are wind erosion and dust storms in the

San Luis Valley that can be severe and impact public health, visibility, and regional haze (see Section 3.1, Air Quality). Existing drivers of accelerated soil erosion and erosion-exacerbated resource conditions in the SLVFO represent an existing and long-term regional agricultural productivity, hydrologic, visibility, and public health issue.

3.17 SPECIAL DESIGNATED AREAS

3.17.1 Wilderness Study Areas

Within the SLVFO planning area, there are three WSAs. They are Papa Keal WSA (400 acres), Black Canyon WSA (1,100 acres), and San Luis Hills WSA (10,900 acres). Per IM 2000-096, WSAs are managed to VRM Class 1.

The San Luis Hills WSA is located approximately nine miles southeast of La Jara. The WSA includes approximately 10,240 784 acres of public lands. The landscape includes an isolated solitary flat-topped mesa with associated side slopes that is surrounded by flat open prairie land. Elevations range from 7,700 feet along the lower flat prairie area to 9,475 feet at its highest point. The vegetation is diverse and includes semi-arid species in the lower elevations and piñon pine stands on the slopes and mesa top. The WSA has been managed in accordance with the BLM Interim Management Policy for Lands under Wilderness Review (H-8550- I, Interim Management Policy and Guidelines for Lands under Wilderness Review (BLM 1995). These guidelines restrict the use of any motorized and mechanized (e.g., mountain bikes) equipment and vehicles in the WSA. The primary activities occurring are hiking, hunting, backpacking, photography, camping, and wildlife watching. The use has increased over the last 20 years, but the types of recreational activities occurring have stayed relatively the same.

The three existing WSAs within the Field Office will continue to be managed to protect their wilderness characteristics under the BLM Interim Management Policy for Lands under Wilderness Review until Congress designates them as wilderness or releases them for other uses.

3.17.2 Areas of Critical Environmental Concern

The SLVFO RMP designated nine ACECs in 1991. These areas are to be managed to protect and enhance the special values that were identified in the SLVFO RMP. The Sand Castle WSA was adjacent to the Great Sand Dunes National Monument; however, when the Great Sand Dunes National Monument became a National Park and Preserve in 2000, the Sand Castle WSA was transferred to the National Park Service and became part of the Great Sand Dunes National Park and Preserve. The remaining eight ACECs are described briefly below. ACECs are shown in **Figure 3-2**, Areas of Critical Environmental Concern.

Cumbres and Toltec ACEC

This ACEC is the corridor and viewshed for the Cumbres and Toltec Scenic Railroad, running from Antonito, Colorado, to Chama, New Mexico, that is jointly owned by the States of Colorado and New Mexico. Strict conformance to visual standards is imperative with this ACEC, as is the protection of the visual, scenic, and historical values associated with this train operation, which dates to the 1880s. The activities occurring are driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, visiting historic sites, picnicking, and day hiking.

Rio Grande Corridor ACEC

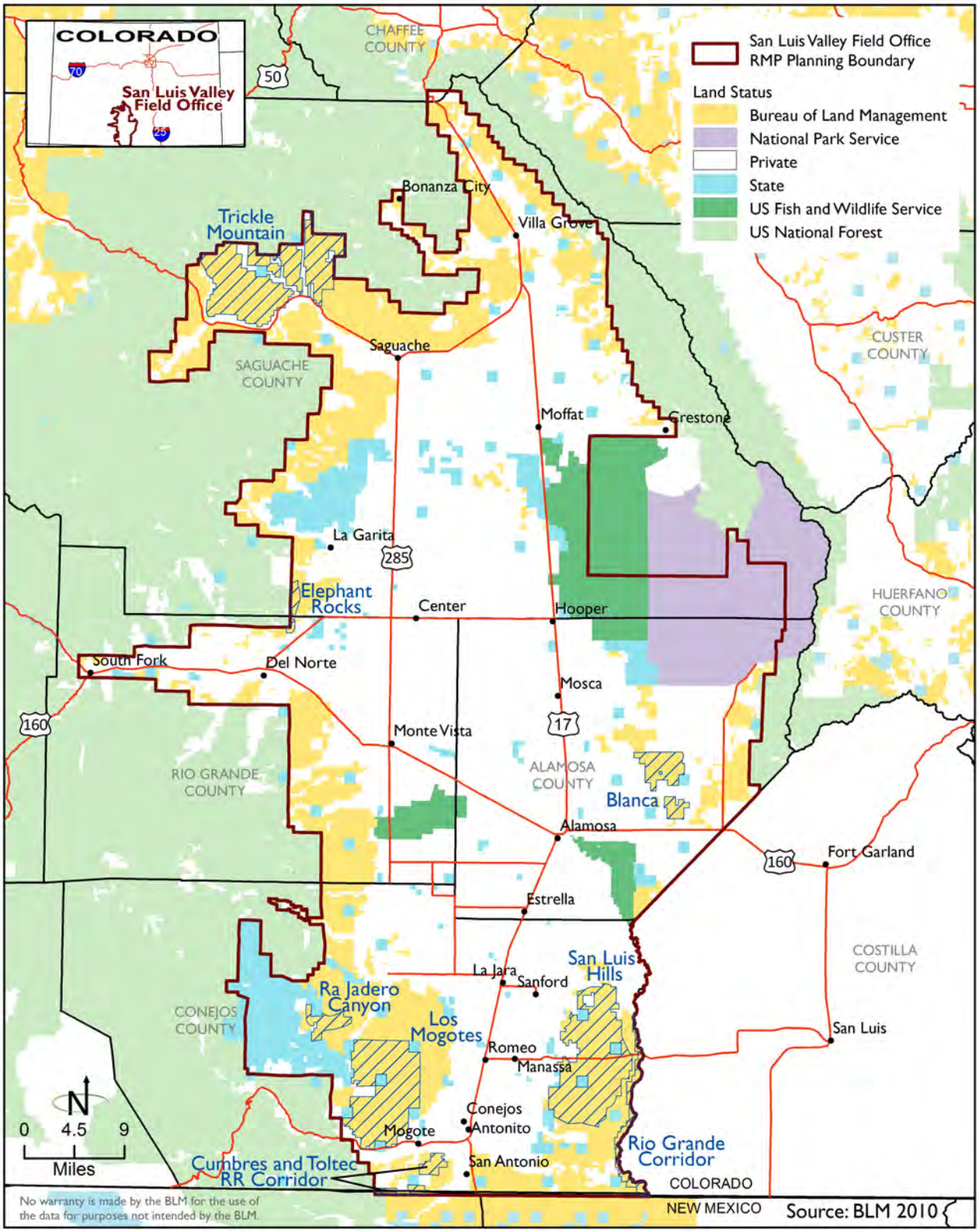
More than 20 miles of Rio Grande frontage is included within this ACEC. It contains significant natural, scenic, and recreational values. Wildlife species use the area as a travel corridor. This area is designated as an SRMA as well, which provides for intensive recreation management. The area has been designated as a Natural Area by Congress. The recreational activities include driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, picnicking, and day hiking.

Elephant Rocks ACEC

This ACEC was designated for its unique geologic formations, special status plants, and unique or special scenic, visual, and recreational values. The recreational activities include driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, picnicking, and day hiking.

Trickle Mountain ACEC

This ACEC is managed to provide big game winter habitat for four species: pronghorn, deer, elk, and bighorn sheep (lambing areas throughout the ACEC). It also has special status plant values. This crucial wildlife habitat is protected by NSO stipulations for minerals, no disposal of land, and seasonal limitation stipulations. The recreational activities include driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, picnicking, and day hiking.



Areas of Critical Environmental Concern

Areas of Critical Environmental Concern are to be managed to protect and enhance the values that were identified in the SLVFO RMP.

Areas of Critical Environmental Concern within the San Luis Resource Area

Figure 3-2

Blanca ACEC

The Blanca ACEC is an 9,100-acre tract that is made up of over 200 wetland basins and is located in the sump of the San Luis Valley where there is no outflow. It is one of the foremost areas in shorebird and waterfowl conservation and production across the western US and provides habitat for 13 threatened, endangered and sensitive species as well as over 160 species of birds. The ACEC has been designated as an Important Bird Area in Colorado by Audubon and the American Birding Association, a nationally significant shorebird migration site by the USFWS, a key site for shorebird passage and nesting by the Intermountain West Joint Venture, a critical site for maintaining breeding habitat for the western snowy plover in Colorado, and a locally significant wildlife production/nesting area. This site is also designated as one of four BLM Healthy Lands Focal Areas in Colorado because of its significant wetland values. BLM designated the wetlands as an ACEC in 1991 in an effort to target protection, restoration and enhancement of the wetlands.

Los Mogotes ACEC

This ACEC is crucial big game winter habitat as well as big game birthing habitat and has special status plants values. Recreational activities include driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, picnicking, and day hiking.

San Luis Hills ACEC

This ACEC contains two isolated solitary mountains within a flat open prairie environment. This landscape provides big game habitat and contains special status plant values, rock-loving neoparrya. One of the two mountains is called Flat Top and is adjacent to a wetlands area. A 2,000 acre portion of the Flat Top area has a NSO stipulation for fluid minerals management and is closed to all motorized uses. Recreational activities include driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, picnicking, and day hiking.

Ra Jadero ACEC

This ACEC contains a special status plant (Ripley's milkvetch) that is unique to this area. Motorized travel is limited to existing routes. The public activities include driving for pleasure, dispersed camping, target shooting, wildlife observation, photography, and day hiking.

3.17.3 Wild and Scenic Rivers

The SLVFO RMP, published in 1991, evaluated all streams on public lands within the planning area to determine whether any streams were eligible and suitable for inclusion in the National Wild and Scenic Rivers System. The only stream segments determined to be eligible and suitable were the portions of the Rio Grande between the Colorado-New Mexico border and the southern boundary of Alamosa National Wildlife Refuge, totaling 41 stream miles. In 2006, the U.S. Congress included these stream segments under an alternative as the "Rio

Grande Natural Area." For the portion of the protected area on federal lands, the designation implements protective measures that are similar to those found under streams protected under the Wild and Scenic Rivers Act. The major difference between a designated Wild and Scenic river and the Natural Area designation is that the Natural Area designation does not include a federal right to support river-dependent values.

3.17.4 National Scenic Byways

Under the Byways Program, certain roads are recognized as scenic byways based on their archaeological, cultural, historic, natural, recreational, and scenic qualities. America's Byways are a distinctive collection of American roads, their stories and treasured places. Portions of US 285,CO 17, and CO 159 have been designated as the Los Caminos Antiguos National Scenic and Historic Byway.

3.17.5 National Heritage Areas

The Sangre de Cristo National Heritage Area was designated by Congress in March 2009. The designation was in recognition of the rich natural resources, variety of recreational opportunities, and unparalleled history of the San Luis Valley. The National Heritage Area covers more than 3,000 acres including the counties of Alamosa, Conejos, and Costilla, the Monte Vista Wildlife Refuge, the Baca National Wildlife Refuge, the Alamosa Wildlife Refuge, and the Great Sand Dunes National Park and Preserve.

3.17.6 National Scenic and Historic Trails

The East Fork of the North Branch of the Old Spanish National Historic Trail traverses along the eastern edge of the San Luis Valley and converges northwest of Saguache with the West Fork of the Old Spanish National Historic Trail. This portion of the trail has been included in the National Trail System.

The route of the West Fork of the North Branch of the Old Spanish National Historic Trail traverses along the western edge of the San Luis Valley and converges northwest of Saguache with the East Fork of the Old Spanish National Historic Trail. Studies are ongoing regarding the significance of this portion of the trail. If warranted, this portion of the trail could be included in the National Trail System. See **Section 3.3**, Cultural Resources, for additional information on the Old Spanish National Historic Trail.

3.17.7 National Parks and Preserves

The Great Sand Dunes National Monument, located near Mosca, Colorado, became a National Park and Preserve in 2004, and is managed by the US DOI, National Park Service. The park contains the tallest dunes in North America and one of the most fragile and complex dune systems in the world. The designation of the Great Sand Dunes as a National Park and Preserve protects a globally significant water- and wind-driven system, including creeks that demonstrate surge flow, a rare hydrological phenomenon.

The natural hydrological system of the Great Sand Dunes is complex and includes many unique features that are essential to the continued existence of the dunes. The dunes sit atop an aquifer that extends up to a mile below the valley floor. Streams flow on top of the high water table, and runoff from snowmelt recharges the aquifer each year. Wind carries sand to Medano and Sand Creeks, which bring the sand back downstream to the valley floor, where it is picked up again by the wind in a continuous cycle which perpetuates the formation of the dunes. The high water table beneath these creeks is essential to this wind/water recycling process which builds the dunes. If the water table were permanently lowered, even by a few feet, the creeks' surface flow would diminish or stop, and the sand recycling process would slow down or cease, permanently altering the landscape.

The Great Sand Dunes have cultural significance as well as pristine visual resources. Some of the oldest known archaeological sites in the US exist within the park (some are over 9,000 years old). The park provides opportunities for recreation and has many unique resources, including essential hydrological and ecological features, outstanding opportunities for natural quiet, and outstanding night skies and other visual resources. The park is home to an essential watershed; the sand deposits associated with dune mass and the wetlands depend on the preservation and protection of this system.

Great Sand Dunes National Park and Preserve is withdrawn from geothermal leasing. There are approximately 77,200 acres of the park within the planning boundary. The park is adjacent to BLM surface estate along the southeast portion of the park (approximately 2.5 miles of shared boundary). The expansion of the park in 2004 occurred, in large part, to protect the entire natural hydrological system that maintains the dunes.

3.17.8 National Wildlife Refuges

The San Luis Valley is home to the Alamosa NWR, the Monte Vista NWR, and the Baca NWR, which are managed by the USFWS.

The Alamosa NWR was established in 1962 as a haven for migratory birds and other wildlife. This refuge protects 11,900 acres of land and is located 2 miles east of the city of Alamosa. There are approximately 10,200 acres of split estate (BLM mineral estate) within the refuge. The southeast portion of the refuge is adjacent to BLM surface estate (approximately 3.5 miles are shared). The refuge includes habitats of wet meadows, river oxbows, and riparian corridors within the floodplain of the Rio Grande. The Alamosa NWR protects songbirds, waterbirds, raptors, mule deer, beaver, and coyotes.

The Monte Vista NWR was established in 1953 to provide a much needed habitat for wildlife, particularly waterfowl, in the San Luis Valley. This refuge comprises 14,800 acres of land and is 13 miles south of the city of Monte Vista. There are approximately 13,800 acres of split estate (BLM mineral estate) within the refuge. The western edge of the refuge is adjacent to BLM surface

estate (approximately 1.5 miles are shared). Water is intensively managed in the Monte Vista NWR. Artesian wells dating back to the 1880s supply water for the wetlands in the Monte Vista NWR. Other management tools, such as mowing, prescribed burning, and farming, are implemented to ensure that species are provided food, cover and nesting habitat (for waterfowl and other birds). Elk also graze the refuge seasonally.

The Baca NWR was established by Congress in 2000. It comprises 92,500 acres and is adjacent to the western border of Great Sand Dunes National Park and Preserve. There are approximately 5,100 acres of split estate (BLM mineral estate) within the refuge. The refuge is adjacent to a BLM parcel of approximately 6,100 acres to the west of the refuge. This refuge is home to a diverse suite of habitats including shrublands, grasslands, wet meadows, and playa wetlands. These habitats provide sanctuary to an abundance of wildlife in an otherwise arid landscape. The NWR is also home to historic and cultural resource sites, some of which are over 12,000 years old. Split mineral estate exists within the refuge, and the exploration of potential for oil and gas resources may be pursued. A group known as Lexam Explorations has provided documentation to the USFWS showing that it is an owner of mineral rights below portions of the surface estate of the refuge and has the right to use the surface for exploration.

3.18 VEGETATION

3.18.1 Plant Communities

Based on the criteria developed in the Colorado Land Bird Conservation Plan (Beidleman 2000), sixteen plant communities are present within the SLVFO. The distribution of these plant communities is shown in **Figure 3-3,** Colorado Vegetation Classification Project – Habitat Types in the San Luis Valley Field Office.

Semi-Desert Shrubland

Semi-desert shrubland is the most extensive habitat type and occurs on approximately 258,571 acres (50 percent) of planning area public lands. This habitat type is typical of cold, arid, interior lowlands and is characterized by shrub species such as fourwing saltbush (*Atriplex canescens*), greasewood (*Sacrobatus vermiculatus*), Greene's rabbitbrush (*Chrysothamnus greenei*), winterfat (*Krascheninnikovia lanata*), and fringed sage (*Artemisia frigida*). Understories and interspatial areas often contain grasses such as blue grama (*Bouteloua gracilis*), Indian ricegrass (*Oryzopsis hymenoides*), and ring muhly (*Muhlenbergia torreyi*). Seasonal forb species include Indian paintbrush (*Castilleja* spp.), penstemon (*Penstemon* spp.), and aster (*Aster* spp.).

Piñon/Juniper

The piñon (*Pinus edulis*)/juniper (*Juniperus scopulorum* and *J. monosperma*) habitat type occurs on approximately 66,328 acres (13 percent) of planning area public

lands. Piñon/juniper occurs on gentle to steep slopes and is home to a variety of tree, shrub, and forb species, including mountain mahogany (*Cercocarpus montanus*), currant (*Ribes* spp.), common rabbitbrush (*Chrysothamnus nauseosus*), buckwheat (*Eriogonum* spp.), Indian paintbrush, penstemon, aster, and scarlet globemallow (*Sphaeralcea coccinea*). Grasses include blue grama, squirreltail (*Elymus elymoides*), needle-and-thread grass (*Stipa comata*), and other species.

Grasslands

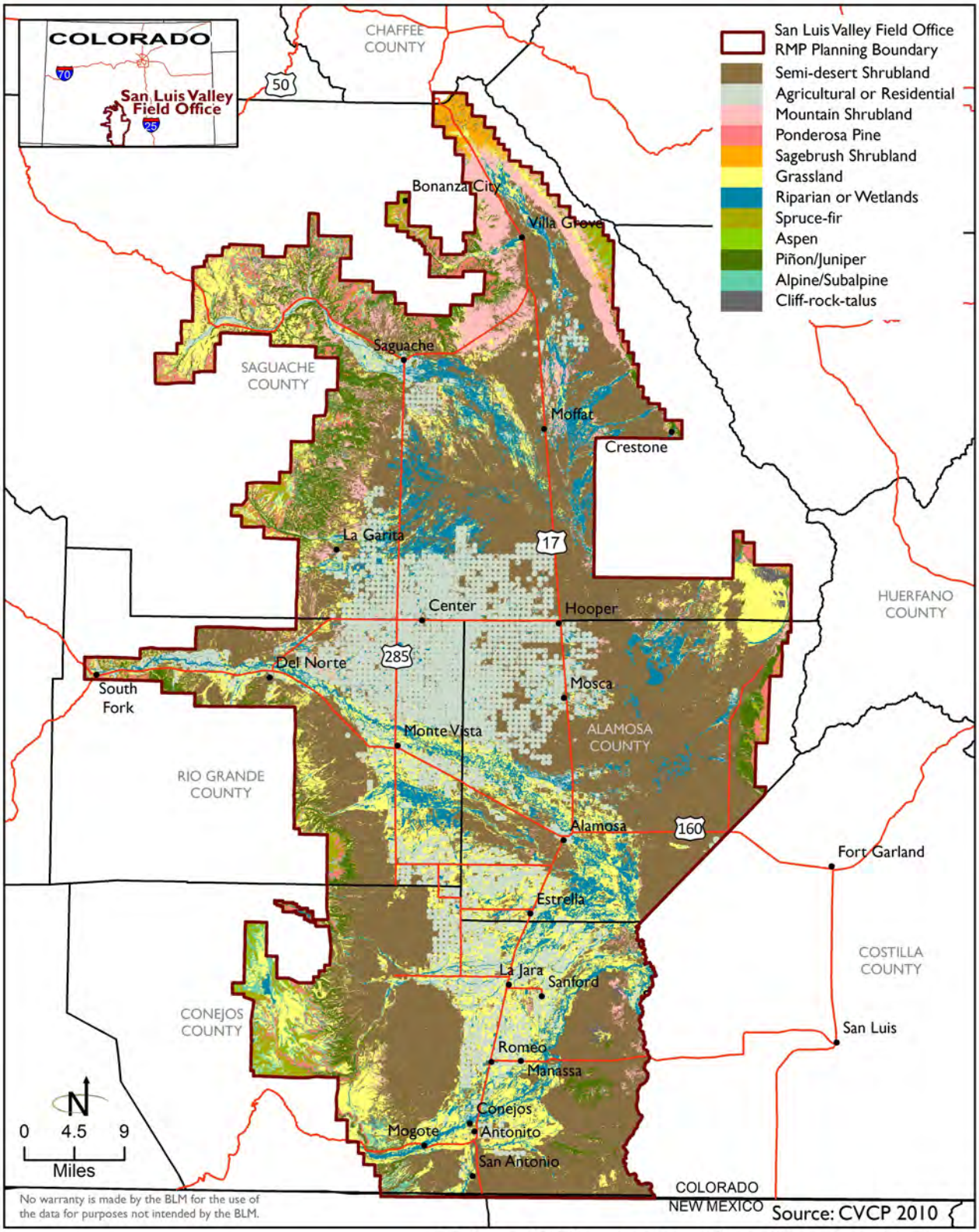
The grassland habitat type occurs on approximately 60,131 acres (12 percent) of planning area public lands. Common grasses include Arizona fescue (*Festuca arizonica*), ring Muhly, Indian ricegrass, and western wheatgrass (*Pascopyrum smithii*. Common forbs and shrubs include yucca (*Yucca glauca*), fringed sage, winterfat, locoweed (*Astragalus* spp.), and scarlet globemallow. Thurber fescue (*Festuca thurberi*) and Parry's oatgrass (*Danthonia parryi*) are common species at higher elevations.

Mountain Shrubland

The mountain shrubland habitat type occurs on approximately 59,018 acres (11 percent) of planning area public lands. Gambel oak (*Quercus gambelii*) is a primary component of this habitat type, although sagebrush (*Artemisia* spp.), currants, mountain mahogany, chokecherry (*Prunus virginiana*), skunkbrush (*Rhus trilobata*), and other shrub species may be intermixed. Common forbs include mule-ears (*Wyethia* spp.), scarlet gilia (*Ipomopsis aggregata*), and fleabanes (*Erigeron* spp.). Common grasses include Arizona fescue, Thurber fescue, junegrass (*Koeleria macrantha*), and mountain muhly (*Muhlenbergia montana*).

Ponderosa Pine

The ponderosa pine (*Pinus ponderosa*) habitat type occurs on approximately 27,095 acres (5 percent) of planning area public lands. This habitat type occurs at elevations of about 7,600 to 10,500 feet and may be intermixed with other species such as piñon pine, Douglas fir (*Pseudotsuga menziesii*), and mountain mahogany. Wood's rose (*Rosa woodsii*), snowberry (*Symphoricarpos* spp.), and chokecherry are common shrubs. Thurber fescue, Parry's oatgrass, and mountain Muhly are common grass species.



Semi-desert shrubland is the most extensive habitat type and occurs on approximately 258,600 acres (50 percent) of planning area public lands. Mixed-conifer areas not shown due to small size within San Luis Valley Field Office.

Colorado Vegetation Classification Project-Habitat Types in the San Luis Valley Field Office

Figure 3-3

Spruce-Fir

The spruce-fir (*Picea* spp. and *Abies* spp.) habitat type occurs on approximately 13,425 acres (3 percent) of planning area public lands and generally occurs at elevations of 8,600 to 12,000 feet.

Alpine/Subalpine

The alpine/subalpine habitat type occurs on approximately 11,791 acres (2 percent) of planning area public lands at elevations beginning at 11,000 feet. Spike trisetum (*Trisetum spicatum*), timber oatgrass (*Danthonia intermedia*), and alpine bluegrass (*Poa alpina*) are some of the grass species found at these higher elevations.

Sagebrush Shrublands

The sagebrush shrubland habitat type occurs on approximately 7,137 acres (1 percent) of planning area public lands. Local sagebrush shrublands are characterized by extensive stands of mountain big sagebrush (*Artemisia tridentata* var. *pauciflora*) and black sagebrush (*Artemisia nova*), although other shrub species such as rabbitbrush and currant may be present.

Cliff/Rock/Talus

The cliff/rock/talus habitat type occurs on approximately 6,491 acres (1 percent) of planning area public lands. Although this habitat type does not encompass a large percentage of the public lands, it provides important habitat for specialized species such as rock-loving neoparrya (*Neoparrya lithophila*) and fragile rockbrake (*Cryptogramma stelleri*). Both of these plants are on the BLM Colorado State Director's Sensitive Species List (November 20, 2009).

Wetlands, Low-Elevation Riparian, and High-Elevation Riparian

Wetlands, low-elevation riparian, and high-elevation riparian habitats represent three different riparian habitat types that occupy approximately 3,809 (0.7 percent), 2,789 (0.5 percent), and 9 acres (0.002 percent), respectively, of planning area public lands. Although they represent a small portion of the landscape (13 percent combined), they are extremely important habitat types for all species of wildlife. The Blanca ACEC and the McIntire/Simpson property comprise the majority of the wetlands and support at least 15 bird species of concern. Low-elevation riparian habitat generally surrounds rivers and streams below 8,000 feet and is dominated by cottonwood (*Populus* spp.) galleries, understories of willows (*Salix* spp.), and other riparian shrubs. High-elevation riparian habitats occur above 8,000 feet and are locally represented by a mid-elevation riparian zone referred to as foothills riparian habitat.

Aspen

The aspen (*Populus tremuloides*) habitat type occurs on approximately 2,393 acres (0.5 percent) of planning area public lands. This habitat type comprises a small portion of the project area.

Mixed-Conifer

The mixed-conifer habitat type occurs on a small portion (220 acres or 0.04 percent) of planning area public lands. Mixed-conifer forest is a transitional habitat type between the drier coniferous forest types, such as ponderosa pine, and the moister spruce-fir forest.

Agriculture, Residential, and Unclassified Habitat Types

The agriculture and residential habitat types represent a very small portion (185 acres and 0 acres, respectively) of planning area public lands. An additional 1,384 acres (0.3 percent) are unclassified.

3.18.2 Riparian Resources

Riparian and wetland resources in the SLVFO have been described broadly in the Geothermal PEIS (BLM 2008). A finer-scale description of riparian and wetland resources was completed for the SLVFO Travel Management Plan EA (BLM 2009a). Riparian areas, according to the BLM, are green zones along flowing-water features such as rivers, streams, and creeks. These areas exclude streams where water flows for only brief periods during storm runoff events (ephemeral streams). Wetlands are shown in **Figure 3-4,** National Wetlands Inventory (NWI).

The SLVFO planning area and affected riparian zones comprise portions of the Rio Grande, Saguache Creek, San Luis Creek, Alamosa River, and Conejos River watersheds. The riparian zones range in elevation from 7,544 to 11,068 feet. The highest number of individual riparian segments administered by the BLM in the SLVFO planning area occurs in Saguache County, while the longest individual stretches occur along the Rio Grande NA in Conejos and Costilla Counties.

The BLM also administers approximately 2,367 acres of wetlands in the SLVFO planning area as described in **Table 3-6**, BLM-administered Riparian Zones in San Luis Valley, Colorado. These include wetlands found in the Blanca ACEC and SRMA, McIntire-Simpson, Mishak Lakes, and O'Neal Spring. The Blanca wetlands are maintained by flows from confined aquifer wells, and by mitigation water from Reclamation Closed Basin Project. The McIntyre-Simpson wetlands are partially maintained by irrigation ditch diversions from the Conejos River.

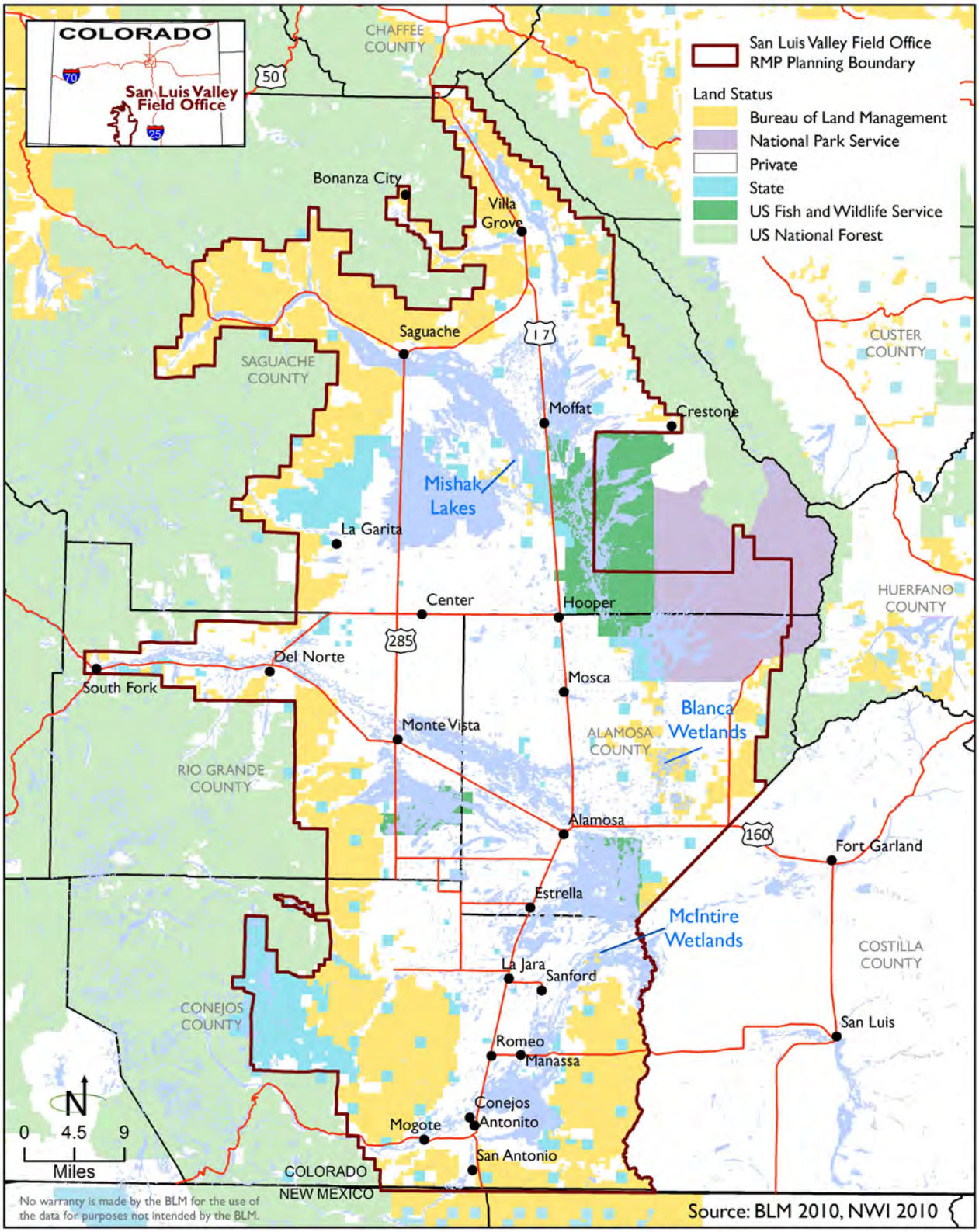
Table 3-6
BLM-administered Riparian Zones in San Luis Valley, Colorado

Wetland Name	Acres
Blanca Wetlands	1,388
Simpson/McIntire	769
Mishak Lakes	208
O'Neal Spring	2
Total	2,367

Source: US Fish and Wildlife Service, 2010 National Wetlands Inventory

Riparian and wetland vegetative communities under BLM jurisdiction represent a minute fraction (less than 1 percent) of the surface area administered by BLM in the SLVFO. That low relative land cover is counterbalanced by the resource value of these riparian zones and wetlands. The SLVFO riparian areas and wetlands provide ecological services, such as fisheries, wildlife habitat, migration corridors, flood protection, recreation, and forage for wildlife species and livestock. These areas also provide water storage relevant to some drinking water sources and commercial ranching irrigation.

The Blanca ACEC and SRMA and the McIntire-Simpson wetlands, Conejos River, and Rio Grande corridor provide nationally significant migratory and shorebird habitat and recreational opportunities, including bird watching and hunting. Existing riparian and wetland conditions are good, and overall trends are upward in the northern SLVFO based on over 10 years of intensive land management focus to reduce previous drivers degrading riparian and resource conditions. A south San Luis Lakes Wetlands Restoration Project is underway to augment playa-wetland pools north of the Blanca ACEC and SRMA. This project will expand the BLM's opportunity to allow periodic drying, promote and mimic ecological processes in a modified hydrological system, remove salts, and maintain habitat vigor (BLM 2010a).



National Wetlands Inventory (NWI)

Wetlands and riparian areas are an extremely important habitat type for all species of wildlife

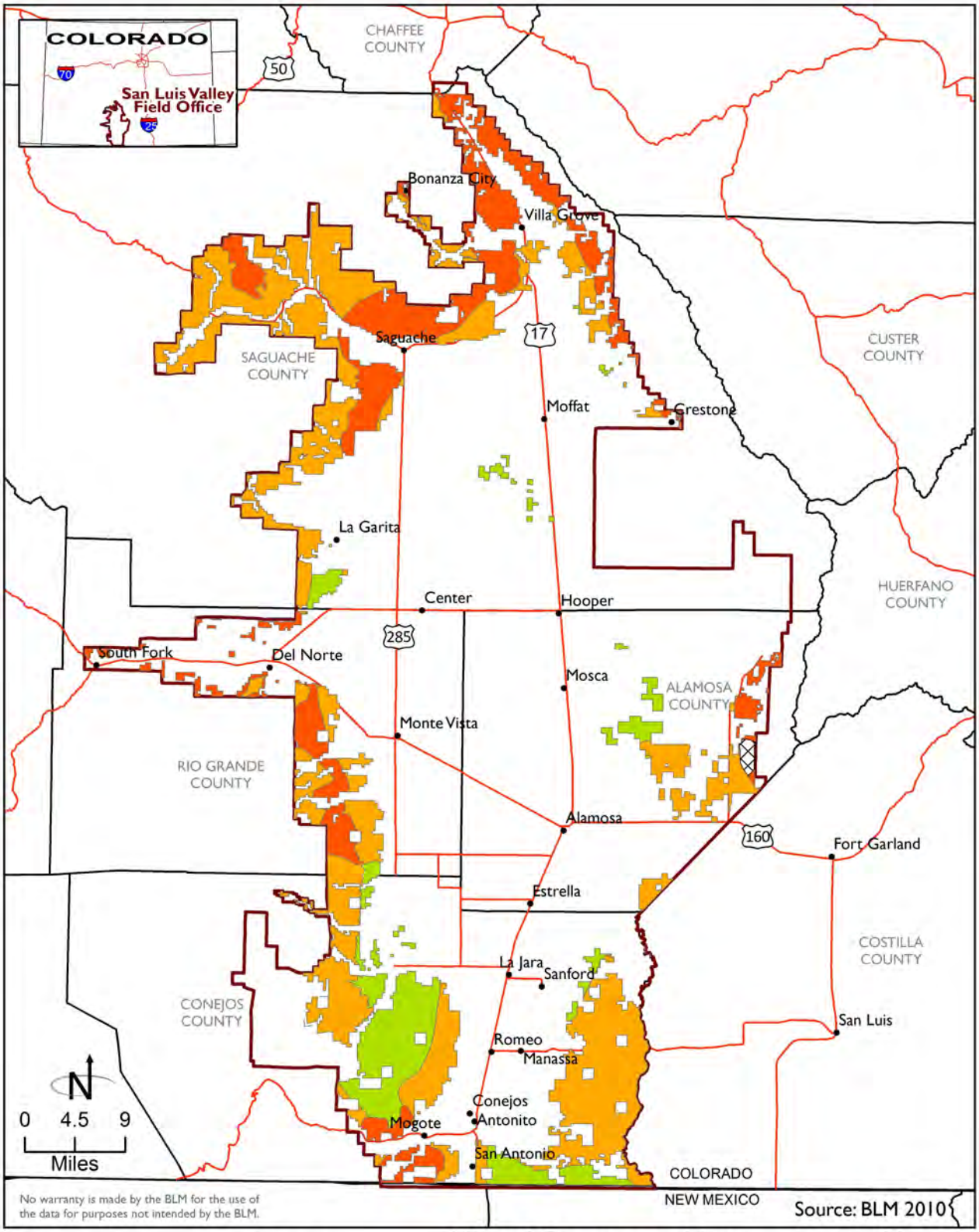
Figure 3-4

3.19 VISUAL RESOURCE MANAGEMENT AND NIGHT SKY

The BLM's responsibility for managing visual (scenic) resources of public lands is established by law. NEPA requires that measures be taken to "assure for all Americans … aesthetically pleasing surroundings," and the FLPMA states that "public lands will be managed in a manner which will protect the quality of scenic values of these lands."

The San Luis Valley is widely known for its outstanding scenic qualities and impressive diversity of features such as rock formations, flora, fauna, and water features. This area is one of Colorado's most scenic places with seven of Colorado's 14,000 foot peaks on public lands, one of the four Sacred Mountains of the Navajo, and a diversity of vegetation, wildlife, and cultural elements that make this landscape a special scenic place. Areas such as Penitente Canyon, Zapata Falls, Sangre de Cristo Mountains, and the San Luis Hills contain many of these outstanding scenic features that visitors and local residents value as part of the characteristic landscape. This area has several special designations including the Los Caminos Antiguos National Scenic and Historic BywayLos Caminos Antiguos Scenic and Historic Byway, the Rio Grande Corridor, Penitente Canyon, Blanca Wetlands Habitat Management Area, Zapata Falls, and the San Luis Hills WSA. BLM Visual Resource Management Classes across the SLVFO are shown in **Figure 3-5**, Visual Resource Management Classes.

The San Luis Valley, especially Great Sand Dunes NP, has relatively high quality night skies. Shielded from cities along the Interstate-25 corridor, the skies have minimal light pollution. The major light sources are those found in the valley itself. Additionally, the exceptional air quality and dry air combine to enhance the aesthetic night quality. Artificial light can impact nighttime visual quality for many miles, with typical outdoor lights visible for up to 25 miles and industrial lights being visible from further than that. Because of the near-pristine quality of night skies in the area, even a modest amount of artificial light at night can have a measureable impact.



VRM classes are only assigned on BLM land.

Visual Resource Management Classes

- San Luis Valley Field Office RMP Planning Boundary
- Class II Management activies may be seen, but should not attract the attention fo the casual observer.
- Class III Management activities may attract attention but should not dominate the view of the casual observer.
- Class IV Management activites may dominate the view and be the major source of viewer attention.
- Undesignated

Figure 3-5

3.20 WATER RESOURCES

The San Luis Valley is a part of the Upper Rio Grande hydrologic basin, covering approximately 2,900 square miles, of which about 1,000 square miles is in the San Luis Valley. The northern part of the San Luis Valley, known as the Alamosa Basin, is a closed basin that is internally drained and underlain by saturated alluvial deposits that fill the valley.

The southern part of the San Luis Valley is drained by the Rio Grande River. The climate of the San Luis Valley is arid; average annual precipitation is about 8 inches in the valley and 30 inches in the mountains. Evapotranspiration rates potentially exceed 40 inches in the valley (Mayo et al. 2007; Emery 1994; Leonard and Watts 1989).

Figure 3-6, Location and Extent of the Rio Grande Basin Showing Distribution of Mapped Quaternary Alluvium and Permitted Water Wells, shows the San Luis Valley in the context of the Upper Rio Grande hydrologic basin, shows the distribution of water wells as permitted by the Department of Water Resources, and identifies surface water features including lakes, reservoirs, and the Rio Grande itself.

The United States Geological Survey (USGS) keeps track of hydrologic units through a series of hydrologic unit codes, starting from 4-digit subregions, followed by 6-digit accounting units, and followed finally by 8-digit cataloguing units. The San Luis Valley is within USGS Subregion 1301-Rio Grande headwaters. Subregion 1301 covers the Rio Grande Basin from headwaters to the river's intersection with the Colorado-New Mexico state line, including the San Luis Valley closed basin, and covers an area of 7,580 square miles. Cataloging Units within Subregion 1301 include:

- 13010001- Rio Grande headwaters, CO. Area = 1,320 square miles;
- 13010002 - Alamosa-Trinchera, CO/NM. Area = 2,560 square miles;
- 13010003 -- San Luis, CO. Area = 1,590 square miles;
- 13010004 – Saguache, CO. Area = 1,320 square miles; and
- 13010005 – Conejos, CO/NM. Area = square miles.

3.20.1 Rio Grande Hydrologic Region

The Rio Grande Hydrologic Region includes south-central Colorado (BLM 2007a). This Hydrologic Region encompasses the Rio Grande Aquifer system, the Pecos River Basin alluvial aquifer, the Roswell Basin Aquifer, the southeastern portion of the Colorado Plateau aquifers, and the northern extreme of the Pecos River Basin alluvial aquifer (USGS 2002).

3.20.2 Surface Water

The Rio Grande River is a major surface water resource that derives its water from the mountainous regions of southern Colorado and flows through New Mexico and Texas to the Gulf of Mexico. Most basins along the Rio Grande have surface drainage to the river and are topographically open basins. The northern end of the San Luis Valley and most other basins distant from the river have internal surface water drainage and generally do not contribute stream flow to the Rio Grande (USGS 2002).

The Rio Grande is the largest river in the area and has perennial flow through most of its length in Colorado and New Mexico. Much of the stream flow in the mountainous northern part of the Rio Grande is derived from mountain snowmelt runoff. Stream flow in the southern part of the river system is derived from upstream flow, groundwater discharge, and summer thunderstorm runoff (USGS 2002). Agricultural diversions account for approximately 90 percent of surface water use from the river and may result in little or no flow during the summer months toward and at its terminus at the Gulf of Mexico (BLM 2007a).

The Conejos River is a tributary to the Rio Grande and flows eastward from the San Juan Mountains in the west. eastward where ilt meets the Rio Grande at a point south of Alamosa. A portion of stream flows in the Conejos River and Rio Grande are derived from discharge from the confined and unconfined aquifers of the San Luis Valley, which are discussed below.

One unique feature of the San Luis Valley is the Closed Basin. This large area in the northern part of the valley drains about 2,900 square miles. It is separated from the open basin to the south by a slight divide in topography, formed by the alluvial fan of the Rio Grande on the west and alluvial material from the Sangre de Cristo Mountains on the east. and is separated from the rest of the valley by a low alluvial fan. There is no drainage from the basin and much of the water that flows into it is lost through evapotranspiration. Water that is not lost flows into San Luis Lakes on the periphery of the valley (US Bureau of Reclamation 2011).

Figure 3-6. Location and Extent of the Rio Grande Basin Showing Distribution of Mapped Quaternary Alluvium and Permitted Water Wells

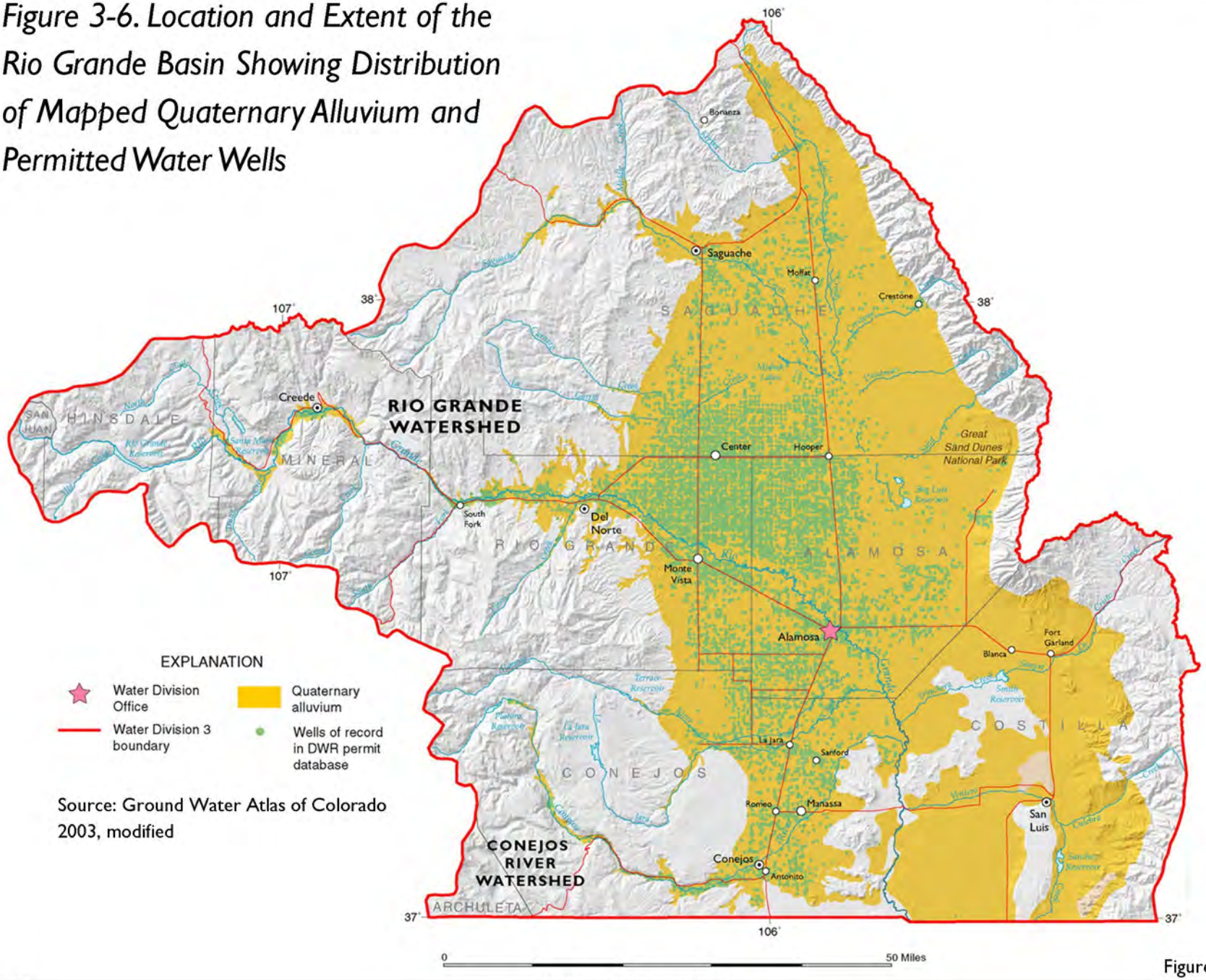


Figure 3-6

3.20.3 Groundwater

The Rio Grande aquifer system is the principal aquifer in a 70,000-square-mile area of southern Colorado and central New Mexico. The aquifer system consists of a network of hydraulically interconnected aquifers in basin-fill deposits located along the Rio Grande Valley and nearby valleys (USGS 2002). These aquifers are generally composed of unconsolidated sediment deposits present in intermountain basins between discontinuous mountain ranges in southern New Mexico and between mountains and tablelands in northern New Mexico. High mountains border the aquifers in southern Colorado (USGS 2002).

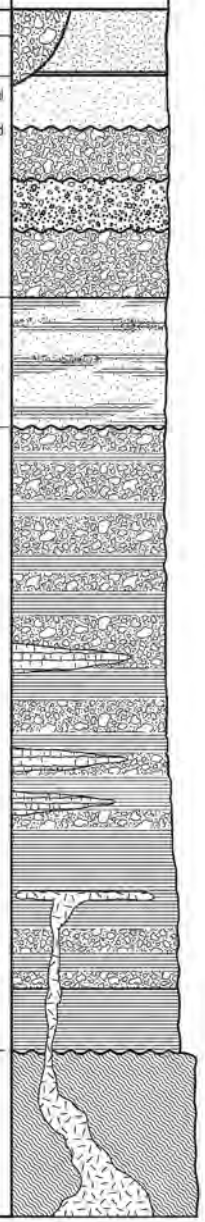
Most groundwater withdrawal in the San Luis Valley occurs as discharge from wells, of which about 90 percent is used for irrigation of commercial crops. Most cities and communities in the area, such as Alamosa and Monte Vista, rely on groundwater for municipal use. Groundwater withdrawals in closed basins have caused long-term water level declines, while withdrawals from wells located near the Rio Grande or its perennial tributaries generally do not cause long-term water level declines in the aquifer (BLM 2007a).

As shown in **Figure 3-7,** Hydrogeologic Units of the San Luis Valley, the upper 6,000 feet of fill below the valley surface consists of unconsolidated clay, silt, sand and gravel, and interbedded lava flows. Some of the underground water is in an unconfined aquifer system at shallow depths. Beneath the unconfined aquifer are relatively impermeable beds of clay and basaltis a series of clay, and beneath these confining layers are substantial quantities of water which comprise the confined aquifer. The confining clay layer generally does not exist around the valley's perimeter, and the confined aquifer system is recharged from surface flow to the underground water system at the edges of the valley (Colorado Division of Water Resources 2004).

Because the recharge areas are higher in elevation than the floor of the valley, the confined aquifer is under artesian pressure, resulting in the free flow of water from some artesian wells and springs at natural breaks in the confining layer. In some places, where the confining layer is less thick and more transmissive, water from the confined aquifer will leak upward through the confining clay layers into the unconfined aquifer. The unconfined aquifer is directly connected with the surface streams in some places. To varying degrees, the surface streams, the unconfined aquifer, and the confined aquifer are hydrologically connected (Colorado Division of Water Resources 2004).

Approximately 2 billion acre-feet of groundwater is estimated to be stored in these aquifers. The unconfined aquifer is estimated to have 140 million acre-feet of recoverable water (San Luis Valley Development Resources Group 2007). The unconfined aquifer is the principal source of groundwater for irrigation, supplying as much as 80 percent of all large-capacity (yielding greater than 300 gallons per minute) wells (Colorado Division of Water Resources 2010).

Era	System	Series	Strati-graphic Unit	Physical Characteristics	Hydro-geologic Unit		Saturated thickness (feet)	Hydrologic characteristics
Cenozoic	Quaternary	Holocene	Stream deposits	Well to poorly sorted, uncemented, sands, silts, and gravels	Unconfined aquifer (HRS unit 1)	Qal		Permeability controlled by reworked older alluvial materials
			Eolian sands	Well-rounded sands forming active and stabilized dunes		Qs		Hydraulic conductivity ranges from 0.020 to 0.072 cm/sec, with an average of 0.042 cm/sec
			Alluvial fan 4	Poorly sorted, rounded to sub-angular gravels, sands, and silts; forms small, steeply-sided undissected alluvial fans, standing at modern stream level; found only as small cones at the mouths of small canyons and at the toes of older alluvial fans		Qf_4		Hydraulic conductivities in the alluvial fans ranged from 0.033 to 1.333 centimeters per second (cm/sec), and averaged 0.225 cm/sec
		Pleistocene	Alluvial fan 3	Poorly sorted, rounded to sub-angular gravels, sands, and silts; forms large gently sloped relatively undissected alluvial fans, standing (8–12 feet) above modern stream level		Qf_3		
			Alluvial fan 2	Poorly sorted, rounded to sub-angular gravels, sands, and silts, forming large intermediate-sloped moderately dissected alluvial fans, standing (40 feet) above modern stream levels		Qf_2		Pumping tests in Qf_3 produced permeabilities of 3.8×10^{-3} to 2.8×10^{-2} cm / sec and transmissivities of 2,400 to 11,600 gpd / ft
			Alluvial fan 1	Poorly sorted, rounded to sub-angular gravels, sands, and silts, forming large steeply sloped strongly dissected alluvial fans, standing (60–90 feet) above modern stream level; characterized by a caliche layer near upper fan surface		Qf_1		
			Alamosa Formation	Interbedded, discontinous, blue, gray, and green clays and dark sands; sands are dominantly fine-grained; uppermost clay layers divide valley into an upper unconfined aquifer and lower confined aquifers; 0–20,000 feet	Confined aquifer		0–200	Unconfined aquifer has trans-missivities ranging from 5,000 to 225,000 gpd/ft; specific yield estimated to be 0.20; yields as much as 3,000 gpm (Emery and others, 1971)
	Tertiary	Pliocene	Vallejo-Santa Fe Formation	Red to maroon shales, siltstones, and poorly sorted sandstones and conglomerates, with interbedded volcanic flows of the San Juan Mountains; top of the unit is dominantly conglomerates and sandstones, while bottom is dominantly siltstones and shales; deposits are cross-bedded and channel cut; Oligocene sills are found in section			4,050–14,500	Confined aquifer has trans-missivities ranging from 4,000 to 300,000 gpd/ft; storage coefficient estimated to be 0.0001; water under artesian pressure; yields as much as 4,000 gpm (Emery and others, 1971). Interbedded volcanic flows have different aquifer characteristics from the valley-fill deposits
		Miocene						
Precambrian			Crystalline rocks	Granite, gneiss, and schist				Not tapped by wells



Source: Colorado Water Atlas 2012

Hydrogeologic Units of the San Luis Valley

Figure 3-7

Groundwater recharge primarily originates as precipitation in the mountainous areas surrounding the basins, while most of the precipitation that falls in the valleys is lost to evaporation and transpiration (BLM 2007a). Aquifers in the San Luis Valley are predominantly recharged by snowmelt runoff from higher elevations of the surrounding mountain ranges along the valley rim. Return flow of irrigated water and seepage along the stream valleys are also important sources of recharge. Because of the low precipitation rates and high evaporation rates in the valley, precipitation within the valley is not a significant recharge source (making up only about 1 percent of the annual precipitation reaching the aquifers) (Radford University undated).

Depth to the confining clay layers varies from about 100 feet in the northern part of the basin to about 40 feet in the southern part of the basin. Based on well permit records, 90 percent of the wells have reported completion depths of less than 400 feet. The mean well depth is 172 feet, and the median well depth is 100 feet. These statistics include wells in both the unconfined and confined aquifers (Colorado Geological Survey 2011).

The confined aquifer is loosely defined as encompassing all groundwater from depths of 200 feet to 14,500 feet (Colorado Geological Survey 2011). Any commercially viable geothermal resources tapped into within the San Luis Valley for power production would likely occur within the 5,000 foot to 10,000 foot depth range and would therefore be an inherent part of the confined aquifer.

3.20.4 Water Use and Water Rights Management

Colorado administers its water rights using the Prior Appropriation Doctrine (BLM 2001). Groundwater and surface water rights are administered by the CDWR, Office of the State Engineer (see **Section 1.4.5**, State of Colorado Water Laws and Regulation). In 2008, the San Luis Valley Advisory Committee was established to modify and propose new rules and regulations regarding water rights in the Rio Grande Basin (CDWR 2010). These new rules and regulations governing surface water and groundwater are not final but should be adopted in the near future and will impose a hard limitation on the amount of water that can be developed in the San Luis Valley (McDermott 2009).

Obtaining water supplies for some utility-scale renewable energy projects in the San Luis Valley requires the purchase and transfer of existing water rights. A serious burden for new water users in this region is the need to replace any out-of-priority depletions associated with the new withdrawal in terms of timing, location, amount, and quality by having augmentation water available (CDWR 2004). Finding augmentation water in the quantities necessary for utility-scale renewable energy projects may be very difficult. For the proposed utility-scale renewable energy in the San Luis Valley Water Conservancy District, however, the current scarcity of available water supplies in the San Luis Valley suggests that technologies that consume more than 300 acre-feet per year may not be legally viable (Gibson 2009).

The Closed Basin Division project, located in the San Luis Valley in a topographic basin called the Closed Basin, salvages unconfined groundwater and available surface flows in the Closed Basin that would otherwise be lost to evapotranspiration by vegetation. The salvaged water is delivered through a 42-mile conveyance channel to the Rio Grande to assist Colorado in meeting its water delivery requirements to other states under interstate compacts. The project also provides for the delivery of water to the Alamosa National Wildlife Refuge (NWR) and Blanca Wildlife Habitat Area, stabilization of San Luis Lake, recreational facilities at San Luis Lake, and fish and wildlife enhancement.

CHAPTER 4
ENVIRONMENTAL EFFECTS

4.1 INTRODUCTION

Many management actions proposed in Chapter 2 are planning-level decisions, such as open or closed allocation of areas on the landscape for geothermal leasing, and have no direct impacts on the environment; however, each action is a commitment of the resource for potential future exploration, drilling operations and development, utilization, reclamation, and abandonment and is subject to environmental review and permits. Therefore, an analysis is provided of the potential impacts of the various stages that may follow a leasing decision along with the potential cumulative impacts throughout the entire planning area.

This chapter evaluates potential environmental impacts that could occur from implementing each of the RMP amendment alternatives described in Chapter 2. The methodology for the impact assessment conforms to the guidance found in the CEQ regulations for implementing NEPA (40 CFR 1502.24; 40 CFR 1508.7; and 40 CFR 1508.8). These regulations require agencies to "rigorously explore and objectively evaluate" the impact of all alternatives. Since the action alternatives propose amending the SLVFO RMP with land allocations as open or closed to geothermal leasing, rather than project level exploration, development, and utilization of the resource, the focus of this analysis is on the impacts of these stages, which may follow leasing.

4.2 METHODS OF IMPACT ANALYSIS

Allocating lands and amending land use plans, in and of itself, does not cause any direct impacts as defined by the CEQ regulations, which state that such effects "are caused by the action and occur at the same time and place" (40 CFR 1508.8(a)). Prior to any ground disturbance or other future actions that would occur consistent with implementing the amended plan, further decision-making would be required. This decision-making must take place prior to future actions and involves consideration of a wide variety of factors, including, but not limited

to, whether any applications are submitted, whether funding is available, and compliance with other authorities and policies.

Similarly, lease issuance itself does not cause direct effects. The regulations governing geothermal leasing and development provide for several decision stages prior to any ground-disturbing activities and may include further compliance with applicable authorities during these decision stages. Until BLM receives and adjudicates an application for a permit to drill or other authorization that includes specific information about a particular project, impacts of actual development that might follow lease issuance are speculative, as so much is unknown regarding location, scope, scale, and timing of that development. At each decision stage, the BLM retains the authority to approve, deny, or approve subject to conditions any permit, based on compliance with applicable authorities and policies. Therefore, the analysis of effects of development in this EA reflects a more general, programmatic approach.

Any future development of geothermal resources, if and when it does take place, would result in effects. It is reasonable, therefore, to foresee that on-the-ground impacts would occur if the BLM issues geothermal leases. Those impacts would not occur, however, until some point in the future and following several decision stages. The following analysis, therefore, focuses primarily on both direct and indirect impacts of future development of geothermal resources based on the foreseeable on-the-ground actions, taking into consideration the stipulations, BMPs, and procedures outlined in Chapter 2. These impacts cannot be analyzed site-specifically, but they can be analyzed in general terms for the leasing area based on the RFDS.

The following analysis focuses on those resources most likely to be affected during future geothermal development activities. Therefore, this chapter presents a programmatic-level analysis of common impacts from indirect and direct geothermal development by analyzing the RFDS and assessing potential impacts during the four sequential phases of geothermal development: (1) exploration, (2) drilling operations, (3) utilization, and (4) reclamation and abandonment. The discussion of impacts from geothermal development activities is general in nature and would occur regardless of the alternative selected.

Following the discussion of impacts associated with the RFDS and common impacts associated with each phase of geothermal resource development, a programmatic analysis illustrates the nature and magnitude of the impact on the resource that would be associated with any anticipated future action taken consistent with each of the respective alternatives.

The Proposed Action and alternatives do not propose development of a geothermal resource. In order to gain an understanding of the types of impacts that can be anticipated, the analysis relies on the RFDS, which projects future geothermal leasing and development on public lands within Colorado over the next 20 years. The RFDS assumes all lands are available for leasing, and therefore,

does not consider any allocations (lands open or closed to geothermal leasing) prescribed under any of the alternatives. Its purpose is to demonstrate the level of expected development and show where the potential development might occur. However, it is important to note that the RFDS is not a document that attempts to accurately predict the scope of future development; rather, it presents a speculative "best case" scenario of possible development, constrained by current technical and legal considerations. In doing so, it expressly disregards a host of factors (e.g., changes in technology, electricity prices, transmission connectivity, power agreements, line load capacities, etc.) that any reasonable developer at the project level could hardly ignore.

The RFDS is also used as an upper limit for possible development that could occur and described as an expression of the acreage required for one megawatt production. Using this assumption, the magnitude and extent of impacts on any resource or resource use will vary depending on the amount of land apportioned for each land allocation as described in **Chapter 2**.

4.2.1 Determining Significance

Determining significance can be complex, particularly at a planning level. The significance of a resource or impact is dynamic and could change during the planning period. Significance can be real and supportable by fact, or perceived, and perhaps not fully supportable even with rigorous study. The significance criteria used in this analysis are intended to provide thresholds for comparison of the impacts of the planning alternatives but are not necessarily thresholds that would trigger the need to prepare an EIS for site-specific actions as required by Section 102 (C) of NEPA. The significance of impacts associated with implementation-level decisions will be made based on more site-specific analysis and further consideration of the context and intensity of impacts as explained in 40 CFR 1508.27. Specific significance criteria, if necessary, are presented under each resource topic.

4.2.2 Incomplete or Unavailable Information

As is typical in programmatic planning efforts, site-specific data are used to the extent possible and may not be entirely available. The best available information was used in developing this EA. Considerable effort has been made to acquire and convert resource data into digital format for use in the planning amendment—both from BLM sources and from outside sources, such as the Colorado Natural Heritage Program. However, certain information was unavailable for use in developing this plan, usually because inventories have not been conducted or were incomplete. For the unavailable data, estimates were made concerning the number, type, and significance of these resources based on previous surveys and existing knowledge. In addition, some impacts cannot be quantified given the proposed management actions. Where this occurs, impacts are projected in qualitative terms or may be described as unknown. Subsequent project-level analysis will provide the opportunity to collect and examine site-specific inventory data required to determine appropriate application of RMP-level guidance.

4.3 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR THE SAN LUIS VALLEY FIELD OFFICE

This impact analysis assumes that a maximum of one power plant (30- to 50-MW) would be developed within the SLVFO planning area by year 2040. Development of this magnitude is at the upper threshold of any likely development scenarios. Under any given alternative, the location of such development could occur anywhere in the areas identified as being open to leasing. Typical impacts from geothermal power plant development are described in **Table 4-1**, Typical Disturbances by Phase of Geothermal Resource Development, which has been reprinted from the Geothermal PEIS (BLM and USFS 2008).

Table 4-1
Typical Disturbances by Phase of Geothermal Resource Development

Development Phase	Disturbance Estimate per Plant
Exploration	2 – 7 acres
Geologic mapping	negligible
Geophysical surveys	30 square feet[1]
Gravity and magnetic surveys	negligible
Seismic surveys	negligible
Resistivity surveys	negligible
Shallow temperature measurements	negligible
Road/access construction	1- 6 acres
Temperature gradient wells	1 acre[2]
Drilling Operations and Utilization	51 – 350 acres
Drilling and well field development	5 – 50 acres[3]
Road improvement/construction	4 – 32 acres[4]
Power plant construction	15 – 25 acres[5]
Installing well field equipment including pipelines	5 – 20 acres[6]
Installing transmission lines	24 – 240 acres[7]
Well workovers, repairs, and maintenance	negligible[8]
Total	**53 – 367 acres**

Source: BLM and USFS 2008.

[1] Calculated assuming 10 soil gas samples, at a disturbance of less than three square feet each.

[2] Calculated assuming area of disturbance of 0.05 to 0.25 acre per well and six wells. Estimate is a representative average disturbance of all well sites. Some wells may require a small footprint (e.g., 30 by 30 feet), while others may require larger rigs and pads (e.g., 150 by 150 feet).

[3] Size of the well pad varies greatly based on the site-specific conditions. Based on a literature review, well pads range from 0.7 acres up to 5 acres (GeothermEx 2007; USFS 2005). Generally a 30-MW to 50-MW power plant requires about five to 10 well pads to support 10 to 25 production wells and five to 10 injection wells. Multiple wells may be located on a single well pad.

[4] One-half mile to nine miles; assumes about 0.25 mile of road per well. Estimates 30-foot wide surface disturbance for an 18 to 20 foot road surface, including cut and fill slopes and ditches.

[5] a 30-MW power plant disturbs approximately 15 acres; a 50-MW power plant disturbs approximately 25 acres.

[6] Pipelines between well pad to plant assumed to be 0.25-mile or less; for a total of 1.25 to seven miles of pipeline in length, with a 25-foot-wide corridor

[7] Five to 50 miles long, 40-foot-wide corridor.

[8] Disturbance would be limited to previously disturbed areas around the well(s).

4.4 AIR QUALITY

4.4.1 Scoping Comments on the Resource

No scoping comments related to air quality were received. However, windblown fugitive dust events are a concern in the planning area, including the effects these events have on visibility in the Great Sand Dunes National Park, a Prevention of Significant Deterioration Class I airshed.

4.4.2 How Resource Impacts were Evaluated

Methodology

The methodology for air quality impact analysis is incorporated by reference from the Geothermal PEIS and summarized here. While geothermal leasing itself would not impact air quality, the impacts of any possible future development on leased areas could affect air quality. These potential effects on air quality are those that may result from pollutants that are typically generated by geothermal development.

Potential effects were evaluated by examining the typical air emissions associated with the various stages of geothermal development and comparing those emissions with current air quality of the planning area. Additional methodology included comparing potential geothermal development against Prevention of Significant Deterioration standards applicable to the Great Sand Dunes National Park Class I airshed. There are no federally designated nonattainment areas in the planning area; therefore, Clean Air Act Conformity guidelines do not apply.

Indicators/Significance Criteria

Potential impacts on air quality could occur if reasonably foreseeable future actions were to:

- Conflict with or obstruct implementation of the applicable air quality attainment plan;
- Violate any stationary source air quality standard or contribute to an existing or projected air quality violation; or
- Expose sensitive receptors (e.g., concentrations of children, elderly, or persons with respiratory conditions) to major pollutant concentrations.

Assumptions

This analysis assumes the following:

- Based on current knowledge, information and data available, the temperature of the geothermal resource in SLV is only expected to supply binary production, therefore flash production is not analyzed in this section.

- Other regulatory requirements would be required at the project-specific phases of analysis and permitting.
- Analysis was conducted using the estimates of mass of carbon dioxide generated per kilowatt-hour by geothermal, natural gas, petroleum, and coal power production.

4.4.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Air Quality and Atmospheric Values Associated with Geothermal Development section of the Geothermal PEIS is incorporated here by reference and summarized below. **Table 4-2**, Activities and Related Pollutants from Geothermal Project Phases, summarizes the phase of activity, main pollutants released, and factors contributing to the release.

Table 4-2
Activities and Related Pollutants from Geothermal Project Phases

Activity	Pollutant	Project Phase	Factors
Exhaust from vehicular traffic	Carbon monoxide, carbon dioxide, oxides of nitrogen, volatile organic compounds, particulates, sulfur dioxide, air toxins	All	Vehicle miles traveled
Fugitive dust from vehicle traffic on paved and unpaved roads	Particulates	All	Vehicle miles traveled, road conditions
Fugitive dust from earth-moving activities	Particulates	All	Acres disturbed, soil conditions
Exhaust from construction equipment	Carbon monoxide, carbon dioxide, oxides of nitrogen, volatile organic compounds, particulates, sulfur dioxide, air toxins	All	Volume of fuel used, engine/abatement technology
Release of geothermal fluid vapor	Carbon dioxide, hydrogen sulfide, mercury, arsenic, boron	Exploration, drilling operations, utilization	Chemical composition of geothermal resource, duration and volume of flow testing, frequency, duration, and volume of well blow-outs, type of power plant

Source: BLM and USFS 2008

The air quality impacts associated with the exploration phase are short term, meaning impacts are anticipated to last only through primary and secondary phases of exploration (usually one to five years total), and generally limited to the release of fugitive dust from surface disturbance and emissions from vehicles

and construction and drilling equipment. Surveying and sampling activities would have minimal air quality impacts, again associated with fugitive dust and vehicle exhaust. Secondary exploration activities (e.g., site clearing, exploration well pad development, etc.) would have more intensive exhaust-related emissions lasting through the period of drilling and testing.

Air emissions during the drilling operations phase include fugitive dust and those from combustion engines, the same as those described above. Sources of fugitive dust and exhaust emissions include vehicle traffic, removing vegetative cover, constructing roads, well pads, laydown areas, excavation, grading, drilling production wells, drilling injection wells, and constructing fluid sump pits. Once the well is drilled, the new emission is from venting of geothermal fluids to the atmosphere, which can include hydrogen sulfide, carbon dioxide, mercury, arsenic, and boron when/if these compounds are in the geothermal fluid. The amount and ratio of these constituents varies by geothermal resource, with carbon dioxide generally comprising over 95 percent of the non-condensable gases. Hydrogen sulfide is generally the primary pollutant of concern for air districts considering permitting a geothermal well. Minor releases of hydrogen sulfide can occur during drilling and flow testing of wells. Monitoring devices can be installed and operated during drilling and testing, and hydrogen sulfide releases can be abated if necessary to avoid health risks to drill personnel or to mitigate public nuisance odors. Overall duration of the drilling operations phase can be up to 10 years, however emissions would occur only during active phases, such as drilling production wells which can last (depending on well depth) from 10 days up to 70 days.

A binary power plant would have no emissions realized during operations in the utilization phase, except for during well venting during maintenance activities or leaks in the heat exchangers resulting in a release of volatile organic compounds. Binary power plants operate on a closed cycle in which heat is transferred from high temperature geothermal fluids to a cooler working fluid that has a lower boiling temperature, usually a hydrocarbon such as isopentane or isobutane. The heat exchange consists of a large metallic surface area against which brine is passing on one side and the working fluid is passing on the other. Corrosion in the metal is currently a reality of geothermal operations and over time results in porosity of the metallic interface. The working fluid is kept under high pressure so that any leakage happens in a one-way direction from the working fluid into the geothermal fluid; this prevents geothermal fluid from contaminating the working fluid, which would result in corrosive damage to the turbines. Binary power plants have leak detection systems in place to monitor the volume of the working fluid in the system. After a certain rate of fluid loss is reached, heat exchanger units are shut down for repair. If the power plant is venting other non-condensable gases to the atmosphere, such as hydrogen sulfide, then the working fluid that leaks into the brine would be vented along with these gases. In such systems, a geothermal power plant operator would have acquired a permit from the Colorado Department of Public Health, Air Pollution Control

Division, which would allow for the venting of a certain volume of working fluid hydrocarbons to the atmosphere along with the non-condensable gases. The permitted volume would vary on a case-by-case basis.

Any development within 100 kilometers (62.1 miles) of Great Sand Dunes National Park has the potential to affect visibility within that Class I airshed from fugitive dust, exhaust emissions, and/or vapor plumes. Constructing a geothermal power plant and associated infrastructure (beginning of the utilization phase) would create the greatest amount of fugitive dust and exhaust from combustion engine of the types noted above in previous phases. Amount of dust or exhaust emissions would depend on several factors, such as acreage disturbed for the development, soil type specific to the development locality, miles driven by site workers, and road types travelled, to name a few. During the operations phase, fugitive dust and exhaust from combustion engines are generally limited to worker and maintenance vehicle traffic. Carbon dioxide (CO_2) emission estimates from projected geothermal power plant generation were calculated at a national level as part of the Geothermal PEIS (pg. 4-54 to 4-55); the formula was used here to illustrate the comparison between geothermal CO_2 generation and other traditional fossil fuel sources (**Table 4-3**, Hourly Carbon Dioxide Emissions Rates).

Under normal operations, binary power plants operate in a closed environment, where the geothermal fluid and the working fluid do not come in contact with the atmosphere. However, emissions of water vapor and gases from cooling towers can form a vapor plume during times of high humidity when the water vapor is not readily absorbed into the atmosphere. Cooling tower drift is a type of moisture release that results when small quantities of water droplets of 10 microns or greater and small amounts of dust and dissolved and suspended solids become airborne and are carried out with the exhaust air. Cooling tower drift can be avoided through the use of drift eliminators or other control technologies. Safety systems can be incorporated in the plant design to prevent the accidental release of significant amounts of hydrocarbons to the atmosphere. During maintenance, there may be minor emissions of nitrogen, carbon dioxide, and oxygen from the working fluid system. Operation of a binary power plant would likely have emissions below the level that constitutes a major source of new emissions in the federal Prevention of Significant Deterioration program. Additional air quality permits would be required, as discussed in the Geothermal PEIS.

Table 4-3
Hourly Carbon Dioxide Emissions Rates

	Geothermal (0.20 lbs. CO2/kWh)	Coal (2.095 lbs. CO2/kWh)	Petroleum (1.969 lbs. CO2/kWh)	Natural Gas (1.321 lbs. CO2/kWh)
Estimated Emissions per hour (1 power plant at 50 MW)	15 tons[10]	52.38 tons	49.23 tons	33.03 tons

Source: BLM and USFS 2008

Impacts from reclamation and abandonment activities would be limited to emissions from vehicles and construction equipment and fugitive dust from the movement of vehicles. Depending on the flow and temperature of the geothermal fluids or steam at the well heads at the time of abandonment, well capping could result in the potential release of the range of pollutants listed above and in **Table 4-2**.

4.4.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and actions in other areas would be assessed based on goals, objectives, and management actions contained within the existing RMP. Short-term emissions associated with exploration, drilling, utilization, and reclamation and abandonment would be less but could occur over a longer period of time. Existing BMPs (not those included with the preferred action) would be included as COAs during each permitted phase of development to control fugitive dust emissions and emissions associated with vehicle exhaust, equipment operations, and emissions from geothermal power plants and wells.

Alternative B (Proposed action)

Alternative B would have the same types of air quality impacts as described under Common Impacts; however, allocation decisions made in Alternative B have more areas surrounding the national park closed to geothermal leasing than under Alternative A and would include the comprehensive list of stipulations, BMPs, and procedures to serve as consistent guidance for future geothermal leasing. In accordance with BMPs, operators would be required to minimize air quality impacts from fugitive dust, vehicle exhaust, and equipment

[10] Sample calculation based on the formula from the Geothermal PEIS (pg. 4-55): (100 MW) x (1,000 kW/MW) x (0.2 lbs. CO_2/kWh) x (0.0005 ton/lb.) = 10

operations. Requirements for emissions controls would be incorporated into the terms of individual geothermal leases. It is expected that these measures would effectively minimize impacts on air quality and atmospheric values by reducing sources of air quality degradation including particulates and hydrocarbons. While a more regimented process would result under Alternative B because of amendments that address geothermal leasing and development, measures to reduce air quality impacts would likely be similar to those that would be required under Alternative A.

Alternative C

Air quality emissions and types of impacts for Alternative C would be the same as those described under Common Impacts. However, with less BLM-administered land available for leasing (due to closure), it would probably take longer to realize the same level of geothermal production and reduced air quality impacts than under Alternative A or B.

4.5 GREENHOUSE GASES AND CLIMATE CHANGE

4.5.1 Scoping Comments on the Resource

No scoping comments related to greenhouse gases and climate change were received. However, direction for how to address greenhouse gases and climate change in NEPA documents is in DOI and BLM policy, and therefore is discussed below.

4.5.2 How Resource Impacts were Evaluated

Methodology

The tools necessary to quantify climatic impacts are presently unavailable (USGS 2008). As a consequence, impact assessment of specific effects of anthropogenic activities and specific levels of significance cannot be determined. Therefore climate change analysis for the purpose of this document is limited to accounting for and disclosing greenhouse gas emissions that may result from future activities related to the plan amendment proposed.

While the greenhouse gas emissions of future actions that may be taken under each alternative analyzed can be estimated, current science does not permit quantification of the relationship between these emissions and the phenomena associated with global climate change. While the relationship appears on a global level, it is not possible to make the connections between greenhouse gas emissions and climate change on a local or even regional level (USGS 2008).

Indicators/Significance Criteria

On September 22, 2009, the EPA released final regulations for a Greenhouse Gas Monitoring Rule (see 74 Federal Register 56260). The reporting rule requires suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of greenhouse gas emissions to submit annual reports to the EPA. As there

are no Clean Air Act significance thresholds for evaluating greenhouse gases, this analysis compares likely greenhouse gas emissions from each alternative against the Greenhouse Gas Monitoring Rule.

Assumptions

This analysis assumes the following:

- Power produced by geothermal power plants would displace energy produced by fossil fuel sources.

4.5.3 Common Impacts Associated with Geothermal Development

The information presented in the Geothermal PEIS is incorporated by reference and summarized here. Temporary emissions of greenhouse gases associated with geothermal development would occur during all phases of geothermal development. Sources of these temporary greenhouse gas emissions are vehicles, truck traffic, and construction equipment required for exploration, well drilling, and power plant construction. As discussed under **Section 4.4**, Air Quality, well drilling also has the potential to release non-condensable gases such as carbon dioxide; carbon dioxide generally comprises over 95 percent of the non-condensable gases.

Greenhouse gas emissions associated with development of wells and construction of a power plant are discussed above. Greenhouse gas emissions associated with the operation of a geothermal power plant would be limited to commute traffic, maintenance traffic, and truck deliveries and potential releases of carbon dioxide during maintenance.

Some of the greenhouse gases associated with geothermal exploration and development will be naturally sequestered, while the balance of those emissions will accumulate with greenhouse gas concentrations in the atmosphere. This, in turn, is believed to contribute to further manifestations of climate change. However, since geothermal energy is a renewable energy with low carbon output compared with nonrenewable sources that currently dominate the US energy landscape, actual release of greenhouse gas emissions would depend upon plant technology and design; however, operation of a geothermal power plant would have a net beneficial impact on greenhouse gas emissions if the power produced by the geothermal plant displaced electricity generated by conventional sources of electricity.

As shown by the emission rates in **Table 4-3**, Hourly Carbon Dioxide Emissions Rates, electricity produced from geothermal sources emits a fraction of the carbon dioxide emitted by conventional energy sources. Therefore, electricity produced by a geothermal power plant would result in a net decrease in greenhouse gas emissions if power produced by the geothermal plant displaced electricity generated by conventional fossil fuel sources of electricity. Greenhouse gas emissions from a 50-MW power plant would be expected to be

well below the 25,000 tons per year reporting limit under the Greenhouse Gas Monitoring Rule.

On March 22, 2010, Colorado passed House Bill 1001, which requires utilities to supply at least 12 percent of their retail electric sales from renewable sources from 2011 to 2014, 20 percent from 2015 to 2019, and 30 percent for 2020 and thereafter[11]. Development of geothermal power plants could help utilities achieve these renewable portfolio standards.

The discussion of greenhouse gas emissions and climate change under each alternative is limited to a comparison in terms of possible greenhouse gas emissions and the potential for offsets between the respective approaches to development reflected in each of the alternatives.

4.5.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

It is projected that Alternative A's land use allocation and approach to leasing would result in the least beneficial effect on reducing greenhouse gas emissions and the least amount of new, clean energy being brought on-line, despite the alternative having the largest amount of acreage open to leasing. This is due to the longer time period required to process each individual lease nomination package as the geothermal procedures, stipulations and BMPs would not be adopted as part of this alternative.

Alternative B (Proposed action)

It is expected that projects developed consistent with Alternative B would result in the greatest amount of geothermal development, the greatest amount of new, clean energy being brought online, and the greatest potential for reducing greenhouse gas emissions. Compared with Alternative A, anticipated future actions consistent with Alternative B are expected to have the greatest beneficial effect on reducing greenhouse gas emissions because of the greater potential for greenhouse gas offsets.

Alternative C

Alternative C was developed with more areas allocated as closed to leasing and more areas with NSO stipulations, and as such would likely limit development of geothermal resources in the future. Alternative C has the least amount of acreage open to geothermal leasing (475,500 acres); therefore potential net benefits could be less under this alternative than under Alternatives A and B. As such, it would likely result in less new, clean energy coming online and potential reductions in greenhouse gases than Alternative A or B. In as much as a relationship can be drawn between greenhouse gas emissions and climate

[11] These requirements apply to all providers of retail electric service in the state, with the exception of municipal utilities serving 40,000 customers or less.

change, it is expected that Alternative C would have only a marginally better beneficial impact on climate change than Alternative A.

4.6 CULTURAL RESOURCES

4.6.1 Scoping Comments on the Resource

- Commenters suggested that specific guidelines be incorporated into the RMP Amendment/EA to protect historic trails and other valued heritage resources.
- Commenters stressed the importance of the San Luis Valley as a culturally significant area for archaeology, historic sites, and areas of Native American significance.
- Commenters wanted information available to understand what the impacts on cultural resources from leasing decisions are and what stipulations or COAs would be included to prevent impacts on eligible sites.

4.6.2 How Resource Impacts were Evaluated

Methodology

Cultural resources are past and present expressions of human culture and history in the physical environment. The term "cultural resource" can refer to archaeological, historical, and architectural sites, structures, or places with important public and scientific uses, and may include locations (i.e., sites, natural features, resource gathering areas, or places) of traditional cultural or religious importance to specified social and/or cultural groups.

This section discusses impacts on cultural resources from the proposed geothermal leasing program procedures, allocation decisions, and management actions as noted in **Chapter 2**, Alternatives. Existing conditions concerning cultural resources are described in **Section 3.3**, Cultural Resources.

Consultations on programmatic actions including allocating areas as open or closed to leasing and determining lease stipulations are ongoing. Leasing allocations do not grant any rights or authorize any activities affecting cultural resources, therefore the impact analysis focuses on the anticipated future actions consistent with the implementation of the alternatives described in **Chapter 2**.

Cultural resource baseline information in **Section 3.3** was reviewed for current understanding of known resources and to determine the condition of the resources. Also, all laws pertinent to determining effects on cultural resources (e.g., NHPA) were considered and included in criteria for determining impacts. This known information was overlain with the actions found under each alternative in **Chapter 2**, and conclusions were drawn based on an

understanding of how these types of actions may affect the known and potentially discoverable resources.

Indicators/Significance Criteria

Impacts on cultural resources occur when there is damage to or loss of cultural resources or their settings. Under NEPA, impacts on cultural resources are assessed by applying the criteria of adverse effect as defined in the implementing regulations for Section 106 of the NHPA (36 CFR 800) as noted in the first assumption above. Additionally, assessment of effects involving Native American or other traditional community, cultural, or religious practices, resources, or areas requires focused consultation with the affected group and impact analysis would be informed by said consultation.

For the purposes of this analysis, indicators for determining effects on cultural resources include asking whether the action would:

- Conflict with management goals and objectives that sustain cultural resources and their qualities set forth in the SRLA RMP;
- Result in proposed uses that are incompatible with maintaining and identifying cultural resources and their qualities;
- Cause physical destruction or damage to all or part of the property;
- Alter a property, by restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary of the Interior's standards for the treatment of historic properties (36 CFR 68) and applicable guidelines;
- Remove the property from its historic location;
- Change the character of the property's use or physical features within a property's setting that contribute to its historic significance (e.g., isolating the property from its setting);
- Introduce visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features;
- Neglect a property, which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe;
- Disturb any human remains, including those interred outside of formal cemeteries; or
- Indicators relating to individual sites would contribute to an adverse effect (under the NHPA) to a cultural resource if it is listed on or eligible for listing on the NRHP or if it is an area of importance to a Native American or other traditional community. If a site is determined to be eligible for listing or is listed on the NRHP, any

physical disturbance would also constitute a significant impact under NEPA. If a site is determined to be ineligible for listing, then any disturbance may be considered substantial, but would not be significant under NEPA or "adverse" under NHPA.

Assumptions

This analysis assumes the following:

- Impacts on cultural resources are assessed by applying the criteria of adverse effect, as defined in 36 CFR Part 800.5a: "An adverse effect is found when an action may alter the characteristics of a historic property that qualify it for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, workmanship, feeling, or association. Adverse effects may include reasonably foreseeable effects caused by the action that may occur later in time, be farther removed in distance, or be cumulative."
- The criteria of adverse effect provide a general framework for identifying and determining the context and intensity of potential impacts on other categories of cultural resources, such as Native American or other traditional community, cultural, or religious practices or resources, if these are present. Assessment of effects on these resources requires focused consultation with the affected group.
- BLM will follow 36 CFR 800, Section 106 (including Native American consultation), and the Colorado Protocol when addressing federal undertakings; therefore, adverse effects on cultural resources would be appropriately mitigated.
- Human occupation of North America over the last 10,000 years has left its mark on all landforms and sites may be manifest on the surface or deeply buried. There may be areas of importance to contemporary Native Americans that are not readily identifiable outside of those communities.
- The information on cultural resources in the planning area is based on the results of industry and BLM inventory projects and depicts the relative potential for cultural resource sites within the planning area. However, as these data are geographically biased toward past project-oriented undertakings and cannot accurately predict where and how many resources may exist in unsurveyed areas, this analysis does not attempt to quantify affected resources.
- Cultural resource protection and mitigation measures apply to all proposed federal or federally assisted undertakings and to leases granted by BLM, and would be applied at project design and implementation phases.

- Cultural resource inventories, either federal undertakings or related programs, would result in the continued identification of cultural resources. The cultural resource data acquired through these inventories and evaluations would increase overall knowledge and understanding of the distribution of cultural resources in the region.
- Impacts on known cultural resource sites from authorized uses would be mitigated after appropriate Section 106 and Colorado protocol consultation requirements are met. Mitigation can include project cancellation, redesign, avoidance, or data recovery.
- The number of sites that could be affected by actions correlates with the degree, nature, depth, and quantity of surface disturbing activities within the planning area and the cultural sensitivity of the area.

4.6.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the direct and indirect impacts on cultural resources associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the Geothermal Leasing PEIS; they are summarized below and incorporated by reference here.

Any activities during exploration, drilling operations, plant construction, utilization, or reclamation that would involve surface disturbing activities would have potential direct and indirect impacts on cultural resources, including damaging, destroying, and/or displacing artifacts and features, and construction of modern features out of character with a historic setting. Damaging, displacing, and/or destroying cultural resources could include removing artifacts from their situational context, breaking artifacts, and/or shifting, obliterating, or excavating features without appropriate scientific recording.

Indirect impacts on cultural resources would include changing the character of the property's use or physical features within the property's setting that contribute to its historic significance (e.g., isolating the property from its setting) and introducing visual, atmospheric, or audible elements that diminish the integrity of the property's historic features. Construction of the geothermal plant(s), well pads, and associated facilities would place modern features onto a landscape that did not have them previously, thereby juxtaposing "modern" industrial features onto an historic landscape. Additionally, with the increased human presence of site workers during all phases of geothermal development, there is the risk of illicit collecting of surface artifacts resulting in a loss of scientific information.

The potential for undiscovered buried cultural resources and human remains exists despite previous archaeological surveys and investigations. Surface disturbing activities during all phases of development would directly impact undiscovered cultural resources and human remains by exposing buried

material, resulting in inadvertent artifact destruction or loss of scientific context. Indirect impacts could result from the increased human presence from anticipated site workers, leading to possible illicit collecting of newly exposed materials.

Reclamation and abandonment of geothermal developments would eliminate the indirect viewshed or setting impacts for cultural resources. With reclamation practices, the natural and historic setting would be restored. However, direct impacts on cultural resources or any unanticipated discoveries made would remain as they were permanently destroyed or damaged by construction, operations or maintenance practices. Similar to impacts during earlier phases, the potential for undiscovered buried cultural materials and/or human remains continues to exist through reclamation and abandonment. Abandonment activities may expose buried materials, resulting in inadvertent artifact destruction or loss of scientific context; additionally, the increased presence of site employees may lead to illicit collection of exposed materials.

4.6.4 Potential Impacts Associated with Preferred Action and Alternatives

Potential impacts on cultural resources and their settings from subsequent geothermal related undertakings would be addressed at the project design and implementation phase. Required separate compliance with Section 106 would result in the continued identification, evaluation, mitigation, and nominations to the NRHP. Effects on cultural resources eligible for listing in the NRHP would be avoided or mitigated. If previously undiscovered resources are identified during an undertaking, work would be suspended while the resource is evaluated and mitigated to avoid any further impact. Consultation would continue with Native American groups to identify any traditional cultural properties or resource uses and address impacts. Through this process, impacts on cultural resources would be minimized or eliminated.

Alternative A

Under Alternative A, geothermal leasing is closed around five eligible NRHP sites, thereby protecting the cultural resources in those areas. In areas identified as open to leasing with NSO stipulations, direct impacts related to damage or destruction of cultural resources would not occur; however, indirect impacts, such as visual, atmospheric or audible intrusions on the setting and/or landscape, may occur outside the immediate NSO area that could diminish the integrity of the site's historic features, setting, and/or landscape. Other areas that are open to geothermal leasing and any subsequent development would likely have impacts of the type and characteristic noted above and would be concentrated in those areas identified as containing cultural resources. As the BLM-required Section 106 consultation procedures would not change under this alternative, cultural resources would continue to be identified and any damage or impacts on them would be evaluated and mitigated to avoid adverse effects.

Until finalization of the Old Spanish National Historic Trail Comprehensive Management plan, both the Old Spanish Trail and the West Fork of the Old Spanish Trail will be managed under interim guidance which states an area of 0.25 to 0.5 miles on either side of the centerline of the trail will be identified to protect associated cultural resources from direct impacts, such as damage or destruction of the trail footprint, and setting up to five miles for protecting the viewshed from indirect impacts, such as modern intrusions on the landscape as a result of exploration, utilization and development. However, outside the protection area, standard leasing stipulations and procedures for Section 106 consultation would be used to mitigate possible indirect impacts on the trail setting and/or landscape.

Alternative B (Proposed action)

Under Alternative B, the areas allocated as closed to geothermal leasing would contribute to protecting cultural resources in those areas. However, if sites were located along the margins of closed areas, and adjoining lands are allocated open with standard stipulations or CSU, there may be indirect impacts of the nature noted above if the area were leased and exploration, development, or utilization occurred. Areas identified as open to leasing would have impacts of the type and characteristic noted above; these would be concentrated in those areas identified as containing cultural resources. Areas allocated "Open with NSO Stipulation" would have the same direct and indirect effects as noted under Alternative A. Alternative B, however, includes allocations of "Open with CSU Stipulations" that would lessen the direct and indirect impacts on cultural resources. The impacts would be similar in characteristic as those listed above under Common Impacts, but projects could be designed to avoid or be moved so as to have less or no impact upon the cultural resources.

The Old Spanish Trail and West Fork of the Old Spanish Trail would be managed the same as under Alternative A and have the same type of impacts noted previously. Additionally, CSU stipulation for protecting the trail's viewshed may be applied to adjacent lands to mitigate possible visual, atmospheric, or audible intrusions on the landscape and setting.

Relevant stipulations designed to minimize impacts on cultural resources include NSO within the setting and boundary of properties designated or eligible for the NRHP, including National Historic Landmarks and National Register Districts and Sites, and additional lands outside the designated boundaries to the extent necessary to protect values where the setting and integrity is critical to their designation or eligibility. Under the proposed leasing procedures, the BLM authorized officer would be required to consult with the appropriate Native American Tribes and the Colorado State Historic Preservation Office regarding historic and cultural resources per Section 106 of the National Historical Preservation Act prior to leasing. The presence of archaeological sites and historic properties would be determined on the basis of a records search and literature review of recorded sites and properties in the proposed lease area

and a buffer around the lease area, if appropriate. Additional historical, cultural or ethnographic research, consultation and/or inventories may be required to identify resources, determine effects, mitigate adverse effects, and complete the Section 106 process.

In accordance with BMPs, if cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a cultural RMP would be developed that identifies appropriate monitoring and protection measures. Unexpected discovery of cultural resources during geothermal development would be brought to the attention of the BLM authorized office immediately and work shall be halted in the vicinity of the finds to avoid further disturbance while the finds are evaluated and appropriate mitigation measures are developed. Specific to National Historic Trails, if the right-of-way application includes remnants of the National Historic Trail, is located within the viewshed of the National Historic Trail, or a trail eligible for listing on the NRHP (i.e., West Fork of the Old Spanish National Historic Trail, Old Spanish Trail, and Pike's Historic Trail), the project proponent will evaluate the potential visual impacts and identify the appropriate mitigation measures (e.g., visual design considerations, low profile structures, etc.) to be included in the operations plan. It is expected that these measures would effectively avoid and/or minimize impacts on cultural resources by identifying, preserving, and protecting significant cultural resources, districts, and landscapes; maintaining viewsheds of important cultural resources as appropriate; and reducing the indirect impacts from land uses on cultural resources.

Alternative C

Impacts as a result of Alternative C would be the same as those described under Alternative B, except that more areas would be closed to leasing and protected with NSO stipulations which would result in protecting all the known and unknown sites within those areas from direct impacts (e.g., damage or destruction of the site or artifacts). As noted previously, "Open with NSO Stipulation" would create more areas and cultural resources protected from said direct impacts; however, indirect impacts, such as modern intrusions on an historic landscape, may still occur under any of the open allocation decisions.

4.7 TRIBAL INTERESTS

This section discusses impacts on tribal interests from the proposed geothermal leasing program procedures, allocation decisions, and management actions as noted in **Chapter 2**, Alternatives.

4.7.1 Scoping Comments on the Resource

- Commenters wanted to know if leasing decisions would impact areas of Native American concern or sensitivity.

4.7.2 How Resource Impacts were Evaluated

Methodology

Tribal consultations on programmatic actions including allocating areas as open or closed to leasing and determining lease stipulations are ongoing. Leasing allocations do not grant any rights or authorize any activities affecting tribal interests or resources; therefore, the impact analysis focuses on the anticipated future actions consistent with the implementation of the alternatives described in Chapter 2.

BLM conducted government-to-government tribal consultations with affected, federally recognized Indian tribes to identify tribal interest, treaty rights, and traditional cultural resources within the SLVFO planning area. Also, all laws, regulations, and policies pertinent to determining effects on tribal interests and resources (such as Executive Order 13007, Native American Sacred Sites) were considered and included in impacts criteria. This known information was overlain with the actions found under each alternative in **Chapter 2**, and conclusions were drawn based on an understanding of how these types of actions may affect known and potentially discoverable resources. Throughout the analysis process, assumptions were verified.

Indicators/Significance Criteria

Potential impacts on tribal interests or traditional cultural resources could occur if anticipated future actions consistent with implementing the alternatives described in **Chapter 2** were to:

- Conflict with land uses, management, and economic wellbeing of adjacent or nearby reservations, trust lands, restricted Indian allotments, and federally tribal-dependent Indian communities;
- Conflict with the exercise of off-reservation treaty and reserved rights, including grazing rights, hunting and fishing rights, gathering rights and interests, and water rights;
- Conflict with federal trust responsibilities to tribes and individual Indians regarding real property, physical assets, or intangible property rights;
- Conflict with existing court decisions, laws, policies, executive orders, and agency agreements with tribes regarding land and resource use;
- Result in proposed uses that are incompatible with maintaining and identifying cultural resources and their qualities;
- Have an adverse effect on historic properties or their settings, especially traditional cultural properties and cultural landscapes under Section 106 of the NHPA (36 CFR 800);

- Impact or restrict access to traditionally used hunting, fishing, and gathering areas and species;
- Change or reduce access to traditionally used or culturally important water sources and hot springs;
- Impact culturally important trails or trail systems; or
- Impact sacred sites or their settings, access, or use.

Assumptions

This analysis assumes the following:

- Areas proposed for leasing would likely include lands where there are tribal interests and traditional cultural resources that are not currently identified;
- BLM would coordinate with Indian Tribal governments to identify issues and concerns during all phases of geothermal leasing and/or development;
- There may also be unidentified conflicts with existing tribal treaty rights or claims of ownership related to hot springs and water sources.

4.7.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the impacts on tribal interests associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the Geothermal PEIS; they are summarized below and incorporated by reference here.

Types of impacts that could occur from exploration, drilling operations, utilization, and reclamation and abandonment include direct disturbance of locations or landscapes associated with traditional beliefs, resource gathering areas, hunting and fishing areas, water sources, hot springs, ancestral sites, human remains, and trails. Other impacts could result from alterations of visual and aural aspects of the cultural landscape's setting both on the lease site and in adjacent areas; increased access and site workers, which could lead to increased incidents of vandalism, unauthorized collection of ancestral sites; decreased tribal member access or interference with the exercise of treaty rights or cultural uses and practices such as resource gathering or hunting; and the potential for erosion, pollution, habitat loss, and less tangible changes to natural features and resources that tribal members may consider sacred.

Exploration, drilling operations, and utilization in or around hot spring sources would likely impact traditional cultural resources and could possibly impact other tribal interests. Impacts could include loss of access, interference with use, and changes in flow or temperature of hot springs. Since the thermal water in these springs is often considered sacred, there is a potential for loss of sacred

sites, and the healing energy and power they provide to the tribal users who value them.

While visual and aural settings could be restored and it may be possible to restore some habitats, it is unlikely that some cultural or sacred uses could be restored. Changes in flow or temperature of hot springs would not be restored, and cultural uses and religious value may be permanently lost.

4.7.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, there are no specific protections applied to areas of tribal interest or significance. If an area of tribal interest or significance fell within a closed area, it would not have any direct impacts, such as disturbance of locations associated with traditional beliefs. If a specific location or landscape was within an area allocated as open with NSO stipulations, the surface resources would also be protected from direct impacts; however, adjacent lands could be impacted thereby resulting in indirect impacts on the area of importance (e.g., increased vandalism or interference with the exercise of treaty rights). Areas of importance that did not have surface protections could be protected or impacts mitigated as a result of tribal consultation at the time of leasing and/or development.

Alternative B (Proposed action)

Areas allocated as closed to leasing under Alternative B would likely protect locations and/or settings important to tribes and associated cultural resources. For areas identified as open with NSO, CSU, or standard stipulations, direct and indirect impacts of the type described above could be located in those areas identified as containing tribally significant heritage resources.

Impacts on tribal interests and resources would be minimized or avoided through consistent application of the geothermal leasing program procedures and BMPs, including closures, any required consultations, environmental reviews, and stipulations. Indian trust or restricted lands within or outside the boundaries of Indian reservations would remain closed to leasing. For all lands open to geothermal leasing, compliance with NEPA, NHPA, and Executive Orders 13007 and 13084 would be required therefore reducing the potential for impacts. NSO stipulations would be required in areas with important cultural and archaeological resources, such as traditional cultural properties and Native American sacred sites, as identified through any required government-to-government consultation with tribes. It is expected that these measures, along with the measures outlined under cultural resources, will minimize impacts on tribal interests and traditional cultural resources; however, there may be residual effects, such as permanent abandonment of an area by tribes that are difficult or impossible to adequately mitigate.

Alternative C

Impacts as a result of Alternative C would be the same as those described under Alternative B, except that more areas would be closed to leasing and protected with NSO stipulations which would result in protecting all the known and unknown areas of tribal significance within those areas from direct impacts (e.g., damage or destruction). As noted previously, open with NSO stipulation would create more tribally significant areas and associated heritage resources protected from said direct impacts; however, indirect impacts, such as modern intrusions on the landscape, may still occur under any of the open allocation decisions. Mitigation of these impacts would be the same as Alternative B, namely occurring through consistent application of the previously mentioned geothermal leasing program procedures and BMPs, including required consultation, closed areas, and compliance with Executive Orders 13007 and 13084.

4.8 FISH AND WILDLIFE HABITAT

4.8.1 Scoping Comments on the Resource

- Commenters suggested that specific guidelines, BMPs, and stipulations be incorporated into the RMP Amendment/EA to protect SWAs and wildlife resources.
- Commenters wanted to know the effects of this project on wildlife habitat, specifically sensitive habitat areas.
- Commenters were concerned about how the Orient Mine, Colorado's largest bat colony, would be affected as it is home to nearly a quarter-million Mexican free-tailed bats.
- Commenters were concerned that the BLM would not offer lease protections to state lands that use geothermal resources to benefit wildlife, including state fish production units.
- Commenters want a variety of big game, small game, waterfowl, and other species to be considered for protection.
- Commenters were concerned that geothermal development could disturb sensitive wetland areas and the waterfowl that inhabit them.
- What impacts on critical big game winter range, wetlands, sage-grouse leks, and other wildlife habitats can be expected as a result of geothermal leasing decisions? What stipulations would be needed to lessen any impacts?

4.8.2 How Resource Impacts were Evaluated

Methodology

Leasing of geothermal resources does not affect fish and wildlife. These resources would be affected only by development of specific geothermal projects. Potential impacts of geothermal development were evaluated based on

the typical disturbance of geothermal projects for the various stages of development and then assessed based on projected intensity as described in the RFDS. The types of fish and wildlife that could be affected by geothermal development depend on the specific location of the proposed project, the time of year, the project design, and its environmental setting.

Additionally, the analysis used GIS quantitative analysis, when available, and assessment relative to Land Health Standard 3, which aims to achieve healthy, productive resilient, diverse, and vigorous plant and animal communities. Since most fish and wildlife species rely to some extent on the vegetation within the planning area, impacts on vegetation, as described in **Section 4.22**, would also likely impact fish and wildlife.

Indicators/Significance Criteria

Potential impacts on fish and wildlife could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self-sustaining levels, or causing a substantial loss or disturbance to habitat. Such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonally important habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the MBTA;
- Interfere with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the BLM.

Assumptions

This analysis assumes the following:

- In general, impacts on fish and wildlife and habitats would be more likely to occur with increasing acres open to geothermal leasing. Conversely, the more acres that are closed to geothermal leasing, the less likely that species and habitats would be impacted.
- NSO stipulations would prevent direct disturbance to relevant habitats and species by restricting surface-disturbing activities where they are applied.
- TL stipulations would help to prevent direct disturbance to species during sensitive periods, such as during winter, when forage is sparse, and during breeding and birthing.

- If monitoring reveals that mitigation is unsuccessful in precluding impacts, immediate measures to prevent further impacts would be implemented as appropriate to the species affected prior to the accumulation of impacts to a significant level.
- Disturbance of a key or critical component of a species' habitat would be detrimental, with the degree of detriment dependent on the importance of the habitat component to the maintenance of the population.
- Habitat conditions and quality are directly linked to the health, vigor, and cover of vegetative communities, as well as soil conditions and water quality and quantity.
- Human disturbance would often displace wildlife beyond the actual disturbance footprint, although some wildlife may adapt over time depending on the nature of the disturbance and the species being impacted.

4.8.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Fish and Wildlife Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here. However, additional information specific for this EA includes quantitative analysis, when available, and consideration of the particular fish and wildlife species that occur within the SLVFO planning area.

The effects of implementing the RFDS would have very little effect on most species populations. This is because the RFDS would affect relatively small areas of habitat and would typically affect individual species instead of large populations. The instances where individuals, communities, or populations can be affected from geothermal activities involve the stressors and associated impacts on vegetation and important habitats noted below.

Habitat Disturbance

Species requiring large contiguous tracts of land can be affected by habitat fragmentation and degradation caused by site clearing, well drilling, construction of access roads and geothermal facilities, and maintenance and operational activities that disturb habitat. These activities could also cause disruption of breeding and migration and increased mortality and injury to fish and wildlife. Other habitat disturbances could include increased risk of invasive species introduction and spread, and alteration of water dynamics, seed dispersion, and wildlife use patterns, which can further affect fish and wildlife habitat.

Invasive Vegetation

Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and nonnative species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued

existence of endemic species. This can affect wildlife by reducing habitat quality and species diversity, thereby affecting foraging and breeding behavior.

Injury or Mortality

Wildlife could be injured or killed during roadway clearing, vehicle staging, building construction, and other activities. Small or less mobile animals such as reptiles, amphibians, and rodents would be most susceptible to injury or mortality from geothermal activities. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities, would involve mowing, herbicide treatment, and other mechanical or chemical means of controlling vegetation that could directly affect species that depend on that vegetation for food, cover, or other habitat needs.

Erosion and Runoff

Site clearing, grading, access roads construction, containment basins, site runoff, and vehicle and human foot traffic cause erosion. The effects of erosion include the loss of habitat for terrestrial species and increased turbidity, which can directly affect fish and other aquatic biota.

Fire

Increased vehicular and human traffic, equipment operation, and geothermal fluid extraction can increase the risk of fire. Vehicles, electrical lines, and smoking can all result in accidental fires. During fires, wildlife can be killed or injured. After fires, wildlife may be forced to move to other habitats or may be without suitable habitat for important behavioral activities.

Noise

Constructing and operating geothermal facilities can produce noise far above normal ambient levels. Many species are sensitive to increases in noise, and the increased stress may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.

Exposure to Contaminants

Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

General Fish and Wildlife

In general, effects from geothermal development on common, widespread species, such as many small rodents, amphibians, and reptiles, would have impacts on individuals in localized areas. Many species are mobile, adaptable to small local changes to their environment, and are generally resilient to human disturbance. As such, geothermal development on the scale anticipated in the SLVFO planning area would be unlikely to have population-level effects on these species.

Low-level noise from power plant operation could have long-term effects on wildlife, causing them to avoid the area, or potentially putting chronic stress on animals, affecting their energy budget, reproduction, and long term survival (Radle 2007). Acoustical cues play a dominant role in sexual communication, territory defense, habitat quality assessment, and predator-prey interactions (Barber et al. 2009a), and may be impacted by low-level noise. For example, noise could interfere with bats that use echolocation to detect prey species. Studies have documented substantial changes in foraging and anti-predator behavior, reproductive success, density, and community structure in response to noise (Barber et al. 2009b). Given the predicted maximum extent of disturbance, the likelihood of extensive habitat loss or population-level effects on species is low.

Any geothermal power plant would require a transmission or distribution line to connect the generated power into the power grid. Depending on the production capacity of the power plant, connection to high-voltage transmission lines may not be necessary. For smaller geothermal power plants (5 MW or less) transmission could be connected to the grid by low-voltage four-phase connections and could require shorter lengths of transmission. Bird or bat mortality and injury could occur due to collision or electrocution with a transmission line. Bird and bat collisions may occur when a transmission line transects a daily flight path used by a concentration of birds or when migrants are traveling at reduced altitudes and encounter tall structures in their path. These collisions generally occur during inclement weather or low light levels and are more common with waterfowl, shorebirds, and other large species with low maneuverability (APLIC 2006; Faanes 1987). Guidelines provided by the Avian Power Line Interaction Committee (APLIC 2006, 1994) would likely be implemented to reduce the risk of impacts on birds.

Similarly, transmission lines or other related geothermal plant facilities could cause bird electrocution. Electrocution occurs when a perching bird simultaneously contacts two energized phase conductors or an energized conductor and grounded hardware. This can occur when horizontal separation is less than the wrist-to-wrist (flesh-to-flesh) distance of a bird's wingspan or when vertical separation is less than a bird's length from head to foot. Raptors are usually more at risk of this type of electrocution because of their size, distribution, and behavior. Guidelines have been developed to reduce avian electrocution risk (APLIC 2006). Substations also may pose electrocution hazards for some birds, since the wires, bus work, and support structures can provide potential roosting, perching, and nesting sites. Birds may be electrocuted when making conductor-to-conductor or conductor-to-ground contact with uninsulated equipment.

Of particular concern related to bird and bat collision and electrocution are: 1) a project's proximity to existing power lines and trees, which are current barriers to bird and bat movement to which resident birds may have adapted,

and 2) a project's proximity to areas that are heavily used by migratory birds and bats, which could be affected by nearby transmission lines as they fly between water sources. Impacts would vary depending on the location of a transmission line, but given the importance and use of the San Luis Valley by migratory birds and bats, it is safe to assume that siting a transmission line close to migratory bird and bat habitat would pose a flight hazard to birds and bats in the planning area.

Another consequence of transmission line construction is that it could provide perching or nesting habitat to corvids or raptors, which could allow them to prey upon other bird species. This would especially be an issue in areas where migratory birds, shorebirds, and waterfowl congregate, as predators would have ample prey. However, perch deterrents would likely be required where feasible and appropriate along power line sections near high value habitat. Perch deterrents have been demonstrated to minimize raptor and common raven activity on recently constructed transmission lines (Slater and Smith 2010).

Bats could be impacted by the large cooling fans associated with geothermal plants, although there is no documented evidence for this type of impact (Kirk Navo, personal communication, 2012). The fans could be a threat due to their physical structure as well as their vertical plume of air exhaust, which could affect bat flight patterns. In addition, any pesticides used during site preparation or development could reduce the prey base for bats. Noise could impact bat location capabilities, as mentioned above.

Under all alternatives, COAs and master planning would be required, which would provide basic protection to and consideration for fish and wildlife species and would help to ensure that habitat restoration is completed. Transmission lines constructed on federal lands would be subject to separate NEPA analysis, including site-specific analysis of impacts on fish and wildlife and mitigation efforts such as the development of an avian protection plan.

Big Game

While impacts on big game from geothermal development are not yet well-researched, impacts are likely to be similar to those from oil and gas development, as many of the facilities would be similar. Studies have shown that roads and oil and gas development affect terrestrial wildlife, particularly big game species (Rowland et al. 2004; Trombulak and Frissell 2000). Impacts include those stated in the Geothermal PEIS, such as weed spread, habitat degradation, injury or mortality, and noise. Other impacts include increased daily movements and home range (Rowland et al. 2004). Such increases in movement and stress levels would cause individuals to expend more energy, which could impact reproductive success or susceptibility to mortality, predation, or disease. Species have also been shown to avoid habitat extending to distances of over a mile from a source of disturbance (WGFD 2010). Mule deer were less likely to occupy areas in close proximity to well pads than those

farther away, and no evidence of well pad acclimation occurred over time (Sawyer et al. 2006). Mule deer were less likely to use habitat within 1.7 to 2.3 miles of well pads, suggesting that indirect habitat loss may be substantially greater than direct habitat losses (Sawyer et al. 2006). Impacts are greater in areas with high densities of well pads, roads, facilities, and high traffic (WGFD 2010). Such impacts could occur as a result of geothermal development within the SLVFO. However, given the maximum extent of disturbance that the RFDS predicts, the likelihood of extensive habitat fragmentation or population-level effects on big game species is low.

Under all alternatives, the probability of bighorn sheep being affected by geothermal projects is low since bighorn sheep generally occur in steep, rocky, remote habitat that geothermal developers would normally avoid. However, if geothermal development is proposed within or near either severe wintering habitat or calving areas, local populations could be affected. Under Alternatives B and C, TLs would prohibit all human activities in occupied winter range from November 1 to April 15.

Pronghorn antelope require extensive areas for both summer and winter browse and are sensitive to human disturbance. Furthermore, the distribution of this species coincides with many of the higher potential geothermal areas in the SLVFO planning area. As such, geothermal development proposed near year-round forage areas and severe winter habitat could impact local populations. Under all alternatives, TLs would protect pronghorn antelope birthing areas.

Mule deer are widespread throughout the planning area, and population numbers are large. As a result, development of geothermal facilities could impact this species; population-level effects could occur if facilities were to impact severe winter habitat or calving areas.

Due to the large, localized numbers of elk that occur in the planning area, their relatively widespread distribution, and their need for large areas of undisturbed severe winter habitat during harsh winters, elk are likely to be affected by the development of geothermal facilities. Population-level effects could occur if development were to occur in elk critical winter habitat or calving areas.

Migratory Birds

In general, bird species would be most sensitive to geothermal development, particularly any construction activities, drilling, or increased human presence during summer months when bird use of the SLVFO planning area is high and birds are breeding and rearing young. Under all alternatives, TLs would prevent direct impacts on eagle wintering areas and waterfowl nesting areas.

4.8.4 Potential Impacts Associated with Preferred Action and Alternatives

Since the sustainability of fish and wildlife populations is intricately tied to the condition of the vegetation within the SLVFO, impacts on vegetation would be relevant to fish and wildlife (see **Section 4.22**, Vegetation).

Alternative A

General Fish and Wildlife

Alternative A would allow for geothermal leasing but with fewer restrictions and guidance compared to the action alternatives. Alternative A would allow geothermal leasing with standard stipulations on 106,500 acres and close 17,100 acres. Lands would be open with stipulations on 531,600 acres. The Rio Grande NA would be closed to leasing, which would protect this wildlife corridor and the many species that use it. In addition, an NSO would be applied within the Flat Top Mesa wetlands, Blanca wetlands, and the Rio Grande River corridor, which would prevent impacts on the fish and wildlife that use these areas.

Big Game

NSOs would be applied on 26,800 acres, including five bighorn sheep lambing ranges within the Trickle Mountain ACEC, which would protect bighorn sheep lambing areas from disturbance and development. Under Alternative A, 51,800 acres of big game severe winter and winter range would be open to geothermal leasing, subject to standard stipulations, and 1,700 acres (1 percent) would be closed. An NSO stipulation would be applied on 14,000 acres (3 percent) of big game severe winter and winter range.

Migratory Birds

Under Alternative A, 6,700 acres of wetlands would be open to geothermal leasing, subject to standard stipulations, and 300 acres would be closed. NSO stipulations would be applied on 1,400 acres of wetlands. In particular, the NSO within the Flat Top Mesa wetlands, Blanca wetlands, and the Rio Grande River corridor would prevent impacts on the many species of shorebirds, waterfowl, and migratory birds that use these areas, such as snowy plover and long-billed curlew in the Blanca ACEC and SRMA, and white pelican in the Blanca ACEC and SRMA and Rio Grande corridor. TL stipulations would be applied on 13,200 acres of wetlands, which would reduce impacts on nesting birds.

Small Mammals

Under Alternative A, there would be no protective setback for the Mexican free-tailed bat around Orient Mine. Therefore, impacts on bats would be the same as those described above in **Section 4.8.3**, Common Impacts Associated with Geothermal Development.

Alternative B (Proposed action)

General Fish and Wildlife

Under Alternative B, three times more acres would be closed to geothermal leasing compared with Alternative A. Also, NSO stipulations would be applied on two times more acres than Alternative A, and CSU stipulations would be applied on over 200,000 acres, which would benefit wildlife and their habitats in these areas. In particular, the Blanca ACEC, Rio Grande NA, and McIntire/Simpson wetland complex would be closed to geothermal leasing, which would protect species in these areas. NSOs would be applied in all SWAs, which would also protect species. A CSU stipulation would be applied as needed and to all SRMAs. These CSUs would provide a buffer around these SRMAs to further reduce the likelihood that species utilizing these habitats would be disturbed. A CSU stipulation would also be applied within 500 feet of riparian and wetland areas and in migration corridors and important habitats. A CSU stipulation would also apply to the area that extends west from the Town of Saguache to Gunnison along Highway 114. Another stipulation requires that all proponents are required to consult with the local highway department during development planning for projects. Overall, stipulations, as well as BMPs, would reduce the likelihood for direct and indirect impacts on fish and wildlife.

Big Game

Under Alternative B, 76,100 acres of big game severe winter and winter range would be open to geothermal leasing, subject to standard stipulations, and 7,300 acres would be closed. In addition, NSOs and CSUs would be applied on 34,500 acres and 197,300 acres, respectively, of severe winter and winter range. TL stipulations would protect big game winter range; pronghorn antelope birthing areas, winter concentration areas, and migration corridors; bighorn sheep migration/production areas and winter range areas; elk migration/production areas and winter concentration areas; moose winter range; and mule deer crucial winter range and migration corridors.

Migratory Birds

Under Alternative B, 2,400 acres of wetlands would be closed to geothermal leasing, including the Blanca wetlands, Rio Grande NA, and McIntire/Simpson wetland complex; no acres would be open, subject to standard stipulations. NSO stipulations would be applied on 3,400 acres of wetlands. In particular, NSO stipulations would be applied within the Russell Lakes and Hot Creek SWAs and within all water bodies, wetlands, and riparian areas. A CSU stipulation would be applied within 500 feet of riparian and wetland areas and in migration corridors and important habitats. TLs would be applied on 2,300 acres of wetlands as well as waterfowl nesting areas and bald eagle winter range, roosts, and winter concentration areas. In addition, to reduce impact on waterfowl under Alternative B, the BLM would require a preconstruction inventory, conservation measures if necessary, and monitoring of mitigation measures.

Small Mammals

Under Alternative B, there would be a 0.25 mile NSO stipulation around Orient Mine. This is because the Mine is a Mexican free-tailed bat roost site during the summer.

Alternative C

General Fish and Wildlife

Alternative C would close the most acres to geothermal leasing – nine times more than Alternative A. In addition, 40 percent fewer acres would be open to leasing, subject to standard stipulations. All ACECs, all SWAs, and the McIntire/Simpson wetlands would be closed to leasing, which would have the greatest benefit to wildlife that use these areas. Alternative C would also require NSO stipulations on the greatest acreage (186,200 acres). These stipulations would apply to all water bodies and riparian areas, including a half-mile buffer around designated cutthroat trout habitat and cutthroat habitat watershed. NSO stipulations also would apply to split estate lands adjacent to the McIntire/Simpson wetlands, within a two mile buffer surrounding the Orient Land Mine to protect bats, and the Blanca ACEC and SRMA. A TL stipulation for Alternative C would prohibit all human activities in designated cutthroat trout habitat from May 1 through June 30. CSU stipulations, as well as BMPs, would be the same as described for Alternative B.

Standing water at facilities can become highly concentrated with such compounds as chloride, sodium, sulfate, TDS, biphenyl, diphenyl oxide, potassium, selenium, and phosphate. These compounds would make the water toxic to bats (BLM 2010a) and other wildlife species. Water sources such as these are very likely to attract wildlife, especially in an arid environment such as the San Luis Valley. Other potential impacts include bats flying into structures associated with geothermal facilities, which could be exacerbated by initial attraction of insects to night lighting (BLM 2010a; Fenton 1997). To reduce these impacts, additional mitigation measures to modify night lighting and to reduce the amount of standing water on-site may be required (see Appendix C, Best Management Practices).

Big Game

Under Alternative C, 68,800 acres of big game severe winter and winter range would be open to geothermal leasing, subject to standard stipulations, and 120,100 acres would be closed. In addition, NSOs and CSUs would be applied on 116,100 acres and 75,100 acres, respectively, of severe winter and winter range. In addition, the closure of all ACECs to geothermal leasing would particularly protect big game and prevent disturbance to big game habitats. TLs would also protect big game during sensitive periods; these would be the same as described for Alternative B.

Migratory Birds

Under Alternative C, 17,600 acres of wetlands would be closed to geothermal leasing, including all ACECs, SWAs, and the McIntire/Simpson wetlands; no acres would be open, subject to standard stipulations. NSO stipulations would be applied on 3,100 acres of wetlands. In particular, NSO stipulations within water bodies and riparian areas, as well as on split estate lands adjacent to the McIntire/Simpson wetlands and Blanca ACEC and SRMA would provide protection to water-dependent bird species. CSUs and TLs would also protect bird species; these would be the same as described for Alternative B. Waterfowl inventory, conservation measures, and monitoring are the same as described under Alternative B.

Small Mammals

Under Alternative C, there would be a 2 mile NSO stipulation around Orient Mine. This is because the Mine is a Mexican free-tailed bat roost site during the summer.

4.9 SPECIAL STATUS SPECIES

4.9.1 Scoping Comments on the Resource

- Commenters requested that the BLM include Colorado State Species of Concern and Threatened and Endangered species as "other special status species."
- Commenters wanted to ensure that geothermal leasing would be consistent with the Gunnison Sage-Grouse Rangewide Conservation Plan and take into account new peer-reviewed literature that outlines suggested guidelines for sage-grouse protection.
- How could threatened, endangered, or sensitive species be affected by leasing decisions? What stipulations will be needed in order to conserve suitable sensitive habitat to ensure and maintain healthy local populations of listed and sensitive plant and animal species?

4.9.2 How Resource Impacts were Evaluated

Methodology

The methodology for Special Status Species impact analysis is incorporated by reference from the Geothermal PEIS. Additional methodology specific for this EA includes quantitative analysis using GIS, when available. Since most special status species are associated with specific vegetation communities, impacts on vegetation, as described in Section 4.12, would also likely impact special status species. Acres of land that would be open and closed to geothermal leasing would be correlated with the likelihood of impacts on special status species habitats. **Table 4-4**, Special Status Species Habitats, shows the potentially occurring special status species in the SLVFO planning area, and the vegetative communities that they use. In addition, many of the impacts on fish and wildlife

associated with geothermal development described in **Section 4.8.3** would also apply to special status species.

Potential effects on federally listed, proposed, and candidate species were analyzed according to the direction in the SLVFO RMP, the Public Land Health Standards in Colorado, BLM Manual 6840 containing BLM special status species management policy, IMs, and Information Bulletins. The Land Health Standards pertinent to the assessment of wildlife include those related to riparian systems, plant and animal communities, and sensitive, threatened, and endangered species. Land Health Standard 4 provides direction regarding maintenance and enhancement of threatened and endangered and sensitive species habitats and populations on a local and landscape level.

Indicators/Significance Criteria

Potential impacts on federally threatened, endangered, or proposed species, as well as special status species, could occur if reasonably foreseeable future actions were to:

- Violate the ESA, Bald and Golden Eagle Protection Act, MBTA, or applicable state laws or BLM regulations (e.g. BLM Manual 6840 and related IMs); or
- Adversely affect any individual or population of federally listed or proposed species.

Assumptions

This analysis assumes the following:

- The analysis presented is largely qualitative, due to the lack of data or uncertainty in existing data on special status species occurrences. Furthermore, since many special status species may potentially use habitats that are currently unoccupied, quantitative analysis of occupied habitat would underestimate potential impacts on special status species. Quantitative analysis is included when data are available.
- Because of the large number of BLM sensitive species, it was determined that the most effective way to disclose impacts at the programmatic level would be to analyze the impacts on the habitat cover types used by these species. In the analysis, species are grouped into habitat types where they are most likely to occur, although they are likely to use other habitat types as well (**Table 4-4**).
- Ground-disturbing activities could lead to modification (positive or negative) of habitat and loss or gain of individuals, depending on the amount of area disturbed, nature of the disturbance, the species affected, and the location of the disturbance.

Table 4-4
Special Status Species Habitats

Species[1]	SDS	G	PJ	MS	PP	SF	Alp	RW	SS	CRT	Asp	Ag	MC
Mountain plover	X	X										X	
Southwestern willow flycatcher								X					
Milk snake		X	X					X	X			X	
Northern leopard frog								X					
Big free-tailed bat	X	X	X	X				X		X			
New Mexico meadow jumping mouse								X					
Gunnison prairie dog	X	X		X									
Townsend's big-eared bat	X		X	X	X			X	X	X			X
Bald eagle	X	X		X		X		X		X			X
Ferruginous hawk	X	X		X					X				
Gunnison sage-grouse				X				X	X				
Northern goshawk		X		X		X		X			X		X
Burrowing owl	X	X							X				
Yellow-billed cuckoo								X					
Snowy plover								X					
Brewer's sparrow	X		X	X					X				
White-faced ibis								X					
Black swift										X			
Peregrine falcon		X	X		X	X							X
Rio Grande chub								X					
Rio Grande cutthroat trout								X					
Rio Grande sucker								X					

[1] SDS = Semi Desert Shrubland
G = Grassland
PJ = Piñon-Juniper
MS = Mountain Shrub
PP = Ponderosa Pine
SF = Spruce – Fir
Alp = Alpine
RW = Riparian and Wetland
SS = Sagebrush Shrubland
CRT = Cliff, Rock, Talus
Asp = Aspen
Ag = Agricultural, Barren
MC = Mixed Conifer

Source: BLM 2011

- Changes in air, water, and habitat quality could lead to direct impacts and could have cumulative impacts on species survival.
- Impacts on special status species would be more significant than impacts on common species because population viability is already uncertain for special status species.
- The USFWS would be consulted for any actions that have a potential to affect any federally listed endangered, threatened, or proposed species.
- The Uncompahgre fritillary butterfly and boreal toad do not occur within the planning area. As such, they will be given no further consideration in this document.

4.9.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Special Status Species Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here. However, additional information specific for this EA includes quantitative analysis and consideration of the particular special status species and habitats that occur within the SLVFO planning area.

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on threatened and endangered and special status species from geothermal resource development. Geothermal exploration, drilling operations, utilization, and reclamation and abandonment could affect threatened, endangered, and sensitive species in the same manner that vegetation, wildlife, and aquatic resources could be affected (see **Section 4.8**, Fish and Wildlife Habitat). BLM special status species could be affected as a result of habitat disturbance, the introduction of invasive vegetation, injury or mortality, erosion and runoff, fugitive dust, noise, exposure to contaminants, and interference with behavioral activities. Which species may be at risk to construction-related effects would depend on the project location and specific habitat present at or near the site. Because of the regulatory requirements of the ESA and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management and other resource-specific regulations and guidelines, appropriate survey and avoidance measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

Under all alternatives, COAs and master planning would be required, which would help to ensure consideration of special status species and their habitats during geothermal development. COAs may include site-specific survey requirements for any potentially occurring special status species. Additional stipulations would be applied as needed to protect any documented special status species.

Under all alternatives, the following COA from the Bald and Golden Eagle Protection Act would be attached to all renewable energy authorizations/actions occurring within the range of bald and golden eagles:

> Bald and/or golden eagles may now or hereafter be found to utilize the project area. The BLM will not issue a notice to proceed for any project that is likely to result in take of bald eagles and/or golden eagles until the applicant completes its obligation under applicable requirements of the Bald and Golden Eagle Protection Act, including completion of any required procedure for coordination with the USFWS or any required permit. The BLM hereby notifies the applicant that compliance with the Bald and Golden Eagle Protection Act is a dynamic and adaptable process which may require the applicant to conduct further analysis and mitigation following assessment of operational impacts. Any additional analysis or mitigation required in order to comply with the Bald and Golden Eagle Protection Act will be developed in coordination with the USFWS.

The probability of Canada lynx, Mexican spotted owl, New Mexico meadow jumping mouse, and North American wolverine being affected by geothermal development is anticipated to be low due to the limited amount of habitat and/or absence of any documented occurrence of these species on BLM lands within the planning area.

Impacts on mountain plover, southwestern willow flycatcher, yellow-billed cuckoo, Gunnison sage-grouse, and Gunnison's prairie dog would depend on the location of proposed geothermal development. Mountain plover and Gunnison's prairie dog generally co-occur in the same upland habitat, although mountain plover has a more restricted distribution in comparison to Gunnison's prairie dog, which occurs throughout the valley floor. Similarly, southwestern willow flycatcher and yellow-billed cuckoo co-occur in similar riparian habitats. Gunnison sage-grouse only occur in the northernmost portion of the SLVFO. Geothermal activities in such habitats and locations could affect these species, especially the Gunnison sage-grouse, due to increased background noise which can have an impact on the success of the acoustics and interfere with the ability to communicate.

Rio Grande cutthroat trout, Rio Grande chub, and Rio Grande sucker all rely on clean, cool-water habitat. Due to the potential of indirect impacts caused by alteration of groundwater resources, impacts on these species could occur resulting from geothermal development.

Impacts on Ripley's milkvetch would depend on the location of proposed geothermal development. Since it is a fairly large plant (20 to 24 inches in height), the likelihood of detecting and avoiding Ripley's milkvetch would be high in most areas. Impacts could also occur on rock-loving neoparrya and pale blue-eyed grass. Rock-loving neoparrya has a fairly broad distribution throughout the

planning area. Pale blue-eyed grass occurs in more mesic conditions. To date, this species has only been documented in valley areas in the northern end of the SLVFO.

The majority of the documented occurrences of slender spiderflower are located within the Great Sand Dunes National Park and Preserve as well as other protected wetland preserves. However, there are documented occurrences of this species outside of those protected areas. As a wetland-dependent species, the likelihood for impacts on slender spiderflower would most likely be tied to any potential drop in groundwater levels or changes in year-round substrate temperatures that could be affected by proposed geothermal development.

Since suitable habitat for fragile rockbrake is uncommon within the planning area, and since the species usually occurs on limestone cliffs where geothermal development would be undesirable, impacts on this species are considered unlikely to occur.

4.9.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Federally Listed and Proposed Species

Alternative A would allow for geothermal leasing but with fewer restrictions and guidance compared to the action alternatives. Alternative A would open geothermal leasing, subject to standard stipulations, on 106,500 acres and close 17,100 acres. NSOs would be applied on 26,800 acres, which would generally prevent direct impacts on federally listed or proposed species.

Southwestern Willow Flycatcher. Under Alternative A, 100 acres of riparian habitat would be open to geothermal leasing, subject to standard stipulations, and 400 acres would be closed. The Rio Grande NA would be closed to leasing, which would prevent direct disturbance to this wildlife corridor and the southwestern willow flycatcher, which may use this area. In addition, TL stipulations would be applied on 100 acres of riparian habitat. Site-specific survey requirements would help to prevent or minimize impacts on this species in areas that are open to leasing.

Mountain Plover. Under Alternative A, 7,400 acres of potential mountain plover habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 9,600 acres of potential habitat. Mountain plover would be protected from direct disturbance on areas closed to leasing and areas where an NSO stipulation would be applied. Site-specific survey requirements would help to prevent or minimize impacts on this species in areas that are open to leasing.

BLM Sensitive Species

Semi-desert Shrubland. Under Alternative A, 10,900 acres of semi-desert shrubland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 13,700 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, mountain plover, Gunnison's prairie dog, ferruginous hawk, burrowing owl, Brewer's sparrow, and Yuma myotis (**Table 4-4**).

Grassland. Under Alternative A, 400 acres of grassland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 3,100 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, milk snake, mountain plover, big free-tailed bat, ferruginous hawk, northern goshawk, Gunnison's prairie dog, Yuma myotis, and burrowing owl (**Table 4-4**).

Coniferous and Mixed Coniferous Forests. Under Alternative A, 400acres of coniferous and mixed coniferous forest would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 1,300 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including, but not limited to, northern goshawk, peregrine falcon, bald eagle, North American wolverine, and Townsend's big-eared bat (**Table 4-4**).

Riparian and Wetland. Under Alternative A, 700 acres of riparian and wetland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 1,300 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, northern leopard frog, New Mexico meadow jumping mouse, bald eagle, Gunnison sage-grouse, yellow-billed cuckoo, snowy plover, white-faced ibis, Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker (**Table 4-4**).

Under Alternative A, 16,200 acres of bald eagle winter range would be closed to geothermal leasing and 53,600 acres would be open, subject to standard stipulations. In addition, NSO stipulations would be applied on 16,500 acres to reduce the likelihood for direct impacts on bald eagles during winter.

Under Alternative A, no occupied Rio Grande cutthroat trout habitat would be closed to geothermal leasing and NSO stipulations would not be applied in any occupied Rio Grande cutthroat trout habitat.

Closure of the Rio Grande NA to leasing would prevent direct impacts on BLM sensitive species that use it, such as bald eagle and BLM sensitive fish and amphibians. NSOs within the Flat Top Mesa wetlands, Blanca wetlands, and the Rio Grande River corridor would prevent impacts on the BLM sensitive species that use these areas, such as bald eagle and other BLM sensitive birds, fish, and amphibians. A TL stipulation in bald eagle wintering areas would protect this species during winter, as disturbance could cause avoidance behavior that would expend energy at a time when food is less readily available. Standard stipulations within the Los Mogotes, Ra Jadero, and Elephant Rocks ACECs would protect BLM sensitive plant species in these areas.

Sagebrush Shrubland. Under Alternative A, 100 acres of sagebrush shrubland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 100 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including, but not limited to, milk snake, Gunnison sage-grouse, and Brewer's sparrow (**Table 4-4**).

Under Alternative A, no potential Gunnison sage-grouse habitat would be closed to geothermal leasing and NSO stipulations would not be applied in any potential Gunnison sage-grouse habitat.

Cliff, Rock, and Talus. Under Alternative A, 100 acres of cliff, rock and talus habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 1,400 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, big free-tailed bat, Townsend's big-eared bat, black swift, and peregrine falcon (**Table 4-4**).

Alternative B (Proposed action)

Federally Listed and Proposed Species

Under Alternative B, three times more acres would be closed to geothermal leasing compared with Alternative A. Also, NSO stipulations would be applied on two times more acres than Alternative A, and CSU stipulations would be applied on over 200,000 acres, which would generally benefit federally listed and proposed species and their habitats in these areas.

Southwestern Willow Flycatcher. Under Alternative B, 100 acres of riparian habitat would be open to geothermal leasing, subject to standard stipulations, and 400 acres would be closed. In particular, the Blanca wetlands, Rio Grande NA, and McIntire/Simpson wetland complex would be closed to geothermal leasing, which would prevent direct disturbance to southwestern willow flycatcher in these areas. In addition, NSO stipulations would be applied on 100 acres of riparian habitat. NSOs in the Russell Lakes and Hot Creek SWAs, in all water bodies, wetlands, and riparian areas, and in listed-species critical habitat would prevent direct impacts on southwestern willow flycatcher in these areas. TL stipulations would be applied on 400 acres of riparian habitat. A CSU stipulation would also be applied within 500 feet of riparian and wetland areas and in migration corridors and important habitats. These CSUs would provide a buffer to further reduce the likelihood that southwestern willow flycatchers would be disturbed. Lease stipulations, site-specific survey requirements, and BMPs would reduce the likelihood for direct and indirect impacts on this species.

The standard stipulation for ESA-listed species would be required, which would cover areas where southwestern willow flycatcher could occur. This stipulation would give BLM the flexibility to recommend modifications to or to disapprove proposed activities that are likely to result in jeopardy to the continued existence of the species.

Mountain Plover. Under Alternative B, 12,700 acres of potential mountain plover habitat would be closed to geothermal leasing. In addition, NSO and CSU stipulations would be applied on 7,200 acres and 61,500 acres, respectively, of mountain plover habitat. Mountain plover would be protected from direct disturbance on areas closed to leasing and areas where an NSO stipulation would be applied. Site-specific survey requirements would help to prevent or minimize impacts on this species in areas that are open to leasing.

BLM Sensitive Species

Under Alternative B, the sensitive species stipulation would be applied, which would allow BLM to impose a lease stipulation (NSO, CSU, or TL) in areas where BLM sensitive species could occur.

Semi-desert Shrubland. Under Alternative B, 21,800 acres of semi-desert shrubland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 9,100 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, mountain plover, Gunnison's prairie dog, ferruginous hawk, burrowing owl, Brewer's sparrow, and Yuma myotis (**Table 4-4**).

Grassland. Under Alternative B, 2,100 acres of grassland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on

5,200 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including, but not limited to, milk snake, mountain plover, big free-tailed bat, ferruginous hawk, northern goshawk, Gunnison's prairie dog, Yuma myotis, and burrowing owl (**Table 4-4**).

Coniferous and Mixed Coniferous Forests. Under Alternative B, 600 acres of coniferous and mixed coniferous forest would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 10,400 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, northern goshawk, peregrine falcon, bald eagle, North American wolverine, and Townsend's big-eared bat (**Table 4-4**).

Riparian and Wetland. Under Alternative B, 1,700 acres of riparian and wetland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 800 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, northern leopard frog, New Mexico meadow jumping mouse, bald eagle, Gunnison sage-grouse, yellow-billed cuckoo, snowy plover, white-faced ibis, Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker (**Table 4-4**).

Under Alternative B, 29,800 acres of bald eagle winter range would be closed to geothermal leasing and 152,100 acres would be open, subject to standard stipulations. In addition, NSO and CSU stipulations would be applied on 19,000 acres and 92,800 acres, respectively, to reduce the likelihood for direct impacts on bald eagles during winter.

Under Alternative B, one mile of occupied Rio Grande cutthroat trout habitat would be closed to geothermal leasing. In addition, NSO and CSU stipulations would be applied on 0.6 miles and 2.8 miles, respectively, of occupied Rio Grande cutthroat trout habitat.

Closure of the Blanca wetlands, Rio Grande NA, and the McIntire/Simpson wetland complex to geothermal leasing would protect bald eagle and other BLM sensitive birds, as well as BLM sensitive fish and amphibians. NSOs in the Russell Lakes and Hot Creek SWAs and listed species critical habitat would protect a suite of BLM sensitive species, particularly wetland-dependent species, such as western yellow-billed cuckoo and bald eagle. CSU stipulations, described for federally listed and proposed species, as well as BMPs, would reduce the likelihood for direct and indirect impacts on BLM sensitive species.

TL stipulations would protect bald eagle and cutthroat trout during periods when these species would be sensitive to disturbance.

Sagebrush Shrubland. Under Alternative B, 100 acres of sagebrush shrubland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 6,500 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, milk snake, Gunnison sage-grouse, and Brewer's sparrow (**Table 4-4**). TL stipulations would protect Gunnison sage-grouse during periods when this species would be sensitive to disturbance.

Under Alternative B, NSO and CSU stipulations would be applied on 2,500 acres and 0 acres, respectively, of potential Gunnison sage-grouse habitat.

Cliff, Rock, and Talus. Under Alternative B, 500 acres of cliff, rock, and talus habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 1,200 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including, but not limited to, big free-tailed bat, Townsend's big-eared bat, black swift, and peregrine falcon (**Table 4-4**). TL stipulations would protect peregrine falcon during periods when this species would be sensitive to disturbance.

Alternative C

Federally Listed and Proposed Species

Alternative C would close the most acres to geothermal leasing – nine times more than Alternative A. In addition, 40 percent fewer acres would be open to leasing. Alternative C would also require NSO stipulations on the greatest acreage – nearly seven times more than Alternative A.

Southwestern Willow Flycatcher. Under Alternative C, 400 acres of riparian habitat would be closed to geothermal leasing. In particular, all ACECs, all SWAs, and the McIntire/Simpson wetlands would be closed to leasing, which would have the greatest benefit to southwestern willow flycatchers that use or could potentially use these areas. In addition, NSO stipulations would be applied on 100 acres of riparian habitat. These stipulations would include all water bodies and riparian areas, as well as split estate lands adjacent to the McIntire/Simpson wetlands and Blanca ACEC and SRMA. The ESA standard stipulation, site-specific survey requirements, and BMPs would be the same as described for Alternative B.

Mountain Plover. Under Alternative C, 73,000 acres of potential mountain plover habitat would be closed to geothermal leasing. In addition, NSO and CSU

stipulations would be applied on 30,500 acres and 29,400 acres, respectively, of mountain plover habitat. Mountain plover would be protected from direct disturbance on areas closed to leasing and areas where an NSO stipulation would be applied. Site-specific survey requirements would help to prevent or minimize impacts on this species in areas that are open to leasing.

BLM Sensitive Species

Under Alternative C, CSU and TL stipulations as well as BMPs would be the same as described for Alternative B.

Semi-desert Shrubland. Under Alternative C, 87,300 acres of semi-desert shrubland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 52,300 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, mountain plover, Gunnison's prairie dog, ferruginous hawk, burrowing owl, Brewer's sparrow, and Yuma myotis (**Table 4-4**).

Grassland. Under Alternative C, 32,800 acres of grassland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 20,800 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, milk snake, mountain plover, big free-tailed bat, ferruginous hawk, northern goshawk, Gunnison's prairie dog, Yuma myotis, and burrowing owl (**Table 4-4**).

Coniferous and Mixed Coniferous Forests. Under Alternative C, 7,500 acres of coniferous and mixed coniferous forest would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 19,300 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, northern goshawk, peregrine falcon, bald eagle, North American wolverine, and Townsend's big-eared bat (**Table 4-4**).

Riparian and Wetland. Under Alternative C, 11,800 acres of riparian and wetland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 1,100 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, northern leopard frog, New Mexico meadow jumping mouse, bald eagle, Gunnison sage-grouse, yellow-billed cuckoo, snowy plover, white-faced ibis, Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker (**Table 4-4**).

Under Alternative C, 136,200 acres of bald eagle winter range would be closed to geothermal leasing and 100,300 acres would be open, subject to standard stipulations. In addition, NSO and CSU stipulations would be applied on 63,400 acres and 50,300 acres, respectively, to reduce the likelihood for direct impacts on bald eagles during winter.

Under Alternative C, 3.2 miles of occupied Rio Grande cutthroat trout habitat would be closed to geothermal leasing. In addition, NSO and CSU stipulations would be applied on 1.5 miles and 1.2 miles, respectively, of occupied Rio Grande cutthroat trout habitat.

Closure of all ACECs, all SWAs, and the McIntire/Simpson wetlands to leasing would have the greatest benefit to BLM sensitive species that use these areas, particularly birds, fish, and amphibians. NSO stipulations on all water bodies and riparian areas, as well as split estate lands adjacent to the McIntire/Simpson wetlands and Blanca ACEC and SRMA would also prevent direct impacts on BLM sensitive species.

Sagebrush Shrubland. Under Alternative C, 300 acres of sagebrush shrubland habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 4,800 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, milk snake, Gunnison sage-grouse, and Brewer's sparrow (**Table 4-4**).

Under Alternative C, NSO and CSU stipulations would be applied on 2,100 acres and 400 acres, respectively, of potential Gunnison sage-grouse habitat.

Cliff, Rock, and Talus. Under Alternative C, 3,900 acres of cliff, rock, and talus habitat would be closed to geothermal leasing. In addition, NSO stipulations would be applied on 2,400 acres of this habitat type. These actions would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. Such designations would help to protect BLM sensitive species that utilize this habitat type, including but not limited to, big free-tailed bat, Townsend's big-eared bat, black swift, and peregrine falcon (**Table 4-4**).

4.10 GEOLOGY AND SEISMICITY

4.10.1 Scoping Comments on the Resource

No comments related to geology and seismicity were received during the scoping period.

4.10.2 How Resource Impacts were Evaluated

Methodology

The potential effects of geothermal development were evaluated by assessing the effects that anticipated future actions consistent with the alternatives would have on the geology and unique geologic resources of the planning area. In this section, impacts on geologic features are evaluated only from the perspective of scientific value (rather than cultural, recreational, or scenic value).

Indicators/Significance Criteria

The following indicators have been identified in order to evaluate potential impacts on geology and seismicity:

- Earthquake activities, ground failure, or landslides;
- Substantial erosion of geological units, such as with landslides and subsidence; and
- Unstable geological units, including parent material, slope angle, amount of vegetation, and location of fault lines within a project area disturbance footprint. Facilities located on a geologic unit that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

4.10.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Geology Resources and Seismic Setting Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here. However, additional information specific for this EA includes a description of EGS and how they may cause earthquakes.

Although the concerns identified above within the Indicators/Significance Criteria are discussed here and in the Geothermal PEIS, due to the inability to predict future types of development, their timing, and locations, the potential for them to occur can only be fully evaluated for a site-specific project proposal. Any subsequent, site-specific projects that might occur in the SLVFO would undergo NEPA review, during which geotechnical investigations may be conducted if such concerns are expressed.

The potential impacts on geologic resources from geothermal development mainly concern physical disturbance (e.g., movement, removal or destruction). For example, road construction or enhancement would occur during the drilling and utilization phases, and to a lesser extent during exploration. The exploration phase road work that may be required would have short term (lasting the duration of the exploration activity), then reclaimed immediately afterward. However, roads constructed during later phases would likely continue to be used for site access and therefore have longer term impacts,

such as greater public access for the life of the project until the abandonment phase. These impacts are considered long term, as they cannot be reclaimed. In order to approve most BLM permitted actions, such as leasing and associated development or other physical disturbance, sensitive geologic resources must be avoided. Additional indirect impacts would result from greater public access to formerly inaccessible areas. Greater public access can result in increased wear and vandalism of sensitive geologic features. These impacts can be short term if roads are reclaimed.

Seismic risk is more likely to impact geothermal facilities than operation of geothermal facilities is to increase seismic risk. If a proposed geothermal resource development includes high-pressure reinjection, there is a small chance that seismic activity could increase along any faults intersected by the injection well. The high pressure injection of fluids directly into fault zones has been related to increases in seismic activity in some cases (Majer et al. 2007; Majer 2008). However, the high pressure injection of fluids from outside the geologic system is not the same as where geothermal fluid withdrawn from the resources is used and then reinjected back into the system for a near zero net change. The near zero net change would represent much lower risk of increasing seismicity.

Subsidence can occur where groundwater is pumped from underground aquifers at a rate exceeding the rate that it is replenished. Subsidence is rare at new facilities since injection programs are now standard practice. Because there is reinjection of the geothermal fluid after the heat is used and maintenance of static pressure of the geothermal reservoir, the potential for subsidence is low.

Enhanced Geothermal Systems

The Geothermal PEIS does not address EGS technology or its potential to cause earthquakes, also called "induced seismicity," so this topic will be discussed in the following paragraphs (as well as in **Section 1.4.4**, Electrical Power Generation and Capacity).

The process of stimulating production and injection wells through the injection of water under pressure, and often at a much cooler temperature than the receiving rock, results in the expansion of existing fractures and sometimes the creation of new fractures through the movements of masses of rock at depth. These movements of masses of rock at depth result in seismic activity. Since the seismic activity is created by the reservoir stimulation, it is distinguished from natural seismicity with the term *induced* seismicity. Whether or not the induced seismicity is able to be felt at the surface depends upon the depth of the reservoir, the degree to which the rock masses are shifted from the stimulation, and the nature of the overlying geology and its ability to transfer the shock waves to the surface.

Typically, natural fractures vary in length on a scale of 1 to 10 meters. Seismic energy radiated during the shearing process depends on the length of the

fracture or the stress release from the constraining natural forces. A majority of the observed data from existing EGS projects suggest that the higher energy radiated from the shearing is caused by a high stress release from relatively small joint lengths (Michelet et al. 2004). This would suggest that if there were some perceived events on the surface, the frequency content would be too high to generate any seismic risk, but minor events may still raise concern among local inhabitants.

As part of the NEPA process for any specific EGS proposal, mitigation measures would be developed to address the potential for seismic-related risks. The following potential mitigations have been implemented for other EGS projects occurring on BLM-administered lands:

Protocols
The International Energy Agency developed a peer-reviewed and accepted protocol for dealing with induced seismicity during geothermal projects, and the DOE has adopted them. Such protocols may be made a requirement of any EGS project.

Induced Seismicity Hazards Risk Analysis
An independent consultant can be contracted to prepare an induced seismicity and seismic risk hazards analysis. Such analyses identify and quantify the risk associated with induced seismicity and can focus its content on potential effects on nearest communities and homeowners.

Prediction of Event Number and Magnitude
Recent advances have been made in predicting the number and magnitude of induced seismicity events that can be expected during hydroshearing operations. Mechanisms of induced seismicity can be quantified and a "seismogenic index" can be developed for a specific project area. Such an index would characterize the potential number of induced seismicity events greater than a particular magnitude as a function of the injected volume. Changes to injection rates and total fluid volumes can be used during operations to manage seismic effects. The maximum allowable magnitude event is determined by the induced seismicity and seismic hazard risk analysis. Evaluation of the seismogenic index will allow project geologists to place initial bounds on the hydroshearing operational and mitigation limits for a given project.

Control of Rate and Pressure and Flow-back after Injection
Mitigation measures can be implemented if induced seismicity events approach defined limits. The primary mitigation method may be reducing the rate of water injection to a level where induced seismicity rate and magnitude are within an acceptable range. A secondary method can be to backflow the well to reduce reservoir pressure.

The utilization phase of EGS projects could produce microseismic events. Seismic data collection arrays may be set up prior to any well stimulation so that

induced seismicity can be monitored in real time. This monitoring allows supervising geologists to track where the reservoir is opening up and allows operations to be modified, as needed. The ongoing monitoring of microseismicity with multi-station sensor arrays would allow regulators to continuously review the project and halt or make modifications to operations if the risk to properties is considered to be too great.

4.10.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, geothermal lease nominations could be made and geothermal leases could be issued on 638,100 acres that are allocated as being open to geothermal leasing including the Elephant Rocks ACEC which has been noted for special geologic features among other resource values. The nature and types of impacts that could be expected are described above in the Common Impacts section, notably if parts of significant geologic features were removed, disturbed, or destroyed. While there are no standard stipulations related to geology or seismicity, specific additional stipulations could be attached to any leases to be issued that contain an identified unique geologic feature, such as within the Elephant Rocks ACEC which could help mitigate any possible impacts on the geologic features. At the time of lease nomination and lease issuance, it would not be known whether or not an EGS project is proposed, and so even at the stage of lease issuance no stipulations would be attached with respect to induced seismicity. Protective measures related to induced seismicity would be identified in a subsequent NEPA analysis and applied to the project as a COA.

Alternative B (Proposed action)

Impacts under Alternative B would be similar to those described under Alternative A, but the potential locations of leasing and subsequent development would be slightly restricted since 591,400 acres would be open to geothermal leasing. The Elephant Rocks ACEC, noted for special geologic features, is open for leasing, however under this alternative CSU stipulations could be applied to protect the specific, unique geologic features that contribute to the ACEC's designation.

Alternative C

Impacts under Alternative C would be similar to those described under Alternative A, but the potential locations of leasing and subsequent development would be more restricted since 475,500 acres would be open to geothermal leasing. However, under this alternative, the Elephant Rocks ACEC would be closed to leasing and therefore its unique geologic features would be protected.

4.11 HEALTH AND SAFETY

4.11.1 Scoping Comments on the Resource

- Commenters were concerned about on-site storage of the chemical additives used in geothermal development and production.
- There were concerns regarding the toxic wastes generated during the geothermal drilling process.

4.11.2 How Resource Impacts were Evaluated

Methodology

Potential effects of geothermal development on human health and safety were evaluated by examining the typical hazards associated with the various stages of geothermal development.

Indicators/Significance Criteria

Potential impacts on health and safety could occur if reasonably foreseeable future actions were to:

- Create a hazard to the public through the routine transport, use, or disposal of hazardous materials;
- Create a hazard to the public through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;
- Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school; or
- Be located on a site that is included on a list of hazardous materials sites compiled by the federal or state government and, as a result, would create a hazard to the public.

Assumptions

The risk of exposure to hazardous materials, situations, and accidents would be highest among geothermal project staff; the general public would have a lower risk of exposure due to the reduced likelihood of being on the project site during exploration, development, operations and abandonment.

4.11.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the impacts on health and safety associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the Geothermal PEIS; they are summarized below and incorporated by reference here.

Due to the inability to predict future development scenarios, including types of development, timing, and location, what follows is a general description of

common impacts on human health and safety from geothermal resource development. Impacts could include:

- Exposure of individuals to drilling mud and geothermal fluid or steam during exploration and development drilling activities;
- Exposure of individuals to hydrogen sulfide contained in geothermal fluid or steam during exploration, development, and operation phases;
- Exposure of individuals to hazardous materials used and stored at facilities, such as petroleum, oil, lubricants, paints, solvents, and herbicides;
- Exposure of individuals to electrical fires or wildfires caused by project activities;
- Exposure of individuals to electric shock involved in maintenance of transmission lines and substations;
- Vehicular accidents due to increased traffic on local roads;
- Exposure to paints, solvents, herbicides, electrical fires, and other hazards typical of construction activities;
- A variety of potential accidents inherent to exploration, development, operations, maintenance, and abandonment and reclamation, as listed in the Geothermal PEIS; and
- A variety of potential accidents inherent to industrial facilities.

Potential health and safety impacts would last for the duration of exploration activities (estimated between one and five years for an individual project), development phase (two to ten years for an individual project), and operations and maintenance phase (10 to 30 years for an individual project).

4.11.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, there are no specific requirements or procedures related to protection of human health and safety. There would be no impact on human health and safety from geothermal leasing allocation decisions; however, impacts resulting from anticipated future actions consistent with implementing Alternative A would be of the same nature and character as those described under Common Impacts associated with Geothermal Development.

Alternative B (Proposed action)

Impacts would be similar to Alternative A. However, under this alternative, the BLM would apply the stipulations, BMPs, and procedures described in the alternative and appendices to ensure the health and safety of workers and public. For example, operators would be required to develop hazardous

material management plans, develop waste management plans, and establish safety zones. It is expected that these measures would effectively minimize impacts on health and safety from geothermal related actions.

Alternative C

Impacts under Alternative C would be the same as for Alternative B.

4.12 LAND USES

4.12.1 Scoping Comments on the Resource

- How would potential development of the leases impact adjacent landowners?

4.12.2 How Resource Impacts were Evaluated

Methodology

Land status baseline information in **Section 3.8**, Land Uses was reviewed for an understanding of current lands and realty program goals, management practices, and ownership breakdown in the planning area. This known information was overlain with the actions found under each alternative in **Chapter 2**, and conclusions were drawn based on an understanding of how these types of actions may affect the lands and realty program and adjacent landowners.

Indicators/Significance Criteria

Potential impacts on BLM-administered public lands could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the BLM in order to sustain the health, productivity, and diversity of federal lands; or
- Result in proposed uses that are incompatible with existing or adjacent land uses.

Assumptions

This analysis assumes the following:

- Existing rights-of-way and communication sites would be managed to protect valid existing rights.
- The BLM would continue to process land tenure adjustments.
- Allocating leasing areas as open or closed and issuing leases would not create any surface disturbances and current activities on federal lands could continue as long as they did not interfere with the rights of the geothermal lessee.

4.12.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Land Use with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here.

Impacts on land uses and adjacent landowners include the possibility for increased traffic on the existing roadway network and additional traffic on new or enhanced roads developed during the exploration, utilization and drilling operations phases of geothermal development. Additional roads could improve motorized and non-motorized access to previously inaccessible areas, therefore increasing motorized traffic in those areas and possibly affecting activities such as grazing and/or recreation. Increased traffic on existing paved roadways and highways could affect the physical condition of and travel times on the roadway network. The magnitude and extent of the impact would depend on the current land use in the specific area proposed for development which is unknown at this time. The impact would last for the duration that the roads were in use (short term for exploration phase, longer term during drilling operations and utilization phases), but would be expected to be reclaimed in the reclamation and abandonment phase. Coordination with the CDOT before any specific geothermal development project begins would likely minimize potential impacts on the roadway network.

Lands converted to geothermal use during the drilling and utilization phases (well pad, power plant, pipeline and transmission line construction and uses) would result in long term impacts on other uses such as grazing, recreation, hunting, and mining as it would displace these activities and uses. Short term (lasting only the duration of the actual activity) impacts would include maneuvering construction and maintenance equipment and vehicles associated with the drilling and utilization phase activities.

Reclamation and abandonment phase activities would likely return the landscape to its pre-construction condition and the previous uses and activities could resume.

4.12.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Issuing geothermal leases on a case-by-case basis is not expected to directly affect land uses. However, in the absence of allocating areas as open or closed to geothermal leasing, lease nominations and project development would likely result in fragmented and segregated land uses and thereby not follow BLM's policy for appropriate planning to meet its multiple use mandate and achieve BLM's mission and goals related to land uses. Additionally, there could be increased unanticipated environmental impacts from the lack of planning for appropriate land uses, such as visual, aural, or atmospheric intrusions on sensitive cultural and tribal landscapes.

Alternative B (Proposed action)

Under this alternative, the BLM would implement a comprehensive list of stipulations, BMPs, and procedures to serve as consistent guidance for future geothermal leasing. Relevant stipulations (**Section 2.2.2**) designed to protect existing land uses include CSU in areas that have the potential for adverse impacts on residential areas, schools, or other adjacent urban land uses. In addition, in accordance with the identified BMPs (**Appendix C**), BLM and operators would contact appropriate agencies, property owners, and other stakeholders early in the project planning process to identify potentially sensitive land uses and issues. It is expected that these measures would effectively avoid or minimize impacts over the long term on land uses by identifying conflicts early in the process and requiring specific measures to maintain public uses and values. It is anticipated that impacts under Alternative B would be less than under Alternative A due to the implementation of BMPs and additional lease stipulations. Alternative B would allow for more flexibility in siting geothermal plants and infrastructure.

Alternative C

Alternative C would have more acreage closed to geothermal leasing and more areas with stringent restrictions than the other alternatives, resulting in limited siting options for potential geothermal plants and infrastructure. This alternative has the same stipulations for protecting existing land uses as Alternative B and therefore would have the same long-term beneficial mitigating effects. Compared to Alternatives A and B, Alternative C has a lower potential to impact lands due to the smaller acreage of lands available for leasing.

4.13 LANDS WITH WILDERNESS CHARACTERISTICS

The BLM SLVFO completed its inventory of lands with wilderness characteristics, in accordance with IM 2011-154, and found only one area that contained lands with wilderness characteristics, the San Luis Hills WSA. As the area is also a WSA, the area is addressed under **Section 4.21**, Special Designations.

4.13.1 Scoping Comments on the Resource

- Leasing should be closed in citizen-proposed wilderness areas.
- BLM should prioritize leasing and development in areas that do not have wilderness quality.

4.13.2 How Resource Impacts were Evaluated

Methodology

The potential for geothermal leasing impacts on lands with wilderness characteristics would have been evaluated for impacts on the wilderness characteristics of untrammeled, natural, and undeveloped appearance, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values.

Indicators/Significance Criteria

Potential impacts on BLM-administered lands could occur if reasonably foreseeable future actions were to:

- Change wilderness characteristics of untrammeled, natural, and undeveloped appearance, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values.

Assumptions

This analysis assumes the following:

- Recreational activities on lands with wilderness characteristics will continue in the same manner as current conditions, but recreational use on lands with wilderness characteristics will continue to increase into the future.

4.13.3 Common Impacts Associated with Geothermal Development

A loss of wilderness characteristics would occur from the development of new facilities and access roads on lands with wilderness characteristics. All wilderness could be further impaired with the development of infrastructure required for geothermal development, pipelines and power plants. During the construction and operation phase, there would be increased traffic in the area from workers, creating auditory and visual intrusions that could impact solitude and opportunities for primitive recreation.

If geothermal development occurred adjacent to lands with wilderness characteristics, indirect impacts include a decrease in opportunities for solitude and a perceived loss of natural and undeveloped characteristics to recreationists if roads, structures, or any other construction activities associated with geothermal development. Other potential impacts would include aural or visual intrusions and degradation of scenic values the same as those discussed in **Section 4.23**, Visual Resource Management and Night Sky.

As noted in **Section 3.15**, Lands with Wilderness Characteristics, BLM completed an inventory for lands with wilderness characteristics in the planning area, in accordance with IM 2011-154. The only area found to have lands with wilderness characteristics was the San Luis Hills WSA. Under both alternatives, the San Luis Hills WSA is allocated as closed to geothermal leasing; therefore, there will be no impacts on lands with wilderness characteristics. For additional detail on impacts on WSAs, see discussion **Section 4.21**, Special Designated Areas.

4.14 LIVESTOCK GRAZING

4.14.1 Scoping Comments on the Resource

Commenters want to ensure that geothermal energy development in the San Luis Valley does not lead to the loss of lands available for grazing.

4.14.2 How Resource Impacts were Evaluated

Methodology

Livestock grazing baseline information in **Section 3.10**, Livestock Grazing, was reviewed for an understanding of current management practices. This known information was overlain with the actions found under each alternative in **Chapter 2**, and conclusions were drawn based on an understanding of how these types of actions may affect the livestock grazing program and current grazing allocations.

Indicators/Significance Criteria

Potential impacts on livestock grazing could occur if reasonably foreseeable future actions were to:

- Decrease acreage available for grazing;
- Decrease AUM number or forage; or
- Harass or result in the death of livestock.

Assumptions

This analysis assumes the following:

- Making geothermal leasing allocations and issuing geothermal leases would not impact livestock grazing operations; therefore, the analysis focuses on impacts related to anticipated future actions following leasing.

4.14.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Livestock Grazing Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here.

Geothermal exploration affects large areas of grazing in the short term during temporary construction of well pads, exploration wells, and roads. Impacts would include loss of forage, reduced forage palatability because of dust on vegetation, and displacement of livestock from construction noise. Additional roads could also impact livestock by opening up areas that were not previously accessible, thereby increasing disturbance or harassment of livestock. However, creating new access roads to areas where livestock graze would help livestock operators manage their stock more efficiently.

Geothermal drilling operations affect larger areas of grazing in the longer term during construction of additional production wells, injection wells, and sump pits after exploration. Sump pits could impact livestock grazing by providing a catch basin for rainwater (an assumed water source). Sump pits often contain high concentrations of minerals and chemicals from the drilling fluids, which can be toxic to grazing animals unless fencing mitigation is implemented.

Impacts during initial construction within the utilization phase are similar to, but greater than, the drilling operations phase and include loss of forage, reduced forage palatability because of dust on vegetation, restriction of livestock movement from pipelines and protective fencing surrounding the development area, harassment of livestock from additional access to livestock grazing areas, and temporary displacement of livestock from construction noise.

In the long term, a smaller amount of permanent grazing acreage is lost during geothermal operation from the project footprint of the power plant, access roads, and well pads. Impacts would be similar to, but less than, the impacts identified under drilling operations, above. The length of time that impacts would occur depends on the life of the individual project.

Impacts on livestock grazing during the reclamation and abandonment phase would be short term and limited to the footprint of developed areas. Impacts would include increased noise and dust from demolition of existing pipelines and facilities. In the long term, restored vegetation would provide forage for grazing that was originally lost in development.

4.14.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Due to the fact that the vast majority of BLM lands within the SLVFO have been allocated for grazing, it is likely that any geothermal project proposed for BLM lands would affect one or more permittees. Under this alternative, approximately 472,200 acres, or 97 percent of acres available in grazing allotments, would be open to geothermal leasing. Of this amount, approximately 432,400 acres would be subject to NSO, CSU, or other geographic-specific stipulations, and 60,900 acres would be subject to only standard stipulations. Impacts would be site-specific and depend on location of geothermal development. Any significant decrease in allotment acreage could have a negative effect on the permittee's operation.

As noted in **Section 3.10**, Livestock Grazing, BLM is required to give permittees two years' notice prior to any changes to their permits that would affect their grazing operation. Mitigation of impacts of geothermal development could be achieved by BLM's modification of existing lease boundaries to compensate for acres lost to geothermal development, or proponent's movement of a proposed geothermal project to an alternative parcel lacking grazing conflicts.

Alternative B (Proposed action)

Impacts would be similar to those described under Common Impacts and Alternative A. Under Alternative B, approximately 462,600 acres, or 95 percent of acres available for grazing, would be open to geothermal leasing. Of this amount, approximately 434,400 acres would be subject to NSO, CSU and TL stipulations, and 141,400 acres would be subject to only standard stipulations.

Stipulations and BMPs developed specifically for geothermal leasing, as defined in **Chapter 2** and **Appendix C**, would be applied to all geothermal leases in the project area and would reduce the potential for impacts under Alternative B. In accordance with these BMPs, operators would employ dust control measures to reduce impacts on livestock forage during construction and demolition. Litter and noxious weeds would be controlled and removed regularly. In addition, geothermal companies would work with grazing permittees to mitigate impacts on water by producing off-site water developments as needed. It is expected that these measures would effectively minimize impacts on livestock grazing by reducing impacts on forage.

Alternative C

Impacts under Alternative C would be similar to those described in Alternative B. As described under Alterative B, standard stipulations and BMPs for geothermal leasing would be applied to all leases. Under this alternative, approximately 361,100 acres or 74 percent of acres available for grazing would be open to geothermal leasing. Of this amount, approximately 340,200 acres would be subject to NSO, CSU, or, TLs and 99,700 acres would be subject to only standard stipulations. Alternative C has the lowest potential to impact soil resources due to the lowest acreage of grazing allotment lands available for geothermal leasing as well as the implementation of standard stipulations and BMPs.

4.15 MINERALS AND ENERGY

4.15.1 Scoping Comments on the Resource

No comments related to fluid minerals were received during the scoping period.

4.15.2 How Resource Impacts were Evaluated

Methodology

Impact analysis for Fluid Minerals was conducted by examining whether the leasing of areas for geothermal resources would have the potential to impact oil, gas, and geothermal leasing or the subsequent development of those resources.

Indicators/Significance Criteria

The following indicators have been identified in order to evaluate potential impacts on fluid minerals:

- Changes in land use allocations that would change the areas that are open or closed areas to oil, gas, or geothermal leasing.
- The utilization of tracts of lands for geothermal in areas of interest for oil and gas such that oil and gas development would be precluded.

4.15.3 Common Impacts Associated with Geothermal Development

As noted in Section 3.7, Fluid Minerals, although the whole San Luis Basin area has been identified in the BLM's SLVFO RMP (BLM 1991) as an area of low potential for oil and gas development, most of the area is open for discretionary mineral leasing, including leasing for oil and gas and for other fluid minerals (e.g., geothermal resources). Although much of the SLVFO was leased for oil and gas at one time, at present there is only one oil and gas lease, south of Del Norte, being considered for drilling and possible production.

In general, any infrastructure improvements (e.g., roads, transmission lines, pipelines) associated with the exploration and development of geothermal resources would provide access and possibly new routes for pipelines or transmission for the exploration and development of other energy and mineral resources within the immediate area. The degree of impact would depend on the existing limits to access in the area and the distance of the roads to the other mineral resources. However, any land being used for exploration and development activities would become unavailable for developing other mineral resources (e.g., aggregates, solid minerals). Introducing new transmission lines would encourage developing other energy resources along the transmission line. Mineral resource developments would be encouraged due to the new availability of power for their operations. These impacts would be reduced with increased distance from the power plant, roads, and transmission lines. During the utilization phase, other operations in the immediate area of the power plant might be able to take advantage of the downstream heat from the power plant.

Geothermal plants and infrastructure development could be compatible with other forms of renewable energy, such as solar, wind, and biomass. A geothermal plant could have co-located wind turbines or solar panels to supply additional power if needed. While geothermal open allocation would not preclude large scale solar or wind energy developments, areas that are permitted for large scale utility solar or wind development could preclude geothermal development if there was competition for the same flat landscape lands.

Considering the planning area has low potential for oil or natural gas development and the types of impacts described above, there would likely be negligible impacts on energy and mineral resources. Utilization of the geothermal resources would have minor or no impact on other energy or mineral resources.

4.15.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Alternative A would not change the areas open to geothermal leasing and would have no impact on oil and gas leasing or development. Alternative A would have no direct impact on the ability to develop geothermal energy within the SLVFO;

however, it may take longer to process geothermal applications without the streamlining procedures.

Alternative B (Proposed action)

Types of impacts would be the same as described in Common Impacts. Alternative B would decrease the areas available for geothermal leasing; the reduction in land base is unlikely to impact oil and gas development as areas under leasing agreements would still be available for oil and/or gas development. The reduced land base may increase competition for areas that could also be proposed for solar or wind energy development.

Alternative C

Types of impacts would be the same as described in Common Impacts and magnitude would be similar to Alternative B. However, with the further reduction in land base open to geothermal leasing, there could be a greater increase in competition for lands that may be permitted for wind or solar energy development.

4.16 NOISE

4.16.1 Scoping Comments on the Resource

Scoping comments related to noise concerned increased noise levels from developing geothermal energy facilities in the San Luis Valley.

4.16.2 How Resource Impacts were Evaluated

Methodology

The methodology for the noise impact analysis is incorporated by reference from the noise section of the Geothermal PEIS.

Indicators/Significance Criteria

Impact criteria for noise are incorporated by reference from the noise section of the Geothermal PEIS. More specifically, the analysis discusses potential noise levels and compares these levels to those set by the Federal Geothermal Resources Operational Order Number 4, which mandates that noise levels must be 65 dBA or less at the geothermal lease boundary or 0.5 mile from the source, whichever is greater.

Assumptions

This analysis assumes the following:

- Future analysis for site-specific projects would identify the presence of sensitive noise receptors (e.g., residences, schools, or National Parks and Wildlife Refuges) in the vicinity of the proposed well drilling or geothermal plant activities.

- Noise levels for the specific activities would be assessed to determine their compliance with applicable noise guidelines, and measures to reduce noise impacts would be identified if necessary.
- For project-specific analysis, BLM may require consultation with the NPS to ascertain specific ambient sound levels.

4.16.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Noise Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized in this section. Noise levels associated with exploration, well pad development, power plant construction, and reclamation and abandonment would be temporary and short-term, while noise associated with geothermal plant operation would be long-term. Potential noise impacts related to the different phases of geothermal development are discussed below.

During construction, heavy earth-moving equipment would be used to prepare access roads, drill pads, and the geothermal power plants. Sound pressure levels for these activities have been measured up to 95 dBA at a distance of 50 feet (Leitner undated). Because noise decreases with distance from the source, a 95-dBA noise level would fall below 65 dBA at 1,500 feet from the noise source, therefore falling within the federal standard.

The dominant noise sources associated with well drilling are the large diesel engines that power the rotary rig and mud pumps and the large diesel-driven air compressors. These noise sources are consistent throughout drilling. Additional intermittent noise sources result from the hoisting of drill pipe or casing and the auto-driller. The noise of hoisting during drilling is usually masked by the air compressors, but the noise from auto-drillers is not. Well drilling generally occurs 24 hours per day for a number of days or months, depending upon the depth to the resource. Typical sound levels during drilling when mud is used as the circulating medium range from 75 to 85 dBA at 50 feet (Leitner undated). A noise level of 85 dBA decreases to 65 dBA at a distance of 500 feet from the noise source, therefore falling within the federal standard.

The process of flowing geothermal wells to test production capability generates noise. Noise is made primarily by the diesel generator that powers the down-hole electric pump, with lower noise level emitted from the fluids flowing through the well head and pipeline to the reinjection well. Increased noise levels may be realized from any additional diesel generator that is required to power a second pump at the injection well. Flow testing occurs 24 hours per day and is generally conducted for 30 3three to 90 7seven days per well (CDWR, 2004a). Data from geothermal exploration in Imperial Valley, California, suggest that sound pressure levels during flow testing can be as high as 90 dBA at 50 feet (Leitner undated), reaching the 65-dBA level at 800 feet from the noise source, therefore falling within the federal mandate.

The primary source of noise at binary plants is the cooling towers, which have been recorded as generating noise in the range of 75 to 85 dBA at a distance of 50 feet. As described for well drilling, noise levels of 85 dBA decrease to 65 dBA at a distance of 500 feet from the noise source, therefore falling within the federal mandate.

As discussed above, phases of geothermal development produce temporary sources of noise in the exploration and development phases and long-term sources of noise during plant operation. The level of impact from these activities is highly dependent upon the surrounding land uses and the presence or absence of sensitive noise receptors.

4.16.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, lease applications would continue to be processed on a case-by-case basis, allowing for geothermal development in areas open to geothermal leasing. Indirect use geothermal projects can be expected to continue to come online and generate noise at the existing pace of development, therefore noise impacts would be of the same nature as those noted in the Common Impacts section.

Alternative B (Proposed action)

Noise impacts under Alternative B would be of the same nature as those noted in the Common Impacts section. A slightly smaller area (as compared to Alternative A) would be open to geothermal leasing, which could decrease the potential for noise impacts near developed land uses. Additionally, BMPs and noise reduction measures as noted in the BMPs would be implemented to reduce project impacts as determined during site-specific analysis at the various stages of development.

Alternative C

Noise impacts under Alternative C would be of the same nature as those noted in the Common Impacts section. However, a smaller area would be open for geothermal leasing under this alternative, which could result in a lesser potential for noise-related impacts.

4.17 PALEONTOLOGICAL RESOURCES

4.17.1 Scoping Comments on the Resource

No scoping comments were received regarding paleontological resources.

4.17.2 How Resource Impacts were Evaluated

Methodology

Potential impacts on paleontological resources were evaluated using the recently revised Potential Fossil Yield Classification system (BLM 2008-009).

This evaluation of potential effects on paleontological resources assumes that geothermal leasing alternatives associated with the largest acreage of disturbance correlate with the greatest likelihood of impacts on paleontologically sensitive (Potential Fossil Yield Classifications 3 through 5) geologic formations.

Based upon a reasonable prediction of possible future types of development, but not the timing and/or location, the following impact analysis provides a general description of common impacts on paleontological resources from geothermal resource development.

Indicators/Significance Criteria

Paleontological resource impacts primarily concern the potential destruction of nonrenewable fossil resources and the loss of information associated with these resources, and includes destruction as the result of surface disturbance and the unlawful or unauthorized collection of fossil remains. Criteria for determining significant impacts on paleontological resources include:

- Loss of any fossil that could yield information important to prehistory or that embodies the distinctive characteristics of a type of organism, environment, period of time, or geographic region.

More generally, potential impacts on paleontological resources could occur if reasonably foreseeable future actions were to:

- Conflict with paleontological resource management objectives and guidelines established by the BLM; or
- Disturb paleontologically sensitive geologic formations (Potential Fossil Yield Classifications 3 through 5).

Assumptions

This analysis assumes the following:

- Potential for impacts on both surface and subsurface paleontological resources is directly proportional to the amount of surface disturbance associated with a proposed action;

At the programmatic level of analysis, it is not possible to identify and evaluate areas of higher paleontological sensitivity with respect to locations of proposed surface disturbance. Therefore, potential impacts on paleontological resources under each alternative can only be generally estimated, and they correlate directly to the amount of anticipated surface disturbance proposed under each alternative.

4.17.3 Common Impacts Associated with Geothermal Development

Surface disturbance activities related to geothermal development, such as grading, drilling wells, seismic and resistivity surveys, pipeline construction, and plant construction, have the potential to impact fossils that may occur on or underneath the surface in areas containing paleontologically sensitive geologic units. Without mitigation, such as monitoring during construction, excavation of materials, or avoidance of surface exposures, these fossils, as well as the paleontological data they could provide, could be destroyed, rendering them permanently unavailable. Impacts can typically be mitigated to below a level of significance by implementing paleontological mitigation such as those mentioned above and identified in the BMPs or stipulations. If data recovery is the prescribed mitigation, this can also result in fossils being salvaged that may never have been unearthed as the result of natural processes; these newly exposed fossils would become available for scientific research, education, display, and preservation into perpetuity at a public museum.

Throughout the utilization, operations, maintenance, and reclamation stages, there would be an increase in geothermal workers and an increase in the accessibility of public lands, both of which in turn allow for an increased potential for loss of paleontological resources by vandalism and unlawful collecting (poaching). These impacts are difficult to mitigate to below the level of significance, but they can be greatly reduced by increasing public awareness about the scientific importance of paleontological resources through education, community partnerships, and interpretive displays, and by informing the public about penalties for unlawful destruction or unlawful collection of these resources from public lands.

4.17.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, other than current paleontological resources policies, there are no specific additional protections applied to paleontological resources. If paleontological resources occurred within a closed area, there would not be any direct impacts on exposed surface resources. A loss of any fossil that could yield information might be important to prehistory. If a locality was within an area allocated as open with NSO stipulations, the surface exposure would be protected from direct impacts; however, subsurface resources could be impacted by directional drilling activities. Localities outside of closed or NSO stipulated areas would not be given extra protections and possibly would result in more damage or loss of the resource if development actions are proposed.

Alternative B (Proposed action)

This alternative includes more acreage closed to geothermal leasing and open with NSO stipulation than Alternative A, thereby increasing the amount of area protected from surface disturbing activities in all phases of geothermal development and lessening the direct and indirect impacts (as discussed above)

on paleontological resources. While NSO stipulations would protect exposed surface paleontological resources, undiscovered subsurface resources could be impacted as a result of directional drilling or other operations. Under this alternative, the BLM would issue a comprehensive list of stipulations, BMPs, and procedures to serve as consistent guidance for future geothermal leasing. In accordance with BMPs, operators would determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search of past paleontological finds in the area, or, depending on the extent of existing information, paleontological survey. If paleontological resources are present at the site, or if areas with high potential have been identified, a paleontological resource management plan would be developed that identifies appropriate monitoring and protection measures. Unexpected discovery of paleontological resources during geothermal development would be brought to the attention of the responsible BLM-authorized office immediately and work would be halted in the vicinity of the finds to avoid further disturbance while the finds are evaluated and appropriate mitigation measures are developed. It is expected that these measures would effectively avoid, minimize or mitigate impacts on paleontological resources by protecting and conserving significant paleontological resources as they are known to exist or are discovered on public lands.

Alternative C

Same as Alternative B, except that more areas are proposed as closed to leasing and open with NSO stipulation which, if paleontological resources occurred in these areas, Alternative C would allow more protection to and further lessen the direct and indirect impacts on the resource(s).

4.18 RECREATION

4.18.1 Scoping Comments on the Resource

- Commenters want the BLM to take precautions in order to prevent the loss of open space lands.

4.18.2 How Resource Impacts were Evaluated

Methodology

This section presents potential impacts on recreation resources, opportunities, and experiences from management prescriptions provided in the Geothermal PEIS. The potential impacts on SRMAs will be the primary issue assessed due to their high recreation values.

Indicators/Significance Criteria

Potential impacts on BLM-administered public lands could occur if reasonably foreseeable future actions were to:

- Change the essential physical, social, and/or operational setting character conditions in SRMAs.

Assumptions

This analysis assumes the following:

- Recreational activities will persist in similar manner and extent as current usage patterns, but will likely increase over time.
- SRMAs are of particularly high use and the frequency and extent of the use of these lands is likely to increase.
- Areas not designated as SRMAs are considered Extensive Recreation Management Areas (ERMAs), which do not have the heightened restrictions associated with SRMAs or other special designations, therefore there is an increased likelihood that geothermal leasing and development will occur within the ERMAs.

4.18.3 Common Impacts Associated with Geothermal Development

Each SRMA would be affected in unique ways, as recreational uses vary within each planning area. In general, isolated recreational uses, such as float-boating, fishing, or rock-climbing are unlikely to be impacted, whereas recreational uses that require large expanses of land (e.g. wildlife viewing, hunting, mountain biking, hiking, or horseback riding) would be more prone to impacts of geothermal leasing.

Exploration phase activities within the planning area could likely reduce the frequency and number of visitors to the recreation areas over the course of one to five years, and it is likely that recreational enjoyment would be somewhat diminished as noise, dust, or other consequences of exploration would be visible or audible to the user. Additionally, the vehicles and transportation of materials during the construction process could lead to a shift toward a more urban feeling environment. Access roads created as a result of exploration could both increase opportunities for recreationists, while at the same time inhibit attributes which many recreationists enjoy, such as remoteness and solitude. Once exploration activities are completed, recreation activities would likely resume to previous levels.

The drilling operations phase activities, such as road and well pad construction, would likely effect recreation by aural and visual intrusions on the landscape and loss of recreational values such as solitude and uninterrupted expanses of land.

Recreation users would experience major effects during the utilization phase of geothermal development. Construction of roads, geothermal power plant, pipelines, and transmission lines would likely inhibit the flow of the populace trying to access recreation areas, create visual, aural, and atmospheric intrusions on the landscape, diminish recreational enjoyment due to noise, dust or traffic, and possibly create a more urban feeling environment. Areas immediately around the power plant would be unavailable for recreational uses.

If geothermal development was to occur in or adjacent to SRMAs, there would be changes to the essential physical, social, and/or operational setting character conditions within SRMAs. Potential impacts associated with development would include disruption of recreational activities, compromised accessibility, fragmentation of the landscape due to the creation of roads, and aural and visual intrusions. These effects would diminish the values that many visitors enjoy, such as remoteness and solitude and last for the short term through duration of the development activity, as well as longer term for features and structures that would remain on the landscape, such as transmission lines, well heads, power plants, and access roads.

Similar to construction, the processes of reclamation and abandonment could increase traffic and create difficulty for access to recreation points, however, the areas would be reclaimed to BLM standards returning the areas to preconstruction condition, and opportunities for recreational activities would likely improve.

4.18.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, the Blanca SRMA (9,100 acres), Zapata Falls SRMA (3,700 acres), the Rio Grande SRMA (4,100 acres), and the Penitente Canyon SRMA (4,200 acres) would be open to geothermal leasing with standard lease terms and conditions and likely have the range of impacts noted above. There are no specific stipulations applied to SRMAs themselves under Alternative A, but stipulations could be applied to the values and resources contained within SRMAs, such as special status species, cultural resources, or wildlife corridors, at the later stages of lease sale and geothermal development permitting if the future NEPA analysis indicated the need for said protections.

Alternative B (Proposed action)

Under Alternative B, the Blanca SRMA, Zapata Falls SRMA, the Rio Grande SRMA, and the Penitente Canyon SRMA and surrounding areas would be open to geothermal leasing with a CSU stipulation that would lessen the intensity of the range of impacts noted above. Alternative B incorporates all of the Geothermal PEIS procedures, BMPs, and stipulations, and tailors them to critical identified resource issues and locations; by applying stipulations and BMPs to leases and development permits, impacts such as aural and visual intrusions would likely be lessened and visitor experiences of remoteness and solitude values would be better preserved.

Alternative C

All SRMAs would be open to geothermal leasing with an NSO stipulation that would prevent or limit impacts caused by surface disturbing activities associated with geothermal exploration and development. By prohibiting surface development, an NSO stipulation would provide greater protection for

recreational experiences of remoteness and solitude values than a CSU stipulation.

4.19 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

4.19.1 Scoping Comments on the Resource

No scoping comments were received directly related to socioeconomics and environmental justice.

4.19.2 How Resource Impacts were Evaluated

Methodology

Impacts were analyzed in terms of the predicted increase in geothermal energy activities and the associated changes expected in employment, income, tax revenue, royalties, public infrastructure needs, and other socioeconomic factors. Under any given alternative, the location of such development could occur anywhere in the areas identified as being open to leasing. Components of geothermal plant construction and operation, including the number of temporary and permanent workers required, are partially determined by plant megawatt potential.

Indicators/Significance Criteria

The analysis of socioeconomic and environmental justice issues associated with the development of geothermal facilities considers impacts within the planning area and an associated 50-mile (80-kilometer) radius around the boundary of the planning area.

The allocation of lands as open or closed to geothermal leasing and the issuance of geothermal leases would not impact socioeconomics or environmental justice. Impacts would result from construction and operation of geothermal energy projects in the planning area. Potential impacts on socioeconomics and environmental justice could occur if reasonably foreseeable future actions were to:

- Impact other land uses that currently create revenue;
- Impact the nonmarket values of open space;
- Induce growth or population concentrations and cause additional demands on housing or social services that could not be met by the local communities;
- Cause a change in local or project area employment;
- Have a disproportionately high and adverse impact on minority populations; or
- Have a disproportionately high and adverse impact on low-income populations. In the event impacts are significant, disproportionality would be determined by comparing the proximity of any high and

adverse impacts with the location of low-income and minority populations.

4.19.3 Common Impacts Associated with Geothermal Development

Impacts on area socioeconomics and environmental justice would vary dependent on types of development, timing, and location of development. Due to the inability to predict these conditions, the following impact analysis provides a general description of common impacts from geothermal resource development. The largest impact on socioeconomics would result from employment and income directly and indirectly associated with geothermal electricity plant construction and operation. In addition, geothermal power plants may generate additional revenue streams for local government including property taxes and royalties. Information and impacts for these factors are discussed at length in the Geothermal (BLM and USFS 2008), and this information is incorporated by reference and summarized here.

Based on the RFDS for Colorado and the information provided in the Geothermal PEIS, direct economic impacts of geothermal electricity generation for Colorado are described in **Table 4-5**, Direct Economic Impacts of Geothermal Electricity Generation in Colorado.

Table 4-5
Direct Economic Impacts of Geothermal Electricity Generation in Colorado

Estimated geothermal MW	100
Total construction jobs (temporary jobs)[1]	310
Construction income (million $)[2]	18.0
Operations and maintenance jobs (permanent, full time jobs)[3]	74
Operations and maintenance income (million $)[4]	6.4
Property tax estimate (annual, in million $)[5]	3.0
Federal royalty estimate (30-year total, in million $)[6]	32.0

[1] Assuming an average of 3.1 total construction jobs/MW, per Hance 2005.

[2] Assuming a rate of $9 million for 50-MW power plant, as discussed in BLM 2007b.

[3] Assuming a rate of 0.74 permanent full time jobs/MW, per Hance 2005.

[4] Assuming a rate of $3.2 million annually for a 50-MW power plant, as discussed in BLM 2007b.

[5] At rate generated in Imperial County (NRCS 2007).

[6] With average electricity price of 6 cents/kWh and 95% capacity factor, following Kagel 2006.

Source: BLM and USFS 2008

Activities associated with exploration provide temporary jobs for the local community near geothermal resources, as well as expenditures for fuel, lodging, food, and other needs providing stimulus to the local economy. However, given the low number of temporary jobs estimated to be associated with this phase of development, these impacts are expected to be low.

The level of impact resulting from the drilling operations phase would vary depending on size and location of geothermal development. Changes to air

quality, water quality, and noise and hazardous material impacts potentially resulting from geothermal development could impact area communities and minority populations should they be located on private lands adjacent to areas developed for geothermal resources. Due to location of BLM lands, geothermal plant development is not likely to occur adjacent to residential areas, and significant impacts on minority populations are not likely to occur. Potential environmental justice impacts would be mitigated through BMPs applied to specific project leases.

The level of impact resulting from utilization phase activities generally varies depending on resource potential for the area. Due to the geothermal resource potential occurring in a limited portion of the planning area (generally in the northern and eastern areas), the impacts are anticipated to be low, or roughly $9 million dollars per 50-MW power plant and associated activities. In summary, construction of a 50-MW power plant and the associated transmission lines would require a total of 1,870 person-months, or 155 person-years, with a variable number of employees required at any given time during construction. A 50-MW power plant is estimated to require approximately 37 permanent full-time jobs. Generally, employment would provide positive impacts on the surrounding area in the form of employment opportunities as well as secondary impacts from money spent in the local economy. Additionally, geothermal resource development may provide an opportunity to broaden the economic base of the communities in and around the planning area. With the given RFDS, a large influx of workers is not anticipated to the region, and, therefore, extensive demands on local housing, schools, or other social services are not likely.

Some economic impacts could also occur should ranching, recreation, hunting, mining, or other land use activities be altered by geothermal development. Natural resources play an important role in the local area economy by attracting tourists and providing opportunities for local residents. In addition, public lands provide important non-market values, such as open space. Alteration of the visual landscape or sense of place in the area may impact regional visitation numbers.

In addition, should geothermal development alter the geothermal resource to the extent that other area businesses, including hot springs and agriculture as discussed in Chapter 3, were affected, there is the potential for loss of jobs and subsequent impacts on the area economy.

In the short term (during actual construction activities or exploration phase), other land uses and income derived from these uses may be displaced by geothermal development. In the long term (duration of the project's life, or approximately 10 to 30 years), many other land uses may be compatible with geothermal use due to the small footprint of geothermal plants; however the aesthetic value would be permanently altered (although potentially minimally

altered). Impacts for these resources are discussed under the appropriate headings in **Chapter 5**.

The reclamation and abandonment phase would likely involve additional construction jobs for reclaiming disturbed areas. As in other phases, expenditures for equipment, materials, fuel, lodging, food, and other needs would stimulate the local economy but only in the short term (length of time required to complete reclamation or one to five years). BMPs would be used to minimize disturbance adjacent to communities so that potential environmental justice effects would be avoided. Reclamation could increase the aesthetic value and bring back income to local industry that supports recreation or other uses based on open space and landscapes.

4.19.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Issuing leases under current regulations is not expected to affect socioeconomics or environmental justice. Impacts would occur during subsequent exploration, drilling operations, and utilization phases. Impacts would vary depending on specific locations developed for geothermal resources. Under Alternative A, geothermal leasing would be based on the existing SLVFO RMP and RMP amendments. Lands would not be allocated as closed or open to leasing, and no standard lease stipulations or BMPs for geothermal leasing based on the Geothermal PEIS would be applied. Measures to protect area communities from impacts would be determined on a case by case basis. Alternative A would provide the least defined protection for socioeconomics and environmental justice of any alternative in regard to geothermal development.

Alternative B (Proposed action)

As for Alternative A, issuing leases under current regulations is not expected to affect socioeconomics or environmental justice. Impacts would occur during subsequent exploration, drilling operations, and utilization phases. Impacts would vary depending on specific locations developed for geothermal resources. Under Alternative B, Geothermal Leasing PEIS program procedures, BMPs, and stipulations would be applied. Additional lease stipulations, such as NSO, CSU, and TLs, would be applied based on site-specific resources as detailed in **Chapter 2**. Specific to socioeconomic resources, CSU stipulations would be applied to minimize the potential for adverse impacts on residential areas, schools, other adjacent urban land uses. In addition, stipulations and BMPs under Alternative B would limit the impacts on area resources and other existing land uses thereby decreasing the likelihood that economic and social benefits derived from these resources would be impacted. In summary, the potential for impacts on local adjacent communities, including minority populations, are likely to be reduced under this alternative.

Alternative C

Impacts under Alternative C would be similar to those described under Alternative B. Geothermal PEIS program procedures, BMPs, and stipulations would be applied. Additional closures to geothermal development and site-specific lease stipulations would be applied as described in **Chapter 2**. Alternative C is the most restrictive for geothermal development siting; BLM lands adjacent to communities under this alternative are more likely to be closed to leasing or have NSO stipulations under this alternative. As a result, potential for impacts on local adjacent communities, including minority populations, are likely to be the lowest under Alternative C.

4.20 SOILS

4.20.1 Scoping Comments on the Resource

No scoping comments were received related to soil resources.

4.20.2 How Resource Impacts were Evaluated

Methodology

The potential impacts of the alternatives were evaluated on the basis of amount of area that would be open for exploration and development and the general presence of easily eroded soils. The amount of disturbance that would be associated with the RFDS was assessed for the soil resources present in the planning area. The project area does not contain areas of prime and unique farmlands; therefore, there is no discussion of the impacts on these resources.

Indicators/Significance Criteria

Potential impacts on soil resources could occur if reasonably foreseeable future actions were to:

- Take place on slopes greater than 40 percent;
- Increase the mid- to long-term erosion of soil resources in the areas;
- Cause soil resource compaction where soil crusts are present; or
- Result in spills of hazardous materials.

Assumptions

This analysis assumes the following:

- Site-specific surveys and additional protection measures may be required at the project-specific phase of analysis and permitting.

4.20.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Soil Resources Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here.

The potential impacts on soil resources from geothermal development include physical disturbance (e.g., movement or removal), compaction, changes to erosion patterns, and changes in current use as farmland. Any development or infrastructure (e.g., wells, roads, or pipelines) on steep slopes would increase erosion and could increase risk of landslides. These types of impacts would occur in every phase of geothermal development due to construction related activities, such as road creation, power plant and well pad construction, temperature gradient and production well drilling, and seismic survey pulse sites.

These initial impacts would be direct and generally short term, meaning they would occur at the same time and place as the activity and last for the duration that it takes to complete the activity. For example, the impacts from drilling temperature gradient wells would include soil removal, compaction, and likely erosion pattern changes. However, impacts last only the duration of the drilling and activities (several weeks).

Road construction or enhancement, which would be mostly needed in drilling operations and utilization phases, would have initial direct, short term physical disturbance, compaction, and erosion pattern changes impacts, but also have longer term impacts if they were used for continued access to well pads, the power plant, or transmission lines. Compaction and erosion would continue for the life of the project (possibly several decades), until abandonment and reclamation. At that point, they could be removed and restored to original site conditions.

The utilization phase includes constructing roads to accommodate larger equipment, the power plant and access roads into the plant, and field equipment and support structures such as pipelines, as well as the daily operations and maintenance of the project. This phase of development would result in long-term impacts on soil resources, such as compaction and erosion pattern changes due to repeated use of the roads for access and the plant and support features footprints. All of these impacts would last for the life of the project until the reclamation and abandonment phase.

Reclamation and abandonment impacts related to vehicles used during reclamation activities would be short term (lasting only during the actual reclamation work), with an overall long term negligible impact after the area is returned to pre-disturbance conditions. All disturbed lands would be reclaimed in accordance with BLM standards.

4.20.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Issuing leases under current regulations is not expected to affect soil resources. Impacts on soil resources would occur during subsequent exploration, drilling operations and utilization phases. Of the 638,100 acres opened to geothermal

leasing (which includes lands with standard lease terms and conditions and timing limitations), approximately 175,400 acres of soils have a severe or very severe erosion hazard classification; if development were proposed in these areas, there is potential for soil erosion on these lands of the nature and type described above. While there are no NSO or CSU stipulations specific to soil resources there are other resources protected with NSO or CSU that would contribute to protecting the soil resources, such as the NSO stipulations in the 2,000 acres Semi-primitive Nonmotorized area of Flat Top Mountain in the San Luis Hills ACEC. In addition, BMPs from the Geothermal PEIS would not be incorporated, and as a result, protective measures for soil recourses in leasing approvals or stipulations would vary for site-specific actions.

Alternative B (Proposed action)

Under Alternative B, the nature of impacts would be the same as those described under Common Impacts; however, lands identified as open to geothermal leasing would include minor to moderate constraints to reduce impacts on soil resources based on site-specific environmental conditions. A total of 173,600 acres of soils have a severe or very severe erosion hazard classification in the area open to geothermal leasing under Alternative B.

Under this alternative, the BLM would issue a comprehensive list of stipulations, BMPs, and procedures to serve as consistent guidance for future geothermal leasing. NSO and CSU stipulations would likely minimize the impacts of future development on erodible soils. Specifically, Alternative B would have NSO stipulations for slopes over 40 percent and for soils with high erosion potential, and CSU stipulations for those areas with slopes greater than 30% available to minimize potential for adverse impacts on erosive soils defined as severe or very severe erosion based on Natural Resources Conservation Service mapping. In addition, standard BMPs would be applied to all future geothermal leases. Relevant BMPs include identification of unstable slopes and local factors that can induce slope instability. Special construction techniques would be used where applicable in areas of steep slopes, erodible soils, and stream channel crossing. Operators would also be required to adhere to a plan of development that includes spill prevention measures and cleanup provisions. It is expected that these stipulations and BMPs would avoid or minimize the impacts on soil resources by protecting sensitive soil resources, thus minimizing erosion and secondary impacts on air quality associated with erosion.

Alternative C

Impacts under Alternative C would be similar to Alternative B. Due to more area being closed under this alternative, there is less acreage (approximately 135,500 acres) of soils that have a severe or very severe erosion hazard classification. Stipulations and BMPs would be in place as described for Alternative B, therefore impacts would be minimized. Compared to Alternative B, Alternative C has a lower potential to impact soils due to the smaller acreage of highly erodible soils available for leasing.

4.21 SPECIAL DESIGNATED AREAS

4.21.1 Scoping Comments on the Resource

- Commenters were highly concerned that areas in the National Landscape Conservation System, including National Heritage Areas, as well as scenic byways should be protected.
- How should other land uses and special designation areas be addressed, and what areas should be automatically closed to geothermal leasing? Specific concerns included: ACECs, Wilderness and WSAs, National Scenic Trail Corridors, National Landscape Conservation System units, WSRs, Scenic Byways and Backcountry Byways, and Interpretive Sites.

4.21.2 How Resource Impacts were Evaluated

Methodology

Baseline information for all special designation areas was reviewed for an understanding of current goals, objectives, management practices, and resource values. GIS data were incorporated in order to consider how management of lands adjacent to the special designation areas might impact the vitality of known resources. This known information was overlain with the actions found under each alternative in **Chapter 2**, and conclusions were drawn based on an understanding of how these types of actions may affect the special designation areas' resource values.

Indicators/Significance Criteria

Potential impacts on BLM-administered public lands could occur if reasonably foreseeable future actions were to:

- Change wilderness characteristics within WSAs of untrammeled, natural, and undeveloped appearance, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values. Note that because WSAs are closed to geothermal leasing, this criteria applies to allowable uses adjacent to WSAs that could indirectly impact their wilderness characteristics. However, actions that would negatively impact the wilderness characteristics or result in any loss of characteristics in the WSA would be illegal under the IMP and would not be approved;
- Lessen the important historic, cultural, and scenic values; fish and wildlife resources or other natural systems or processes; or the protections for which an ACEC was designated;
- Impact National Parks and Preserves, including changes to nationally significant natural, cultural, or recreational resources;

- Impact National Wildlife Refuges including changes to the biological integrity, diversity, and environmental health of fish, wildlife, and plant resources and their habitat.

Assumptions

This analysis assumes the following:

- WSAs in the planning area would continue to be managed consistent with the Interim Management Policy until Congress either designates or releases all or portions of the WSAs from further consideration;
- Recreational activities in existing WSAs will continue in the same manner as current conditions, but recreational use in WSAs will continue to increase into the future.
- Management prescriptions for ACECs are specific to the land areas contained within each ACEC and are not mandated to the entire field office area;
- ACECs will continue to be managed to protect and enhance the special values that were identified in the 1991 SLVFO RMP;
- BLM would coordinate with other federal agencies including the National Park Service and USFWS to identify issues and concerns during all phases of geothermal leasing and development that may affect the agency units located in the planning and analysis areas;
- Lands that are part of the National Park Service and National Wildlife Refuge System are closed to geothermal leasing, and adjacent public lands require special analysis prior to issuance of geothermal leases.

4.21.3 Common Impacts Associated with Geothermal Development

Wilderness Study Areas

Under all alternatives, WSAs would be closed to geothermal leasing, thereby having no direct impacts. Indirect impacts include a decrease in opportunities for solitude and a perceived loss of natural and undeveloped characteristics to recreationists if roads, structures, or any other construction activities associated with geothermal development were to occur adjacent to the WSAs. Other potential impacts would include aural or visual intrusions and degradation of scenic values the same as those discussed in **Section 4.23**, Visual Resource Management and Night Sky. Accessibility issues could exist during any of the stages of geothermal development that would require new road construction or transportation of heavy machinery that could in turn create traffic or degrade road conditions.

ACECs

The planning area includes eight ACECs with a range of resources and values that each area was originally designated to help conserve and protect (see **Section 3.17.2**, Areas of Critical Environmental Concern, for a full description of each ACEC and its values). Many of the ACECs contain protections for the surface resources, such as NSO or TL stipulations. However, nearly all of the lands surrounding and within the ACECs have BLM-administered federal mineral estate that could be leased and subsequently developed, resulting in possible direct and indirect affects to the ACEC resources. Direct and indirect effects could occur on those resource values that contribute to the ACECs designation, including water resources, visual setting, recreation, special status species, wildlife and fish habitat, cultural resources, vegetation, and geologic features, and would be of the same nature and type described under these resource sections: Water (**Section 4.24**), Visual Resource Management (**Section 4.23**), Recreation (**Section 4.18**), Special Status Species (**Section 4.9**), Fish and Wildlife Habitat (**Section 4.8**), Cultural Resources (**Section 4.6**), Vegetation (**Section 4.22**), and Geology and Seismicity (**Section 4.10**).

Rio Grande Natural Area

Even though the designated area is excluded from leasing, any development adjacent to its boundaries could impact the natural, historic, cultural, scientific, scenic, wildlife, and recreational values for which the area was designated. Indirect impacts include a decrease in opportunities for solitude and a perceived loss of natural and undeveloped characteristics to recreationists if roads, structures, or any other construction activities associated with geothermal development were to occur adjacent to the WSAs. Other potential impacts would include aural or visual intrusions and degradation of scenic values the same as those discussed in **Section 4.23**, Visual Resource Management and Night Sky. Accessibility issues could exist during any of the stages of geothermal development that would require new road construction or transportation of heavy machinery that could in turn create traffic or degrade road conditions.

National Park System Units

The Great Sand Dunes National Park and Preserve is the only National Park Service unit located within the planning area and is managed under the US National Park Service. It contains vital recreational, cultural, scenic and wilderness values, as well as ecological and hydrologic values and resources. As the Great Sand Dunes National Park and Preserve is managed by the National Park Service and is closed to geothermal leasing, BLM has no authority to make leasing or development decisions within the Park's boundary. Therefore, there will be no direct effects on the Park or its resources.

However, there is a small amount of BLM land adjacent to the park (2.5 miles of BLM surface along the southeast portion of the park) containing subsurface mineral estate that could be leased and subsequently developed under the authority of BLM, resulting in possible indirect effects on the Great Sand Dunes

National Park and Preserve. Indirect effects could occur on those resource values that contribute to the Park's designation, such as water resources, visual setting, atmospheric values, and recreation, and would be of the same nature and type described under other resource sections including Water (**Section 4.24**), Visual Resource Management and Night Sky (**Section 4.23**), Air Quality (**Section 4.4**), and Recreation (**Section 4.18**). As noted above, adjacent public lands that may be nominated for leasing or proposed for development would require special analysis prior to any decision being made.

National Wildlife Refuge System Units

The planning area includes the Alamosa National Wildlife Refuge (NWR), the Monte Vista National Wildlife Refuge, and the Baca National Wildlife Refuge, which are all managed by the USFWS. The Refuges consist of a diversity of habitats which provide sanctuary to a variety of plant and animal species, including several species of birds. As the refuges are managed by the USFWS and are closed to geothermal leasing, BLM has no authority to make leasing or development decisions within the refuges' boundaries. Therefore, there will be no direct effects on the Refuges or their resources.

However, there is a small amount of BLM-administered federal mineral estate adjacent to the refuges that could be leased and subsequently developed under the authority of BLM, resulting in possible indirect effects toeffects on the refuges. Indirect effects could occur on those resource values that contribute to the refuges' designation, such as water resources, visual setting, atmospheric values, recreation, special status species, and wildlife and fish habitat, and would be of the same nature and type described under these resource sections: Water (**Section 4.24**), Visual Resource Management and Night Sky (**Section 4.23**), Air Quality (**Section 4.4**), Recreation (**Section 4.18**), Special Status Species (**Section 4.9**), and Fish and Wildlife Habitat (**Section 4.8**). As noted above, adjacent public lands that may be nominated for leasing or proposed for development would require special analysis prior to any decision being made.

4.21.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Wilderness Study Areas

As all WSAs are closed to geothermal leasing which would result in no direct impacts on the resources values within the WSAs. Much of the lands surrounding WSAs in this alternative are open with standard stipulations or TLs, which could result in development being proposed adjacent to the WSAs. If development were to occur on adjacent lands, there would likely be indirect impacts of the type described above, including compromised opportunities for solitude, and increased visual, aural or atmospheric intrusions on the landscape. Additionally, as part of this alternative, no comprehensive list of VRM, ecological, or transportation planning protection stipulations, BMPs, or

procedures would be applied to any issued leases; such measures would be determined on a case-by-case basis. The leasing approvals and stipulations would continue to be varied, as would mitigation and reclamation levels.

Areas of Critical Environmental Concern

All ACECs are open to geothermal leasing, but some have NSO and TL stipulations that constrain development on the surface estate. Additionally, all of the surrounding BLM-administered lands are open with standard stipulations or TLs, which could result in development being proposed within and adjacent to the ACECs. If development were to occur on adjacent lands, there would likely be direct and indirect impacts of the type described above, including compromised opportunities for recreation, wildlife viewing, and increased visual, aural or atmospheric intrusions on the landscape. Additionally, as part of this alternative, no comprehensive list of VRM, ecological, or transportation planning protection stipulations, BMPs, or procedures would be applied to any issued leases; such measures would be determined on a case-by-case basis. The leasing approvals and stipulations would continue to be varied, as would mitigation and reclamation levels.

National Park Service Units

Under this alternative, there would be no direct impacts on the lands or resources within the Great Sand Dunes National Park and Preserve. Indirect impacts would likely be of the type, intensity and duration described in the individual resource sections referenced in the Common Impacts section. As noted previously, any proposal for leasing or development on lands adjacent to the Great Sand Dunes National Park and Preserve would require special analysis and consultation with the National Park Service.

National Wildlife Refuge System Units

Under this alternative, there would be no direct impacts on the lands or resources within the NWRs. Indirect impacts would likely be of the type, intensity and duration described in the individual resource sections referenced in the Common Impacts section. As noted previously, any proposal for leasing or development on lands adjacent to the NWRs would require special analysis and consultation with the USFWS.

Alternative B (Proposed action)

Wilderness Study Areas

As all WSAs are closed to geothermal leasing which would result in no direct impacts on the resources values within the WSAs. Much of the lands surrounding WSAs in this alternative would have NSO, CSU, and TL stipulations. If development was proposed on lands adjacent to the WSAs, there would likely be impacts of the type, intensity, and duration described in the individual resource sections referenced in the Common Impacts section, including compromised opportunities for solitude, and increased visual, aural, or

atmospheric intrusions on the landscape. However, this alternative includes a comprehensive list of VRM, ecological, and transportation planning protection stipulations, BMPs, and procedures would be applied to any issued leases and subsequent development permits. Although this alternative has less area open to leasing than Alternative A, it allows BLM a great deal of flexibility with siting development and mitigation measures to reduce the intensity of the indirect impacts on WSAs.

Areas of Critical Environmental Concern

Under this alternative, the Blanca ACEC and SRMA is closed to leasing; therefore, there would be no direct effects on the resources within the ACEC. The remainder of the ACECs would have all of the geothermal program procedures and stipulations, and BMPs would be applied to leases and development permits. Much of the lands surrounding the ACECs would have NSO, CSU, and TL stipulations. If development was proposed on lands within or adjacent to the remaining ACECS, it would likely be of the type, intensity, and duration described in the individual resource sections referenced in the Common Impacts section, including compromised opportunities for recreation and wildlife viewing, and increased visual, aural, or atmospheric intrusions on the landscape. However, this alternative includes a comprehensive list of VRM, ecological, and transportation planning protection stipulations, BMPs, and procedures would be applied to any issued leases and subsequent development permits. Although this alternative has less area open to leasing than Alternative A, it allows BLM a great deal of flexibility with siting development and mitigation measures to reduce the intensity of the indirect impacts on WSAs.

National Park Service Units

Impacts would be the same as Alternative A. However, under this alternative, there is a comprehensive list of geothermal procedures, stipulations, and BMPs. In addition, lands adjacent to the Great Sand Dunes National Park and Preserve would include some parcels closed to leasing, and the remaining area would be covered with NSO, CSU and TL stipulations adding further protections to the Great Sand Dunes National Park and Preserve resource values.

National Wildlife Refuge System Units

Impacts would be the same as Alternative A. However, under this alternative, there is a comprehensive list of geothermal procedures, stipulations, and BMPs, and lands adjacent to the NWRs would include NSO, CSU and TL stipulations adding further protections to the NWRs' resource values.

Alternative C

Wilderness Study Areas

Impacts would be the same as described for Alternative B. Many of the lands adjacent to the WSAs also contain NSO, CSU, and TL stipulations that would

further protect the resource values within WSAs thus further reducing the indirect impacts to minor or negligible.

Areas of Critical Environmental Concern
As all ACECs are closed to geothermal leasing, there would be no direct impacts on the resources values within the ACECs. Much of the lands surrounding ACECs in this alternative would have NSO, CSU, and TL stipulations. If development was proposed on lands adjacent to the ACECs, it would likely be of the type, intensity and duration described in the individual resource sections referenced in the Common Impacts section, including compromised opportunities for recreation and wildlife viewing, and increased visual, aural or atmospheric intrusions on the landscape. However, this alternative includes a comprehensive list of geothermal procedures, stipulations and BMPs that would be applied to any issued leases and subsequent development permits, thereby further reducing the indirect impacts to minor or negligible.

National Park Service Units
Impacts would be the same as Alternative B. However, under this alternative, there would be more lands closed to leasing adjacent to the Great Sand Dunes National Park and Preserve, and the remaining areas covered with NSO, CSU, and TL stipulations thus adding further protections to the Great Sand Dunes National Park and Preserve resource values.

National Wildlife Refuge System Units
Impacts would be the same as Alternative B. However, under this alternative, there are more lands closed to leasing. There is also a comprehensive list of geothermal procedures, stipulations, and BMPs. Lands adjacent to the NWRs would include NSO, CSU, and TL stipulations, adding further protections to NWR resource values.

4.22 VEGETATION

4.22.1 Scoping Comments on the Resource

No scoping comments were received that specifically addressed impacts on vegetation.

4.22.2 How Resource Impacts were Evaluated

Methodology
Leasing geothermal resources would not affect vegetation or important habitats and communities. These resources would be affected only by development of specific geothermal development projects that occurred subsequent to the leasing action. Potential impacts of geothermal development were evaluated based on the typical disturbance of geothermal projects for the various stages of development and then assessed based on projected intensity as described in the RFDS. The types of vegetation and important habitats and communities that

could be affected by geothermal development depend on the specific location of the proposed project which is unknown at this time. Additionally, geographic information system (GIS) data-mapping was used to determine which habitats had more or less acreage under each of the allocations (e.g., closed, open with NSO, etc.) to roughly estimate which vegetation communities may experience the highest impacts. Only the vegetative communities that occur within the SLVFO planning area were considered for this analysis.

Indicators/Significance Criteria

Potential impacts on vegetation could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for its ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes, or regulations;
- Establish or increase noxious weed populations; or
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species.

Assumptions

This analysis assumes the following:

- In general, impacts on vegetation would be more likely to occur with increasing acres open to geothermal leasing. Conversely, the more acres that are closed to geothermal leasing, the less likely that vegetation would be impacted.
- NSO stipulations would prevent direct disturbance to vegetation by restricting surface-disturbing activities where they are applied.
- CSU stipulations could be used to avoid impacts on sensitive vegetation in certain areas.
- The degree of impact attributed to any one disturbance or series of disturbances would be influenced by several factors, including location in the watershed; the type, time, and degree of disturbance; existing vegetation; precipitation; and mitigating actions applied to the disturbance.
- Weed and pest control would be carried out in coordination with the appropriate county weed and pest control district and owners of adjacent property.
- Activities that would disturb soils could cause erosion, loss of topsoil, and soil compaction, which could affect the ability of vegetation to regenerate. Further, surface disturbing activities could

increase dust, which could cover existing vegetation and impair plant photosynthesis and respiration. Resulting impacts could include lowered plant vigor and growth rate, and increased susceptibility to disease.

- Ecological health and ecosystem functioning depend on a number of factors including vegetative cover, species diversity, nutrient cycling and availability, water infiltration and availability, and percent cover of weeds.
- Climatic fluctuation would continue to influence the health and productivity of plant communities on an annual basis.
- BLM would comply with the Colorado Statewide Strategic Plan for Control and Eradication of Noxious and Invasive Weeds.

4.22.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Vegetation Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here. Additional information on the specific vegetation communities occurring within the planning area is also discussed.

Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on vegetation and important habitats from geothermal resource development. As such, this section will qualitatively address the impacts on vegetation and important habitats and communities.

Regardless of the location of geothermal development projects, the nature of the impacts from exploration and development to vegetation and important habitats and communities would be similar in all vegetation communities. Vegetation would be affected by direct destruction and removal, fugitive dust, exposure to contaminants, alterations to soils and water dynamics, and the introduction of invasive species. The extent of the impacts is typically associated with the size of the area that is disturbed and the types of vegetation habitats and communities present. The ability of an area to recover from disturbance also affects the extent of the damage. In general, effects from geothermal development on vegetative communities that are common within the SLVFO planning area, such as semi-desert shrubland, would be localized. However, geothermal development on the scale anticipated would be unlikely to change the composition or health of most vegetative communities.

Habitat Disturbance

Site clearing, well drilling, constructing access roads and geothermal facilities, and maintenance and operational activities would disturb habitat, which would cause localized mortality and injury, increase the risk of invasive species introduction and spread, compact and disturb soils, and alter water dynamics,

seed dispersion, and wildlife use patterns, which can further affect vegetation communities.

Direct Removal and Injury

Vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss or compaction of soil, loss of seed bank in soil, deposition of dust, and destruction of biological soil crusts. Maintenance around project components such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would potentially result in a net loss of important habitats and communities throughout the planning area.

Invasive Vegetation

Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and nonnative species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species. Other impacts from the spread of invasive species may include:

- A decrease in biological diversity of ecosystems;
- A reduction in water quality and availability for wildlife species;
- A decrease in the quality of habitats for wildlife;
- Alterations in habitats needed by threatened and endangered species; and
- Health hazards as some species are poisonous to humans, wildlife, and livestock.

Fire

Equipment operation, increased vehicular and human traffic, using drilling muds, and extracting geothermal fluids can increase the risk of unintended fires. Vehicles, electrical lines, and smoking can all result in accidental fires. Fires can alter vegetation and can aid in the establishment of invasive species.

Erosion

Containment basins, site clearing, grading, constructing access roads, site runoff, and vehicle and human foot traffic cause erosion. The effects of erosion include topsoil removal, seed bank loss, native vegetation loss, invasive species establishment, stream sedimentation, and flooding (which can affect riparian vegetation and riparian habitats).

Exposure to Contaminants

Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would

control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on non-target vegetation.

Riparian and Wetland Habitat

Riparian and wetland habitats may be affected by activities associated with all phases of geothermal projects. Riparian and wetland habitat may be cleared to provide access to geothermal sites.. Habitat removal may result in increased stream temperatures, reduced wildlife presence, increased erosion, and sedimentation. Although unlikely due to Colorado water law, water may be extracted from groundwater sources to support geothermal exploration, production, and operation Water extraction may result in lowered groundwater tables, which can affect stream flows and duration and can dewater wetland and marsh habitat. Changes in riparian and wetland hydrology can affect vegetation species assemblages and may eventually alter the wildlife species composition. Accidental spill of fuel, solvents, or geothermal working fluids could degrade water quality and affect riparian vegetation.

Riparian and wetland habitat can be adversely affected by invasive species such as salt cedar and Russian olive, which can be introduced during disturbance. Salt cedar is highly tolerant of high salinity soils, low water tables, wildfires, livestock browsing, and conventional weed controls. Native plant species are damaged by unusually large guilds of insects and plant pathogens, but salt cedar has few natural insect or plant pathogens in the planning area. Salt cedar and other invasive riparian plants can lower water tables, and they often establish soon after disturbance.

Riparian and wetland habitats are relatively scarce throughout the west and are very important thus should be avoided. The suite of stipulations and BMPs noted in the alternatives and Appendix C, such as closing the McIntire-Simpson wetland complex to geothermal leasing and applying No Surface Occupancy stipulation to water bodies, riparian areas, wetlands, floodplains, and/or fens, as well as identifying important, sensitive, or unique habitat and biota in the project vicinity and designing the project to avoid impacts on these resources, are intended to limit the impacts of possible development actions in riparian and wetland areas.

Impacts by Development Phase

Exploration would disturb small areas of vegetation and habitat during the construction of access roads and drill pads. Habitat would be removed, and vegetation would likely be destroyed. Surveying and drilling activities could result in impacts from weed infestation. If the area is not used for development and production, it would be reclaimed within three years. Native species would be used to revegetate the area.

Large areas of vegetation would be cleared to accommodate production wells, injection wells and sump pits, roadways, and other critical infrastructure. This

would destroy vegetation, alter soils, create erosion potential, and increase incidence of invasive weed infestation.

Drilling operations could increase the spread of invasive species that can outcompete and alter the plant species assemblages in surrounding habitat through direct and indirect effects. The dispersal of invasive plant seeds by vehicles may affect native plant communities. In such cases, plant communities dominated by native vegetation may be replaced with plant communities dominated by invasive species.

Drilling operations would require increased vehicle traffic, which would require staging and parking areas. Increased traffic would increase soil compaction, create more fugitive dust and pollutants indirectly affecting vegetation, and would increase the potential for fuel and other contaminant spills that may directly affect vegetation.

Although unlikely due to Colorado water law, water used for drilling could affect wetland and riparian areas; drilling requires large amounts of water, and local drawdown of water tables can have a direct effect on wetlands and groundwater flows, which can directly affect riparian vegetation.

The greatest amount of disturbance, vegetation clearing, and injury would occur during the initial construction within the utilization phase. Areas of vegetation would be cleared for well pads, power plants, pipelines, roadways, and other critical infrastructure. This would destroy vegetation, alter soils, create erosion potential, and increase incidence of invasive weed infestation. Drilling operations in this phase would have the same impacts as noted previously.

Wetland and riparian areas would be affected by roadways and bridges that may be built to access drilling operation areas. Runoff from construction could increase turbidity in streams, and potential spills of fuels and other contaminants from vehicles and on-site construction activities could affect water quality.

Vegetation and important habitats would be affected by site maintenance activities that involve mowing or cutting vegetation, exposure to contaminants and herbicides, decreased water quality due to surface runoff, vehicle traffic that produces fugitive dust, and direct injury from human and vehicle traffic. Wetlands and aquatic resources could be affected by human activities associated with increased access to public lands in the immediate vicinity of a geothermal project site. Potential impacts from increased access may include disturbance of vegetation in wetland and aquatic habitats and the introduction of invasive vegetation. Access roads and maintenance activities would increase vehicle and human traffic, which may result in direct injury to vegetation, added soil compaction, and increased incidence of invasive plants.

Site maintenance activities at geothermal project sites would likely include the licensed application of herbicides to control vegetation along access roads and

around buildings and power plant structures for indirect-use projects. The accidental spill of herbicides may affect native vegetation in surrounding areas via plant morbidity or mortality.

In addition, geothermal utilization would increase the likelihood of fire in the semi-desert shrubland community since vehicles and electrical lines can result in accidental fire. Since this vegetative community does not respond well to fire and takes a long time to return to pre-fire conditions, a fire event would have long-term consequences on the vegetation community.

Reclamation and abandonment could have similar impacts as those described for construction as buildings and structures are removed, but on a smaller scale and shorter time frame as ultimately, this phase would result in previously affected areas being restored to pre-construction conditions. Fire, erosion, and invasive vegetation would be the predominant potential impacts during the reclamation and abandonment phase.

4.22.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

General Vegetation

Alternative A would allow geothermal leasing on 106,500 acres and close 17,100 acres. The greatest impacts from geothermal leasing are likely in the semi-desert shrubland, grassland, piñon-juniper, and ponderosa pine vegetation communities, since these communities have the greatest acreage open to leasing. NSOs would be applied on 26,800 acres, which would protect vegetation in these areas. Standard stipulations would also be applied, which would provide minimum basic protections to vegetation.

Riparian and Wetland Areas

Under Alternative A, 5,100 acres of riparian and wetland communities would be open, subject to standard stipulations, and 700 acres would be closed to geothermal leasing. NSO stipulations would be applied on 1,300 acres of riparian and wetland communities. NSO for the Flat Top Mesa wetlands, Blanca area, and Rio Grande River Corridor would protect these riparian areas and wetlands. In addition, the Rio Grande NA would be closed to geothermal leasing, which would protect the longest stretch of riparian habitat within the planning area.

Alternative B (Proposed action)

General Vegetation

Under Alternative B, more acreage would be closed to geothermal leasing and open with NSO stipulation than under Alternative A, which would lessen the direct and indirect impacts (as described in the Common Impacts section above) on the vegetation resources. Of the remaining areas open with TLs, CSU and

standard lease terms and conditions, the grassland and semi-desert shrubland vegetation communities have the largest acreage areas; therefore they are more likely to experience a higher amount of impacts than other vegetation communities, such as removal of vegetation. Most of the anticipated impacts from geothermal development would be mitigated with application of the BMPs included as part of this alternative, such as a habitat restoration plan that would identify revegetation, soil stabilization, and erosion reduction measures, require that restoration occur as soon as possible after completion of activities, and speed up the recovery to natural habitats.

Riparian and Wetland Areas

Alternative B would protect more riparian areas and wetlands compared with Alternative A. Under Alternative B, the majority of wetland and riparian habitat (17,600 acres) would be closed to geothermal leasing (including over the Russell Lake and Hot Creek SWAs), and 3,400 acres would be have the NSO stipulation applied(including Rio Grande NA, Blanca ACEC and SRMA, and McIntire-Simpson wetland complex), thereby protecting these areas from direct and indirect impacts of the type noted above in the Common Impacts section. Additionally, as the BLM could apply a CSU stipulation within 500 feet of riparian areas and wetlands, more protection for this sensitive and critical resource would be available. Application of the BMPs noted in **Appendix C** (and discussed above in General Vegetation) would further reduce impacts on riparian and wetland areas.

Alternative C

General Vegetation

Impacts under this alternative would be the same as Alternative B; however, as more acreage is closed to leasing or protected with NSO stipulations, more area in vegetation communities would be protected from direct and indirect impacts of the type and nature noted above. Similar to Alternative B, the areas most likely to experience impacts are in the semi-desert shrubland and grassland vegetation communities, since these communities have the greatest acreage open to leasing. As in Alternative B, application of BMPs would further reduce impacts on vegetation communities.

Riparian and Wetland Areas

Under this alternative, the type and nature of impacts on riparian and wetland areas would be the same as Alternative B, however the extent, intensity and degree of those impacts would be less than those under any other alternative. Alternative C would protect more riparian areas and wetlands from direct and indirect impacts as more area would be closed to leasing (17,600 acres) and all water bodies and riparian areas (including split estate lands adjacent to the McIntire-Simpson wetlands and the Blanca wetlands) would be protected with an NSO stipulation. As in Alternative B, application of BMPs would further reduce impacts on riparian and wetland areas.

4.23 VISUAL RESOURCE MANAGEMENT AND NIGHT SKY

4.23.1 Scoping Comments on the Resource

- Commenters stressed the importance of protecting key visual resources, specifically lands currently maintained under land trusts and historic trails.
- How would potential development of the leases impact visual resources? Are there ways to mitigate visual impacts?

4.23.2 How Resource Impacts were Evaluated

Methodology

The impact analysis for visual resources was based on review of existing baseline data for the planning area as described in **Section 3.19**, Visual Resource Management and Night Sky, and information gathered from the public during the planning process. To the extent practical, spatial data were used to compare environmental conditions with the alternatives. Various actions that might create changes to the basic landscape elements (such as form, line, color, and texture) were considered in identifying potential impacts.

Indicators/Significance Criteria

The potential risk of impacts on visual resources is assessed for five significance criteria. Potential impacts on visual resources could occur if reasonably foreseeable future actions were to:

- Have adverse effects on a scenic vista;
- Damage a scenic resource within a scenic roadway;
- Degrade the existing visual character or quality of the site and its surroundings;
- Create a new source of light or glare; or
- Be incompatible with the VRM system or other applicable visual resource objectives.

Receptors sensitive to disturbances of visual resources are varied and depend on the landscape's visual resources; the project's location; the view distance, angle, and duration; the location of travel routes; public areas of interest; the season; the topography; recreation activities; and the number of viewers. Because of this, it is important to note that site-specific impact assessment is needed to thoroughly assess impacts on visual resources from a particular project. Without precise information about a specific project, it is not possible to detail the visual impacts. However, by using the RFDS as a general description of expected geothermal resource development activities, a generalized assessment of the possible impacts on visual resources can be made by describing the range of expected visual changes.

Assumptions

This analysis assumes the following:

- Other visual impact mitigation measures would likely be required at the project-specific phase of analysis and permitting;
- Scenic resources will remain in demand on public lands;
- Any new surface-disturbing geothermal activities would be subject to further NEPA analysis which would include an analysis to determine consistency with applicable visual resource objectives;

4.23.3 Common Impacts Associated with Geothermal Development

Geothermal development would not result in any changes inconsistent with management objectives. Power plants and infrastructure would be sited in accordance with VRM Class objectives. Specific visual impacts in regard to project location would be evaluated on a site-specific basis and would most likely have to comply with defined mitigation measures to reduce visual impacts as much as possible.

As a result of typical exploration phase activities, the following alternations to visual resources would likely occur:

- Vegetation damage creating changes in texture and color;
- Scarring of the terrain from vehicles creating changes in texture, form, and color;
- Truck-mounted drilling rig and support equipment detracting from the natural environment creating changes in line, form, texture, and color; and,
- Lighting during drilling and for safety intruding on the night sky.

These disturbances would be short term, lasting for the duration of the individual activities with reclamation to BLM guidelines likely occurring immediately following completion of the activities. Compared to other phases of the geothermal development process, exploration activities involve the least amount of permanent, long-term disturbance to the visual environment.

All geothermal development would be sited with consideration to VRM classification. Most of the lands in the study area are classified as VRM Class III or Class IV. In VRM Class III areas, moderate changes to the visual landscape are allowed, and in VRM Class IV areas, major changes are allowed. There are some portions that are classified as VRM Class II, where only minor changes would be allowed. Any changes to VRM Class II lands would be evident and would create a landscape that does not appear intact, mostly from the use of truck mounted drilling rigs as these would be a noticeable deviation and would attract the attention of casual observers. Finally, WSAs are managed as VRM Class I, the objective of which is to preserve the existing character of the landscape.

Because geothermal development could not be constructed in a manner to meet the objectives of VRM Class I, these areas would not experience direct impacts. However the viewshed from these areas could be impacted if geothermal development is visible from VRM Class I lands.

Drilling operations phase activities would likely result in all of the same impacts as the exploration phase with the addition of:

- Visibility of activities involving construction work creating man-made intrusions on a natural landscape;
- Alternating the natural landform or contours;
- Clearing of vegetation for roads creating changes in texture, color and form;
- Building new roads and creating new linear features on the landscape; and
- Fugitive dust from construction activities and newly exposed soils diminishing views and atmospheric clarity.

Depending on the development activity's location, this phase could alter a scenic vista or scenic roadway, fragment the open space of the landscape, or reduce the aesthetics of recreation or cultural areas. Impacts from this phase would likely dominate the landscape in VRM Class II areas and the view of the casual observer for the duration of activities (or short term). BLM reclamation standards would return the landscape to pre-construction condition at the conclusion of drilling operations, thereby reducing long term impacts on the visual setting. However, some impacts, such as new roads for access, would remain for the life of the project (long-term).

Utilization phase activities would likely result in many of the same impacts noted for previous development phases with the addition of:

- Clearing of vegetation for additional production wells creating changes in texture, color, and form;
- Building new structures and roads creating new form and linear features on the landscape;
- Release of steam plumes diminishing views and atmospheric clarity; and
- Conversion of undeveloped land to land with human-made structures.

These scale impacts would be greater during the utilization phase than in previous phases. They would last the duration of actual construction activities (short term) but many, such as intrusion of wells and a power plant on the viewshed, would be long term, lasting the life of the project (10 to 30 years).

Reclamation and abandonment activities would result in the following types of impacts:

- Visibility of activities involving demolition work and removal of surface structures and equipment creating intrusions on the viewshed and landscape;
- Regrading disturbed areas to pre-disturbance contours creating new lines, forms, and textures;
- Fugitive dust from demolition activities and newly exposed soils diminishing views and atmospheric clarity; and
- Removing weeds and replanting native vegetation creating changes in forms, texture, and color.

Considering these impacts would occur to return the area to pre-construction conditions, all of them would be beneficial from a VRM perspective. Depending on the location, they could enhance a scenic vista, the landscape's open space, or the aesthetics of recreation or cultural areas to pre-project conditions. While the duration of actual reclamation/abandonment activities would create short term impacts, this phase is expected to result in a more long-term, natural appearance to the landscape.

4.23.4 Potential Impacts Associated with Preferred Action and Alternatives

There are currently several ongoing management plans that will protect or conserve visual resources. These include the Rio Grande Scenic Railroad, Old Spanish National Historic Trail Comprehensive Management Plan, and the Sangre de Cristo National Heritage Area. In addition, there are several areas with special designations, including the Los Caminos Antiguos National Scenic and Historic Byway, the Rio Grande Corridor, Penitente Canyon, Blanca Wetlands Habitat Management Area, Zapata Falls, and San Luis Hills WSA. All of these plans and special designations will protect visual resources directly or indirectly within sensitive or scenic areas to some extent, but they contain no specific guidelines for geothermal development, with the exception of the San Luis Hills WSA, which is closed to geothermal leasing.

The visual impacts from a binary cycle power plant that is dry cooled would mostly come from required infrastructure associated with the plant, as there would be no water vapor released.

Alternative A

Under Alternative A, visual resources would continue to be managed with current designations and alternatives based on the existing SLVFO RMP (BLM 1991) and other existing policies. The type and nature of impacts from geothermal development under this alternative would be the same as those described above in the Common Impacts section. Areas closed to geothermal leasing (the Rio Grande NA, all WSAs, etc.) would not experience any of the

direct impacts but may have indirect impacts occurring within the viewshed. Additionally, as this alternative does not have NSO or CSU stipulations for specific scenic areas, those areas would likely experience more direct and indirect impacts of the type described above. Scenic features such as the Old Spanish National Historic TrailOld Spanish Trail National Historic Trail and Pike's Stockade National Historic Landmark could potentially be affected by geothermal development if their visual characteristics are altered or if viewsheds from within these areas are affected. Alternative A would provide visual resources with the least defined protection of any alternative in regard to geothermal development.

Alternative B (Proposed action)

Impacts under this alternative would be of the same type and nature as those described in the Common Impacts section, but the amount and degree of impacts would be less than under Alternative A due to the implementation of BMPs and lease stipulations.

Alternative B would manage 63,700 acres of BLM surface and split estate as closed to geothermal leasing, which includes the Blanca ACEC and SRMA, the Rio Grande NA, the Old Spanish National Historic Trail, Pike's Stockade National Historic Landmark, 320 acres within the town of Del Norte, and the McIntire/Simpson wetland and homestead area, thereby protecting these areas from direct impacts. Additionally, there are more specific visual resource protections, such as NSO for VRM Class I, CSU for VRM Class II, National Scenic and Historic Trails, and residential areas, which would protect more areas from direct impacts. However, if development were proposed for areas adjacent to or within the viewshed of sensitive visual resource areas, there would likely be many of the types of indirect impacts noted previously, such as fugitive dust or alternation of the natural landform contours.

Under Alternative B, less acreage would be closed to geothermal development thereby allowing more flexibility in siting geothermal plants and infrastructure. Alternative B would assist in managing visual resources and meeting VRM Class objectives by providing clear direction for potential geothermal development. This alternative would also have more defined protection for visual resources than Alternative A. It is expected that site design and other stipulations and BMPs included as part of this Alternative would help achieve VRM Class objectives by effectively avoiding or minimizing impacts on visual resources.

Alternative C

Impacts under this alternative would be of the same nature and type as described in the Common Impacts section. The amount and degree of impacts would be less than under Alternative A and slightly less than under Alternative B since more areas would be closed and contain NSO stipulations directly and indirectly protecting visual resources. However, due to the high amount of closed and NSO areas, the BLM would be more limited in their siting options

for potential geothermal plants and infrastructure which could result in more indirect impacts by siting projects within viewsheds adjacent to these closed or NSO areas. Similar to Alternative B, this alternative would assist in managing visual resources and meeting VRM Class objectives by providing clear direction for potential geothermal development, and it is expected that these measures would effectively avoid or minimize impacts on visual resources.

4.24 WATER RESOURCES

4.24.1 Scoping Comments on the Resource

The following comments related to water resources were received during the scoping period:

- Commenters requested that their water wells be protected from degradation or from the lowering of the water table.
- Commenters requested that lands adjacent to the San Luis Creek not be developed to maintain the integrity of the San Luis Creek watershed and protect the riparian habitat.
- Commenters were concerned about the sensitivity of Valley View Hot Springs and how geothermal development could impact the temperature and quality of the hot springs.
- Commenters want the geothermal leasing areas to minimize groundwater contamination.
- Commenters suggested that all impacts on water resources be considered, including how surface and sub-surface water rights could change the socioeconomic and cultural values of the area.

4.24.2 How Resource Impacts were Evaluated

Methodology

Allocating BLM-administered lands for geothermal leasing and leasing the land does not involve ground-disturbing activities or any type of construction, so there would be no direct impact on water resources. Impacts would result from activities pursued after leasing. Water quality and quantity is of interest to other resources and uses as well. Biological resources, cultural resources, and recreation may be impacted by changes to water quantity and quality. In this section, impacts on water resources are evaluated only from the perspective of changes to water availability and quality. General impacts on water resources as a result of geothermal development were discussed in the Geothermal PEIS and are incorporated by reference and summarized below. Additionally, baseline information from **Chapter 3**, Affected Environment, for water resources within the SLVFO planning area was reviewed, and then overlaid with the actions and allocation decisions from the alternatives to determine the range of impacts that could result from the BLM decisions within the SLVFO.

Indicators/Significance Criteria

Potential impacts on water resources could occur if anticipated future geothermal development activities were to:

- Alter surface water drainage patterns, which could result in increases in suspended sediment and turbidity in surface water drainages;
- Release pollutants other than sediment to the environment; and
- Where shallow aquifers are hydraulically connected to the geothermal producing zone:
- Lower groundwater levels due to extraction wells that could affect soils (reduced saturated zones and increased fugitive dust); wetlands and riparian areas (reduced vegetation and source water); springs (reduced flows); changes in wildlife habitat; changes in range/grazing (reduced vegetation and/or water availability); and water rights (depressed groundwater levels in wells; reduced flow in surface water). Reductions in groundwater levels could decrease the volumes of groundwater stored in the various aquifers and reduce yield;
- Mound groundwater levels due to injection wells that could affect soil (increased saturated zones); wetlands and riparian areas (increased water available to wetland areas); springs (increased flows); and groundwater flow patterns;
- Change flow from springs and in surface water drainages;
- Change water temperature, flow rate, and quality at hot springs;
- Change groundwater and/or surface water temperatures;
- Change groundwater and/or surface water quality; and
- Change source water and vegetation at wetland areas

Assumptions

This analysis assumes the following:

- Water rights in the SLVFO are already fully allocated. Any proposed project would need to purchase and transfer water rights from existing water right holders.
- The Colorado Department of Natural Resources maintains authority over water resources in the SLVFO, including the appropriation of water rights.
- Wells would be drilled and cased in accordance with State of Colorado regulations.

- Wells would be maintained, plugged, and capped in accordance with BLM guidelines and State of Colorado regulations.
- Any on-the-ground development would comply with the BLM Gold Book, which provides surface operating standards and guidelines for oil and gas operations, and which are also used for geothermal operations.

The Colorado BLM will comply with the recently signed BLM-Colorado Department of Natural Resources MOU concerning Geothermal Leasing, Permitting, and Administration in Colorado.

4.24.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Water Resources Associated with Geothermal Development section of the Geothermal PEIS is incorporated by reference and summarized here. However, additional information specific for this EA includes a description of the RFDS and the associated estimated water consumption for the power plant, and the acreages of disturbed soils that could contribute to the transport of eroded soils (sedimentation) into surface waters.

Many of the concerns addressed during scoping that relate to impacts on water resources are beyond the scope of this analysis for the RMP Amendment/EA and would be analyzed at the time of a specific project proposal. Any subsequent, site-specific projects that might occur in the SLVFO would be required to comply with the BLM-Colorado Department of Natural Resources MOU (previously discussed in **Section 1.4.5**), applicable Colorado laws governing water resources, the BLM's Gold Book, which outlines BMPs for avoiding impacts related to soil erosion and surface waters, and all stipulations, BMPs, and COAs that may be adopted as part of the Decision Record for this action. The Colorado Department of Natural Resources reserves the ultimate authority to manage, allocate, and protect water resources, regardless of land ownership.

The RFDS estimates up to one power plant would be constructed by 2040. The maximum extent of disturbance would be approximately 350 acres. This development could increase soil erosion, sedimentation, and contamination of surface waters.

The power plant would be either air-cooled, wet-cooled, or would utilize hybrid cooling. Air-cooled power plants consume no process water, utilizing only approximately 50 acre-feet per year of domestic water for bathrooms, maintenance and landscaping. A wet-cooled power plant would consume the 50 acre-feet per year of domestic water, plus up to 300 gallons per megawatt-hour (MWh) of electricity produced (EPA 2008). For the purpose of this analysis it is assumed that the power plant would be up to 50 MW in capacity, and over the course of a year, assuming the plant is running 100 percent of the time, it would produce 438,000 MWh. At 300 gallons per MWh, this translates into 131.5

million gallons of water per year, or approximately 403 acre-feet per year. With the additional 50 acre-feet per year for domestic uses, the total estimated maximum consumption of such power plants would represent an annual withdrawal from SLVFO waters of approximately 453 acre-feet.

This RFDS and the level of water consumption do not vary by alternative; however, the range of locations available for any future development would vary depending on which alternative is implemented.

Early exploration work, such as surveys, would have little to no impact on surface or groundwater as they do not include ground-disturbing activities. Exploration drilling would involve some ground-disturbing activities such as road and drilling pad construction that could lead to a moderate increase in soil erosion, with the result that more soil may be transported in surface runoff. However, in compliance with stormwater pollution prevention requirements of the Clean Water Act, BMPs (such as those required in the Gold Book) to reduce sediment erosion into surface water areas would be implemented thereby mitigating the impact to a minor level. The duration of these possible impacts would be short term, lasting only during the time period of actual construction activities; long term impacts would be negligible.

As geothermal fluids in the resource can be under high pressure, drilling operations can create pathways for these fluids into the groundwater at shallower depths or commingling between aquifers of differing quality. The impacts of these pathways can alter the natural circulation of the geothermal fluids and impact the usefulness of the resource. Subsurface pathways also can allow the natural contaminants in the geothermal fluids to impact the shallow groundwater quality if mixing were to occur. The degree of impact depends on aquifer characteristics and whether special conditions (e.g., sole source aquifers) are present. Proper drilling practices and closure and capping of the wells can reduce this potential. DWRCDWR monitors well construction in order to prevent contamination of aquifers.

As discussed in **Section 3.20**, any geothermal resource used in the San Luis Valley would inherently be part of the confined aquifer. The extent to which one part of the confined aquifer (containing waters hot enough for geothermal energy production) is hydraulically connected to another part of the confined aquifer (contained waters pumped for municipal, domestic or agricultural uses) would depend on the nature of the geology between the two portions and would vary by the location and depth of the two wells in question.

Generally, the more separated two aquifers are by both depth and layers of geology, the less connectivity is likely. Bottom-hole temperature data from nine oil wells within the San Luis Valley indicate that one would need to drill to depths of at least 5,000 feet to obtain temperatures high enough (greater than 250 degrees Fahrenheit) for commercial production of electricity. With existing technologies, most geothermal operators are looking for higher temperatures in

the 300 degree Fahrenheit range. These higher temperatures are not expected to occur in the San Luis Valley without drilling to 10,000 feet or deeper (Morgan 2010). Since the vast majority of wells for municipal and agricultural uses are drawing from depths of less than 2,000 feet deep, it is expected that any geothermal wells would be tapping into geothermal fluids that are at least 3,000 feet deeper and more likely 8,000 feet deeper. As shown in **Figure 3-7,** Hydrogeologic Units of the San Luis Valley, many layers of geologic material are documented to occur throughout this depth range and any observable connectivity is expected to be minimal to non-existent.

If not contained, surface release of geothermal fluids during well testing can cause temporary impacts on surface waters within the immediate area of the test wells. These impacts include thermal changes and changes in water quality depending on the differences in the geothermal fluid and the surface waters. Accidental spills of geothermal waters may occur due to well blowouts during drilling, leaking piping or well heads, or overflow from sump pits. BLM guidelines and Colorado state regulations for maintaining, and plugging and capping wells to prevent blowouts, and mandating proper well casing and drilling techniques would minimize the risk of impacting surface water and groundwater in the immediate area.

Groundwater extraction and injection wells are installed and pumped to cycle geothermal fluids within the geothermal reservoir to remove heat energy. To be effective, it is desirable to create an efficient circulation system where the injected (cool) fluid is resident in the formation long enough to heat up to the maximum temperature without significantly altering subsurface pressures. This requires a highly permeable geothermal aquifer that is preferably isolated from any shallow cool water or potable water aquifer above it.

Extracting geothermal fluids could result in drawdowns in connected shallower groundwater aquifers when injection programs are not a part of operation; however, injection programs are now standard practice at all new geothermal facilities since they are required to maintain the pressure and performance of the geothermal reservoir. While the likelihood of drawdown occurring is next to nil, the nature of theoretical impacts are discussed here nonetheless.

Flash technology plants that vent geothermal steam to the atmosphere and geothermal plants of any technology that use water cooling result in a net loss of water from the geothermal reservoir. Drawdown of geothermal reservoirs is not only undesirable because it depletes the geothermal resource and because it may cause drawdown of any hydraulically connected aquifers closer to the surface and may in turn affect springs and streams connected to those aquifers, but also because the loss of pressure in the reservoir reduces the power producing capability of the associated power plant. Where such water-consuming processes occur, power plant operators need to inject make-up water to replace the withdrawn water to maintain system pressure. This

maintenance of system pressure would eliminate any risk of drawdown of shallower aquifers.

Although unlikely, it is possible that a project proponent could obtain water rights and select a water consuming technology without injecting make-up water. This would mean the operator could expect potentially declining power plant performance over the expected lifetime of the plant (typically 30 years). Under these conditions, drawdown effects of shallower reservoirs could be observed if natural replenishment of the reservoir was slower than the rate of flow to the power plant.

The potential for these types of adverse impacts is reduced through extensive aquifer testing, which is the basis for designing the geothermal plant and for locating, designing, and operating the extraction and injection wells. Combined with the requirement to comply with state and federal regulations that protect water quality and with limitations imposed by water rights issued by the Sstate Eengineer, the impacts on water quality and the potential for depleting water resources is expected to be minimized. There is a minimal risk for low to moderate impacts on groundwater supplies from the use of groundwater for geothermal activities.

To guard against any unacceptable adverse impacts on existing water uses from this minimal risk of connectivity, the BLM would work with the state and CDWR to institute a water monitoring program on a project-specific basis. Such a monitoring plan would collect pre-project data on water levels, water quality, and water temperature. It is typical in such plans for water samples to then be collected on a quarterly basis during geothermal exploration activities for the first one to two years of power plant operations. A qualified hydrologist then analyzes the monitoring data and looks for any indications of the upper aquifers being affected by geothermal power production. Monitoring results would be made public and would inform decision makers as to any need to modify or halt geothermal operations. COAs incorporated in each facility's operating permit would specify how operations would be adjusted to avoid adverse impacts to geothermal hot springs.

During construction, ground-disturbing activities such as road and foundation pad construction and utility installation could lead to an increase in soil erosion, with the result that more soil might be transported in surface runoff. Construction activities may also increase the risk of fire which could also result in increased erosion. As noted in other phases above, BMPs would be implemented in compliance with the Clean Water Act to reduce impacts. The Clean Water Act would require any developers to prepare a Stormwater Pollution Prevention Plan. Developers would also need to acquire a Construction General Permit under the National Pollutant Discharge Elimination System.

During normal operations and when production wells are tested, geothermal plants produce wastewater from cooling tower blowdown. This is the spent water that is periodically discharged from the cooling system. Makeup water is used to replace or make up for the evaporative losses and blowdown in a wet-cooled system. The quantity of cooling tower blowdown depends on the size of the power plant, the quality of the makeup water (lower quality water requires more frequent cycling), the nature of the additives to prevent mineral scale, and the number of times the water is cycled. The source of cooling water could be either surface water or groundwater.

Different wells have different flow rates depending on the nature of the portion of the geothermal resource each drill hole intersects. Production of geothermal fluids at other geothermal projects generally vary from 1 to 6 million gallons per day per well. Assuming an average flow rate of 3 million gallons per day per well and a resource temperature of 300 degrees Fahrenheit, it would take approximately 16 wells all feeding into a single power plant to produce 50 MW of electrical generation capacity. A total of 48 million gallons of geothermal fluids are estimated to be needed to run through a 50 MW plant in any given day. Once a plant is operational, most geothermal fluids produced are reinjected back into the geothermal reservoir via reinjection wells. Binary power plants are nonconsumptive and use a closed loop system. However, fluids could be lost due to pipeline failures or surface discharge for monitoring and testing the geothermal reservoir.

In the unlikely event that cooling towers are used, the cooling water could be discharged either to the ground or to an evaporation pond. Discharging cooling tower blowdown or water from testing geothermal production wells could affect shallow groundwater quality if the discharged water percolated to a shallow aquifer. Discharging cooling tower blowdown water would be subject to BLM's Onshore Order 7. The EPA, which regulates disposals of produced waters, and would require a National Pollution Discharge Prevention Elimination System permit, issued by the Colorado Department of Environmental Quality Public Health and the Environment (CDPHE). , The CDPHE which would require testing to ensure that the water met the discharge requirements and did not degrade groundwater quality. The state and. It would likely require that the cooling water be discharged to a lined pond to prevent infiltration. Therefore, the potential for water quality impacts on surface water from operational discharges of a geothermal plant are expected to be minor or mitigatable.

The original coolant water and the replenishment water, if produced at all, contain salts that become concentrated in the cooling system over time, requiring that the coolant be periodically replaced. The cooling water may also contain metals or other constituents introduced from corroding pipes or from chemical additives used to inhibit corrosion or microbial growth in the system.

Low-toxicity additives are available that could be used in the cooling towers to lower the potential for impacts from this source.

Air-cooled systems use less cooling water and are more common in arid regions. Air-cooled systems would have fewer impacts associated with cooling water.

During binary plant operations, geothermal fluids are kept as part of a closed loop until they are reinjected into the geothermal resource. However, small amounts of these contaminants within the fluids can be accidentally released into the surface environment from venting steam to eliminate excessive pressure or through mechanical breakdowns like broken pipes. The temporary release of fluids from tests and accidents would have short-term minor impacts on any surface waters in the immediate area.

Hot springs are surface features that indicate the presence of geothermal features resources at depth. These springs can be part of sensitive ecosystems, recreation areas, or traditional cultural properties. The geothermal resources that would be developed are usually at greater depths (5,000 to 10,000 feet or more) than the shallow groundwater associated with the hot springs. However, withdrawing shallow groundwater or surface water for cooling water purposes could affect nearby springs. Any geothermal development in the vicinity of hot springs would require a water monitoring plan that would include baseline data from the springs on flow rates, quality and temperature. Water samples are then typically collected on a quarterly basis for the first year or two of operations and a qualified hydrologist would examine any indications of effects on the hot springs from geothermal power production. Monitoring results would be made public and would inform decision makers as to any need to modify or halt geothermal operations.

The reclamation and abandonment phase would involve plugging and capping production and injection wells. Improper abandonment could allow the wells to serve as pathways for geothermal fluids to migrate to other aquifers, affecting both the geothermal resource and other groundwater quality. Proper well closure and capping would reduce the risk of these impacts.

Any fill or discharge into wetlands or other Waters of the United States would require a permit from the Army Corps of Engineers under Section 404 of the Clean Water Act. The Army Corps of Engineers would identify mitigation for any impacts on Waters of the United States.

4.24.4 Potential Impacts Associated with Preferred Action and Alternatives

Alternative A

Under Alternative A, all of the types of impacts noted above could occur in areas that would be proposed for geothermal development; however, under

Colorado laws, the ultimate authority to manage and protect water resources rests with the Colorado Department of Natural Resources.

Under Alternative A, the BLM would not apply a comprehensive list of water protecting stipulations, BMPs, or procedures to any issued leases; instead, such measures would be determined on a case-by-case basis. The leasing approvals and stipulations would continue to be varied, as would mitigation and reclamation levels. Geothermal development could occur only on lands allocated as open to geothermal leasing and only after leases had been issued, further NEPA analysis had been conducted, and appropriate permits and water rights had been obtained and approved through the Colorado Department of Natural Resources.

Leases with standard stipulations could be issued on the 106,500 acres that are allocated as being open to geothermal leasing. Impacts on water resources, as described above, could occur on these lands. Leases would be subject to further NEPA analysis and acquisition by project proponents of appropriate permits and water rights through the Colorado Department of Natural Resources.

Water resources would be protected from direct impacts of the type noted above on the 17,100 acres being allocated as closed to geothermal leasing and on the 26,800 acres identified for NSO stipulations.

While stipulations and mitigations would be applied to projects on a case-by-case basis, Alternative A keeps open the potential for impacts of the type and intensity noted above in the Common Impacts section on the following identified water features within the SLVFO Planning Area:

- Blanca wetlands
- SWAs
- McIntire-Simpson wetlands

While the RFDS does not change by alternative, future geothermal development under Alternative A could occur near these sensitive water resources.

Alternative B (Proposed action)

Under Alternative B, the range and type of impacts noted in the Common Impacts section above could occur in areas that were proposed for geothermal development only after leases had been issued, further NEPA analysis had been conducted, and appropriate permits and water rights had been obtained and approved through the Colorado Department of Natural Resources. As compared with Alternative A, Alternative B would close three times as many acres to geothermal leasing, NSO stipulations would be applied on nearly twice as many acres, and CSU stipulations (of which there were none in Alternative A) would be applied on over 200,000 acres, which would help to mitigate possible impacts on water resources on these lands. Specific identified water

resources would receive protections under Alternative B through the following closures and NSO stipulations:

- Closure of
  - The Blanca ACEC and SRMA
  - The Rio Grande Corridor ACEC
  - McIntire-Simpson wetlands
- NSO stipulations on
  - Russell Lakes SWA
  - Hot Creeks SWA

Despite the above protections, which would decrease the potential intensity of impacts when compared with Alternative A, Alternative B leaves the potential for leasing to occur on federal mineral estate near Valley View Hot Springs and Joyful Journey Hot As noted above in the Common Impacts section, geothermal resources that could be developed are usually at greater depths than the shallow groundwater associated with the hot springs.

Alternative C

Under Alternative C, all of the types of impacts could occur, as discussed in the Common Impacts section above. However, they would occur only after leases had been issued, further NEPA analysis had been conducted, and appropriate permits and water rights had been obtained and approved through the Colorado Department of Natural Resources. However, nine times as many acres would be closed to geothermal leasing compared with Alternative A. Also, NSO stipulations would be applied on six times as many acres compared with Alternative A, and CSU stipulations would be applied on over 100,000 acres, which would mitigate the impacts on water resources occurring on these lands. Specific identified water resources would receive protections under Alternative C through the following closures and NSO stipulation:

- Closure of
  - All ACECs
  - McIntire-Simpson wetlands
  - Hot Creek SWA
  - Russell Lakes SWA
- NSO stipulations on
  - All SWAs
  - Federal mineral estate within 0.5-mile buffer surrounding the Orient Land Trust lands (Valley View Hot Springs) and Joyful Journey Hot Springs

- Split estate lands adjacent to McIntire/Simpson wetland complex and homestead
- All split estate surrounding the Blanca ACEC and SRMA within the boundaries of:
  - County Road 6 to South
  - State Highway 150 to West
  - State Highway 60 to North
  - State Highway 17 to East

The above protections would decrease the potential intensity of impacts when compared with Alternatives A and B.

4.25 CUMULATIVE IMPACTS

The analysis presented in this chapter, as required by CEQ regulations (40 CFR 1500-1508), addresses the potential cumulative impacts associated with the alternatives. Impacts associated with allocating public lands as open or closed to geothermal leasing and amending land use plans are placed into a broader context that takes into account the full range of impacts from reasonably foreseeable future actions in the SLVFO planning area. The CEQ regulations state that the cumulative impact analysis should include the anticipated impacts on the environment resulting from "the incremental impact of [an] action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time" (40 CFR 1508.7).

4.25.1 Methodology

The cumulative impact analysis in the following sections builds upon the analyses of the direct and indirect impacts of anticipated future actions to be taken consistent with the alternatives. In addition to those incremental impacts of anticipated future actions to be taken consistent with the alternatives, the cumulative impact analysis considers other past, present, and reasonably foreseeable future actions' impacts on natural resources, ecosystems, and human communities in the SLVFO planning area.

The CEQ discusses the assessment of cumulative effects in detail in its report, "Considering Cumulative Effects under the National Environmental Policy Act" (CEQ 1997). Because the allocation of lands as open or closed and the decision to lease do not have any direct impacts (see discussion above), the cumulative analysis focuses primarily on the cumulative impacts associated with the development of geothermal resources. That is, this analysis considers future actions anticipated to be taken consistent with the Proposed Action and the alternatives because it is more informative for the decision-making process. Based on the CEQ's report and this approach to informing the decision-making process, the following methodology was developed for assessing cumulative impacts:

The geographic extent is defined for the analysis. The geographic extent encompass the areas of affected resources and the distances at which impacts associated with anticipated future actions to be taken consistent with the alternatives may occur. The geographic scope is discussed in **Section 4.25.2**.

The time frame for the analysis is defined. The temporal aspect of the cumulative impacts analysis generally extends from the past history of impacts on each resource through the anticipated life of the project (and beyond, for resources having more long-term impacts). The time frame of the actions to be evaluated in the cumulative analysis is presented in **Section 4.25.2**.

Past, present, and reasonably foreseeable future actions are identified in **Table 4-6**, Cumulative Project List. These include projects, activities, or trends that could impact human and environmental resources within the defined regions of influence during the defined time frame. Past and present actions are generally accounted for in the analysis of direct and indirect impacts for each resource and are carried forward to the cumulative impacts analysis.

The baseline conditions of resources are described in the affected environment sections for each resource in **Chapter 3**.

Table 4-6
Cumulative Projects

Description	Status	Resources Affected
	Renewable Energy	
Renewable Portfolio Standards	Ongoing	Land use
San Luis Valley GDA (Solar) Designation	Ongoing	Land use
Xcel Energy/SunEdison Project; 8.2 MW PV	Ongoing	Land use, ecological resources, visual
Alamosa Solar Energy Project; 30 MW, PV	Under way	Land use, ecological resources, visual
Greater Sandhill Solar Project; 17 MW, PV	Under way	Land use, ecological resources, visual
San Luis Valley Solar Project; Tessera Solar, 200 MW, dish engine	Reasonably foreseeable future action	Land use, ecological resources, visual, cultural
Solar Reserve; 200 MW, solar tower	Preliminary application	Land use, ecological resources, visual
Cogentrix Solar Services; 30 MW, Concentrator PV	Approved/under way	Land use, ecological resources, visual
Lincoln Renewables; 37 MW PV	County permit approved	Land use, ecological resources, visual
NextEra; 30 MW, PV	County permit approved	Land use, ecological resources, visual

Table 4-6
Cumulative Projects

Description	Status	Resources Affected
De Tilla Solar Project; Enel Greenpower Solar 1; MW to be determined; PV	On hold until Solar PEIS is completed.	Land use, ecological resources, visual
Los Mogotes Solar Project; Enel Greenpower Solar 1, 100 MW, PV	On hold until Solar PEIS is completed.	Land use, ecological resources, visual
San Luis Valley Solar Ranch; Iberdrola, 30 MW; PV	County permit – ongoing	Land use, ecological resources, visual
Saguache Co. Project; Tessera Solar; 200 MW; PV	County permit – ongoing	Land use, ecological resources, visual
Oil/Gas		
San Francisco Creek Application for Permit to Drill	Ongoing	Ecological resources, cultural resources
Baca NWR oil and gas exploratory wells (2)	Ongoing	Ecological resources, minerals extraction
Transmission		
San Luis Valley–Calumet-Comanche Transmission Project (upgrade 69 KV to 115 KV)	Reasonably foreseeable future action	Land use, ecological resources, visual, cultural
Transportation		
Travel Management Plan (BLM)	Reasonably foreseeable future action	Transportation, ecological resources, recreation
Saleable Minerals		
Sand & Gravel pit next to Orient Land Trust	Ongoing	Ecological resources, air quality, land use
Recreation		
Rio Grande Scenic Railroad	Ongoing	Visual, ecological resources, socioeconomics
CTSR	Ongoing	Visual, ecological resources, socioeconomics
Water Management		
Rio Grande Compact	Ongoing	Water, ecological resources
San Luis Valley Project – Conejos Division	Ongoing	Water, ecological resources
Conservation		
Rio Grande Riparian Enhancement Project	Reasonably foreseeable future action	Ecological resources
Old Spanish National Historic Trail Comprehensive Management Plan (BLM and National Park Service)	Reasonably foreseeable future action	Cultural, visual resources

Table 4-6
Cumulative Projects

Description	Status	Resources Affected
Sangre de Cristo National Heritage Area	Ongoing	Cultural, visual resources
San Luis Valley Regional Habitat Conservation Plan	Ongoing	Ecological resources

Source: BLM and USFS 2008; BLM 2011

Direct and indirect impacts on resources from anticipated future actions that may be taken consistent with the respective alternatives are characterized at a level appropriate for a programmatic analysis such as presented in this planning EA. Direct impacts are caused by anticipated future actions to be taken consistent with implementing an alternative, and they occur at the same time and place as those actions. Indirect impacts are caused by anticipated future actions to be taken consistent with the alternative but occur later in time or farther in distance from those actions and are still reasonably foreseeable. These impacts are detailed in the environmental consequences sections above for each resource.

The potential impacting factors of each past, present, or reasonably foreseeable future action or activity are determined. Impacting factors are the mechanisms by which an action affects a given resource. Anticipated future actions to be taken consistent with the alternatives could also generate factors that could impact resources; these individual contributions form the basis of the cumulative impacts analysis.

The cumulative impact assessment focuses on past, current, and reasonably foreseeable future actions, including commercial uses, regardless of who undertakes them and regardless of where they are located in the SLVFO planning area. In other words, the assessment considers other uses on all lands in the planning area regardless of landownership. The descriptions of the other reasonably foreseeable future actions considered address all lands; the data do not specifically break out public lands.

Cumulative impacts on resources are evaluated by considering the impacting factors for each resource and the incremental contribution of anticipated future actions to be taken consistent with implementing the alternatives to the cumulative impact. The analysis for each resource is presented in **Section 4.24.3**.

In cases where the contributions of individual actions to an impacting factor were uncertain or not well known, a qualitative evaluation of cumulative impacts was necessary. A qualitative evaluation covers the locations of actions, the times

they would occur, the degrees to which the impacted resource is at risk, and the potential for long-term or synergistic effects.

4.25.2 Geographic Extent and Time Frame

To determine which other actions should be included in a cumulative impacts analysis, the geographic extent must first be defined. This area should not be limited to only the geographic areas of resources addressed by the alternatives, but they should also take into account the distances that cumulative impacts may travel and the regional characteristics of the affected resources. Because this EA addresses allocating public lands as open and closed to geothermal leasing and amending land use plans at a planning level, the geographic extent for each resource evaluated by the cumulative impacts analysis is, unless otherwise noted, the SLVFO planning area.

The time frame of the cumulative impact analysis incorporates the sum of the effects of anticipated future actions consistent with the implementation of the alternatives in combination with other past, present, and future actions, because impacts may accumulate or develop over time. The future actions described in this analysis are those that are "reasonably foreseeable;" that is, they are ongoing (and will continue into the future), are funded for future implementation, or are included in firm near-term plans. The reasonably foreseeable time frame for future actions evaluated in this cumulative analysis is 20 years from the allocation of lands available for geothermal leasing and completion of the land use plan amendment. While it is difficult to project reasonably foreseeable future actions (or trends) beyond a 20-year time frame, it is acknowledged that the effects identified in the cumulative impacts analysis will likely continue beyond the 20-year horizon.

4.25.3 Cumulative Impacts by Resource

Air Quality

While geothermal energy generates minimal emissions compared to fossil fuels, the exploration, development, and operation of this renewable resource would be responsible for minor amounts of air pollutants. Most of the emissions associated with geothermal development would be during exploration, drilling, and construction activities and would include particulate material (dust) and emissions from vehicles and equipment. When combined with the other projects and reasonably foreseeable future actions noted in the table above near geothermal developments, there would be a minor localized increase in emissions. Dust control requirements would be required as conditions of permit approval for individual projects, which would reduce the magnitude of cumulative human-caused fugitive dust impacts in the planning area.

Noise

As discussed in the Geothermal PEIS, geothermal projects are typically developed at remote locations that are away from other noise sources, where

noise generated by power generation, substations, transmission lines, and maintenance activities generally approach typical background levels for rural areas at distances of 2,000 feet or less. Therefore, the sphere of noise impact is limited in scope and would not be expected to combine with other projects and result in cumulative impacts on local residents. However, if geothermal exploration or other action occurs near a cave, mine or other bat roosting site, such as Orient Mine, associated noise could cause cumulative effects when combined with human visitor noises. The cumulative impacts of these noises could act to delay the bats nightly migration out of the cave and could affect their overall foraging behavior in that area (Kirk Navo, personal communication, 2012).

Climate and Climate Change

Over the long-term, geothermal electrical generation combined with proposed solar projects in the project area may have a beneficial cumulative impact on air quality and atmospheric values by offsetting the need for energy production that results in higher levels of emissions, such as coal, oil, and natural gas.

Soils

Geothermal energy exploration, development, and utilization would have a minor cumulative impact on soil compaction and erosion when combined with other development projects and land uses such as livestock grazing or other renewable energy developments across the planning area. Projects in the planning area with the potential to contribute to soil erosion include solar development projects under construction, or proposed for development, such as the 8.2-MW Xcel Energy/SunEdison Project, 30-MW Alamosa Solar Energy Project, 17-MW Greater Sandhill Solar Project, the 200-MW San Luis Valley Solar Project, the 200-MW Solar Reserve, 30-MW Cogentrix Solar Services, 37-MW Lincoln Renewables, and 30-MW Next Era project. Other energy and transmission development, including oil and gas leasing on private lands, the San Luis Valley to Calumet-Comanche Transmission Project and the Sand & Gravel pit next to Orient Land Trust would also contribute to soil erosion.

Based on the RFDS of one 50 MW power plant, it is anticipated that approximately 58 to 367 acres of land could be disturbed by geothermal development within the SLVFO over the next 20 years. Stipulations that limit siting projects in steeply sloped areas and BMPs that address stormwater runoff and fugitive dust would limit erosion-related impacts.

Water Resources

The cumulative impact assessment area for Water Resources is the SLVFO and the entire length of the Rio Grande. Cumulative impacts on water resources related to surface disturbance and siltation of eroded soils from geothermal exploration and development activities could combine with the effects of other energy projects identified in the SLVFO and cumulatively contribute to the degradation of water ways; however, BMPs, stipulations and mitigation measures

would decrease any such effects. When combined with the other reasonably foreseeable actions noted above, it is likely that any geothermal development activity would contribute a minor amount of additional water impacts. As most of the foreseeable actions require ground disturbing activities, the nature of impacts would be similar to those described for geothermal activity, such as silt accumulation in water courses. Although the activities are reasonably foreseeable, until site specific studies are done it is not possible to quantify specific impacts.

Geology and Seismicity

The cumulative impact assessment area for Geology and Seismicity is the SLVFO. Until projects are specifically located, it is unknown whether they would result in impacts on unique geologic formations. None of the identified projects are anticipated to result in increased seismic activity or geologic hazards; therefore there would be no additive impacts on those already noted for geothermal resource development.

Fluid Minerals

The cumulative impact assessment area for fluid minerals is the SLVFO. Of the reasonably foreseeable future actions identified in the cumulative impact assessment area, the limited additional oil and gas exploratory drilling in the Baca NWR is anticipated to increase impacts through extraction of the subsurface fluid minerals, as well as additional surface disturbing impacts similar in nature to geothermal drilling impacts described in the EA. The other solar development projects in the cumulative impact assessment area could combine with any future geothermal projects to increase electrical transmission connections into the cumulative impact assessment area, which could in turn increase opportunities for additional development of geothermal resources within the SLVFO through improved access to power markets for any electricity produced.

Paleontological Resources

Cumulative impacts result from individually minor but collectively significant actions taking place over a period of time. In general, if previously unrecorded, scientifically significant paleontological resources are present within the planning area, the potential cumulative impacts would be low, so long as mitigation was implemented to salvage the resources. The use of stipulations, BMPs, and paleontological RMPs as described in the EA would effectively recover the value to science and society of significant fossils that would otherwise have been destroyed by ground-disturbing actions.

Vegetation

The impacts on vegetation presented in the cumulative impacts section of the Geothermal PEIS are incorporated by reference here. In general, reasonably foreseeable future renewable and non-renewable energy development, as well as recreation activities, could remove or degrade vegetation in the planning area

and result in the overall spread of invasive weeds. In addition, depending on the technology utilized, solar energy projects in the planning area could affect water quantity, which could impact wetlands and riparian areas. The travel management process, habitat conservation planning on private lands, such as the Orient Land Trust, and the Rio Grande riparian enhancement project would all aim to protect native vegetative communities within the planning area and reduce the likelihood of weed spread.

Livestock Grazing

Cumulative impacts on livestock grazing would occur from the loss of forage for grazing, loss of AUM capacity, and the disruption of livestock grazing practices where geothermal development and other projects overlay grazing allotments. Current or proposed projects in the planning area with the potential to impact grazing include solar development projects underway or proposed for development, such as the 8.2-MW Xcel Energy/SunEdison Project, 30-MW Alamosa Solar Energy Project, 17-MW Greater Sandhill Solar Project, the 200-MW San Luis Valley Solar Project, the 200-MW Solar Reserve, 30-MW Cogentrix Solar Services, 37-MW Lincoln Renewables, and 30-MW Next Era project. Other energy and transmission development, including oil and gas leasing on private lands, and the San Luis Valley to Calumet-Comanche Transmission Project would also potentially impact grazing.

Geothermal developments would remove some forage, and could lower the AUM capacity in areas with livestock operations. Based on the RFD of one 50 MW power plant, a total of approximately 58 to 367 acres may be developed for geothermal leasing and would likely be unavailable for grazing over the next 20 years. Modification of lease boundaries, siting considerations for geothermal power plants as well as employment of BMPs would minimize impacts on livestock grazing.

Fish and Wildlife Habitat

The impacts on fish and wildlife habitat presented in the cumulative impacts section of the Geothermal PEIS are incorporated by reference here. In general, renewable and non-renewable energy development, as well as recreation, could remove, degrade, or fragment habitats in the planning area, thus impacting the movement and viability of fish and wildlife populations. In addition, depending on the technology utilized, solar energy projects in the planning area could affect water quantity, which could impact species that are dependent on wetlands and riparian areas. Energy development would introduce more transmission and distribution lines, which would create flight hazards for birds and bats throughout the San Luis Valley.

White-nose syndrome is a disease that has spread rapidly from the northeastern US to western states. Over one million bats across the northeast and mid-Atlantic US have been estimated to have died from white-nose syndrome (BLM 2011). It is not yet known to occur in the SLVFO planning area, but could occur

and could affect the large population of Mexican free-tailed bats in the Orient Mine. If this were to occur, the population would decline, and geothermal development would exacerbate the threats on this species, described in **Section 4.14**.

The travel management process, habitat conservation planning, and the Rio Grande riparian enhancement project would all aim to protect and enhance habitats for fish and wildlife within the planning area.

Special Status Species

The impacts on special status species presented in the cumulative impacts section of the Geothermal PEIS are incorporated by reference here. In addition, cumulative impacts would be similar to those described for vegetation, fish, and wildlife habitats.

Lands

The contribution to cumulative impacts of geothermal projects would be small unless a significant permanent, uncompensated loss of the current productive use of a site occurred, or if other future uses were precluded. Geothermal leasing and development requires a relatively small footprint and the land required is not completely occupied by the power plant. Given the small footprint, geothermal development (direct and indirect uses) is generally compatible with many other land uses, including livestock grazing; some forms of recreation; wildlife habitat conservation; and oil, gas, and wind generation. The small number of workers at a geothermal power plant (e.g., about 155 people per year during the peak construction period for a 50-MW power plant, and about 20 workers during operations) would not likely add to cumulative impacts on land use or land disturbance, including existing rights-of-way, that are occurring or have occurred from ongoing and past activities.

While geothermal is compatible with some other land uses and not all geothermal development would occur on federal lands, it is undeniable that any power generation facility constructed where none previously existed would affect resources and resource use in the area. However, given the relatively small area needed to develop geothermal operations, impacts would be minimal.

Recreation

Cumulative impacts could result if geothermal resources in the planning area were developed. One primary cause of cumulative impacts related to recreation would be the influx of vehicles associated with geothermal development. At any stage of development, whether exploration, drilling, utilization, or reclamation and abandonment, an increase in the use of roads in or around the SLVFO could potentially degrade roads to the point of inhibiting access, increasing traffic, or damaging roads with more expedience and severity than would be exhibited by normal use. Damaged roads and their necessary repairs could additionally exacerbate problems of access and traffic.

Combined with the major influx (see Chapter 4) of visitors that occurs during hunting and fishing seasons, cumulative impacts would likely result, and negatively influence the overall availability or the ease of access to certain desirable recreational locations within the SLVFO.

Special Designation Areas

Cumulative impacts on ACECs under the proposed plan and alternatives could result from geothermal leasing and development in or around ACECs. The construction of roads and facilities associated with development could have cumulative impacts on the values and resources within ACECs.

Geothermal development within ACECs would have direct, far-reaching impacts on the natural and cultural resources contained within the ACECs. Development adjacent to ACECs could influence the seasonal ranges of migratory animals or big game species, and consequently impact other resource values, such as natural, recreational, or visual resources within the SLVFO planning area.

Additionally, the viewshed of the Cumbres and Toltec ACEC could be negatively impacted with the advent of geothermal development, and consequently the popularity of the Cumbres and Toltec Scenic Railroad could be affected. Any leasing activities that would influence the number of visitors or tourists in the San Luis Valley would have subsequent impacts on local economies, which heavily rely on the tourism and recreation industries for their subsistence.

Cumulative impacts are most likely to occur because National Parks are afforded the least defined considerations for protection from geothermal leasing. However, cumulative impacts could result from disturbance to the water table and aquifer(s) which underlie Great Sand Dunes National Park and Preserve. The hydrological processes involved in the continued erosion and formation of the Great Sand Dunes are vast, complex, and highly sensitive.

Cumulative impacts on NWRs would result from disturbance to lands contained within or adjacent to NWRs in the planning area. Immediate impacts would be self-evident if leasing was to occur on split-estate lands within the NWRs, but far-reaching, cumulative impacts could result thereafter.

Visual Resources

Development of geothermal resources in the planning area could result in cumulative impacts on visual resources when combined with other projects. For geothermal projects, the heights, type, and color of drilling equipment and power plants, together with their placement with respect to local topography are factors that would contribute to determining the extent of visual intrusion on the landscape. Flexibility in locating power plants and other large structures to avoid cumulative impacts on VRM Class I or Class II viewsheds should be considered during the permitting process. The development of transmission

lines to connect new electrical production facilities to the regional power grid could contribute to cumulative impacts.

In addition to potential geothermal projects, there are five ongoing or underway PV projects, a dish engine project, one solar tower project that has completed preliminary application, one concentrator photovoltaic project underway, and one transmission line project that would contribute to cumulative effects on the visual landscape of the San Luis Valley. All of these projects have industrial equipment and may require new transmission lines that could result in a direct change to the visual character of the San Luis Valley. Therefore, site-specific projects should be sited strategically and include mitigation measures to avoid cumulative impacts on the planning area as a whole.

Cultural Resources and Tribal Interests

Disturbances from geothermal drilling and utilization, combined with other surface-disturbing development activities, could uncover or destroy cultural resources and continue to disturb, destroy or intrude upon important tribal locations and/or resources. However, the proposed stipulations and BMPs addressing cultural resources and tribal consultation requirements and the proposed exclusion of many National Landscape Conservation System lands would limit the potential impacts. Cultural resource program procedures requiring cultural resource surveys and tribal consultation prior to project approval would continue to discover previously unknown sites or areas of tribal significance, thereby expanding the known cultural heritage record for the planning area. As sites and locations are discovered, there will be continued Section 106 and tribal consultation requirements that would mitigate possible impacts as a result of specific project actions. Additionally, as more projects are permitted and constructed, buried cultural resources will continue to be discovered, resulting in additional information for the historic record and continued damage, loss, or destruction of the archaeological resources.

The proposed closure of National Historic Trails to leasing and the inclusion of additional stipulations for leases near historic or scenic trails would reduce impacts on the setting of the trail system. Geothermal developments that are visible from trail sections would result in increased number of visual, atmospheric, or audible intrusion impacts when combined with other projects being developed across the planning area that are also visible from portions of the trail system.

Socioeconomics and Environmental Justice

Development of geothermal resources in the planning area could result in cumulative impacts on socioeconomics or environmental justice when combined with other projects. For geothermal projects, the location of the plants with respect to local communities as well as the timing of development could impact socioeconomics or environmental justice. Local population areas, schools and residences should be taken into account in the permitting process when locating

power plants and associated structures such as transmission lines to avoid adverse cumulative impacts. In addition, the availability of workers as well as the necessity of housing and other services for workers should be considered.

In addition to potential geothermal projects, there are ongoing or renewable energy or transmission line projects that would contribute to cumulative effects on the socioeconomics of the San Luis Valley. All of these projects have the potential to result in changes to air, water and other resources as well as would result in changes to the social character of the San Luis Valley. Therefore, projects should be sited strategically and include mitigation measures to avoid cumulative impacts on communities within and adjacent to the project area.

Health and Safety

The combination of hazardous materials and other health and safety risks associated with the development and operation of geothermal energy facilities in conjunction with similar health and safety concerns for other reasonably foreseeable projects across the planning area is expected to be negligible. All projects would have to comply with state and federal requirements pertaining to worker safety and the use, storage, transport, and disposal of debris and hazardous materials and wastes, thereby minimizing cumulative impacts. The potential for hazardous waste spills (fuel, drilling muds, etc.) would be minimized through the application of BMPs included in lease terms and would not be at a large enough scale to cumulatively affect human health and safety either at the local level when combined with other local projects, or across the planning area when combined with all other projects with similar individual effects.

This page intentionally left blank.

CHAPTER 5
CONSULTATION

This chapter is a description of the public outreach and participation opportunities made available through the development of this RMP Amendment/EA and consultation efforts with tribes, government agencies, and other stakeholders.

The BLM land use planning activities are conducted in accordance with NEPA requirements, CEQ regulations, and the DOI and BLM policies and procedures implementing NEPA. NEPA and the associated laws, regulations, and policies require BLM to seek public involvement early and throughout the planning process to develop a reasonable range of alternatives to proposed actions and prepare environmental documents that disclose the potential impacts of proposed actions and alternatives. Public involvement and agency consultation and coordination, which have been at the heart of the planning process leading to this draft RMP Amendment and associated EA, were achieved through Federal Register notices, public and informal meetings, individual contacts, media releases, Web site, and planning bulletins.

5.1 CONSULTATION

Federal laws require BLM to consult with certain federal and state agencies and entities, and Native American tribes, (40 CFR 1502.25) during the NEPA decision-making process. BLM is also directed to integrate NEPA requirements with other environmental review and consultation requirements to reduce paperwork and delays (40 CFR 1500.4-5).

In addition to formal scoping, the BLM has implemented an outreach and public involvement process that has included coordinating with other local, state and federal agencies, and working closely with the BLM Front Range Resource Advisory Committee. These efforts are summarized below. The BLM will continue to meet with interested agencies and organizations throughout the planning process.

5.1.1 Native American Tribes

The federal government works on a government-to-government basis with Native American tribes. The government-to-government relationship was formally recognized on November 6, 2000, with Executive Order 13175 (Federal Register, Volume 65, page 67249). As a matter of practice, the BLM coordinates with all tribal governments, associated native communities, native organizations, and tribal individuals whose interests might be directly and substantially affected by activities on public lands. In addition, Section 106 of the NHPA requires federal agencies to consult with Indian tribes for undertakings on tribal lands and for historic properties of significance to the tribes that may be affected by an undertaking (Title 36, Part 800.2 (c)(2) of the CFR). BLM Manual 8120 (BLM 2004a) and BLM Handbook H-8120-1 (BLM 2004b) provide guidance for Native American consultations. The BLM has given substantial consideration to the proper conduct of government-to-government consultations for this project in order to provide for multiple opportunities for tribal consultation and has provided tribes with multiple ongoing opportunities to comment and receive information on and participate in the SLVFO Geothermal Leasing RMP Amendment project.

Executive Order 13175 stipulates that tribes identified as "directly and substantially affected" be consulted by federal agencies during the NEPA process. The BLM began tribal consultation in 2010 with an invitation letter to participate in government-to-government consultation on the RMP Amendment/EA. The following tribes were contacted:

- Southern Ute Indian Tribe
- Ute Mountain Ute Tribe
- Jicarilla Apache Tribe
- The Hopi Tribe
- Uintah & Ouray/Northern Ute Tribe
- Navajo Nation
- Pueblo of Santa Ana
- Pueblo of Santo Domingo
- San Ildefonso Pueblo
- Pueblo of Nambe
- Ohkay Owingeh (Pueblo of San Juan)
- Santa Clara Pueblo
- Taos Pueblo

No tribes have requested cooperator status and no written or verbal comments were received from tribal councils or agencies during the scoping period.

Government-to-government consultation has continued throughout the RMP Amendment/EA process to ensure that the concerns of tribal groups are considered in development of the RMP Amendment.

5.1.2 Colorado State Historic Preservation Officer

In accordance with the requirements of Section 106 of the NHPA, the BLM is coordinating with and soliciting input from the Colorado SHPO. The BLM and Colorado SHPO are following the coordination protocols in the Colorado Protocol relating to amending resource management plans; the protocol provides for a phased consultation process related to historic, traditional, and cultural resources for an NEPA document and subsequent activities that could tier from a decision on the action. Per these procedures, the BLM initiated consultation with the SHPO by written correspondence. The letter introduced the SLVFO Geothermal Leasing RMP Amendment/EA and specified the need to consult on information regarding the amendment of SLVFO RMP. SHPO formally responded to the letter, expressing interest and support but no specific concerns.

5.1.3 United States Fish and Wildlife Service

In accordance with the requirements of Section 7 of the Endangered Species Act, the BLM has consulted with the US Fish and Wildlife Service to ensure that the BLM's proposed action would not jeopardize the continued existence of any listed threatened or endangered species. These consultations are ongoing and will result in a biological assessment and biological opinion for the SLVFO Geothermal Leasing RMP Amendment project.

5.1.4 Other Agencies

Other local, state, and federal agencies the BLM consulted with throughout the planning process include:

- US Forest Service
- National Park Service
- Front Range Resource Advisory Committee
- CPW
- Colorado Department of Natural Resources
- Colorado Division of Water Resources
- Costilla, Alamosa, Saguache, Rio Grande, Conejos, Counties

No official cooperating status has been assigned to any agency. Input from interested organizations has been reviewed and incorporated as appropriate into the RMP Amendment EA.

5.2 PUBLIC INVOLVEMENT

Public involvement is a vital and legal component of both the RMP Amendment and EA processes. Public involvement vests the public in the decision-making process and allows for full environmental disclosure. Guidance for implementing public involvement under NEPA is codified in 40 CFR Section 1506.6, thereby ensuring that federal agencies make a diligent effort to involve the public in the NEPA process. Section 202 of FLPMA directs the Secretary of the Interior to establish procedures for public involvement during land use planning actions on public lands. These procedures can be found in the BLM's Land Use Planning Handbook (H-1601-1) (BLM 2005b). Public involvement for the SLVFO RMP Amendment/EA includes the following four phases:

- Public scoping before NEPA analysis begins to determine the scope of issues and alternatives to be addressed in the RMP Amendment/EA;
- Public outreach via newsletters and news releases;
- Collaboration with federal, state, local, and tribal governments; and
- Public review of and comment on the draft RMP Amendment/EA, which analyzes likely environmental effects and identifies the BLM's proposed action.

The public scoping phase of the process has been completed and is described below. The public outreach and collaboration phases are ongoing, while public review of the draft RMP Amendment/EA is estimated for summer 2011.

5.2.1 Scoping Process

The scoping process for the SLVFO RMP Amendment/EA began in June 2010, and the formal scoping comment period began September 13, 2010, with the publication of a NOI in the Federal Register. The NOI notified the public that the SLVFO was soliciting information and feedback from the public, federal, state, tribal, and local government agencies and organizations to help inform the issues, impacts, and potential alternatives that the EA addresses. The public comment period ended on October 13, 2010.

A San Luis Valley Geothermal Leasing EA Web site was launched to serve as a clearinghouse for project information during the planning effort. The Web site (http://www.blm.gov/co/st/en/fo/slvplc.html) provided contact information for site visitors to submit comments about the project. Pubic scoping activities included the following:

- NOI published in Federal Register;
- Two scoping meetings;
- Two press releases;

- A project newsletter; and
- Launching of a project Web site.

Scoping efforts were designed to communicate project details to and solicit input from various stakeholders in the RMP Amendment/EA process.

The BLM received 12 written submissions including a total of 86 separate comments during the public scoping period. Detailed information about the comments received and about the public outreach process can be found in the SLV Geothermal Leasing EA and RMP Amendment Final Scoping Report (BLM 2010c). The issues identified during public scoping and outreach helped refine the list of planning issues, included in **Section 1.9**, Issues that guided the development of alternative management strategies for the RMP Amendment. Public participation efforts will be ongoing throughout the remainder of the SLVFO RMP Amendment/EA planning process.

5.3 PUBLIC REVIEW OF THE RMP AMENDMENT/EA

As stated previously, in Section 1.8.2, Public Comment on the RMP Amendment/EA, the BLM held a public comment review period from March 13 to May 24, 2012. The BLM distributed the EA to individuals, agencies, and organizations via the BLM's Web site and mailings and held public meetings to solicit input for the EA. In total, the BLM received 22 comment letters from individuals, organizations, and agencies. Although each comment letter was diligently considered, the comment analysis process involved determining whether a comment was substantive or nonsubstantive in nature. In performing this analysis, BLM relied on the CEQ's regulations to determine what constituted a substantive comment.

A substantive comment does one or more of the following:

- Questions, with a reasonable basis, the accuracy of the information and/or analysis in the EIS;
- Questions, with a reasonable basis, the adequacy of the information and/or analysis in the EIS;
- Presents reasonable alternatives other than those presented in the Draft EIS that meet the purpose and need of the proposed action and addresses significant issues;
- Questions, with a reasonable basis, the merits of an alternative or alternatives;
- Causes changes in or revisions to the proposed action; and
- Questions, with a reasonable basis, the adequacy of the planning process itself.

Additionally, BLM's NEPA handbook identifies the following types of substantive comments:

- Comments on the Adequacy of the Analysis: Comments that express a professional disagreement with the conclusions of the analysis or assert that the analysis is inadequate are substantive in nature but may or may not lead to changes. Interpretations of analyses should be based on professional expertise. Where there is disagreement within a professional discipline, a careful review of the various interpretations is warranted. In some cases, public comments may necessitate a reevaluation of analytical conclusions. If, after reevaluation, the manager responsible for preparing the EIS (authorized office [AO]) does not think that a change is warranted, the response should provide the rationale for that conclusion.
- Comments That Identify New Impacts, Alternatives, or Mitigation Measures: Public comments that identify impacts, alternatives, or mitigation measures that were not addressed in the draft are substantive. This type of comment requires the AO to determine whether it warrants further consideration. If it does, the AO must determine whether the new impacts, new alternatives, or new mitigation measures should be analyzed in the final document, a supplement, or a completely revised and recirculated draft document.
- Disagreements with Significance Determinations: Comments that directly or indirectly question, with a reasonable basis, determinations regarding the significance or severity of impacts are substantive. A reevaluation of these determinations may be warranted and may lead to changes. If, after reevaluation, the AO does not think that a change is warranted, the response should provide the rationale for that conclusion.

Comments that failed to meet the above description were considered nonsubstantive. Many comments received throughout the process expressed personal opinions or preferences, had little relevance to the adequacy or accuracy of the analysis, or represented commentary regarding resource management without any real connection to the document being reviewed. These comments did not provide specific information to assist the planning team in making a change to the Proposed action, did not suggest other alternatives, and did not take issue with methods used in the EA, and are not addressed further in this document. Examples of some of these comments include the following:

- The best alternative is Alternative C (or A or B);
- BLM has yet to show land stewardship at or above the level currently demonstrated by the private sector;
- Your plan does not reflect balanced land management;
- More land should be closed to leasing;
- You need to protect all areas with wilderness characteristics;
- People need access and the roads provide revenue for local communities; and

Opinions, feelings, and preferences for one element or one alternative over another, and comments of a personal and/or philosophical nature were all read, analyzed, and considered, but because such comments are not substantive in nature, the BLM did not respond to them. It is also important to note that while all comments were reviewed and considered, comments were not counted as "votes." The NEPA public comment period is neither considered an election nor does it result in a representative sampling of the population. Therefore, public comments are not appropriate to be used as a democratic decision-making tool or as a scientific sampling mechanism.

Comments citing editorial changes to the document were reviewed and incorporated. The EA has been extensively technically edited and revised to fix typos, missing references, definitions, and acronyms, and other clarifications as needed. A matrix of the comments and BLM's responses are found in **Section 5.5**, Responses to Comments.

5.4 RESPONSES TO COMMENTS

According to NEPA, the BLM is required to identify and formally respond to all substantive public comments. The BLM developed a systematic process for responding to comments to ensure all substantive comments were tracked and considered. Upon receipt, each comment letter was assigned an identification number and logged into a Microsoft-based database which allowed the BLM to organize, categorize, and respond to comments. Only substantive comments from each letter were added to the spreadsheet and responded to. A comment was coded to appropriate categories based on content of the comment, retaining the link to the commenter. The categories generally follow the sections presented in the EA, though some relate to the planning process or editorial concerns.

ALTERNATIVES

Affected Environment

Comment

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: With regards to context, the recommended plan options presented in the EA do not address the local context of both the ecological environment and the human environment.

Summary: The alternatives do not address the local context.

Response: The EA's range of alternatives provides options for meeting the purpose and need, as well as the planning area, the San Luis Valley Field Office. Context for the affected environment and impact analysis are described in Chapters 3 and 4, respectively. The NEPA directs the BLM to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal that involves unresolved conflicts concerning alternative uses of available resources..." (NEPA Sec. 102(2)(E)). The

range of alternatives explores alternative means of meeting the purpose and need for the action and was developed in the context of the described affected environment, including both the ecological conditions and the human environment (e.g., socioeconomic considerations). The purpose and need defined the range of alternatives. "Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable..." (Question 2a, CEQ, Forty Most Asked Questions Concerning CEQ's NEPA Regulations).

Bat Stipulations

Comment
Submission No.: DOI-BLM-CO-140-2010-014-EA-0006
Commenter: Linda Kaiser

Comment: There is a very large colony of bats (estimated at up to 250,000 thousand) in the old Orient Mine in the San Luis Valley. This large colony is an important ecological resource in the San Luis Valley, as recognized in the EA on page 4-107. A large geothermal facility with noisy equipment and surface transmission lines could impact the bats' outflights from this old mine. Because of the very large number of bats in the outflight, additional NSO protections may be needed for this colony. The EA, in section 4.14.3, discusses potential negative consequences to bats from surface structures and power transmission lines, yet per Table 2-2, only a 0.25 mile NSO buffer is planned around any area where bats are found. Please consider a significantly increased (at least a few miles) NSO setback that allows the bats room to exit the Orient Mine and spread out before encountering a surface power generation facility. This increased buffer for this colony should be included in both alternatives. Protection of nearby surface water resources is also important for the bats' ability to live in this area, and should be considered in leasing decisions and RMP setback decisions. Winter access to the warm water in the nearby springs is necessary for those bats that remain in the winter. Although the bats are not an endangered species, a colony this large is unique and should be protected.

Summary: The BLM should consider additional stipulations to protect the bat roost in the Orient Land Mine.

Response: The BLM considered applying NSO stipulations within two miles of bat roost sites under Alternative C. Under Alternative B, the BLM considered applying NSO stipulations within 0.25 mile of bat roost sites (See Table 2-1, Description of Alternatives A, B, and C). Additionally, mitigation measures to modify night lighting and to reduce the amount of standing water on-site may be required to protect bats from negative impacts of geothermal facilities (see Appendix C, Best Management Practices).

Corridor closure

Comment:
Submission No.: DOI-BLM-CO-140-2010-014-EA-0011
Commenter: Michael Spearman, Chair
Affiliation: Saguache County Board of County Commissioners

Comment: We respectfully request that you apply the designations shown in Alternative C to the area that extends west from the Town of Saguache to Gunnison along Highway 114. Preservation of this corridor has been ongoing in many collaborative efforts of the County, private property owners, public lands managers, recreation and conservation

organizations. This area is of interest for its historic, recreation and wildlife values, and related tourism- an economic driver for our County.
Some key resources of this unspoiled corridor, include:
-Old Spanish Trail;
-the Trickle Mountain Area of Critical and Environmental Concern (ACEC);
-Highway 114, in its entirety, is currently in consideration for CDOT designation as the State's 26th scenic byway - the COCHETOPA SCENIC BYWAY. With local BLM personnel presenting, this designation is slated to be decided at the COOT Byway Commission meeting next month.
Closure and preservation of the ACEC and protecting the scenic byway value, hunting and recreation value, and environmental and wildlife value of the area would be consistent with these uses, regional planning measures and ongoing community interests.

Summary: BLM should consider adding protections to the Hwy 114 corridor.

Response: The BLM has added an NSO stipulation for consideration under Alternative C that would apply to the area that extends west from the town of Saguache to Gunnison along Highway 114. The BLM also considered application of a CSU stipulation to this area under Alternative B (see Table 2-1, Description of Alternatives A, B, and C).

Citizen's Proposed Wilderness

Submission No.: DOI-BLM-CO-140-2010-014-EA-0010
Commenter: Alex Daue and Josh Pollock
Affiliation: The Wilderness Society and Rocky Mountain Wild

Comment: Finally, we recommend that all Citizens' Wilderness Proposal (CWP) areas be closed to geothermal leasing. CWP areas are wilderness quality lands that are not appropriate for development of any kind, including geothermal leasing and development. Alternative C includes 8,130 acres of overlap with CWP areas (25 acres in the San Luis Hills unit and 8,105 acres in the Rio Grande unit). Alternative B includes 19,754 acres of overlap with CWP areas (1 0,804 acres in the San Luis Hills unit and 8,950 acres in the Rio Grande unit). GIS data for CWP units is included as Attachment 1.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0010
Commenter: Alex Daue and Josh Pollock
Affiliation: The Wilderness Society and Rocky Mountain Wild

Comment: The EA for geothermal leasing and development in the San Luis Valley Resource Area must include a range of alternatives for managing lands with wilderness characteristics, and the public must have the opportunity to comment on inventory and management of LWCs. BLM should provide a public comment opportunity once the inventory is completed and management alternatives for LWCs have been developed. LWCs should be closed to geothermal leasing.

Summary: BLM should consider areas recommended for Citizen's Proposed Wilderness as part of the range of alternatives.

Response: As noted in Section 3.9, Lands with Wilderness Characteristics, the BLM completed an inventory for lands with wilderness characteristics in the planning area, in accordance with IM 2011-154, and identified the San Luis Hills WSA as the only area with lands with wilderness characteristics; the

BLM did not identify other lands with wilderness characteristics in the rest of the planning area. Therefore, there will be no impacts on LWC; this is discussed in section 4.13 of the EA.

As noted in public comments, there is a Citizen's Proposed Wilderness (CPW) area that overlaps with the planning area. In Alternative B, the CPW overlap lands are identified as open with standard stipulations and CSU on riparian areas; Alternative C identifies the overlap area as closed (in the San Luis Hills ACEC), open with NSO, open with CSU, and open with standard stipulations. As the areas outside the WSA were not identified as having lands with wilderness characteristics, the alternatives consider appropriate protections for the resources found in these areas.

Direct Use

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: Future direct use is downplayed by BLM due to the presumed high cost of drilling, although the state and federal laws in existence today favor the use of this type of alternative energy. The potential impacts from a number of smaller direct uses in the San Luis Valley, particularly such impacts in close proximity to the existing geothermal features like the Joyful Journey hot springs and hot well, were not evaluated in the Draft EA. And, as a result, the proposed closures and stipulations do not adequately address potential impacts from a power plant in close proximity to the Mineral Hot Springs or additional direct uses in that area.

Summary: The BLM failed to adequately consider direct use in the EA.

Response: As directed in the Geothermal regulations, 43 CFR 3205.6, the BLM may consider issuing a direct use lease to an applicant if the lands included in the lease application are open for geothermal leasing, if the BLM determines that the lands are appropriate for exclusive direct use operations, the acreage covered by the lease application is not greater than the quantity of acreage reasonably necessary for the use, and the appropriate notification procedures are followed.

The purpose of amending the SLVFO RMP is to better facilitate geothermal leasing decision-making and eventual geothermal development projects in an environmentally responsible way, which includes direct use applications. Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The EA considers only planning actions and does not include any implementation actions (i.e., leasing decisions, project specific developments). As specific actions that may affect the area come under consideration, the BLM will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions, which may include direct use.

The EA discusses direct use in several sections of the document, including Section 1.3, Geothermal Leasing Process, Section 2.2.2, Decisions Common to Both Action Alternatives and in Table 2-1, Summary of Alternatives, Section 3.5, Fluid Minerals (page 3-23), and in Appendix A, Geothermal Resources, Technology, Leasing, and Development (specifically on page A-3). The general scope of the planning-level analysis is sufficient for the decision maker to understand the types of impacts that could result from the planning actions presented under the alternatives, including opening areas to direct use applications. As noted in Section 1.7, The Geothermal Programmatic EIS and the San Luis Valley Field Office RMP Geothermal Leasing Amendment, the determination of the necessary level of additional

NEPA analysis is made on a case-by-case basis at the time a lease or project is proposed, which would include the site specific analysis necessary to approve a direct use lease.

Geothermal feature setbacks

Submission No.: DOI-BLM-CO-140-2010-014-EA-0006
Commenter: Linda Kaiser

Comment: Protection of the unique ecosystems in National Parks and large wildlife refuge areas is very important. However, there are smaller ecosystems that have developed around hot and warm springs areas that are also very important, even though they are much smaller. Geothermal development near these areas could disrupt the springs and the ecosystems they support. I would like to see a significant setback (at least a few miles) around these areas similar to those around the larger ecosystems. This setback should close the area to geothermal development instead of just controlling surface use. These small ecosystems support significant wildlife because of the year-round availability of water in a very dry area. This increased protection should be applied for commercially developed hot springs as well as those in natural, undeveloped, hot springs environments.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0006
Commenter: Linda Kaiser

Comment: The authors of the EA have recognized that geothermal development can affect wetlands, hot springs, and similar areas; however, their restrictions appear to be focused on controlling surface use of these areas. While this is an important facet of protection, if geothermal development is allowed near these areas, in some cases the surface water expression could be disrupted, killing the wetland or hot spring as surely as a bulldozer. Subsurface hydrogeology can be complex, and changes to subsurface water flow can sometimes have unintended consequences. Many springs, both geothermal and non-geothermal, rely on deep underground water sources and cannot be protected simply by restricting surface or shallow groundwater use. Setback zones around these areas must include hydrogeology setbacks as well as surface use buffers. Subsurface setback zones should also be larger than those proposed in the plan.

Submission No: DOI-BLM-CO-140-2010-014-EA-0007
Commenter: James P. McCalpin
Affiliation: GEO-HAZ Consulting, Inc.

Comment: the only real protection for existing hot springs is to prohibit geothermal pumping within some reasonable distance of the springs, say 2 miles. This would be 2 miles from Valley View Hot Springs to the bottom of the proposed geothermal production well, not from some surface facilities that are offset from the well bottom via directional drilling.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0017
Commenter: Christine Canaly and Andrea Guajardo
Affiliation: San Luis Valley Ecosystem Council and Conejos County Clean Water, Inc.

Comment: Finally, we again recommend to "Designate a minimum 10-mile buffer zone to protect geothermal resources already prioritized for recreational/scenic values. Research shows that drilling for geothermal energy in proximity to other known geothermal features can disturb and damage these features. The National Park Service's web page on Yellowstone's geothermal resources states, "In Iceland and New Zealand, geothermal drill holes and wells 2.5 - 6.2 miles distant have reduced geyser activity and hot spring discharge. (http://www.nps.gov/yell/naturescience/geothermalresources.htm) This confirms the necessity of creating buffer zones along the fault lines so that geothermal resources with surface features are part of protected areas, such as national parks, or have already been identified for the recreational and scenic values. The SLV has a number of existing geothermal facilities including the Orient Land Trust, Joyful Journey Hot springs, Sand Dunes Swimming Pool & RV Park, and the Colorado Alligator Farm.

Summary: BLM should consider additional surface and subsurface setbacks around geothermal features.

Response: As described in Table 2-1, Description of Alternatives A, B, and C, known wetlands, including the Blanca ACEC and the McIntire-Simpson wetland complex would be closed to geothermal leasing in Alternatives B and C. Additionally, an NSO stipulation would apply within water bodies, riparian areas, and floodplains under both action alternatives. A CSU stipulation would apply within 500 feet of riparian or wetland vegetation, and wildlife buffers and timing limitations also cover many springs and wetland areas. In combination, these protections are adequate for any wetland, spring, or riparian area within the decision area.

As discussed in Section 1.4.1, Resource Geography, the BLM sought guidance from the US Geological Survey to review conflicting interpretations of the geology and hydrogeology for the San Luis Basin comments. In their expert opinion, the USGS noted that the lack of data and differing models used by the commenters highlights the high degree of uncertainty in the area. The BLM followed the requirements outlined in 40 CFR §1502.22 related to environmental impact analysis on the basis of incomplete information. The agency is not required to reach specific conclusions as long as its analysis is based on credible scientific research. Additional environmental impact analysis would occur at the project level before a geothermal well is permitted.

Finally, Section 1.4.3, State of Colorado Water Laws and Regulations, explains that the State of Colorado has jurisdiction over the water aspects of geothermal resources, including permitting wells and apportioning any water use. The BLM does not have the authority to restrict groundwater use.

New Alternative

Submission No.: DOI-BLM-CO-140-2010-014-EA-0010
Commenter: Alex Daue and Josh Pollock
Affiliation: The Wilderness Society and Rocky Mountain Wild

Comment: Identifying priority low-conflict zones can reduce impacts, conflicts and controversy as well as facilitating environmentally responsible development. We understand that identification of high-potential geothermal leasing zones in the San Luis Valley is more challenging than identifying high-potential Solar Energy Zones through the Solar PEIS because there is currently limited detailed information regarding geothermal heat flow in the San Luis Valley. However, we still believe the opportunity exists to identify priority low-conflict zones using the best currently available data and to refine those areas as additional data becomes available, and that BLM should take advantage of this opportunity to do so. Additional details including the types of lands which should and should not be included in zones and specific areas that could be considered in the San Luis Valley are included in Attachment 2.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0017
Commenter: Christine Canaly and Andrea Guajardo
Affiliation: San Luis Valley Ecosystem Council and Conejos County Clean Water, Inc.

Comment: We encourage the development of a comprehensive SLV BLM Energy Plan that coordinates Geothermal Leasing, Solar Study Areas and potential oil and gas/minerals development that uses your current SLV BLM Geothermal Environmental Assessment (EA) Table 4 - 6, Cumulative Projects list as a first step baseline approach towards integration.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0010
Commenter: Alex Daue and Josh Pollock
Affiliation: The Wilderness Society and Rocky Mountain Wild

Comment: Recommendation: BLM should identify priority low-conflict, high potential zones for geothermal leasing and development as part of the geothermal leasing EA process, as detailed in Attachment 2.

Summary: The BLM should consider several new alternatives, including identifying areas of low-conflict and high geothermal potential as part of the EA process.

Response: As discussed in Section 2.3, Alternatives Considered but Eliminated from Detailed Study, all of these alternatives were considered but eliminated from detailed analysis as none of them meet the purpose and need, and due to lack of consistent and reliable, site-specific, geothermal knowledge making these decisions highly speculative.

State Wildlife Area Stipulations

Submission No.: DOI-BLM-CO-140-2010-014-EA-0005
Commenter: Rick Basagoitia
Affiliation: Colorado Parks and Wildlife

Comment: Clearly, it is within the BLM's authority to make resource allocation decisions on the mineral estate with concurrence of the surface owner. CPW is the surface owner of the SWAs outlined in our scoping letter, and we have requested the minerals be withdrawn from geothermal leasing, or that the mineral estate be developed without impacting the surface through NSO designations.

Summary: The decision should be to apply NSO stipulations to all SWAs, not just the 2 areas mentioned in the preferred alternative.

Response: The BLM considered closing all SWAs in Alternative C and applying an NSO stipulation to all SWAs in Alternative B (see Table 2-1, Description of Alternatives A, B, and C).

Recreation Stipulations

Submission No.: DOI-BLM-CO-140-2010-014-EA-0010
Commenter: Alex Daue and Josh Pollock
Affiliation: The Wilderness Society and Rocky Mountain Wild

Comment: We also recommend NSO stipulations for all Special Recreation Management Areas. The environmental effects analysis finds that "by prohibiting surface development, an NSO stipulation would provide greater protection for recreational experiences of remoteness and solitude values than a CSU stipulation" (EA at 4-71). The public lands of the San Luis Valley Resource Area draw a variety of recreationists seeking spectacular scenery, wildlife viewing opportunities, and the sights and sounds of nature. Those experiences must be protected from geothermal development to ensure balanced management and multiple uses of the public lands.

Summary: BLM should consider an NSO stipulation for all SRMAs.

Response: As described in Table 2-1, Description of Alternatives A, B, and C, the BLM considered an NSO stipulation for all SRMAs under Alternative C.

Sage-grouse stipulations

Submission No.: DOI-BLM-CO-140-2010-014-EA-0008
Commenter: Jenny Nehring
Affiliation: Poncha Pass Gunnison Sage-grouse Local Working Group Coordinator

Comment: While geothermal leasing with NSO might be sufficient to protect GUSG and their habitat in other populations it is inadequate at Poncha Pass because of the unique hydrology of the area. The riparian habitat along San Luis Creek and the small creeks that flow into it are of particular importance at Poncha Pass as it provides critical habitat for GUSG hens with broods. Stream flow levels in San Luis Creek and the streams that flow into San Luis Creek at the north end of the Valley especially Decker, Swindinski, Lone Tree, Dorsey, Clover, Alder, and Rock Creek have been significantly reduced by the drought of the last 10 years, and aquifer depletions in the San Luis Valley. Any further disturbance to the hydrology in the Poncha Pass area would likely have detrimental effects on stream flows in the riparian areas and this would have a direct and immediate negative impact on successful GUSG reproduction.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0011
Commenter: Michael Spearman, Chair
Affiliation: Saguache County Board of County Commissioners

Comment: The BoCC respectfully requests that the additional Sage Grouse habitat protections in Alternative 8 be designated for the Poncha Pass area, and, Sage Grouse habitat areas along western Highway 114, in the Cochetopa corridor closer to Gunnison.

Summary: BLM should close the area around the Poncha Pass Gunnison Sage-grouse population.

Response: In response to public comment, the BLM modified the alternatives to include consideration of no surface occupancy stipulation on Gunnison sage-grouse leks and occupied habitat, a timing limitation for no human encroachment in mapped occupied habitat March 1 – August 15, and limitations in the controlled surface use stipulations in occupied habitat related to well pad surface density, noise limitations, and locations for compressors. This combined with other stipulations, including the slope NSO and riparian/wetland NSO will provide protections for the Poncha Pass Gunnison Sage-grouse habitat and population.

Trout Stipulations

Submission No.: DOI-BLM-CO-140-2010-014-EA-0009
Commenter: T.O. Smith
Affiliation: Trout Unlimited

Comment: Other stipulations that should be included in the EA are stronger buffers or riparian setbacks in order to prevent and minimize unnecessary or excess sedimentation and erosion impacts from increased traffic, roads, and accidental spills. TU believes that the 500 foot buffer NSO stipulations were applied through Tiering and not through adequate analysis consideration of the information available on RGCT and their habitat in the San Luis Valley resource planning area. Stronger buffers or riparian setbacks are needed in order to prevent and minimize unnecessary or excess sedimentation and erosion impacts from increased traffic, roads, and accidental spills. Current buffers of 500 feet or less are inadequate especially in core conservation habitat areas. The EA is negligent in not addressing the implementation of protective measures and stipulations for water resources.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0009

Commenter: T.O. Smith
Affiliation: Trout Unlimited

Comment: In addition, RGCT typically spawn between the beginning of May and the end of June depending on annual climate variations. TU recommends establishing a timing stipulation applied to restrict activities from occurring in drainages where RGCT populations are documented.

Summary: BLM needs to make better stipulations to reduce the risk of impacts on RGCT.

Response: In response to these comments, the BLM considered application of NSO stipulations within 0.5 mile from the ordinary high water mark in designated cutthroat habitat under Alternative C. The BLM also considered applying NSO stipulations within 0.5 mile from the centerline of streams in designated cutthroat habitat watersheds under Alternative C. Finally, the BLM considered a TL prohibiting human activities in designated cutthroat habitat from May 1 through June 30 under Alternative C (see Table 2-2, NSO, Timing Limitations, and CSU Constraints for Alternatives B and C).

Water Resource Stipulations

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: The stipulations should impose a minimum distance from geothermal springs and hot wells in which such monitoring is mandatory. Joyful Journey Spa and Mr. Blumenhein request that the BLM require monitoring of all existing geothermal springs and geothermal wells within a six-mile radius of the leased unit for one year prior to any new development to ensure non-injury to water rights and geothermal rights, and to protect these rare and unique geothermal features. Such monitoring should include rate of flow, water temperature and water quality parameters. Similar monitoring for changes in water flow should be required for all water wells within three miles of the new leased area.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: These requirements are not adequate to protect hot wells and hot springs typically having their source of heat from a greater depth or distance due to fracturing and faulting underground. Joyful Journey Spa and Mr. Blumenhein request that the lease stipulation applicable to any alternative adopted include at a minimum, notice to all geothermal spring and geothermal well owners within six miles of the leased property.

Summary: BLM should have a wider buffer (two to five miles wide) around the Joyful Journey Spa as a stipulation.

Response: In response to public comments, the BLM modified alternative C to consider no surface occupancy stipulation on federal mineral estate around one-half mile around the Joyful Journey Hot Springs, which provides analysis for the authorized officer to consider during their decision making process. The impacts associated with this action are described in Section 4.24, Water Resources.

IMPACT ANALYSIS

40 CFR 1508.27

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial." (40 CFR part 1508.27) OLT contends that the cost benefit analysis has great costs to OLT and its constituents and cannot be countered by any benefits presented by BLM leasing of geothermal resources. The costs to OLT are potentially permanent and reconstruction of the natural heat and waters would be impossible. There are no compelling advantages offered by BLM. Any advantages cannot overlook or dilute the huge impact to OLT.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "The degree to which the proposed action affects public health or safety." (40 CFR part 1508.27) OLT's heat and waters come from sources beyond typical groundwater supplies. The EPA voiced a concern regarding groundwater contamination in the 2008 EIS and was addressed with typical grouting and piping technology. What were not addressed are drinking water sources that reside outside typical shallow aquifer sources. The EA admits that any developed geothermal resource in a binary electrical generation would have an end of life, meaning the heat would be eventually consumed and no longer available. The second law of thermodynamics states that heat flows toward cold and creates entropy along the way. Extracting heat near OLT would necessarily cause heat to transfer away from OLT and toward any nearby developed geothermal resource. This flow of heat increases entropy and thusly means a significant disorder to the geothermal and water rights held and protected by OL T. It should be further stated that Colorado Department of Public Health and Environment has a significant interest in the Source Water Protection Plan implemented by OL T for its drinking water. Creating disorder to that source would run afoul to State mandates for water quality protections.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands. wetlands, wild and scenic rivers, or ecologically critical areas." (40 CFR part 1508.27) While the BLM's preferred plan presented in the EA for No Surface Occupancy addresses some of these concerns it does not adequately go far enough. The delicate balance of the natural resources and treasures of the area are far beyond the surface and view. The hot springs have run naturally for many years and been enjoyed culturally since the days of the Ute natives occupation of the valley. As stated in the context section, the critical ecology of the area is on par with the values protected in State and National parks, wildlife refuges and other environmentally designated areas; areas that are easily recommended as closed in the BLM proposals. 26,000 annual day and night visits to this wonderful ecology is very significant. On behalf of those people. OLT recommends a two mile closed buffer around OLT lands.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "The degree to which the effects on the quality of the human environment are likely to be highly controversial." (40 CFR part 1508.27) The Orient Land Trust has a very large member base, with many of them quite dedicated to the mission of OLT and the value of the unique ecology of the hot springs. Some come to love the bats, which rely on the water, some come to soak and enjoy the fireflies, which rely on the water, and others are quite interested in the relationship with US Fish and Wildlife Service and the protection of the Rio Grande Chub and the Rio Grande Sucker. It is almost a given that any actions around the OLT lands will be very controversial. The economic benefits to the area provided by OLT's existence is significant. The land trust employs 17 members and any impact to their jobs from exploration and development will bring vehement controversy.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states "The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks." (40 CFR part 1508.27) Many of the risks are very much unknown. It is OLT's opinion that further expert analysis needs to be done. Additionally the presumption needs to be that remote or unknown risks will occur, which would squarely place the burden of proof of no impacts on the prospector instead of the burden on OLT to prove injury has occurred from a lease that gets developed. By not designating the area as closed, the risks and the significant impacts would fall squarely on the shoulders of the BLM and their willingness to provide an avenue for unacceptable impacts to foster.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration." (40 CFR part 1508.27) Neglecting to treat ecologically sensitive areas is a very bad precedent and a poor decision. Relying on only those areas that have had the NEPA analysis- benefit of a recognized designation, such as a park, wildlife refuge, or wilderness study area, does not alleviate the responsibility to review the underlying principles and values that create those entities and apply them to areas that may not enjoy such a recognizable designation. Geothermal utilization most certainly has is place, but it is a bad precedent to allow it to replace existing utilizations, particularly when they are natural occurrences and have a significant human environmental component. This part of EPA is specifically applicable to plans and their impacts. The claim that, "it is just a plan" and that "a plan has no impacts" is simply erroneous.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts." (40 CFR part 1508.27) This part of NEPA also speaks to planning. The logic presented in the FONSI is limited by this EPA condition. It is highly likely the plan will have a cumulative significant impact. This will be true regardless of any production on the ground. Entities that strive to protect sensitive areas will continue to have to defend against an inadequate plan. These claims are quite reasonable and anticipated.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: NEPA states, "Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial." (40 CFR part 1508.27) OLT contends that the cost benefit analysis has great costs to OLT and its constituents and cannot be countered by any benefits presented by BLM leasing of geothermal resources. The costs to OLT are potentially permanent and reconstruction of the natural heat and waters would be impossible. There are no compelling advantages offered by BLM. Any advantages cannot overlook or dilute the huge impact to OLT.

Summary: The EA impact analysis fails the significance criteria outlined in 40 CFR 1508.27.

Response: As explained in 40 CFR § 1508.27 and the BLM NEPA Handbook (H-1701-1), the BLM should consider numerous factors in evaluating intensity of impacts for a significance determination. However, these factors are not mandatory criteria that, if satisfied, require preparation of an EIS. Rather, they are factors that should be considered when deciding whether, in the BLM's expert opinion, a federal action causes significant environmental effects. When conducting impact analysis, one or more

of these factors may be present while the totality of the circumstances surrounding the federal action will still result in no significant environmental effects.

The comments submitted, taken together, do not provide adequate reasons for the BLM to change its determination that no significant environmental effects will result from this action.

Plan-level Impacts

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: "The plan itself" has significant impact. Comment: The draft EA and unsigned FONSI summarily states that there are no impacts to a plan, and that impacts can only occur once an implementation takes place. This is a simply wrong. It is clear that a plan has impact in and of itself, especially when it involves the future planning for vast resources as does this one.

Summary: The planning allocation decisions have significant impacts and were not considered in the document.

Response: The EA's analysis of effects of geothermal development reflects a general approach, based on the analysis in the PEIS, on the Reasonably Foreseeable Development Scenario (RFDS), and on additional San Luis Valley-specific information (see Sections 1.1, Purpose and Need, 1.2, Description of the Planning Area, 1.5, Decisions to be Made, and 1.6.2 Programmatic EIS for Geothermal Leasing, Exploration, and Development). At the decision stage for the plan amendment, much of the impacts of actual development are speculative, as much is unknown about the location, scope, scale, and timing of that development. As explained in the EA, the proposed action has no direct impacts on the environment. The level of detail in the EA is sufficient to support reasoned conclusions by comparing the amount and the degree of change caused by the proposed action and alternatives.

Socioeconomic Impacts

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: These potential effects, especially the effects on the geothermal features and the businesses and jobs that rely directly on the use of those geothermal resources, demonstrate the need for greater protection of those features and those uses than currently proposed in the Draft EA. Joyful Journey Spa is one of the few local businesses and employers in the this area of the San Luis Valley, with a total of 25 employees and subcontractors. Joyful Journey Spa receives approximately 20,000 visitors a year. As such, it is a cultural and human resource that could be directly impacted by nearby geothermal development.

Summary: The EA did not address the socioeconomic impacts from the possibility of losing the geothermal resource.

Response: The BLM analyzed the socioeconomic impacts from the possibility of losing the geothermal resource in Section 4.19, Socioeconomics and Environmental Justice.

Transportation

Submission No.: DOI-BLM-CO-140-2010-014-EA-0002
Commenter: Tony Cady
Affiliation: State of Colorado, Dept. of Transportation

Comment: The SLVFO RMP fails to describe specific .impacts to the highway system from the proposed action and other alternatives. The specific impacts to both the state highways and interstate highways need to · be disclosed in the SL VFO RMP as both direct and indirect impacts) with mitigation measures included. Under the Council on Environmental Quality (CEQ} regulations, direct impacts are those that are caused by the action and occur at the same time and place n , and indirect impacts are "those that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable" (40 CFR Part 1508.8). The SLVFO RMP needs to disclose all effects from traffic entering and leaving the highway system from the proposed lease sites. These impacts will be direct to the highway system, or indirect through county or private roads accessing the highways. Regardless, the SLVFO RMP is deficient as it does not disclose these impacts to the highway system, nor address mitigation for these impacts.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0002
Commenter: Tony Cady
Affiliation: State of Colorado, Dept. of Transportation

Comment: CDOT has identified numerous intersections under the proposed action that would require access in1provements to safely accommodate the proposed truck turning movements and increases in traffic associated with resource development. This SLVFO RMP or future environmental assessment documents must specifically disclose the numbers of truck and other development related vehicle trips that will be accessing the highway at each intersection under the proposed action, and clearly identify these access points so that CDOT can review the impacts .

Submission No.: DOI-BLM-CO-140-2010-014-EA-0002
Commenter: Tony Cady
Affiliation: State of Colorado, Dept. of Transportation

Comment: This SLVFO RMP does not disclose impacts. of this project onto the highway including the physical deterioration of the local roads and state highways that will occur due to the tremendous increase in heavy truck traffic. Highways US 285, SH 17 and US 160 will receive much of the burden of transporting the heavy truck traffic from the lease areas. Some of these highways are listed by CDOT as having a Remaining Service Life (RSL) of zero. This means that the roads have deteriorated to the point that only a major reconstruction of the roadway will fix the inherent problems with the road surface. The SLVFO RMP does not address the direct impacts that the increased truck traffic will have on these roads, nor does it discuss mitigation for these impacts. This additional traffic may well reduce these roads to rubble.

Summary: The EA needs to discuss the impacts on the transportation network from the planning action and future development.

Response: The BLM described and analyzed the impacts on the transportation network from the planning action and future development in 4.12, Land Uses. The BLM also added a requirement to both action alternatives to coordinate with CDOT to minimize potential impacts on the roadway network before any geothermal development project begins (see Table 2-1, Description of Alternatives A, B, and

C). Site-specific analysis of access points and vehicle trips will occur at that project level once the location and details of a proposed project are known.

Trout

Submission No.: DOI-BLM-CO-140-2010-014-EA-0009
Commenter: T.O. Smith
Affiliation: Trout Unlimited

Comment: The EA fails to consider the impacts from geothermal development on RGCT populations and habitat.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0009
Commenter: T.O. Smith
Affiliation: Trout Unlimited

Comment: Specifically, the BLM needs to consider these specific needs, preferences and threats to the RGCT at a finer scale throughout the planning area and more aggressively apply closed to leasing and NSO designations in areas where RGCT occur in an additional alternative or in the preferred alternative. For example, the BLM should more closely analyze areas adjacent to and impacting Carnero and San Francisco Creeks, the South Fork of Cat Creek, Saguache Creek, Jahara Creek, the Alamosa River and their tributaries (see Maps 1-3).

Submission No.: DOI-BLM-CO-140-2010-014-EA-0009
Commenter: T.O. Smith
Affiliation: Trout Unlimited

Comment: Critical to the life cycle of the RGCT is their preference clear cold water, at temperatures less than 59 degrees F. Geothermal development and utilization activities could alter this limiting habitat factor through fragmentation, vegetation disturbance, erosion, sedimentation effects, and many other impacts. As a result, the BLM needs to include more in-depth analysis as to the impacts from geothermal development to surface and groundwater interactions.

Summary: BLM needs to analyze the impacts on RGCT from geothermal development.

Response: The BLM described and analyzed the impacts on RGCT from geothermal development in Section 4.9, Special Status Species. Due to uncertainty regarding the location of future geothermal projects, analysis of RGCT populations on specific creeks is not warranted at this planning level. Site-specific analysis of impacts on RGCT populations will occur at the project level once the location and details of a proposed project are known.

Water Resources

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: BLM presumes that a large scale power generation plant will be constructed in the San Luis Valley to support its analysis of potential impacts. BLM discounts the likelihood such power plant would be constructed near the Mineral Hot Springs, as too speculative, because the shallow ground water temperature is not hot enough. Joyful Journey Spa sits atop—-and is dependent on—-one of the hotter geothermal aquifers in the area. The area in the vicinity of Joyful Journey is one of the few hot spots in the San Luis Valley. These facts support the conclusion that there is a greater chance that development would impact Joyful Journey, and contradict BLM's statements that geothermal development in the vicinity of Joyful Journey is unlikely.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0007
Commenter: James P. McCalpin
Affiliation: GEO-HAZ Consulting, Inc.

Comment: Although statement 2 is true, the much larger effect on hot springs is withdrawing deep groundwater at geothermal depths (see Fig. 1). [statement 2: withdrawing shallow groundwater or surface water for cooling water purposes could affect nearby springs.]

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: Joyful Journey Spa and Mr. Blumenhein are concerned about the potential impacts from this decision and future activities under federal mineral leasing on the geothermal springs and hot well located on their lands, including potential interference or disruption in the flow of water from the springs and well, reduction in the temperature of those geothermal features, changes in water chemistry or water quality, and lowering of the shallow groundwater table in the unconfined and confined aquifer that provides the source of water for the cold well and irrigation and domestic wells on their properties. They are also concerned with potential loss of water or contamination of water in San Luis Creek that provides surface water to several of Mr. Blumenhein's large farm tracts.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: The EA fails to consider that withdrawal of water from that deep aquifer, contamination, or cooling of that aquifer, as a result of geothermal development in that aquifer, will cause impacts to Joyful Journey's hot springs and hot well.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0015
Commenter: Stephen P. Jeffers
Affiliation: Lyons, Gaddis, Kahn & Hall, PC (Joyful Journey Spa)

Comment: Under Colorado Geothermal Rules and the MOU, Joyful Journey Spa and Mr. Blumenhein would not receive any notice of well drilling into this resource if it is more than ½ mile from the springs or well, even if the new well would be drilled into the same heat or water source or directionally drilled within ½ mile of the springs underground. Joyful Journey could be injured by the federal lease without any notice or opportunity to protect their property rights. As a result, Colorado law is not sufficient to protect existing geothermal features or geothermal resources from injury. BLM should provide greater protection, and not rely solely on the State Geothermal Rules.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0017
Commenter: Christine Canaly and Andrea Guajardo
Affiliation: San Luis Valley Ecosystem Council and Conejos County Clean Water, Inc.

Comment: SLVEC did not see consideration for the potential impacts to water quality mentioned in the EA in regards to nearby riparian areas, wetlands and subsequent impacts to wildlife, biological and aquatic systems.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0022
Commenter: Paul Robertson
Affiliation: The Nature Conservancy

Comment: Groundwater pumping could negatively impact the hydrology of our properties as well as the other regionally and globally significant water resources in the area. In the arid San Luis Valley, groundwater level and quality is important to maintaining regionally and globally important wetland, riparian, and aquatic resources. In a time when the water community is under significant pressure to reduce the amount of groundwater pumping within the San Luis Valley, it does not seem prudent to create leases that would potentially increase this pumping.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: Though the EA states that [hot] springs can be part of sensitive ecosystems, recreation areas, or traditional cultural properties," and that withdrawing deep and shallow water can adversely effect hose values, under the preferred Alternative B, OLT/Valley View Hot Springs is afforded no protection, based on the faulty (in the case of OLT)

assumptions that the geothermal resources developed will be a t greater depths than the hot springs waters. In actuality, as has been set out several times elsewhere in this comment, as well as in the comment of Dr. James McCalpin, the waters of OLT come from nearly one mile below the surface, the same depth that geothermal development would achieve.

Summary: BLM's discussion of the types of impacts from presumed development is faulty and in need of revision.

Response: NEPA requires disclosure of unavailable information or when differences in expert opinion occur. Due to conflicting professional opinions regarding the geology and hydrology structure of the geothermal sources in the Valley, the BLM requested review of the EA and submitted comments by the United States Geological Survey and the Colorado Geological Survey. Both reviews confirmed that the current information provided in the document is accurate, but at the present time, further research is needed to better describe the San Luis Valley geothermal hydrology and geology. The EA includes a discussion of the expert review in Section 1.4.1, Resource Geography, in depth water resource discussion in Sections 3.20 and 4.24, Water Resources, and the geologic structure in Sections 3.6 and 4.10, Geology and Seismicity. Additionally, Appendix C details Best Management Practices (BMPs), including those for water resources, which the BLM can require as a condition of approval for any project. These BMPs include demonstrating an understanding of local hydrogeology and monitoring of hydrogeologic conditions throughout a project.

Additionally, this EA will not eliminate the need for site-specific environmental review for future site-specific geothermal leasing and development proposals. The BLM will make individual decisions on a case-by-case basis whether or not to authorize specific geothermal projects in conformance with the amended land use plan on the basis of this EA. When the BLM considers an application, the BLM decision maker must determine if it would conform to the applicable land use plan (43 CFR, 1610.5-3, 516 BM 11.5) and what level or type of environmental documentation is required. Analysis of proposed geothermal leases and/or projects must comply with NEPA, CEQ NEPA regulations (40 CFR, Parts 1500-1508) and the DOI NEPA manual. The public would have opportunities to participate and comment during the NEPA process (see Section 1.5, Decisions to be Made).

IMPLEMENTATION

Future NEPA analysis requirements

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: The EA suggests there may be site specific NEPA analyses. We request the plan mandate such oversight prior to any lease proposal and before too much investment is made into a potential site.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0006
Commenter: Linda Kaiser

Comment: Page A-16 describes the environmental review requirements for lease sales. Under this process, the BLM can choose to move forward with a lease without additional public input if the DNA determines that the existing environmental analysis is sufficient. For areas near environmentally sensitive areas such as wetlands fed by springs; hot springs; or sensitive plant and animal populations, additional analysis and public input should be provided prior to issuing a lease that could impact the existence or quality of these features. Small geothermal or

sensitive areas should receive the same scrutiny and protection as the larger geothermal or sensitive areas spelled out in the EA. Page B-3 states that in some cases, the RMP and the 2008 Geothermal PEIS may be sufficient NEPA; however, I would request that the RMP state that a new EA be performed for individual leases within 5-10 miles of a geothermal surface feature. I recognize that Colorado water law will also be applicable to these determinations, but strengthening the NEPA process will assist the public in understanding and participating in these individual lease decisions in sensitive areas.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0017

Commenter: Christine Canaly and Andrea Guajardo
Affiliation: San Luis Valley Ecosystem Council and Conejos County Clean Water, Inc.

Comment: In the draft EA, Pg 25, Tiering is mentioned as a way to provide "efficient environmental analysis." This process mentions how the future of NEPA and site specific analysis will move forward, determining a decision will be made on a "case-by-case basis". SLVEC is unclear about how this process will be implemented and request that the BLM spend some time explaining this to the public in a clearer manner. At this time, we do not understand how this will be applied to geothermal projects in an equitable manner.

Summary: The plan amendment should include a requirement for additional NEPA analysis for individual leases.

Response: The BLM added additional information to Section 1.5, Decisions to be Made to further clarify that additional analysis will be required at subsequent stages of lease nomination, sale, and development.

AFFECTED ENVIRONMENT

Lands with Wilderness Characteristics Inventory

Submission No.: DOI-BLM-CO-140-2010-014-EA-0010
Commenter: Alex Daue and Josh Pollock
Affiliation: The Wilderness Society and Rocky Mountain Wild

Comment: However, it's unacceptable to defer public release of the inventory and related management decisions to the final EA, when the public will not have an opportunity to comment. We recommend BLM publicly post the inventory of lands with wilderness characteristics when it is complete and provide a public comment period on the inventory prior to finalizing the EA.

Summary: BLM needs to release the LWC inventory for public review prior to finalizing the EA.

Response: The BLM included a summary of the lands with wilderness characteristics (LWC) inventory in Section 3.9, Lands with Wilderness Characteristics. The full inventory is included in Appendix G, San Luis Valley Field Office Wilderness Characteristics Inventory: 2012 Update.

The public will have an opportunity to review the LWC inventory findings prior to final decision record being signed. The EA was released for a 30-day protest period providing the public an administrative review of the proposed land use plan decisions. The protest review and resolution process may result in changes to the document; only after the protests are resolved will BLM sign the decision record.

Vegetation

Submission No.: DOI-BLM-CO-140-2010-014-EA-0020
Commenter: Suzanne Ewy
Affiliation: Orient Land Trust

Comment: The Draft EA does not consider the fact that OLT has a three mile restored riparian corridor with attached wetlands that is habitat to many wild species of animals and plants, several of which are BLM sensitive species and Colorado species of concern as described below.

Summary: The BLM did not consider the restored riparian habitat on the OLT private land in the affected environment section of the document.

Response: The affected environment section must succinctly describe the existing condition and trend of issue-related elements of the human environment that may be affected by implementing the proposed action or an alternative. Most appropriately discussed in the cumulative impact section ("the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 CFR 1508.7)). Information regarding riparian improvements on OLT lands was added to the cumulative impact section of the document.

Water Resources

Submission No.: DOI-BLM-CO-140-2010-014-EA-0007
Commenter: James P. McCalpin
Affiliation: GEO-HAZ Consulting, Inc.

Comment: Most of the water flowing out of a hot springs is deep groundwater, not shallow groundwater. This deep groundwater has circulated down the fault plane to considerable depths, where it was heated, and has then risen to the surface (see Fig. 1). So it is a fundamental misunderstanding on the part of BLM to state that that the geothermal water to be developed comes from greater depths than the hot springs water. In fact, both of these waters come from the same depth, and extracting one at those depths (see Figure 1) will have an effect on the other. To confirm this, consult any hydrogeology textbook.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0012
Commenter: Paul Morgan

Comment: Colorado experienced extensive volcanic activity 25 to 35 million years ago, but this activity has tapered off since 25 million years. In the past 5 million years activity has been restricted to relatively small basaltic flows. These flows are not considered to be good indicators for high-temperature geothermal resources. The lack of significant volcanic activity in the past 500,000 years and the lack of chemical indicators in the thermal springs of Colorado symptomatic of interaction with volcanic gases and other volcanic products strongly suggest that none of the thermal waters in Colorado are derived from high-temperature (> 350°F) geothermal reservoirs. The waters are probably heated by deep circulation to a depth of a mile or two, with maximum temperatures of about 300°F or less. This is the maximum temperature that is indicated by geothermometry at a number of the thermal springs in the state (J. K. Barrett and R. H. Pearl, 1976, An appraisal of Colorado's geothermal resources, CGS, Denver, CO, Bull. 39, 224 pp.; and CGS data submitted to the National Geothermal Data Center, 2012). Although there was extensive geothermal leasing in Colorado in the late 1970s and 1980, reservoirs at this temperature were not hot enough to generate electricity with the technology available at that time ('dry steam' and 'flash' power plants). The commercial introduction of binary power plants in the past 20 years has allowed the use of lower temperature geothermal resources, 300°F or less. However, binary power plants are generally of lower capacity than power plants using high-temperature geothermal resources. From what

is known about the geothermal resources in the San Luis Valley (SLV), individual power plants in the SLV are likely to be smaller than 5 to 10 MW. Future developments in technology are difficult to predict, but at least for the lifetime of the current EA, there are no indications of a single geothermal resource sustaining generation of more than 10 MW.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0013
Commenter: Frederick B. Henderson III, PhD
Affiliation: Mt. Princeton Geothermal LLC

Comment: The land access restrictions appear to be made with LITTLE or NO recognition of where actual geothermal potential for exploration or development exists. It is RECOMMENDED that the BLM should take into account the distribution of known hot springs and areas of high heat flow. Such information can be provided by the Colorado and the U.S. Geological Surveys and others.

For example, the location of hot springs listed below in the three counties covered in the BLM Plan (Richard Pearl, 1979; Colorado's Hydrothermal Resource Base – An Assessment, CGS Resource Series 6) are not indicated in the areas designated for closure or restricted access (NSO).

- Saguache County: Mineral Hot Springs; Valley View Hot Springs; Shaw's Warm Springs,
- Alamosa County: Sand Dunes Swimming Pool Hot water Well; Splashed Hot water Well;
- Conejos County: Dexter and McIntyre Warm Springs.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0017
Commenter: Christine Canaly and Andrea Guajardo
Affiliation: San Luis Valley Ecosystem Council and Conejos County Clean Water, Inc.

Comment: SLVEC recommends another source to add to the long list of reference material included in the EA regarding the study of groundwater resources. It is the 1987 HRS San Luis Valley Confined Aquifer Study phase one final report, supported by the Colorado Water Resources & Power Development Authority. Our understanding is that it was a study to determine the economic feasibility of agricultural users to develop the deep aquifer. A moratorium was placed on deep aquifer drilling by the Colorado State Water Division Engineer's office for agricultural use in 1972 and this subsequent study clarifies that development of the deep aquifer would not be economically feasible for agriculture. There are a variety of conclusions but the jist of it is that there is communication between the aquifers flowing in both directions (surface to deep and visa versa); the water moves slower in the deeper layers so the water quality is heavily mineralized (not potable) and the "cone of depression" when water is pumped at these deep levels can develop a significant radius of impact. The same conclusions could obviously be drawn regarding geothermal drilling and subsequent development.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0017
Commenter: Christine Canaly and Andrea Guajardo
Affiliation: San Luis Valley Ecosystem Council and Conejos County Clean Water, Inc.

Comment: SLVEC respectfully requests that the *2 billion acre feet* estimate be removed from this government document. There is no conclusive evidence that proves this marketing assumption and to the contrary, there is much evidence that indicates a far more complex layer of geologic systems that do not necessarily contain water.

Summary: The BLM should consider the information provided by commenters related to site specific water resources near hot springs and in the San Luis Valley, including some studies not previously noted in the EA.

Response: NEPA requires disclosure of unavailable information or when differences in expert opinion occur. Due to conflicting professional opinions regarding the hydrology structure of the geothermal sources in the Valley, the BLM requested review of the EA and submitted comments by the United States Geological Survey and the Colorado Geological Survey. Both reviews confirmed that the current

information provided in the document is accurate, but at the present time, further research is needed to better describe the San Luis Valley geothermal hydrology. The EA includes a discussion of the expert review in Section 1.4.1, Resource Geography, and the specific water resource information in Sections 3.20 and 4.24, Water Resources, and some of the information has been incorporated into the affected environment.

This EA will not eliminate the need for site-specific environmental review for future site-specific geothermal leasing and development proposals. The BLM will make individual decisions on a case-by-case basis whether or not to authorize specific geothermal projects in conformance with the amended land use plan. When the BLM considers an application, the BLM decision maker must determine if it would conform to the applicable land use plan (43 CFR, 1610.5-3, 516 BM 11.5) and what level or type of environmental documentation is required. Analysis of proposed geothermal leases and/or projects must comply with NEPA, CEQ NEPA regulations (40 CFR, Parts 1500-1508) and the DOI NEPA manual (see Section 1.5, Decisions to be Made). For example, one of the sources notes that "data from water wells in the deep confined aquifer are sparse, and therefore are highly site-specific" (HRS Water Consultants 1987, pg. S-3). Information related to geothermal potential in one area of the Valley vs. another area was generally discussed in Section 1.4, Colorado Geothermal Potential, and more site-specific information will be considered at later stages of geothermal development and environmental analysis. BLM will be able to consider this site-specific data collection and analysis at this later stage of environmental assessment once project locations are confirmed. The public will have opportunities to participate, provide additional site specific information, and comment on the analysis during the NEPA process.

MONITORING

Submission No.: DOI-BLM-CO-140-2010-014-EA-0006
Commenter: Linda Kaiser

Comment: Page 4-22 and 4-24 describe monitoring to be performed prior to geothermal development and during the first one or two years of plant operation. The details of the monitoring are not very specific, so it is difficult to evaluate if the proposed monitoring is sufficient either to develop a baseline for the area prior to development or to monitor the effects on nearby areas after development. Short-term climate fluctuations have a very significant impact on water flow in surface expressions. Ten to twenty years of data prior to operations and several additional years after operations begin may be needed to develop data sufficient to establish that there is "no material injury" to a sensitive ecosystem, a hot springs, or a nearby rights holder. While the law will require reparation or cessation of operations if unintended disruption occurs, in some cases there may be no way to restore original conditions. Larger setbacks around ecologically sensitive areas would reduce the probability of unintended damage. However, the plan should also require more years of baseline data collection for leases near sensitive areas that may be affected by geothermal development. The plan states that the State would be involved in helping develop the monitoring plans, so perhaps the EA merely needs to cite a current State procedure or guideline that will be used to develop the individual monitoring plans.

Submission No.: DOI-BLM-CO-140-2010-014-EA-0007
Commenter: James P. McCalpin
Affiliation: GEO-HAZ Consulting, Inc.

Comment: Baseline data by definition is collected on a natural system prior to a proposed disturbance. Since fault-hosted hot springs contain a mixture of both deep geothermal water and shallow meteoric water, their discharge and temperature are influenced by seasonal and yearly changes in precipitation. In order to define how climate fluctuations affect a hot spring such as Valley View Hot Springs in its natural condition, you would need your baseline data to span years of widely variable precipitation. To ensure you capture this range, you would need 5-10 years of baseline data to cover a spread of precipitation values and to measure the corresponding hot spring response in terms of spring discharge and temperature. [statement: would

require a water monitoring plan that would collect baseline data from the springs]

Submission No.: DOI-BLM-CO-140-2010-014-EA-0007
Commenter: James P. McCalpin
Affiliation: GEO-HAZ Consulting, Inc.

Comment: Collecting data on nearby hot springs for "a year or two of operations" will form an insufficient basis to prove or disprove that any changes in the spring discharge or temperature were caused by geothermal development, as opposed to being caused by natural variation in precipitation, or in other components of the water balance. It is extremely difficult to prove such causation in a court of law, normally because there is insufficient baseline data collected prior to the project, so the variation of the hot springs under natural conditions is inadequately quantified.

Summary: BLM should better define monitoring requirements for developments.

Response: Appendix C, Best Management Practices, describes monitoring requirements for geothermal projects in more detail than in Chapter 4. Some details of required monitoring plans are not included in the appendix to allow for tailoring plans to fit the specific circumstances and needs of each project.

The BLM corrected the excerpted statement on a water monitoring plan to reflect the fact that the required plan would include existing baseline data from the springs, which may span years before project proposal.

MITIGATION

Transportation

Submission No.: DOI-BLM-CO-140-2010-014-EA-0002
Commenter: Tony Cady
Affiliation: State of Colorado, Dept. of Transportation

Comment: The SL VFO RMP must include mitigation measures for the access and roadway impacts to the state highway. Companies that obtain the leases should be required to provide safe access including obtaining permits and constructing the necessary safety improvements such as acceleration/deceleration lands onto the state highway. Additionally, leasees should be responsible for any necessary reconstruction/resurfacing of the highways caused by the large increase in truck volume.

Summary: The EA needs to discuss mitigation measures for the impacts on the transportation network from the planning action and future development.

Response: In response to this comment, the BLM added a requirement to both action alternatives to coordinate with CDOT to minimize potential impacts on the roadway network before any geothermal development project begins (see Table 2-1, Description of Alternatives A, B, and C). Identification of site-specific mitigation measures will occur at that project level once the location and details of a proposed project are known.

PLANNING

Submission No.: DOI-BLM-CO-140-2010-014-EA-0013
Commenter: Frederick B. Henderson III, PhD
Affiliation: Mt. Princeton Geothermal LLC

Comment: In addition to existing hot springs being indicative of areas of interest for geothermal exploration, areas of known higher heat flow also indicate areas for possible exploration. Heat flow studies rely on the drilling of thermal gradient holes or heat flow measurements in existing deep water and oil/gas wells. Studies have been conducted by the Colorado Geological Survey among others from limited heat flow hole measurements and oil/gas wells in the San Luis Valley. These areas should not be preemptively closed or restricted (NSO) without assessing their geothermal potential.

Summary: Areas should not be preemptively closed or restricted without assessing their geothermal potential.

Response: BLM planning regulations and policy (BLM Land Use Planning Handbook, H-1610-1) require the agency to identify the following:

- Areas open to leasing, subject to existing laws, regulations, and formal orders, including the terms and conditions of the standard lease form;
- Areas open to leasing, subject to moderate constraints such as seasonal and controlled surface use restrictions;
- Areas open to leasing, subject to major constraints such as no surface occupancy stipulations on an area more than 40-acres in size or more than 0.25 mile in width;
- Areas closed to leasing;
- General and/or typical conditions of approval and best management practices that would be employed to accomplish other resource goals and objectives; and,
- Explanation of the circumstances for granting an exception, waiver, or modification.

The plan-level decisions outlined in the three alternatives represent BLM's consideration, based on the information available at this time, that it is appropriate to allow development of the parcel consistent with the terms of a possible future lease and laws, regulations, and orders, and subject to reasonable conditions of approval.

POLICIES

Trout Conservation Strategy

Submission No.: DOI-BLM-CO-140-2010-014-EA-0009
Commenter: T.O. Smith
Affiliation: Trout Unlimited

Comment: The BLM must include in the EA a review of the commitments to the Conservation Team and the Conservation Strategy developed to achieve the conservation management activities for protecting and assuring the long-range viability of RGCT throughout their range.

Summary: BLM should include the Conservation Strategy in the EA.

Response: An overview of the Conservation Strategy was added to the EA in Section 3.4.6, BLM Sensitive Species, specifically the RGCT discussion.

This page intentionally left blank.

CHAPTER 6
LIST OF PREPARERS

This RMP Amendment/EA was prepared by an interdisciplinary team of staff from the BLM and Environmental Management and Planning Solutions, Inc. (EMPSi). The following is a list of people that prepared or contributed to the development of the RMP Amendment/EA.

Name	Title
BUREAU OF LAND MANAGEMENT	
Joseph Vieira	Project Manager, Renewable Energy Team
Nancy Keohane	NEPA Specialist, Renewable Energy Team
Jeff Brown	Realty Specialist, Renewable Energy Team
Gale Finan	Wildlife Biologist, Renewable Energy Team
Alicia Beat	Archeologist, Renewable Energy Team
Melissa Garcia	Wildlife Biologist
Harold Dyer	Environmental Coordinator and Acting Planner
Mike Blakeman	Public Affairs Officer
James Wood	Planning and Environmental Coordinator, Colorado State Office
Sherri Thompson	Natural Resource Specialist, Colorado State Office

Name	Role/Responsibility	Education
ENVIRONMENTAL MANAGEMENT AND PLANNING SOLUTIONS, INC. (EMPSI)		
Angie Adams	Technical Writer (Chapter 4)	BA, Biology, Drake University
David Batts	Project Manager	MS, Natural Resource Planning, Michigan State University; BS, International Development, Lewis and Clark College
James Bode	Recreation, Special Designated Areas	BA, Environmental Studies, University of Colorado
Amy Cordle	Air Resources	BS, Civil Engineering, Virginia Polytechnic Institute and State University
Andrew Gentile	Water Resources, Geology and Seismicity, Fluid Minerals, Renewable Energy	MS, Environmental Management, University of San Francisco BS, Biochemistry, University of Waterloo
Zoe Ghali	Soils, Rangelands and Grazing, Socioeconomics and Environmental Justice	MS Environmental Physiology, University of Colorado; BS Biology, University of California, Santa Barbara
Julia Howe	Visual Resources	MLA, Landscape Architecture, Rhode Island School of Design BA, Psychology, Colorado College
Jenna Jonker	GIS Specialist	BA, Geography, Calvin College
Laura Long	Technical Editor	MA, Media and Communications, European Graduate School
Carol-Anne Murray	Deputy Project Manager; Paleontological Resources; Cultural Resources; Health and Safety	MA, Anthropology, University of Wyoming; BA, Anthropology, University of California, Los Angeles
Holly Prohaska	Technical Writer and Editing	MS, Environmental Management, Univ. of San Francisco; BA, Marine Science, Biological Pathway, Univ. of San Diego

Name	Role/Responsibility	Education
Marcia Rickey	GIS Specialist	MS, Biology, Conservation Biology Sequence, Illinois State University; BS, Biology University of Dayton
Chad Ricklefs	Technical Writer and Editing; Lands	MURP, Environmental Planning, University of Colorado; BA, Political Science and Environmental Conservation, University of Colorado
Drew Vankat	Transportation, Access and Travel Management	MS, Environmental Policy and Planning, University of Michigan; BPh, Urban and Environmental Planning, Miami University
Jennifer Whitaker	Technical Writer	MS, Project Management, Regis University; BS, Public Affairs, Concentration Natural Resource Management, Indiana University
Ernst Strenge	Ecology, Technical Editing	MS, Ecology, Colorado State University; BS, Natural Resources and Environmental Science, University of Illinois
Meredith Zaccherio	Vegetation, Riparian Resources, Wildlife Resources, Special Status Species	MA, Biology, Boston University; BS, Biology, SUNY Binghamton; BS, Environmental Science, SUNY Binghamton

This page intentionally left blank.

CHAPTER 7
GLOSSARY AND REFERENCES

7.1 GLOSSARY

Aquaculture: Farming of organisms that live in water, such as fish, shellfish, and algae.

Allotment: An area of land where one or more operators graze their livestock. It generally consists of public lands but may include parcels of private or state-owned lands. The number of livestock and period of use are stipulated for each allotment.

Amendment: The process for considering or making changes in the terms, conditions, and decisions of approved RMPs using the prescribed provisions for resource management planning appropriate to the proposed action or circumstances. Usually only one or two issues are considered that involve only a portion of the planning area.

Analysis area: Any lands, regardless of jurisdiction, for which the BLM synthesizes, analyzes, and interprets data and information that relates to planning for BLM-administered lands. The analysis area can be any size, can vary according to resource, and can be located anywhere within, around, partially outside, or completely outside the planning or decision areas.

Animal Unit Month (AUM): The amount of forage necessary for the sustenance of one cow or its equivalent for a period of one month (approximately 800 pounds of air-dried material per AUM). A full AUM's fee is charged for each month of grazing by adult animals if the grazing animal: 1) is weaned, 2) is six months or older when entering public land, or 3) will become 12 months old during the period of use. For fee purposes, an AUM is the amount of forage used by five weaned or adult sheep or goats or one cow, bull, steer, heifer, horse, or mule. The term AUM is commonly used in three ways:

1) stocking rate, as in X acres per AUM, 2) forage allocation, as in X AUMs in allotment A, and 3) utilization, as in X AUMs consumed from Unit B.

Area of Critical Environmental Concern (ACEC): Special Area designation established through the BLM's land use planning process (43 CFR 1610.7-2) where special management attention is needed to protect and prevent irreparable damage to important historical, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards. The level of allowable use within an ACEC is established through the collaborative planning process. Designation of an ACEC allows for resource use limitations in order to protect identified resources or values.

Assessment: The act of evaluating and interpreting data and information for a defined purpose.

Best Management Practices (BMP): A suite of techniques that guide, or may be applied to, management actions to aid in achieving desired outcomes. BMPs are often developed in conjunction with land use plans, but they are not considered a land use plan decision unless the land use plan specifies that they are mandatory. They may be updated or modified without a plan amendment if they are not mandatory.

Casual use: Activities on public lands that have negligible disturbance. No notification to or approval by the authorized officer is required for casual use operations. However, casual use operations are subject to monitoring by the authorized officer to ensure that unnecessary or undue degradation of federal lands will not occur. (43 CFR 3809)

Class I airshed: For attainment areas that already meet the national ambient air quality standards, the federal Prevention of Significant Deterioration program establishes a three-tier classification defining the extent to which baseline air quality conditions can be degraded. Class I areas, which have the smallest allowable air quality deterioration limits, consist of 88 wilderness areas managed by the USFS, 48 areas managed by the National Park Service, one area managed by an international park commission, 21 areas managed by the USFWS, and five tribal reservation areas.

Closed: Generally denotes that an area is not available for a particular use or uses; refer to specific definitions found in law, regulations, or policy guidance for application to individual programs. For example, 43 CFR 8340.0-5 sets forth the specific meaning of "closed" as it relates to OHV use, and 43 CFR 8364 defines "closed" as it relates to closure and restriction orders.

Collaboration: A cooperative process in which interested parties, often with widely varied interests, work together to seek solutions with broad support for

managing public and other lands. This may or may not involve an agency as a cooperating agency.

Collaborative partnerships and collaborative stewardship: Refers to people working together, sharing knowledge and resources, to achieve desired outcomes for public lands and communities within statutory and regulatory frameworks.

Conformance: Means that a proposed action shall be specifically provided for in the land use plan or, if not specifically mentioned, shall be clearly consistent with the goals, objectives, or standards of the approved land use plan.

Conservation agreement: A formal signed agreement between the USFWS or National Marine Fisheries Service and other parties that implements specific actions, activities, or programs designed to eliminate or reduce threats or otherwise improve the status of a species. Conservation agreements can be developed at a state, regional, or national level and generally includes multiple agencies at the state and federal level, as well as tribes. Depending on the types of commitments the BLM makes in a conservation agreement and the level of signatory authority, plan revisions or amendments may be required prior to signing the conservation agreement, or subsequently in order to implement the conservation agreement.

Conservation strategy: A strategy outlining current activities or threats that are contributing to the decline of a species, along with the actions or strategies needed to reverse or eliminate such a decline or threats. Conservation strategies are generally developed for species of plants and animals that are designated as BLM sensitive species or that have been determined by the USFWS or National Marine Fisheries Service to be federal candidates under the ESA.

Consistency: Proposed land use plan does not conflict with officially approved plans, programs, and policies of tribes, other federal agencies, and state and local governments to the extent practical within federal law, regulation, and policy.

Controlled Surface Use (CSU) The CSU stipulation is intended for application where standard lease terms and permit-level decisions are deemed insufficient to achieve the level of resource protection necessary to protect the public interest but where an NSO is deemed overly restrictive. A CSU stipulation allows BLM to require that a proposed facility or activity be relocated by more than 200 meters from the proposed location if necessary to achieve the desired level of protection. A CSU is not required if relocating a proposed facility or activity by up to 200 meters would be sufficient for protection of the specified resources.

Cooperating agency: Assists the lead federal agency in developing an EA or EIS. The CEQ regulations implementing NEPA defines a cooperating agency as

any agency that has jurisdiction by law or special expertise for proposals covered by NEPA (40 CFR 1501.6). Any tribe or federal, state, or local government jurisdiction with such qualifications may become a cooperating agency by agreement with the lead agency.

Condition of Approval (COA): A site-specific and enforceable requirement included in an approved Application for Permit to Drill or Sundry Notice that may limit or amend the specific actions proposed by the operator. Conditions of Approval minimize, mitigate, or prevent impacts on resource values or other uses of public lands.

Decision area: The lands within a planning area for which the BLM has authority to make land use and management decisions. In general, the BLM had jurisdiction over all BLM-administered lands (surface and subsurface mineral estate) and over the subsurface minerals only in areas of split estate.

Directional drilling: The intentional deviation of a well bore from a vertical position to reach subsurface areas off to one side from the drilling site.

Endangered species: As defined in the federal Endangered Species Act of 1973, any species which is in danger of extinction throughout all or a significant portion of its range. For terrestrial species, the USFWS determines endangered status.

Environmental Assessment (EA): A public document for which a federal agency is responsible that serves to; (a) briefly provide sufficient evidence and analysis for determining whether to prepare an EIS or a finding of no significant impact; (b) aid an agency's compliance with the NEPA when no EIS is necessary; (c) Facilitate the preparation of a statement when one is necessary. An EA includes brief discussions of the need for the proposal and of the environmental impacts of the proposed action and other alternatives.

Environmental Impact Statement (EIS): A written analysis of the impacts on the natural, social, and economic environment of a proposed project or resource management plan.

Extensive Recreation Management Area: an area that emphasizes the traditional dispersed recreation use of public lands. ERMAs have an undeveloped character that allows visitors to escape crowds, reply on their own skills and equipment for recreation pursuits, and freedom from stricter regulations. All lands that are not within a designated SRMA revert to the ERMA category.

Evaluation (plan evaluation): The process of reviewing the land use plan and the periodic plan monitoring reports to determine whether the land use plan decisions and NEPA analysis are still valid and whether the plan is being implemented.

Exception: is a one-time exemption for a particular site within the leasehold; exceptions are determined on a case-by-case basis; the stipulation continues to apply to all other sites within the leasehold. An exception is a limited type of waiver.

Extinction: The disappearance of a species or group of species. The moment of extinction is generally considered to be the death of the last individual of that species.

Federal land: Land owned by the US, without reference to how the land was acquired or which federal agency administers the land, including mineral and coal estates underlying private surface.

Federal Land Policy and Management Act of 1976 (FLPMA): Public Law 94-579, which gives the BLM legal authority to establish public land policy, to establish guidelines for administering such policy and to provide for management, protection, development and enhancement of the public land.

Geographic Information Systems (GIS): A computer system capable of storing, analyzing, and displaying data and describing places on the earth's surface.

Geothermal potential area: Any area that may contain underground reservoirs of hot water or steam created by heat from the earth, or that have subsurface areas of dry hot rock.

Geothermal energy: Natural heat from within the Earth, captured for production of electric power, space heating or industrial steam.

Geothermal Features: Geothermal features are the materials or landforms (e.g., hot springs, geysers, mud pots) formed by processes related to the heat of Earth's interior.

Geothermal heat pumps: Devices that take advantage of the relatively constant temperature of the Earth's interior, using it as a source and sink of heat for both heating and cooling. When cooling, heat is extracted from the space and dissipated into the Earth; when heating, heat is extracted from the Earth and pumped into the space.

Geothermal power plant: A power plant in which the prime mover is a steam turbine. The turbine is driven either by steam produced from hot water or by natural steam that derives its energy from heat found in rocks or fluids at various depths beneath the surface of the Earth. The energy is extracted by drilling and/or pumping.

Heat pump: A heat and cooling source. Heat pumps extract heat from either the air or ground and transfer that heat by circulating a refrigerant through a

cycle of alternating evaporation and condensation. The cycle can be reversed for cooling. The efficiency of an air source heat pump varies tremendously with climate while ground source heat pumps take advantage of stable ground temperatures to deliver consistent performance.

Historic resources: material remains and the landscape alterations that have occurred since the arrival of Euro-Americans.

Implementation decisions: Decisions that take action to implement land use plan decisions. They are generally appealable to Interior Board of Land Appeals under 43 CFR 4.40.

Implementation plan: A site-specific plan written to implement decisions made in a land use plan. An implementation plans usually selects and applies BMPs to meet land use plan objectives. Implementation plans are synonymous with "activity" plans. Examples of implementation plans include interdisciplinary management plans, habitat management plans, and allotment management plans.

Indian Trust Assets (ITA): Legal interests in assets held in trust by the federal government for recognized Indian tribes or nations or for individual Indians.

Invertebrate: Animals without vertebrae (back bones) or notochord.

Known Geothermal Resource Area: A region identified by the USGS as containing geothermal resources. New leasing regulations no longer use Known Geothermal Resource Areas as a basis for the leasing process.

Lease stipulation: A condition of lease issuance that provides a level of protection for other resource values or land uses by restricting lease operations during certain times or locations or to avoid unacceptable impacts, to an extent greater than standard lease terms or regulations. A stipulation is an enforceable term of the lease contract, supersedes any inconsistent provisions of the standard lease form, and is attached to and made a part of the lease. Lease stipulations further implement the BLM's regulatory authority to protect resources or resource values. Lease stipulations are developed through the land use planning process.

Land use allocation: The identification in a land use plan or land use plan amendment of the activities and foreseeable development that are allowed, restricted, or excluded for all or part of the planning area, based on desired future conditions.

Land use plan: A set of decisions that establish management direction for land within an administrative area for the BLM. BLM plans are commonly called Resource Management Plans (RMPs), although older plans are called Management Framework Plan or Management Plan.

Land use plan decision: Establishes desired outcomes and actions needed to achieve them. Decisions are reached using the planning process in 43 CFR 1600. When they are presented to the public as proposed decisions, they can be protested to the BLM Director. They are not appealable to Interior Board of Land Appeals.

Lands with wilderness characteristics: Those lands that have been inventoried and determined by the BLM to contain wilderness characteristics as defined in Section 2(c) of the Wilderness Act (see definition for *wilderness characteristics*). Outside of existing wilderness study areas, the BLM has the discretion on how the lands are managed. Management prescriptions for lands with wilderness characteristics are documented in resource management plans or amendments thereto.

Leasable minerals: Minerals such as coal, oil shale, oil, natural gas, phosphate, potash, sodium, geothermal resources, and all other minerals that may be acquired under the Mineral Leasing Act of 1920, as amended.

Locatable minerals: A mineral subject to location under the 1872 mining laws. Examples of such minerals would be gold, silver, copper, and lead as compared to oil and natural gas, which are leasable minerals.

Management decision: A decision made by the BLM to manage public lands. Management decisions include both land use plan decisions and implementation decisions.

Mineralized: The process where a substance (in this case, the buried remains of plants or animals) is converted from an organic substance to an inorganic substance, thereby becoming mineralized.

Modification: A change to the provisions of a lease stipulation, either temporarily or for the term of the lease. Depending on the specific modification, the stipulation may or may not apply to all sites within the leasehold to which the restrictive criteria are applied.

Monitoring (plan monitoring): The process of tracking the implementation of land use plan decisions.

National Ambient Air Quality Standards: The Clean Air Act requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality 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, damage to animals, crops, vegetation, and buildings. The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality

Standards for six principal (also called "criteria") pollutants: carbon monoxide, lead, nitrogen dioxide, particulate matter at 10 micrometers and 2.5 micrometers, ozone, and sulfur dioxide. Additional information is available at the EPA website: http://www.epa.gov/air/criteria.html (accessed 4/13/2011).

National Environmental Policy Act (NEPA) of 1969: A law enacted on January 1, 1970, that established a national policy to maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans. It established the Council on Environmental Quality (CEQ) for coordinating environmental matters at the federal level and to serve as the advisor to the President on such matters. The law made all federal actions and proposals that could have significant impact on the environment subject to review by federal, state, and local environmental authorities.

Native (indigenous) species: A species of plant or animal that naturally occurs in an area and that was not introduced by humans.

No Surface Occupancy (NSO): A fluid minerals leasing constraint that prohibits occupancy or disturbance on all or part of the lease surface to protect special values or uses. Lessees may exploit the fluid mineral resources under the leases restricted by this constraint through use of directional drilling from sites outside the NSO area.

Objective: A description of a desired condition for a resource. Objectives can be quantified and measured and, where possible, have established time frames for achievement.

Open: Generally denotes that an area is available for a particular use or uses. Refer to specific program definitions found in law, regulations, or policy guidance for application to individual programs. For example, 43 CFR 8340.0-5 defines the specific meaning of "open" as it relates to OHV use.

Permitted use: The forage allocated by, or under the guidance of, an applicable land use plan for livestock grazing in an allotment under a permit or lease; expressed in AUMs (43 CFR 4100.0-5).

Permittee: A person or company permitted to graze livestock on public land.

Planning area: The geographic area within which the BLM will make decisions during a planning effort, regardless of surface jurisdiction; however, the BLM will only make decisions on lands that fall under the BLM's jurisdiction, including subsurface minerals. The planning area for the SLVFO RMP Amendment/EA is the geographic area associated with the BLM SLVFO, and excludes USFS lands.

Planning analysis: A process using appropriate resource data and NEPA analysis to provide a basis for decisions in areas not covered by RMP decisions.

Planning criteria: The standards, rules, and other factors developed by managers and interdisciplinary teams for their use in forming judgments about decision-making, analysis, and data collection during planning. Planning criteria streamlines and simplifies the resource management planning actions.

Prehistoric resources: Refers to any material remains, structures, and items used or modified by people before Euro-Americans established a presence in the region.

Prevention of Significant Deterioration (PSD) Program: The portion of the Clean Air Act New Source Review program that applies to areas of the country that are in compliance with the National Ambient Air Quality Standards. Key elements of the PSD Program include potential requirements for pre-construction and post-construction ambient air quality monitoring; establishment of baseline ambient air quality levels and maximum cumulative pollutant increments allowed above those baseline levels; evaluation of proposed emission sources to determine their consumption of available PSD pollutant increments; and evaluation of visibility impacts in designated Class I visibility protection areas. PSD pollutant increments and increment consumption analyses are limited to nitrogen oxides, sulfur dioxide, and particulate matter emissions. No PSD increments have been set for other criteria pollutants.

Public lands: Surface acres managed by the BLM, including lands reserved from the federal estate and acquired lands.

Renewable energy: Resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, hydro, and wood. Although particular geothermal formations can be depleted, the natural heat in the Earth is a virtually inexhaustible reserve of potential energy. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents and ocean thermal gradients.

Research Natural Area (RNA): Research Natural Areas (RNAs) are areas that contain important ecological and scientific values and are managed for minimum human disturbance. RNAs are primarily used for non-manipulative research and baseline data gathering on relatively unaltered community types. Since natural processes are allowed to dominate, RNAs also make excellent controls for similar communities that are being actively managed. In addition, RNAs provide an essential network of diverse habitat types that will be preserved in their natural state for future generations.

Resource Advisory Council (RAC): A council established by the Secretary of the Interior to provide advice or recommendations to BLM management. In some states, Provincial Advisory Councils (PACs) are functional equivalents of Resource Advisory Councils.

Resource Management Plan (RMP): The BLM considers resource management plans to be synonymous with land use plans so the terms may be used interchangeably. Land use plan decisions made in RMPs establish goals and objectives for resource management (such as desired future conditions), the measures needed to achieve these goals and objectives, and parameters for using public lands. Land use planning decisions are usually made on broad scale and customarily guide subsequent site-specific implementation decisions.

Resource use level: the level of use allowed within an area. It is based on the desired outcomes and land use allocations in the land use plan. Targets or goals for resource use levels are established on an area-wide or broad watershed level in the land use plan. Site-specific resource use levels are normally determined at the implementation level, based on site-specific resource conditions and needs as determined through resource monitoring and assessments.

Revision: The process of completely rewriting the land use plan due to changes in the planning area affecting major portions of the plan or the entire plan.

Right-of-way: An easement or permit, which authorizes public land to be used for a specified purpose that generally requires a long narrow strip of land. Examples are roads, power-lines, pipelines, etc.

Seismic exploration: Seismic exploration remains the most common way to locate sub-surface resources. The process involves sending sound waves into the earth at one point and recording them at others after having passed through differing geological strata. There are two common methods utilized today. One method involves the detonation of small explosive charges. The other method consists of a truck that drops a huge weight at various intervals. The data collected is used to show probable sub-surface resource deposits.

Site visit: The entry of one person upon a national forest site or area to participate in recreation activities for an unspecified period of time.

Sole source aquifer: Defined by the EPA as an aquifer supplying at least 50 percent of the drinking water consumed in the area overlying the aquifer, where the surrounding area has no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer for drinking water.

Special Recreation Management Area: A Special Recreation Management Area (SRMA) designation intensifies management of areas where outdoor recreation is a high priority. It helps direct recreation program priorities toward areas with high resource values, elevated public concern, or significant amounts of recreational activity. Implementation-level plans are completed for each SRMA to fully describe management actions and objectives.

Special status species: Includes proposed species, listed species, and candidate species under the Endangered Species Act of 1973; State-listed species; and BLM State Director-designated sensitive species (see BLM Manual 6840 - Special Status Species Policy).

Split estate: Areas where the BLM administers federal subsurface minerals, but the surface is owned by a non-federal entity, such as State Trust Land or private land.

Standard lease terms and conditions: Areas may be open to leasing with no specific management decisions defined in an RMP; however, these areas are subject to lease terms and conditions as defined on the lease form (Form 3100-11, Offer to Lease and Lease for Oil and Gas; and Form 3200-24, Offer to Lease and Lease for Geothermal Resources).

Stipulation: A condition of lease issuance that provides protection for other resource values or land uses by establishing authority for substantial delay or site changes or the denial of operations within the terms of the lease contract.

Stipulation Standards: the physical and temporal conditions, resources or resource values that must be present and met for application of a specific stipulation to a specific lease

Strategic Plan (BLM Strategic Plan): A plan that establishes the overall direction for the BLM. This plan is guided by the requirements of the Government Performance and Results Act of 1993, covers a 5-year period, and is updated every 3 years. It is consistent with FLPMA and other laws affecting the public lands.

Subsidence: The lowering of the soil level caused by the shrinkage of organic layers.

Temporal: Refers to geologic time for the purposes of this report.

Tectonic: Tectonics is a field of study within geology concerned generally with the structure of the crust of the Earth and particularly with the forces and movements that have operated in a region to create geomorphic features.

Timing Limitation (TL): This stipulation limits activity during a specified period of the year. A TL stipulation is intended for application where standard lease terms are deemed insufficient to achieve the level of resource protection necessary to protect the public interest, but where an NSO is deemed overly restrictive. The scope of the TL stipulation goes beyond ground-disturbing activities to encompass any source of protracted or high-intensity disturbance that could interfere with normal wildlife behavior and adversely affect habitat use. The limitation is applied annually for a specified period lasting more than 60

days. Under the Proposed Plan, TLs may also be applied to land uses and activities other than oil and gas development.

Transmission: The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers, or is delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution to the consumer.

Threatened species: 1) Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, and 2) as further defined by the Endangered Species Act of 1973.

Tribal interests: Native American economic rights such as Indian trust assets, resource uses and access guaranteed by treaty rights, and subsistence uses.

Traditional cultural resources or properties: Areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas.

Utility: A regulated entity which exhibits the characteristics of a natural monopoly. For the purposes of electric industry restructuring, "utility" refers to the regulated, vertically integrated electric company. "Transmission utility" refers to the regulated owner/operator of the transmission system only. "Distribution utility" refers to the regulated owner/operator of the distribution system which serves retail customers.

Vertebrate: Animals with vertebrae (back bones), including fish, amphibians, reptiles, birds and mammals.

Waiver: A permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.

Watt: The electrical unit of power. The rate of energy transfer equivalent to 1 ampere flowing under a pressure of 1 volt at unity power factor.

Watt-hour (Wh): An electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

Wilderness area: An area of public land designated by an Act of Congress to be protected in its natural condition according to the requirements of the Wilderness Act of 1964.

Wilderness characteristics: According to the WO IM 2011-154, Requirements to Conduct and Maintain Inventory Information for Wilderness Characteristics to Consider Lands with Wilderness Characteristics in Land Use Plans, these attributes include the area‘s size, its apparent naturalness, and outstanding opportunities for solitude or a primitive and unconfined type of

recreation. They may also include supplemental values. Lands with wilderness characteristics are those that have been inventoried and determined by the BLM to contain wilderness characteristics, as defined in Section 2 (c) of the Wilderness Act.

Wilderness Study Area (WSA): Created by the BLM through the inventory process of the FLPMA, which required the BLM to inventory lands under its management authority for wilderness quality. Lands under wilderness review must be managed so as not to impair their suitability for preservation as Wilderness until Congress decides whether or not to designate the land as Wilderness.

7.2 REFERENCES

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electric Institute, Washington, D.C.

_____. 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC and Sacramento, CA.

Barber, J.R., K.M. Fristrup, C.L. Brown, A.R. Hardy, L.M. Angeloni, and K.R. Crooks. 2009a. Conserving the wild life therein – Protecting park fauna from anthropogenic noise. Park Science 26 (3), Winter 2009-2010.

_____. 2009b. The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution 25 (3): 180-189.

Battocletti, L. 2005. An Introduction to Geothermal Permitting. pp. 12-21.

Beidleman, C. (facilitator). 2000. Colorado Partners in Flight Land Bird Conservation Plan. BLM's OHV National Management Strategy for Motorized Off-highway Vehicle Use on Public Lands.

BLM (US Department of the Interior, Bureau of Land Management). 1976. The Federal Land Policy and Management Act.

_____. 1991. San Luis Resource Management Plan and Record of Decision. BLM, Canon City District, San Luis Resource Area, CO. December 1991. Available at: http://www.blm.gov/co/st/en/BLM_Programs/land_use_planning/rmp/archived/san_luis.html.

_____. 1995. BLM Handbook H-8550-1: Interim Management Policy for Lands under Wilderness Review.

_____. 1997. Standards for Public Land Health and Guidelines for Livestock Grazing in Colorado. February 3, 1997.

_____. 2001. Colorado water rights fact sheet. Internet Web site: http://www.blm.gov/nstc/.

_____. 2005b. Final programmatic environmental impact statement on wind energy development on BLM-administered lands in the western United States. BLM, Washington, DC. June 2005. Available online at: http://windeis.anl.gov/.

_____. 2005b. BLM Handbook H-1601-1: Land Use Planning Handbook. March 11, 2005.

_____. 2007b. Geothermal Development on Federal Lands: Projection of Royalty Impacts Resulting from the Energy Policy Act of 2005. Jeffery Eppink, Michael Marquis, and Megan Billingsley, Advanced Resources Intl, Inc. January 2007.

_____. 2009a. San Luis Resource Area Transportation Management Plan (CO-500-2005-016-EA). BLM, San Luis Valley Public Lands Center, Monte Vista, CO. June 4, 2009. Available online at: http://www.blm.gov/co/st/en/fo/slvplc/Travel_Management.html.

_____. 2010a. South San Luis Lakes wetlands restoration project Environmental Assessment (DOI-BLM-CO-140-2010-009-EA). BLM, La Jara Field Office, San Juan Public Lands Center, Monte Vista, CO. March 3, 2010. Available online at: http://www.blm.gov/pgdata/etc/medialib/blm/co/field_offices/slvplc/Upload_Files.Par.67229.File.dat/SSL_Final_FONSI_red.pdf.

_____. 2010c. SLV Geothermal Leasing EA and RMP Amendment Final Scoping Report. November 2010.

_____. 2011a. GIS Database provided by BLM sources.

_____. 2011b. BLM Instruction Memorandum No. 2011-154. 2011. Requirement to Conduct and Maintain Inventory Information for Wilderness Characteristics and to Consider Lands with Wilderness Characteristics in Land Use Plans. July 25, 2011

BLM (US Department of the Interior, Bureau of Land Management) and Colorado Department of Natural Resources. 2011. Memorandum of Understanding Between Bureau of Land Management, Colorado State Office and the Colorado Department of Natural Resources Concerning Geothermal Leasing, Permitting, and Administration in Colorado. March 14, 2011.

BLM (US Department of the Interior, Bureau of Land Management) and USFS (US Department of Agriculture, Forest Service). 2008. Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States. BLM, Washington, DC. October 2008. Available online at: http://www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide/Documents/Final_PEIS.html.

Blume, F. and A. F. Sheehan. 2002. Quantifying seismic hazard in the southern Rocky Mountains through GPS measurements of crustal deformation. Abstract, Paper No. 227-5. The Geological Society of America, 2002 Annual Meeting, Denver, CO.

Bromley, C.J.; Mongillo, M.A. 2008 Geothermal energy from fractured reservoirs: dealing with induced seismicity. OPEN energy technology bulletin, 48: 7 p.

Burnell, J. R. C. Carroll, and G. Young. 2008. Colorado mineral and energy industry activities, 2007. Information series 77. Colorado Geological Survey, Department of Natural Resources, Denver, CO.

Burroughs, R. L. 1974. *Neogene volcanism in the southern San Luis basin, New Mexico*, Geological Society Guidebook, 25th Field Conference, Ghost Ranch (Central-Northern New Mexico). Available online at: http://nmgs.nmt.edu/publications/guidebooks/downloads/25/25_p0291_p0294.pdf.

Camp, Dresser & McKee, Inc. 2007. Regulatory Update: Greenhouse Gases (7/1/07). Website: http://www.cdm.com/knowledge_center.html. Accessed September 2007.

Cappa, J. A., and H. T. Hemborg. 1995, 1992-1993. Low Temperature Assessment Program, Colorado, Colorado Geological Survey, Denver, Open File Report 95-1, 19 pp., 4 tables, 1 plate, 1 CD-ROM.CDWR (Colorado Division of Water Resources). 2004. Rules governing new withdrawals of ground water in water division 3 affecting the rate or direction of movement of water in the confined aquifer system. Internet Web site: http://www.water.state.co.us/pubs/rule_reg/confineduserules.pdf.

_____. 2004a. Rules and regulations for permitting the development and appropriation of geothermal resources through the use of wells. Internet Web site: http://water.state.co.us/DWRIPub/Documents/geothermalrules.pdf

_____. 2010. Colorado's Decision Support Systems. Internet Web site: http://cdss.state.cous/DNN/default.aspx.CEQ (Council on Environmental Quality). 1981. Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations. March 16, 1981. Web site: http://ceq.hss.doe.gov/nepa/regs/40/40p3.htm

Church, M. C., S. G. Baker, B. J. Clark, R. F. Carillo, J. C. Horn, C. D. Spath, D. R. Guilfoyle, and E. S. Cassells. 2007. "Colorado History: A Context for Historical Archaeology." Denver, CO: CCPA

Clutter, T. 2001. Gator in the Sage. GRC Bulletin 30 (6), 246–249.

Colorado Geological Survey. 2003. Ground Water Atlas of Colorado. Special Publication 53, Section 7.1, San Luis Valley & Rio Grande Basin.

Colorado Native Plant Society. 1997. Rare Plants of Colorado sec. ed. Fort Collins, CO.

Connelly, J., M. Schroeder, A. Sands, and C. Braun. 2000. Guidelines to Manage Sage Grouse Populations and Their Habitats. Wildlife Society Bulletin 28(4) pgs. 967-985.

Crone, A., L. Bradley, M. Machette, and S. Mahan. 2006. Paleoseismic investigation of Rito Seco site, central section of the Sangre de Cristo fault zone, Colorado—Data related to late Quaternary surface faulting on the Sangre de Cristo fault, Rito Seco site, Costilla County, Colorado: US Department of the Interior Geologic Survey.

CSWG (Colorado State Working Group). 2007. Colorado Geothermal Development Strategic Plan. Website: http://geosurvey.state.co.us/portals/0/ColoradoGeothermalDevelopmentStratPlan.pdf Accessed January 22, 2008.

DOE (US Department of Energy). 2006. The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems on the United States in the 21st Century. Prepared for the US DOE and Idaho National Laboratory by the Massachusetts Institute of Technology.

_____. 2007a. Energy Efficiency and Renewable Energy. Geopowering the West. Website: http://www1.eere.energy.gov/geothermal/gpw.html. Accessed September 2007.

_____. 2007b. Enhanced Geothermal Systems Technology. Web site: wwwl.eere.energy.gov/geothermal/egs_technology.html.

DOE (US Department of Energy) and BLM (US Bureau of Land Management). 2010. Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States. December 2010.

DOI (US Department of the Interior) 2007. National Atlas of the US, Renewable Energy Sources in the US. Internet Web site: http://nationalatlas.gov/articles/people/a_energy.html.

Dyer, Helen. 2009. "Paleontological Ground Truthing Survey in the Rio Grande National Forest, Colorado." USDA, USFS, RGNF: Monte Vista, Colorado.

EIA (Energy Information Administration). 2007. Federal Lands, Lower 48 States, with geothermal resource potential of 60 or greater. July 2007.

Emery, P. A. 1994. Hydrogeology of the San Luis Valley, Colorado, an overview—national park service, Field Trip 20, Section 2, Paper. Internet Web site: http://www.nps.gov/archive/grsa/resources/docs/Trip2023.pdf.

EPA (US Environmental Protection Agency). 2008. Public Review Draft – National Water Program Strategy: Response to Climate Change. Office of Water. March 2008.

Faanes, C.A. 1987. Bird behavior and mortality in relation to power lines in prairie habitats. US Fish and Wildlife Service. Fish and Wildlife Technical Report 7. Washington, DC.

Fleischmann, D. J. 2007. *An Assessment of Geothermal Resource Development Needs in the Western United States*. Geothermal Energy Association.

GeothermEx 2007. Geothermal Exploration and Drilling Report. As published in: Final Environmental Impact Statement for the Truckhaven Geothermal Leasing Area. United States Department of the Interior. El Centro Field Office. BLM/CA/Es-2007-017-3200. Internet Web site: http://www.blm.gov/ca/pdfs/elcentro_pdfs/TruckhavenFEIS/00a_cover.pdf

Gibson, M. 2009. personal communication from Gibson. (San Luis Valley Water Conservancy).

Gionfriddo, J. P. 2002. Conservation assessment of the Gunnison Sage-Grouse, *Centrocercus Minimus*. Draft report submitted to the Bureau of Land Management, Colorado Natural Heritage Program, Colorado State University. Fort Collins, CO.

Gross, J. E. 1998. Colorado vertebrate ranking system, COVERS Version 2.000. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO.

Gunnison Sage-Grouse Working Group. 1997. *Gunnison Sage-grouse Conservation Plan*. Gunnison, CO.

Guthrie, M., G. Powys, Johnson, and J. Lishka. 1984. Colorado mountains prehistory context. Office of Archaeology and Historic Preservation, Colorado Historical Society, Denver, CO.

Hafner, D., K. Peterson, and T. Yates. 1981. *Evolutionary relationships of jumping mice (genus* Zapus*) of the southwestern United States.* Journal of Mammology, American Society of Mammalogists, Lawrence, KS.

Hammerson, Geoffrey A. 1999. Amphibians and Reptiles in Colorado, second edition. University Press of Colorado and Colorado Division of Wildlife, Niwot, CO.

Hance, Cedric. 2005. Geothermal Industry Employment: Survey Results and Analysis. Geothermal Energy Association for the US Department of Energy. Internet Web site: http://www.geo-energy.org/publications/reports/Geothermal%20Industry%20Employment%20-%20Survey%20Results%20and%20Analysis%20September%202005.pdf.

HRS Water Consultants, Inc. 1987. San Luis Valley Confined Aquifer Study, Phase One. Final Report. A report prepared for the Colorado Water Resources and Power Development Authority. Lakewood, CO. Available on-line at http://digital.library.colostate.edu/cdm4/document.php?CISOROOT=/cowaters&CISOPTR=4681 and last accessed September 25, 2012.

Hurd, B., and J. Coonrod. 2007. Climate change and its implications for New Mexico's water resources and economic opportunities. *Prepared for the National Commission on Energy Policy*. New Mexico State University, Las Cruces, NM.

IMPROVE (Interagency Monitoring of Protected Visual Environments). 2011. Internet Web site: http://vista.cira.colostate.edu/improve/.

Jones, C. A. 1999. *Zapus Hudsonei* in Southern Colorado. Occasional Papers. Museum of Texas Tech University. Lubbock.

Kagel, Alyssa. 2006. A Handbook on the Externalities, Employment, and Economics of Geothermal Energy. Geothermal Energy Association. Internet Web site: http://www.geo-energy.org/publications/reports/Socioeconomics%20Guide.pdf.

Kelson, K. I. P. W. Bauer, D. Love, S. D. Connell, M. Mansell, and G. Rawling. 2004. Initial paleoseismic and hydrogeologic assessment of the southern Sangre de Cristo fault at Taos Pueblo, *in* Brister, B.S., Bauer, P.W., Read, A.S., and Lueth, V.W., eds., Geology of the Taos region, New Mexico Geological Society 55th Annual Field Conference, Guidebook, p. 289–299.

Kershaw, L., A. MacKinnon, and J. Pojar. 1998. Plants of the Rocky Mountains. Lone Pine Publishing, Auburn, WA.

Kirkham, R. M. (compiler). 1998. "Fault number 2315, faults near Monte Vista," in Quaternary Fault and Fold Database of the United States. Internet Web site: http://earthquakes.usgs.gov/regional/qfaults.

Kirkham, R., and W. Rogers. 1981. Earthquake potential in Colorado. Colorado Geological Survey Bulletin 43. Denver, CO.

Leitner, Philip. Undated. An Overview of the Mono-Long Valley Known Geothermal Resource Area – Noise Effects. Prepared for Environmental Science Division, University of California Lawrence Livermore Laboratory, Livermore, California.

Leonard, G. J., and K. R. Watts. 1989. Hydrogeology and simulated effects of ground-water development on an unconfined aquifer in the closed basin division 3, San Luis Valley, Colorado. Water Resources Investigations Report 87-4284, US Geological Survey, Denver, CO.

Lindsey, K. D. 1983. Paleontological inventory and assessment of the San Luis resource area, prepared by Denver Museum of Natural History for US Department of the Interior, Bureau of Land Management, Canon City District.

Lund J. 2003. The USA geothermal country update. Geothermics 32 (2003) 409-418.

Majer, Ernest L., Roy Baria, Mitch Stark, Stephen Oates, Julian Bommere, Bill Smith, Hiroshi Asanuma. 2007. *Induced seismicity associated with Enhanced Geothermal Systems*. Geothermics 36: 185–222.

Majer, Ernest L., and John E. Peterson. 2008. The Impact of Injection on Seismicity at The Geyses, California Geothermal Field. Lawrence Berkeley National Laboratory. Available for download from http://escholarship.org/uc/item/0t19709v (last accessed August 20, 2012).

Martorano, M. A., T. Hoefer, III, M. A. Jodry, V. Spero, and M. L. Taylor. 1999. Colorado prehistory: a context for the Rio Grande Basin. Colorado Council of Professional Archaeologists. Denver, CO.

Mayo, A. L., A. Davey, and D. Christiansen. 2007. *Groundwater Flow Patterns in the San Luis Valley, Colorado, USA Revisited: an Evaluation of Solute and Isotopic Data*. Hydrogeology Journal 15:383–408. New York.

McCalpin, J. 1986. *Quaternary Tectonics of the Sangre de Cristo and Villa Grove Fault zones*. In Contributions to Colorado Seismicity and Tectonics: A 1986 Update, Colorado Geological Survey Special Publication 28, 59-64. Denver, CO.

McDermott, P. 2009. Personal communication from McDermott (Office of the State Engineer) in draft US Department of the Interior, Bureau of Land Management Solar PEIS. (unpublished).

Michelet, S., R. Baria, J. Baumgartner, A. Gérard, S. Oates, T. Hettkamp, and D. Teza. 2004. "Seismic source parameter evaluation and its importance in the development of an HDR/EGS system," Proc. Twenty-ninth Workshop on Geothermal Reservoir Engineering, Stanford University, Calif.

Morgan, Paul. 2010. Power Point presentation: *Geology and Geothermal Energy Potential in the San Luis Valley*. On behalf of the Colorado Geological Survey for *Workshop: Geothermal Uses in the San Luis Valley*. February 27, 2010.

_____. 2012. Personal communication. Name of original pdf. Received date.

Nemzer, Marilyn, Deborah Page, and Anna Carter. 2007. Energy for Keeps. Energy Education Group.

NPS (US Department of the Interior, National Park Service). 2009. Sangre de Cristo national heritage area. Internet Web site: http://www.nps.gov/grsa/28 parknews/sangre-de-cristo-nha.htm.

NREL (National Renewable Energy Laboratory). 2006. Geothermal – The Energy Under our Feet: Geothermal Resource Estimates for the United States. Technical Report NREL/TP-840-40665. By Bruce Green and Gerald Nix. November 2006.

_____. 2007. Learning About renewable Energy, Geothermal Direct Use. Web site: http://www.nrel.gov/learning/re_geo_direct_use.html.

Personius, S. F., and M. N. Machette. 1984. Quaternary and Pliocene faulting in the Taos Plateau region, northern New Mexico, *in* Baldridge, W.S., Dickerson, P.W., Riecker, R.E., and Zidek, J. eds. Rio Grande rift—Northern New Mexico: New Mexico Geological Society 35th Annual Field Conference, Guidebook, pp. 83–90.

Radford University. 1997. Desertscrub. Internet Web site: http://www.radford.edu/~swoodwar/CLASSES/GEOG235/biomes/desert/desert.html.

Radle, A.L. 2007. The effect of noise on wildlife: a literature review. Accessed online at the World Forum for Acoustic Ecology Online Reader: http://interact.uoregon.edu/MediaLit/wfae/library/articles/radle_effect_noise_wildlife.pdf.

Ray, A. J., J. J. Basrsugli, K. B. Avery, K. Wolter, M. Hoerling, N. Doesken, B. Udall, and R. S. Webb. 2008. Climate Change in Colorado – A Synthesis to Support Water Resources Management and Adaptation – *A Report for the Colorado Water Conservation Board*; University of Colorado, Boulder CO, 58 pp. Available online at: http://wwa.colorado.edu/CO_Climate_Report/index.html.

Richter, A. 2007. Glitnir United States-Geothermal Energy Market Report.

Robson, S. G., and E. R. Banta. 1995. Ground water atlas of the United States: Arizona, Colorado, New Mexico, Utah. US Geological Survey. HA 730-C. Internet Web site: http://pubs.usgs.gov/ha/ha730/ch_c/index.html.

Rocky Mountain Oilfield Testing Center. 2007 Geothermal Testing. Web site: http://www.rmotc.doe.gov/Pdfs/geothermal.pdf.

Rogers, G.E. 1964. *Sage grouse investigations in Colorado. Colorado Game, Fish, and Parks Dept*. Tech. Pub. 16. Project W-37-R, federal Aid In Wildlife Restoration. 81 p. + appendices. Denver, CO.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and M.A. Penninger. 2004. Effects of roads on elk: implications for management in forested ecosystems. In: Transactions of the 69th North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, D.C. pp. 491-508.

Sawyer, H., R.M. Nielson, F. Lindzey, and L.L. McDonald. 2006. Winter habitat selection of mule deer before and during development of a natural gas field. Journal of Wildlife Management 70 (2): 396-403.

Simmons, Virginia McConnell. 1999. The San Luis Valley: land of the six-armed cross. University Press of Colorado, Niwot. Second Edition.

Slater, S.J., and J.P. Smith. 2010. Effectiveness of raptor perch deterrents on an electrical transmission line in southwestern Wyoming. Journal of Wildlife Management 74 (5): 1080-1088.

SLV Development Resources Group. 2007. 2007 Comprehensive Economic Development Strategy. Section IV, Chapter F, Water Resources. Available online at: http://www.slvdrg.org/ceds/CEDS2007/F.%202007%20Water%20Resources.pdf.

Trombulak, S.C., and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14 (1): 18-30.

University of Utah Energy and Geoscience Institute. 2007. Enhanced Geothermal Systems. Web site: http://egs.egi.utah.edu/home/main2.htm.

US Bureau of Reclamation. 2011. *The San Luis Valley Project*. Internet Web site: http://www.usbr.gov/history/sanluisv.html. Accessed January 11, 2012.

US Energy Information Administration. 2009. Emissions of Greenhouse Gases Report. Internet Web site: http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html.

USFS (US Department of Agriculture, Forest Service). 1993. Facts about the Mexican Spotted Owl. Southwestern region, Albuquerque, NM.

_____. 2005. Oil, Gas, Coal Bed Methane, and Geothermal RFDS, Wenatchee, Okanogan, Colville National Forests. March 2005.

_____. 1995. Recovery plan for the Mexican Spotted Owl. Vol. 1. Albuquerque, NM. Internet Web site: http://www.fws.gov/southwest/es/mso/critical_habitat/recovery_plan.htm.

_____. 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Albuquerque, NM. Available online at: http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/SWWF/Final%20Recovery%20Plan/ExecSummary_Contents.pdf.

USGS (US Geological Survey). 2008. Assessment of moderate- and high-temperature geothermal resources of the United States: US Geological Survey Fact Sheet 2008-3082, by Williams, Colin F., Reed, Marshall J., Mariner, Robert H., DeAngelo, Jacob, Galanis, S. Peter, Jr., 2008.

Wells, S. J. 2008. Archaeological inventory and National Register Evaluation for the Baca land exchange La Jara parcels Conejos County, Colorado, prepared by the Western Archaeological and Conservation Center, Tucson, Ariz., and Fort Lewis College, Durango, Colo., for the National Park Service, Denver, Colo., the Bureau of Land Management, Lakewood, Colo., and the US Fish and Wildlife Service, Lake, Colo., WACC Publications in Anthropology 101. November issue.

WGA (Western Governors' Association). 2006a. Geothermal Task Force Report.

____. 2006b. Clean and diversified energy initiative. Geothermal Task Force Report. Available online at: http://www.westgov.org/wga/initiatives/cdeac/geothermal.htm.

WGFD (Wyoming Game and Fish Department). 2010. Recommendations for development of oil and gas resources within important wildlife habitats. Version 6.0. April 2010. Cheyenne, Wyoming.

Young, J.R. 2003. *The Gunnison sage-grouse*. Western Colorado College. Internet Web site: http://www.western.edu/bio/young/gunnsg/gunnsg.htm.

This page intentionally left blank.

Appendix A

Geothermal Resources, Technology, Leasing, and Development

This page intentionally left blank.

APPENDIX A
GEOTHERMAL RESOURCES, TECHNOLOGY, LEASING, AND DEVELOPMENT

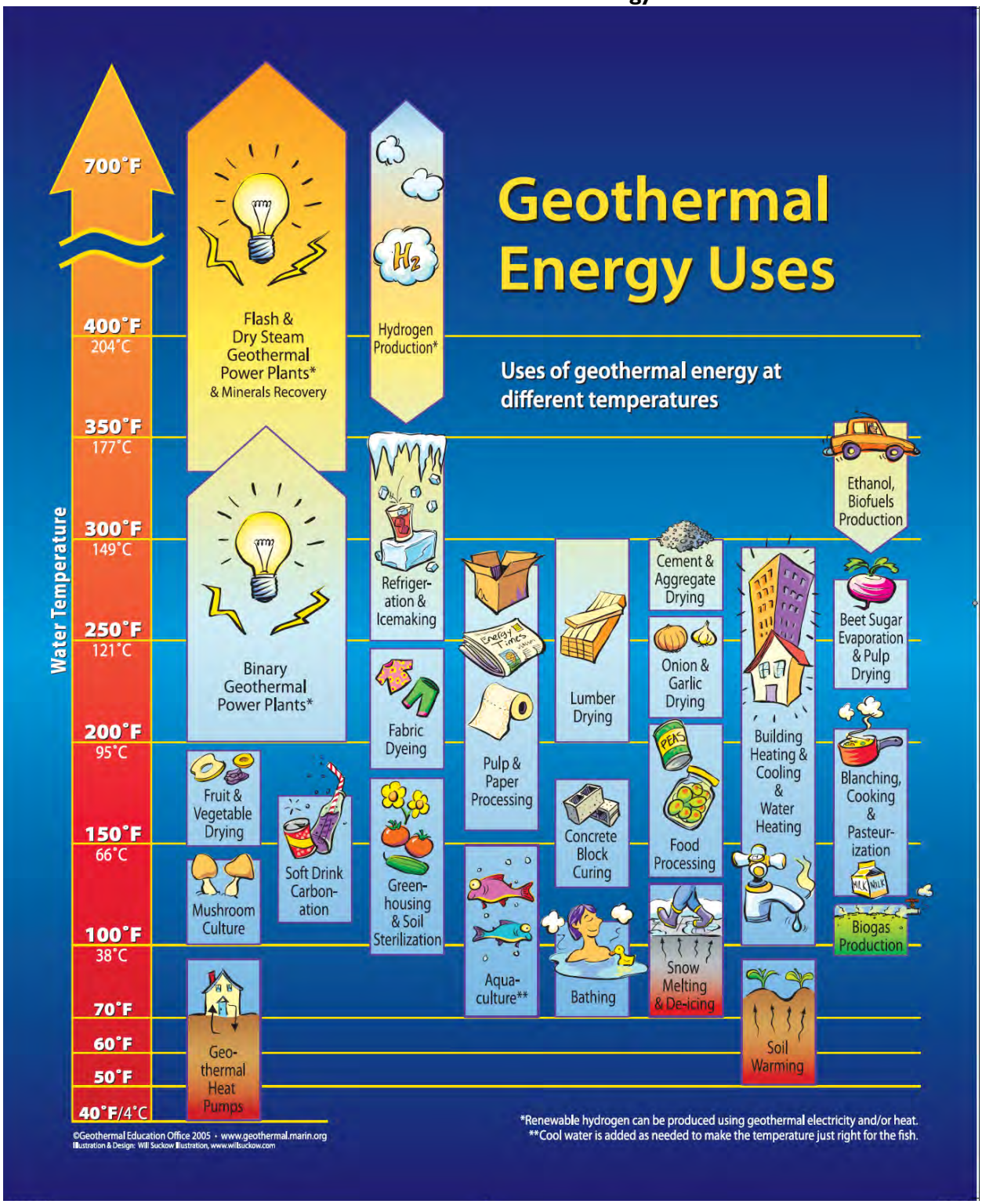
INTRODUCTION

This appendix presents a general overview of geothermal resource information, current technology for developing the resource for direct use and commercial electrical generation, and leasing and development procedures. As each area where geothermal resources may be developed is different, the type of technology used will be different. The following sections describe the current state of geothermal technology available; however, not every type of technology is likely to be used for commercial generation in the SLVFO.

OVERVIEW OF GEOTHERMAL RESOURCES

The term geothermal comes from the Greek *geo* meaning "earth" and *thermal* meaning "heat." As such, geothermal energy is energy derived from the natural heat of the earth. Geothermal resources are typically underground reservoirs of hot water or steam created by heat from the earth, but geothermal resources also include subsurface areas of dry hot rock. In cases where the reservoir is dry hot rock, the energy is captured through the injection of cool water from the surface, which is then heated by the hot rock and extracted as fluid or steam. Geothermal steam and hot water can naturally reach the earth's surface in the form of hot springs, geysers, mud pots, or steam vents. Geothermal reservoirs of hot water are also found at various depths beneath the Earth's surface. In the US, most geothermal reservoirs are located in the western states, Alaska, and Hawaii (NREL 2007). Geothermal resources can be accessed by wells and used to provide heat directly. This is called the direct use of geothermal energy. The heat energy can also be used to commercially generate electricity, a process called indirect use. As shown in **Figure A-1**, Uses of Geothermal Energy, there are a wide range of uses for geothermal resources.

Figure A-1
Uses of Geothermal Energy



Direct Use

Humans have been using geothermal resources in the form of hot springs for thousands of years. Today, geothermal reservoirs of 68°F to 302°F (20°C to 150°C) temperature water provide numerous opportunities for direct use. Direct use means utilization of geothermal resources for commercial, residential, agricultural, public facilities, or other energy needs other than the commercial production of electricity (43 CFR 3200.1). Direct use includes using heat energy from naturally occurring hot water or using other technology to capture the heat from the earth (e.g., heat pumps). Modern hot water direct-use systems access geothermal reservoirs by drilling into them from the surface to develop a steady stream of hot water. The water is brought up through the well, and a mechanical system consisting of piping, a heat exchanger, and controls delivers the heat directly for its intended use. A disposal system then either injects the cooled water underground or disposes of it on the surface.

Geothermal energy is used as heat in the US, either directly or through the use of ground-source heat pumps, for a variety of applications, such as:

- Heating pools, spas, greenhouses, aquaculture facilities, and buildings;
- Melting snow on sidewalks and driveways; and
- Drying agricultural products.

Direct use applications in the US have been growing at about six percent per year (Lund 2003). These low-temperature resources are fairly abundant throughout the West. A recent survey of 10 western states identified more than 9,000 thermal wells and springs, more than 900 low- to moderate-temperature geothermal resource areas, and hundreds of direct-use sites (Western Governors' Association 2006; BLM and USFS 2008).

Commercial Electrical Generation

Commercial electrical generation from geothermal resources is also called indirect use. Electrical generation uses geothermally heated fluid to turn a turbine connected to a generator. As discussed below, the fluid may be the naturally occurring steam or water in the geothermal reservoir or another fluid which has the geothermal heat transferred through a heat exchange system.

Geothermal energy produces about 2,400 MW annually in the western US, supplying less than one percent of the US electrical demand (EIA 2007). It is estimated that the 12 Western states have 5,500 MW of geothermal potential considered viable for commercial development by 2015, with a further 6,600 MW being forecast by 2025 (BLM and USFS 2008).

Geothermal power plants can be small (300 kilowatts), medium (10 to 50 MW) and large (50 MW and higher) (Nemzer et al. 2007). Generation capacity is guided by the number of turbines within a plant. In general, commercial

electrical generation requires hot geothermal reservoirs with a water temperature above 200°F (93°C); however, new technologies have proven that lower-temperature water (e.g., 165°F [74°C]) can also be used for electrical generation (BLM and USFS 2008).

Three types of geothermal power plant systems are commonly used to generate electricity depending on temperature, depth, and quality of the water and steam in the area (DOE 2007a):

- flash steam;
- binary-cycle; and
- dry steam power plants.

These plants can also be hybridized by including elements of the different technologies at a single location. All three methods re-inject the remaining geothermal fluid back into the ground to replenish the reservoir and recycle the hot water.

Flash Steam Power Plants

Flash steam power plants use hot water above 360°F (182°C) from geothermal reservoirs. The high pressure underground keeps the water in the liquid state, although it is well above water's boiling point at standard atmospheric pressure. As the water is pumped from the reservoir to the power plant, the drop in pressure causes the water to convert, or "flash," into steam to power the turbine (**Figure A-2**, Flash Steam Power Plant). Any water not converted into steam is injected back into the reservoir for reuse. Flash steam plants, like dry steam plants, emit small amounts of gases and steam. Flash steam plants are the most common type of geothermal power generation plants currently in operation (DOE 2007a).

Binary-cycle Power Plants

Binary-cycle power plants typically use cooler fluids than flash steam plants (165 to 360°F [74 to 182°C]). The hot fluid from geothermal reservoirs is passed through a heat exchanger, which transfers heat to a separate pipe containing fluids with a much lower boiling point. These fluids, usually iso-butane or iso-pentane, are vaporized to power the turbine (**Figure A-3**, Binary-cycle Power Plant). The advantage of binary-cycle power plants is their lower cost and increased efficiency. These plants also do not emit any excess gas and, because they use fluids with a lower boiling point than water, are able to use lower temperature geothermal reservoirs which are much more common. Most geothermal power plants planned for construction in the US are binary-cycle (DOE 2007a).

Figure A-2
Flash Steam Power Plant

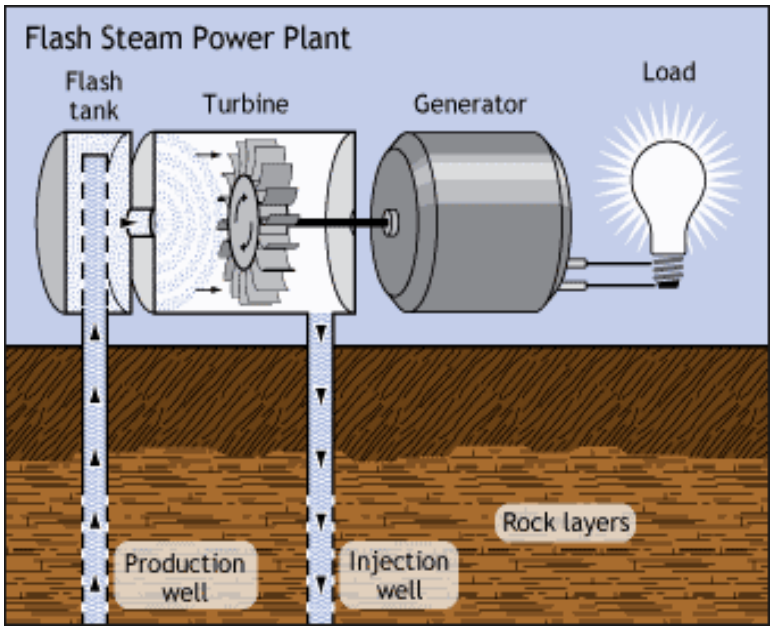
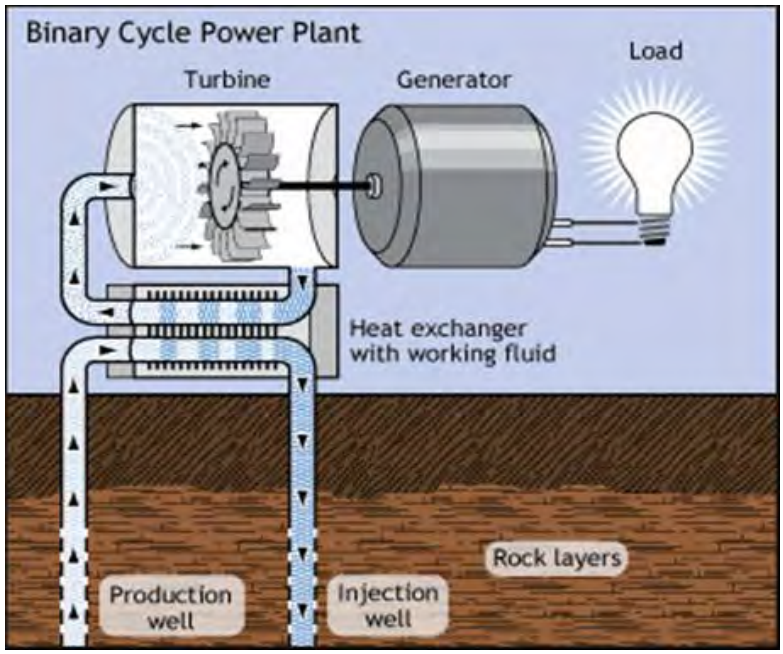


Figure A-3
Binary-cycle Power Plant

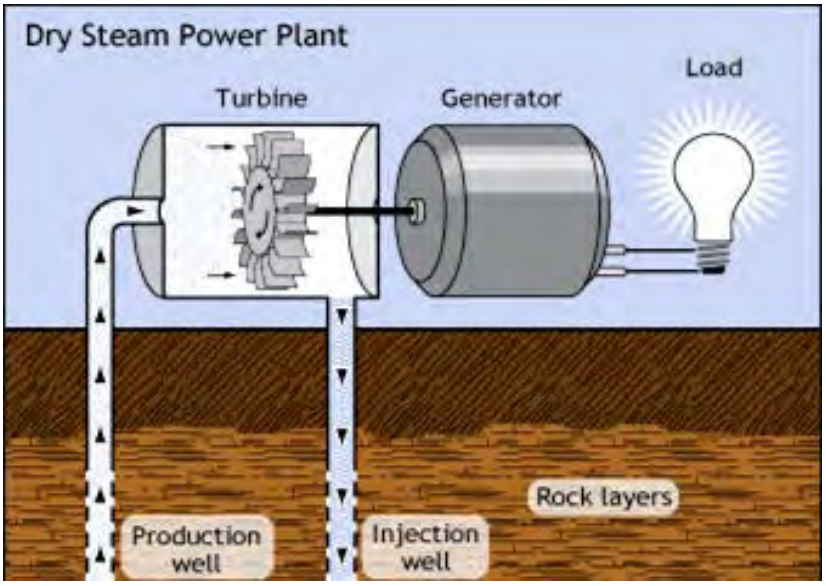


Dry Steam Power Plants

Dry steam power plants use very hot (greater than 455°F [235°C]) geothermal reservoirs that exist primarily in the form of steam. The steam is routed to the

surface via a well and used to turn a turbine. The turbine drives a generator that produces electricity (**Figure A-4**, Dry Steam Power Plant). While this is the rarest form of power plants, it was both the first type of geothermal reservoir used to produce electricity (at Lardarello, Italy, in 1904) and is the reservoir type being used at the world's largest geothermal production site, The Geysers in Northern California. Dry steam power plants emit only excess steam and very minor amounts of gases (DOE 2007a). Geothermal sources with dry steam generation capability are very rare.

Figure A-4
Dry Steam Power Plant



Emerging Technologies

Geothermal Energy from Oil and Gas Production

Oil and gas wells are typically thousands of feet deep and often produce very hot fluid. Along with the oil and gas, wells produce water that must be separated from the oil and gas and usually re-injected deep below domestic aquifers. The Rocky Mountain Oilfield Testing Center, located in the Teapot Dome Oilfield near Casper, Wyoming, is demonstrating the use of warm reservoir fluids from oil and gas production to produce electricity that can be used to power the oil and gas pumps (Rocky Mountain Oilfield Testing Center 2007). This technique is referred to as co-produced geothermal fluids or produced water cut (NREL 2006). Because the electricity is used on site, there is no need to purchase additional electricity which eliminates the need for power lines to be run to oil and gas facilities. This technology could be applied at many oil and gas facilities throughout the West.

Enhanced Geothermal Systems

Enhanced geothermal systems are engineered reservoirs created to produce energy from geothermal resources deficient in water or permeability (DOE 2007b; DOE 2006). With enhanced geothermal systems, a developing reservoir is targeted within a volume of rock that is hot and tectonically stressed. Through a combination of hydraulic, thermal, and chemical processes, the reservoir can be stimulated, causing fractures to open, extend, and interconnect. This creates a fluid-conductive fracture network and an interconnected reservoir system. The process can extend the margins of existing geothermal systems or can create entirely new ones wherever optimal thermal and tectonic conditions exist (University of Utah Energy and Geoscience Institute 2007). Enhanced geothermal systems technology is relatively new in the geothermal field and has been found to have great potential for providing electrical power; one study found the potential for 100 gigawatts of power (DOE 2006). Until recently, lack of research and development funding, government policies, and lack of incentives had not favored the growth of enhanced geothermal systems, with most development occurring outside of the US (DOE 2006). It is anticipated that there may be applications for research and development drilling on public and USFS lands in the future. Until it becomes a technically and economically proven technology, it is unlikely that it will be applied at a large scale in the western US within the next 20 years.

GEOTHERMAL LEASING AND DEVELOPMENT PROCESS

Federal Geothermal Leasing Laws and Regulations

A geothermal lease is for the heat resource of the earth where there is federal mineral estate. Unless specifically owned in fee, the federal government does not own the hot water commonly associated with the heat; this falls under state water laws. Geothermal developers must obtain the appropriate water rights and state permits, in addition to the federal lease for the resource.

The BLM has the delegated authority to issue geothermal leases on federal lands. The BLM currently administers about 480 geothermal leases that covered over 700,000 acres at the end of fiscal year 2007. Of those 57 are producing geothermal energy, 54 producing resource for electrical generation and 3 for direct use (BLM and USFS 2008). It is the policy of the federal government, consistent with Section 2 of the Mining and Mineral Policy Act of 1970 and Sections 102(a)(7), (8), and (12) of the FLPMA (43 USC 1701 et seq.), to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 (30 USC Section 1001, et seq.), which was amended and supplemented by the Environmental Policy Act) of 2005, provides statutory guidance for geothermal leasing by the BLM. New federal geothermal development regulations (43 CFR Parts 3000, 3200, and 3280 – Geothermal Resource Leasing and Geothermal Resources Unit Agreements) were made effective June 1, 2007 (72 Federal Register 24358, May 2, 2007), as a result of a directive provided in the Energy

Policy Act of 2005. These statutes and regulations delineate lands that are available and unavailable for leasing.

Commercial electrical generation from geothermal resources is also called indirect use. Electrical generation uses geothermally heated fluid to turn a turbine connected to a generator. As discussed below, the fluid may be the naturally occurring steam or water in the geothermal reservoir or another fluid which has the geothermal heat transferred through a heat exchange system.

Available and Unavailable Lands for Geothermal Leasing

In accordance with the Geothermal Steam Act of 1970, as amended (30 USC Section 1001) and the Geothermal Resources Leasing Rule (43 CFR 3201.10), the BLM may issue leases on the following "available" lands:

- Lands administered by the DOI, including public and acquired lands not withdrawn from such use;
- Lands administered by the USDA with its concurrence;
- Lands conveyed by the US where the geothermal resources were reserved to the US; and
- Lands subject to Section 24 of the Federal Power Act, as amended (16 USC 818), with the concurrence of the Secretary of Energy.

Conversely, the BLM is prohibited from issuing leases on the following statutorily closed federal lands as defined in the Geothermal Resources Leasing Rule (43 CFR 3201.11).

- Lands where the Secretary of Interior has determined that issuing the lease would cause unnecessary or undue degradation of public lands and resources;
- Lands contained within a unit of the National Park System, or that are otherwise administered by the National Park Service;
- Lands where the Secretary of the Interior determines after notice and comment that geothermal operations, including exploration, development, or utilization of lands, are reasonably likely to result in a significant adverse effect on a significant thermal feature within a unit of the National Park System;
- Lands within a National Recreation Area;
- Fish hatcheries or wildlife management areas administered by the Secretary of the Interior;
- Indian trust or restricted lands within or outside the boundaries of Indian reservations;
- The Island Park Geothermal Area (in Idaho and Montana); and

- Lands where Section 43 of the Mineral Leasing Act (30 USC 226-3) prohibits geothermal leasing, including:

– Wilderness areas or WSA administered by the BLM or other surface-management agencies;

– Lands designated by Congress as WSAs, except where the statute designating the study area specifically allows leasing to continue; and

– Lands within areas allocated for wilderness or further planning in Executive Communication 1504, Ninety-sixth Congress (House Document 96-119), unless such lands are allocated to uses other than wilderness by a land and resource management plan or are released to uses other than wilderness by an act of Congress.

Leasing Process, Rights, and Limitations

The BLM grants access to geothermal resources through a formalized leasing process based on the end use. For direct uses, an applicant can apply noncompetitively for a lease. For indirect use, such as commercial electrical generation, the BLM awards leases through a competitive bidding process. Historically, certain lands were designated as known geothermal resource areas. All lands designated within known geothermal resource areas were leased through a competitive bidding process. Until the passage of the Energy Policy Act of 2005, lands outside of known geothermal resource areas could be leased noncompetitively. Section 222 of the Energy Policy Act of 2005 modified the Geothermal Steam Act of 1970 to allow only competitive lease sales for all federal geothermal resources and their associated lands. The geothermal leasing regulations provide for four types of lands available for noncompetitive leasing: (1) Parcels of land that did not receive bids in a competitive sale; (2) Lands available exclusively for direct use; (3) Lands subject to mining claim and a current plan of operation; and (4) Lands for which a lease application was pending on August 8, 2005, if the applicant so chooses. Lease areas are nominated by the public for a lease sale.

When the BLM receives a nomination, it is adjudicated, and configured into lease parcels by the respective BLM state office. Lease parcels are then forwarded to the appropriate field office where the appropriate environmental analysis and review is conducted.

Per direction in the BLM-Colorado Department of Natural Resources MOU, the BLM Principal Contact will notify the CDNR Principal Contact when the BLM receives a nomination to lease a geothermal parcel. Likewise, the CDNR Principal Contact will notify BLM Principal Contact when the State Land Board (SLB) receives a nomination to lease a geothermal parcel, or when another CDNR division seeks to convey rights to geothermal resources.

The Parties will communicate and cooperate during their respective reviews of nominated parcels and whether and under what conditions to offer a nominated parcel for lease. The BLM will notify surface owners overlying federal geothermal resources that it seeks to lease, consistent with WO IM No. 2009-184, "Courtesy Notification of Surface Owners When Split-Estate Lands are Included in an Oil and Gas Notice of Competitive Lease Sale."

When offering a federal geothermal lease, the BLM will include a stipulation in the Sale Notice requiring any future lessee to comply with Colorado law. The following is an example of language that would meet the intent of this provision:

LEASE NOTICE

The lessee is hereby notified that prior to and during all lease operations including development and utilization of a geothermal resource, the lessee must comply with applicable provisions of the Colorado Geothermal Resources Act, §§ 37-90.5-101, et seq., C.R.S., other state and local statutes, and rules and regulations, now in existence or as may be modified in the future, consistent with lease rights.

On the lands described below: [insert legal description]

A similar notice will be applied to a SLB geothermal lease requiring lessee to comply with BLM rights-of-way rules and regulations where BLM administers the surface estate.

When offering a federal geothermal lease, the BLM will include a stipulation in the Sale Notice putting the lessee on notice that the BLM may require the lessee to conduct monitoring to ensure lessee activities do not cause material injury to senior water or geothermal rights. The following is an example of language that would meet the intent of this provision:

EXTRACTION STIPULATION

To prevent potential material injury to senior water or geothermal rights under Colorado state law, and to ensure that existing geothermal features are protected under the terms of the applicable ELM Resource Management Plan, as amended by the Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States, 2008, as appropriate, this lease is restricted as follows:

Monitoring of the quantity, quality. or temperature of surface or subsurface water resources by the lessee prior to and during all lease operations, including exploration, development, and utilization of a geothermal resource, may be required as directed by the ELM in consultation with the Colorado State Engineer's Office, and the burden of proof shall be on the lessee to ensure compliance with federal and state statutes, rules, and regulations.

Material injury may be determined by the relevant Colorado Water Court, and such an order from the Water Court may result in limitations on the use of the geothermal resource.

On the lands described below: [insert legal description]

Should a prospective developer seek to develop a hot-dry rock resource as defined in § 37-90.5-103, C.R.S., lying beneath BLM-owned surface where BLM does not own the mineral estate, the Parties will meet and confer with the prospective developer to advise on proper leasing and right-of-way procedures.

Leasing geothermal resources by the BLM vests with the lessee a non-exclusive right to future exploration and an exclusive right to produce and use the geothermal resources within the lease area, subject to existing laws, regulations, formal orders, and the terms, conditions and stipulations in or attached to the lease form or included as conditions of approval to permits. Lease issuance alone does not authorize any ground-disturbing activities to explore for or develop geothermal resources without site-specific approval for the intended operation. Such approval could include additional environmental reviews and permits. Also at each stage, the BLM can issue site-specific conditions of approval to protect resource values.

A lease is issued for a primary term of 10 years and may be extended for two five-year periods. Each of these extensions is available provided the lessee meets the work commitment requirements, or lessee made payment in lieu of minimum work requirements of each year. At any time a lease may receive a 5-year drilling extension. Once commercial production is established, the lease may receive a production extension of up to 35 years and a renewal period of up to 55 years. The lease must continue to produce to remain in effect. BLM may grant a suspension of operations and production on a lease when justified by the operator (see 43 CFR 3207).

Geothermal exploration and production on federal land conducted through leases is subject to terms and stipulations to comply with all applicable federal and state laws pertaining to various considerations for tribal interests, sanitation, water quality, wildlife, safety, cultural resources, and reclamation.

Four Stages of Geothermal Resource Development

The four stages of geothermal resource development within a lease are exploration, drilling operations, utilization, and reclamation and abandonment. Each stage requires a permit from the BLM, and are described below. These descriptions are general in nature and actual development plans may suggest other operations than these depending on the specific location or resource issues.

Exploration

Before geothermal resources are developed, a geothermal resource developer explores for evidence of geothermal resources on leased or unleased land. Exploration includes ground disturbance but does not include the direct testing of geothermal resources or the production or utilization of geothermal resources. Exploration operations include, but are not limited to, geophysical operations, drilling temperature gradient wells, drilling holes used for explosive charges for seismic exploration, core drilling or any other drilling method, provided the well does not reach the geothermal resource. It also includes related construction of roads and trails, and cross-country transit by vehicles over public land. Exploration involves first surveying and then drilling temperature gradient wells. It generally takes between one and five years to complete exploration.

Surveying includes conducting or analyzing satellite imagery and aerial photography, volcanological studies, geologic and structural mapping, geochemical surveys, and geophysical surveys of leasable areas that could support geothermal resource development. The surveys consist of collecting electrical, magnetic, chemical, seismic, and rock data. For example, water samples from hot springs could be used to determine the subsurface characteristics of a particular area. Once the data is compiled, geologists and engineers examine the data and make inferences about where the higher temperature gradients may occur. High temperature gradients can indicate the location of potential underground geothermal reservoirs capable of supporting commercial uses.

Surveys may require creating access using four-wheel drive vehicles, or by helicopters or on foot to areas with no roads or very poor roads. Cutting of vegetation may be required in some areas to facilitate access. In some cases, gas collectors may be installed to measure soil gases. These collectors have partially buried sensors and may disturb small areas of less than three square feet.

While not widely used for geothermal surveys, seismic surveys have the greatest survey impact on the local environment. These surveys typically involve setting up an array of geophones and creating a pulse or series of pulses of seismic energy. The pulse is created either by detonating a small charge below the ground surface (requires drilling a narrow "shot hole") or by a vibroseis truck that is driven through the survey area. Data is transmitted from the geophones to a central location. The geophones may be installed on the ground's surface, in small excavations made specifically for burying the geophones, and/or in existing wells. These surveys are typically undertaken over the course of a few days.

Resistivity surveys include various methodologies from laying out long cables (up to 1,000 feet or more) on the land surface, or setting up equipment repeatedly in small areas (a few tens of square feet at the most for each measuring site).

Minor, temporary disturbances are associated with each site for the burial of sensors.

The second step of the exploration phase is to drill temperature gradient wells on leased or unleased land. This process confirms a more precise location of high temperature gradients. Temperature gradient wells can be drilled using a truck-mounted rig and range from 200 feet to over 4,000 feet deep. The number of gradient wells also varies, depending on the geometry of the system being investigated and the anticipated size of power development. Geologists examine either rock fragments or long cores of rock that are brought up from deep within the well. Water samples are taken from any groundwater encountered during drilling. Also, temperatures are measured at depth. Both well temperatures and the results of rock sample analyses are used to determine if additional exploration is necessary to identify the presence and characteristics of an underground geothermal reservoir. After collecting the desired materials and data, the wells are completed with sealed, water-filled tubing from surface to bottom, often with cement around the tubing.

Most temperature gradient wells are drilled with a small rotary rig (often truck-mounted) similar to that used for drilling water wells, or a diamond-coring rig, similar to that used for geologic sampling in mineral exploration and civic works projects. Neither rig of this size requires construction of a well pad or earth moving equipment unless the site is sharply graded. Support equipment is needed, including water trucks, tanks for mixing and holding drilling fluids, personnel and supply transport vehicles, and sometimes a backhoe for earthmoving activities is needed to prepare the drilling site. A temperature gradient drilling operation can be run by about three on-site personnel and others traveling to the site periodically with materials and supplies.

Temperature-gradient well drilling requires road access. Whenever possible, a driller would access the temperature gradient well site using existing roads. When existing roads are not available, new access roads may need to be constructed for the truck-mounted rig to reach the site; this could require one to six acres of disturbance.

Preparing the site for drilling could include leveling the surface and clearing away vegetation. Several temperature gradient wells are usually drilled to determine both the areal extent of the temperature anomaly and where the highest temperature gradient occurs. Each drill site could disturb approximately 0.10 acres, and the drill rig could be approximately 60 feet tall. During exploration, a driller is not permitted to produce any fluids out of, or inject any fluids into, the well; therefore, the site may also host a sump or tanker truck. Additionally, a diesel generator may also be used at the site to power equipment. The well site itself involves excavation of a small cellar (typically less than three feet square and less than three feet deep) to allow the conductor casing to be set beneath the rig. Drilling may last for several weeks.

Temperature gradient wells are not intended to directly contact the geothermal reservoir, and therefore produce no geothermal fluids. In areas of known artesian pressures, any drilling expected to penetrate the groundwater table would include blow-out prevention equipment. In cases where a temperature gradient well does penetrate a geothermal zone, any release of geothermal fluids at the surface is likely to be minimal due to the small well diameters and the use of blow-out prevention equipment.

Drilling fluids may include drilling mud (bentonite clay, activated montmorillonite clay and crystalline silica-quartz), drilling mud additives (caustic soda, sodium bicarbonate, and anionic polyacrylamide liquid polymer), cement (Portland cement and calcium chloride), fuel (diesel), lubricants (usually petroleum-based) and coolants. The specific fluids and additives depends on a variety of factors, including the geologic formations being penetrated and the depth of the well. Releases of drilling muds are not permitted; a sump and tanker truck are required to capture all fluids. The risk of spills of other fluids is similar to that of any other project involving the use of vehicles and motorized equipment.

All surface disturbances would be reclaimed to the satisfaction of BLM. If a temperature gradient well was unsuccessful, it would be abandoned, and the drill site would be reclaimed. Abandonment includes plugging, capping, and covering the wells. Reclamation includes removing all surface equipment and structures, regrading the site to predisturbance contours, and replanting native or appropriate vegetation to facilitate natural restoration.

Drilling Operations

Once exploration has confirmed a viable prospect for commercial development and necessary leases have been secured, the drilling of exploration wells to test the reservoir can proceed. Drilling Operations include flow testing, producing geothermal fluids for chemical evaluation or injecting fluids into a geothermal reservoir. This would also involve the construction of sumps or pits to hold excess geothermal fluids. It could involve development of minor infrastructure to conduct such operations.

Drilling is an intense activity that requires large equipment (e.g., drill rig) and can take place 24 hours a day. A drilling operation generally has from 10 to 15 people on-site at all times, with more people coming and going periodically with equipment and supplies. Getting the rig and ancillary equipment to the site may require 15 to 20 trips by full-sized tractor-trailers; with a similar amount for de-mobilizing the rig. There would be 10 to 40 daily trips for commuting and hauling in equipment.

If a reservoir is discovered, characteristics of the well and the reservoir are determined by flow testing the well. If the well and reservoir were sufficient for development, a wellhead, with valves and control equipment, would be installed on top of the well casing. Excess geothermal fluids are stored in temporary pits

or sumps, generally lined with plastic (small sumps) or clay (large sumps). The water is left to evaporate and any sludge is removed and properly disposed.

Utilization

Utilization and production is the next phase after a viable reservoir is determined and includes the infrastructure needed for commercial operations, including access roads, construction of facility structures, building electrical generation facilities, drilling and developing well fields, and installing pipelines, meters, substations, and transmission lines. The utilization phase could last from 10 to 50 years and involves the operation and maintenance of the geothermal field(s) and generation of electricity.

The type of development utilization that occurs is based on the size and temperature of the geothermal reservoir. Geothermal resources can be classified as low temperature (less than 90°C, or 194°F), moderate temperature (90°C to 150°C, or 194 to 302°F), and high temperature (greater than 150°C, or 302°F). Only the highest temperature resources are generally used for generating electrical power; however, with emerging technologies and in colder climates such as Alaska, even the lower temperature resources are proving usable for electrical generation.

High temperature reservoirs are suitable for the commercial production of electricity. Three types of power plants that harness geothermal resources are dry steam plants, flash steam plants, and binary-cycle plants. Occasionally a hybrid between flashed steam and binary system is also used. Dry steam power plants use the steam from the geothermal reservoir as it comes from the wells and route it directly through turbine/generator units to produce electricity. Flash steam power plants use water at temperatures greater than 182°C (360°F). Water is pumped under high pressure to the generation equipment at the surface, the pressure is suddenly reduced allowing some of the hot water to convert, or "flash," into steam, and the steam is used to power the turbine/generator units to produce electricity. Binary-cycle power plants use water from the geothermal reservoir to heat another "working fluid." The working fluid is vaporized and used to turn the turbine/generator units. The geothermal water and the working fluid never come in contact with each other. Binary-cycle power plants can operate with lower water temperature 74°C to 182° C (165°F to 360°F) and produce few air emissions.

Development of the lease would involve the following construction and operations:

- Access roads – New access roads to accommodate the larger equipment associated with the development phase could be constructed. In general, a plant can require 0.5 mile to nine miles of roads in order to access the site, well pads, and power plant. Depending on the type and use-intensity of the road, the areas of surface

disturbance is about 30-feet wide for a 18-20 foot wide road surface, including cut and fill slopes and ditches.

- Drill site development – Multiple wells may be drilled per lease. Production-size wells can be over two miles (10,560 feet) deep. The number of wells is dependent upon the geothermal reservoir characteristics and the planned power generation capacity. For example, a 50MW (net) power plant could require up to 25 production wells and 10 injection wells. It is common that multiple wells would be installed on a well pad. The size of the well pad is dependent upon site conditions and on the number of wells for the pad, but they are typically about one to five acres, including minor cut and fill. In order to drill these deep holes, a large drilling rig or derrick would be erected. Various temporary support facilities may be located on-site, including generators, mud tanks, cement tanks, trailers for the drillers and mud loggers, housing trailers, and storage sheds. As appropriate, facilities can be painted to blend in with the surrounding environment. Drilling operations can occur 24 hour a day.

- Wellfield equipment – A geothermal power plant is typically supported by pipeline systems in the plant's vicinity. The pipeline systems include a gathering system for produced geothermal fluids, and an injection system for the reinjection of geothermal fluids after heat extraction takes place at the plant. Pipelines are usually 24 to 36 inches in diameter, but can be as small as 8 inches depending on the type of pipeline. Pipelines transporting hot fluids or steam to the plant are covered with insulation, whereas injection pipelines are generally not. When feasible, they would parallel the access roads and existing roads to the destination of the geothermal resource's steam or water. Pipelines are typically constructed on supports above ground, resulting in little if any impact on the surrounding area once construction is complete and the corridor has been revegetated. The pipelines typically have a few feet of clearance underneath them, allowing small animals to easily cross their path. The pipelines are typically painted to blend in with the surrounding environment. In general, plants have about 1.5 to 7 miles of pipes with a corridor width of about 25 feet.

- Power plant – A 50-MW power plant would utilize a site area of up to 20 to 25 acres to accommodate all the needed equipment, including the power plant itself, space for pipelines geothermal fluids and reinjection, a switch yard, space for moving and storing equipment, and buildings needed for various purposes (power plant control, fire control, maintenance shop, etc.). The power plant itself would occupy an estimated 25 percent of this area for a water-cooled plant, or about 50 percent for an air-cooled plant. Where topography permits, the power plant could be situated so as to be less visible from nearby roads, trails,

scenic vistas or scenic highways. The site of the plant requires reasonable air circulation to allow for efficient operation of the plant's condensers. A smaller 20-MW power plant would typically require approximately five to ten acres for the entire complex.

- Electric transmission lines – Transmission lines may range in length from 5 miles to 50 miles with a corridor width of approximately 40 feet. Wooden poles most likely support them, and about 5 acres could be disturbed per mile of transmission line.

- Reclamation – When a production well is successful, a wellhead with valves and control equipment is installed on top of the well casing. If a production well is unsuccessful, the production well would be plugged and capped, and the site would be reclaimed.

The number of personnel required during construction varies significantly, but at any one point there may be a few hundred laborers and professionals on-site with attendant vehicle traffic. The number of people required for routine operation of a power plant is typically three per shift; however, additional personnel (as many as 12 total, depending on plant size) may be on site during the day for maintenance and management.

Activities associated with operation and maintenance and energy production would involve managing waste generated by daily activities, managing geothermal water, landscaping, and the maneuvering of construction and maintenance equipment and vehicles associated with these activities.

Reclamation and Abandonment

This phase involves abandoning the well after production ceases and reclaiming all disturbed areas in conformance with BLM standards. Abandonment includes plugging, capping, and reclaiming the well site. Reclamation includes removing the power plant and all surface equipment and structures, regarding the site and access roads to predisturbance contours, and replanting native or appropriate vegetation to facilitate natural restoration.

Environmental Review Requirements for Lease Sales

All geothermal decisions must be provided for and in conformance with the applicable land use plan. Prior to geothermal lease sales, individual BLM field offices must prepare Documentation of Plan Conformance and NEPA Adequacy for parcels within their respective jurisdictions to determine: (1) whether the issuance of a particular lease is in conformance with the applicable land use plan; and (2) whether the BLM can properly rely upon existing NEPA documents that analyze the potential impacts of geothermal leasing (i.e., an EIS that accompanies a land use plan). Additionally, the BLM must also document completion of required government to government consultation with tribes and environmental reviews required to comply with other laws, including, but not limited to, the ESA and NHPA.

While a DNA can provide NEPA compliance, it is not an "environmental document" per se and cannot supply missing analysis; if the DNA evaluation shows a need for further analysis, a new or supplemental NEPA document would need to be prepared. Upon completion of the DNA, the BLM field office can make one of the following recommendations to the BLM State Office: (1) the parcel(s) be offered for sale; (2) the parcel(s) be offered for sale with slightly modified legal descriptions or additional lease sale notices and stipulations.

Stipulations could include areas identified for NSO areas subject to CSU, or areas subject to timing limitations; (3) that certain parcels not be offered for lease until additional NEPA or other required planning documentation is prepared; or (4) deny the lease due to lack of conformance with the existing land use plan. This EA seeks to amend appropriate land use plans to facilitate the leasing process.

All National Park System lands are closed to geothermal leasing. If a lease parcel is near a National Park, the BLM, in coordination with the National Park Service, must also determine if any subsequent development would likely impact a "significant thermal feature" within a unit of the National Park System.

If the Secretary of the Interior determines that exploration, development, or utilization of the lease parcel is "reasonably likely to result in a significant adverse effect on a significant thermal feature within a unit of the National Park System," then the lease would not be issued. If it is determined that use of the lease would be "reasonably likely to adversely affect" any significant thermal feature, then stipulations are included on leases and permits to protect the thermal features (10 USC Section 1026[c][d]).''

Appendix B

Geothermal Leasing Procedures

This page intentionally left blank.

APPENDIX B
GEOTHERMAL LEASING PROCEDURES

MANAGEMENT PROCEDURES FOR GEOTHERMAL LEASING

To ensure compliance with regulations and federal laws, the following procedures would be implemented prior to any lands being included in a competitive lease sale. Stipulations would also be used to help achieve resource protection in accordance with laws and regulations and the SLVFO RMP.

- The BLM authorized officer would consult with the appropriate Native American tribal governments to identify tribal interests and traditional cultural resources or properties that may be affected by the federal land leases and potential for geothermal energy development. Tribal interests include economic rights such as Indian trust assets and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. There may be issues related to the presence of cultural properties, access rights, disruption to traditional cultural practices, cultural use of hot springs and water sources and impacts on visual resources important to tribes. Areas proposed for leasing may include lands where there are tribal interests and traditional cultural resources that are not currently identified. Consultations on leases should include a full disclosure of the lease as a commitment of the land that may eventually involve future development that could preclude other tribal uses. Consideration and research should be directed to determine if there are other ethnic and social groups that may have traditional uses or ties to the lands proposed for leases.
- The authorized officer of the BLM would consult with the appropriate Native American Tribes and State Historic Preservation Officers regarding historic and cultural resources per Section 106 of the NHPA. The presence of archaeological sites and historic properties would be determined on the basis of a records search and literature review of

recorded sites and properties in the proposed lease area and a buffer around the lease area, if appropriate. The BLM would assess the adequacy of the cultural resource identification and evaluation effort for the leasing stage. Additional historical, cultural or ethnographic research, consultation and/or inventories may be required to identify resources, determine effects, mitigate adverse effects and complete the Section 106 process. The 2009 Geothermal PEIS addresses the Section 106 process at a programmatic level and serves as a basis for the phased consultation process. All existing MOUs and agreements regarding the identification and protection of cultural resources would remain valid.

- The authorized officer of the BLM would determine if any listed or proposed threatened or endangered species or critical habitat is present on nominated lease parcels. If so, the authorized officer would comply with Section 7 of the ESA, which may include consultation or conferencing with the USFWS. Additional compliance activities, which may include consultation, would occur during the site-specific project permitting process.
- The authorized officer of the BLM would review the lands for any other sensitive resources (e.g., paleontological, BLM sensitive status species) and provide for the necessary stipulations to protect these resources and ensure compliance with the land use plan. Assessment of the resource would include consulting with agency experts, coordinating with other appropriate agencies, and site surveys, if warranted.
- Per direction in the BLM-Colorado Department of Natural Resources MOU, the BLM Principal Contact will notify the CDNR Principal Contact when the BLM receives a nomination to lease a geothermal parcel. Likewise, the CDNR Principal Contact will notify BLM Principal Contact when the State Land Board (SLB) receives a nomination to lease a geothermal parcel, or when another CDNR division seeks to convey rights to geothermal resources.
- The Parties will communicate and cooperate during their respective reviews of nominated parcels and whether and under what conditions to offer a nominated parcel for lease. The BLM will notify surface owners overlying federal geothermal resources that it seeks to lease, consistent with WO IM No. 2009-184, "Courtesy Notification of Surface Owners When Split-Estate Lands are Included in an Oil and Gas Notice of Competitive Lease Sale."
- When offering a federal geothermal lease, the BLM will include a stipulation in the Sale Notice requiring any future lessee to comply with Colorado law. The following is an example of language that would meet the intent of this provision:

LEASE NOTICE

The lessee is hereby notified that prior to and during all lease operations including development and utilization of a geothermal resource, the lessee must comply with applicable provisions of the Colorado Geothermal Resources Act, §§ 37-90.5-101, et seq., C.R.S., other state and local statutes, and rules and regulations, now in existence or as may be modified in the future, consistent with lease rights.

On the lands described below: [insert legal description]

- A similar notice will be applied to a SLB geothermal lease requiring lessee to comply with BLM rights-of-way rules and regulations where BLM administers the surface estate.

- When offering a federal geothermal lease, the BLM will include a stipulation in the Sale Notice putting the lessee on notice that the BLM may require the lessee to conduct monitoring to ensure lessee activities do not cause material injury to senior water or geothermal rights. The following is an example of language that would meet the intent of this provision:

  EXTRACTION STIPULATION

  To prevent potential material injury to senior water or geothermal rights under Colorado state law, and to ensure that existing geothermal features are protected under the terms of the applicable ELM Resource Management Plan, as amended by the Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States, 2008, as appropriate, this lease is restricted as follows:

  Monitoring of the quantity, quality. or temperature of surface or subsurface water resources by the lessee prior to and during all lease operations, including exploration, development, and utilization of a geothermal resource, may be required as directed by the ELM in consultation with the Colorado State Engineer's Office, and the burden of proof shall be on the lessee to ensure compliance with federal and state statutes, rules, and regulations.

  Material injury may be determined by the relevant Colorado Water Court, and such an order from the Water Court may result in limitations on the use of the geothermal resource.

  On the lands described below: [insert legal description]

- Should a prospective developer seek to develop a hot-dry rock resource as defined in § 37-90.5-103, C.R.S., lying beneath BLM-owned surface where BLM does not own the mineral estate, the Parties will

meet and confer with the prospective developer to advise on proper leasing and right-of-way procedures.

- Prior to making a leasing decision on lands in proximity to a National Park System unit, the BLM would coordinate with the National Park Service to determine if there would be any impacts on thermal or hydrological features within the unit. In accordance with the Geothermal Steam Act Amendments (30 USC Section 1026), if it is determined based on scientific evidence that exploration, development, or utilization of the lands subject to the lease application or nomination is reasonably likely to result in a significant adverse effect on a significant thermal feature within the National Park System, the lease would not be issued. In the event that development is reasonably likely to adversely affect a significant thermal feature, the BLM would apply the appropriate stipulations to protect the park units (see Protection of Geothermal Features stipulations above).
- Prior to making leasing decisions, the BLM will assess the adequacy of existing NEPA documentation and ensure that the proposed action is in conformance with the SLVFO RMP to determine if there is new information or new circumstances that warrant further analysis.
- The level of environmental analysis to be required under NEPA for subsequent individual exploration, development, and production permits will be determined by the SLVFO. In certain instances, it may be determined that a tiered EA is appropriate in lieu of an EIS. To the extent that land use plans or the 2008 Geothermal PEIS anticipated issues and concerns associated with individual projects, including potential cumulative impacts, the BLM will tier from the RMP and/or the 2008 Geothermal PEIS analysis and decisions; thereby limiting the required scope and effort of additional project-specific NEPA analysis.
- The authorized officer of the BLM would collaborate with appropriate state agencies, especially in the case of geothermal energy, as the states manage and typically have regulatory authority for water quality, water rights, and wildlife.
- Applicants for geothermal development and production on public lands will develop a project-specific operations plan that incorporates the applicable mitigation and BMPs provided in **Appendix C** and, as appropriate, the requirements of other existing and relevant BLM mitigation guidance. Additional mitigation measures will be incorporated into the operations plan and into the conditions of approval or project stipulations. The operations plan will include site plans, location of facilities, wells, pipelines, transmission lines, roads, and other infrastructure.

Appendix C

Best Management Practices

This page intentionally left blank.

APPENDIX C
BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are state-of-the-art mitigation measures applied on a site-specific basis to avoid, minimize, reduce, rectify, or compensate for adverse environmental or social impacts. They are applied to management actions to aid in achieving desired outcomes for safe, environmentally responsible resource development, by preventing, minimizing, or mitigating adverse impacts and reducing conflicts.

This appendix provides a list of sample BMPs addressing geothermal leasing and development. The purpose of this appendix is to provide a list of recommended BMPs that would be incorporated as appropriate into the permit application by the lessee or would be included in the approved use authorization by the BLM as conditions of approval. When implementing the BMPs, SLVFO would work with an affected lessee early in the process, to explain how BMPs may fit into their development proposals and how BMPs can be implemented with the least economic impact on the lessee. The SLVFO would discuss potential resource impacts with the lessee and seek the operator's recommended solutions. The SLVFO would also encourage the lessee to incorporate necessary and effective BMPs into their project proposal. BMPs not incorporated into the permit application by the lessee may be considered and evaluated through the environmental review process and incorporated into the use authorization as conditions of approval or rights-of-way stipulations.

Environmental BMPs to be considered in nearly all circumstances include the following:

- Interim reclamation of well locations and access roads soon after the well is put into production;
- Painting of all new facilities with a color that best allows the facility to blend with the background, typically a vegetated background;

- Design and construction of all new roads to a safe and appropriate standard, "no higher than necessary" to accommodate their intended use; and
- Final reclamation recontouring of all disturbed areas, including access roads, to the original contour or a contour that blends with the surrounding topography.

Other environmental BMPs are more suitable for consideration on a case-by-case basis depending (1) on their effectiveness, (2) the balancing of increased operating costs vs. the benefit to the public and resource values, (3) the availability of less restrictive mitigation alternatives that accomplish the same objective, and (4) other site-specific factors.

Guidelines for applying and selecting project-specific requirements include determining whether the measure would (1) ensure compliance with relevant statutory or administrative requirements, (2) minimize local impacts associated with siting and design decisions, (3) promote post construction stabilization of impacts, (4) maximize restoration of previous habitat conditions, (5) minimize cumulative impacts, or (6) promote economically feasible development of geothermal energy on BLM-administered.

The following typical BMPs provide the BLM, industry, and stakeholders a menu of improved practices for developing geothermal energy and minimize impacts on the biophysical and cultural landscape. The list is extensive but is not meant to be all inclusive given the constant development of improved practices and potential for unique site-specific conditions.

Only those individual mitigation measures reasonably necessary to ensure environmentally responsible geothermal development should be selected from the list below. Not all of the individual mitigation measures below will apply in most situations and selection of appropriated BMPs and mitigation measures should be dependent on factors such as the project size, location, site-specific characteristics, and potential resource impacts. Prior to inclusion into a permit, the measures may be further modified to meet site-specific situations and BLM requirements.

INFORMATION COLLECTION AND MONITORING

General

Prior to geothermal exploration and development, a complete subsurface geotechnical investigation will be conducted to analyze the soil and geologic conditions. The investigation will evaluate and identify potential geologic hazards and would provide remedial grading recommendations, foundation and slab design criteria, and soil parameters for the design of geothermal power infrastructure.

- The operator will collect available information describing the environmental and socio-cultural conditions in the vicinity of the proposed project and will provide the information to the agency.
- A monitoring program will be developed by the operator to ensure that environmental conditions are monitored during the exploration and well drilling, testing, construction, and utilization and reclamation phases. The monitoring program requirements, including adaptive management strategies, will be established at the project level to ensure that potential adverse impacts of geothermal development are mitigated. The monitoring program will identify the monitoring requirements for each major environmental resource present at the site, establish metrics against which monitoring observations can be measured, identify potential mitigation measures, and establish protocols for incorporating monitoring observations and additional mitigation measures into ongoing activities. The operator will provide results of the monitoring program to the agency in an annual report.

Paleontological and Cultural Resources

- Before any specific permits are issued under leases, treatment of cultural resources will follow the procedures established by the Advisory Council on Historic Preservation for compliance with Section 106 of the NHPA. A pedestrian inventory will be undertaken of all portions that have not been previously surveyed or are identified by BLM as requiring inventory to identify properties that are eligible for the NRHP. Those sites not already evaluated for NRHP eligibility will be evaluated based on surface remains, subsurface testing, archival, and/or ethnographic sources. Subsurface testing will be kept to a minimum whenever possible if sufficient information is available to evaluate the site or if avoidance is an expected mitigation outcome. Recommendations regarding the eligibility of sites will be submitted to the BLM, and a treatment plan will be prepared to detail methods for avoidance of impacts or mitigation of effects. The BLM will make determinations of eligibility and effect and consult with State Historic Preservation Office as necessary based on each proposed lease application and project plans. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated. Avoidance of impacts through project design will be given priority over data recovery as the preferred mitigation measure. Avoidance measures include moving project elements away

from site locations or to areas of previous impacts, restricting travel to existing roads, and maintaining barriers and signs in areas of cultural sensitivity. Any data recovery will be preceded by approval of a detailed research design, Native American Consultation, and other requirements for BLM issuance of a permit under the Archaeological Resources Protection Act of 1979.

- If cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a cultural resources management plan will be developed. This plan will address mitigation activities to be taken for cultural resources found at the site. Avoidance of the area is always the preferred mitigation option. Other mitigation options include archaeological survey and excavation (as warranted) and monitoring. If an area exhibits a high potential, but no artifacts were observed during an archaeological survey, monitoring by a qualified archaeologist could be required during all excavation and earthmoving in the high-potential area. A report will be prepared documenting these activities. The cultural resources management plan will also (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of artifacts and destruction of property on public land.
- Operators will determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search for past paleontological finds in the area, and/or, depending on the extent of existing information, a paleontological survey.
- If paleontological resources are present at the site, or if areas with a high potential to contain paleontological material have been identified, a paleontological resources management plan will be developed. This plan will include a mitigation plan for avoidance, removal of fossils, or monitoring. If an area exhibits a high potential but no fossils were observed during survey, monitoring by a qualified paleontologist may be required during excavation and earthmoving in the sensitive area. The operator will submit a report to the agency documenting these activities. The paleontological resources management plan also will (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of fossils on public land.

Water Resources

- In coordination with state regulatory agencies the operator will comply with all state and federal surface and ground water rules and regulations for all phases of geothermal exploration, development, and reclamation.
- Operators will develop a storm water management plan for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.
- Operators will gain and demonstrate a clear understanding of the local hydrogeology. Areas of groundwater discharge and recharge and their potential relationships with surface water bodies will be identified.
- Operators will avoid creating hydrologic conduits between discrete aquifers during foundation excavation and other activities.
- Freshwater-bearing and other usable water aquifers will be protected from contamination by assuring all well casing (excluding the liner) is required to be cemented from the casing shoe to the surface.
- Periodic testing and monitoring via observation wells will be conducted in a manner to assure maximum protection of water resources from geothermal fluids or alterations in reservoir pressure.

Vegetation and Fish and Wildlife

- The operator will conduct surveys for plant and animal species that are listed or proposed for listing as threatened or endangered and their habitats in areas proposed for development where these species could potentially occur, following accepted protocols and in consultation with the USFWS, as appropriate. Particular care should be taken to avoid disturbing listed species during surveys in any designated critical habitat. The operator will monitor activities and their effects on ESA-listed species throughout the duration of the project.
- The operator will identify important, sensitive, or unique habitat and biota in the project vicinity and site and should design the project to avoid (if possible), minimize, or mitigate potential impacts on these resources. The design and siting of the facilities will follow appropriate guidance and requirements from the BLM and other resource agencies, as available and applicable.

National Scenic and Historic Trails

- When any right-of-way application includes remnants of a National Historic Trail, is located within the viewshed of a National Historic Trail's designated centerline, or includes or is within the viewshed of a trail eligible for listing on the NRHP, the operator will evaluate the potential visual impacts on the trail associated with the proposed project and identify appropriate mitigation measures for inclusion in the operation plan.

Air Quality and Climate

- The operator will coordinate with the [State Air Quality Division] to develop and implement an air quality monitoring plan.

PLANNING, LOCATION, AND DESIGN

Traffic Planning

- Operators will consult with local planning authorities regarding increased traffic prior to the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) will be identified and addressed in the traffic management plan.

Roads and Pads

- To plan for efficient use of the land, necessary infrastructure will be consolidated wherever possible.
- Existing roads and pad sites will be used to the maximum extent feasible, but only if located in a safe and environmentally sound location. No new roads and pad sites will be constructed without agency authorization. If new roads and pad sites have been authorized, they will be designed and constructed by the operator to the appropriate agency standard, no higher than necessary to accommodate their intended function. Roads and pad sites will be routinely maintained by the operator maintain public safety and to minimize impacts on the environment such as erosion, sedimentation, fugitive dust, loss of vegetation.
- An access road siting and management plan will be prepared incorporating existing Agency standards regarding road design, construction, and maintenance such as those described in the BLM 9113 Manual and the Surface Operating Standards for Oil and Gas Exploration and Development (i.e., the Gold Book, 4th Edition, 2007).
- A traffic management plan will be prepared for the site access roads to ensure that no hazards would result from the

increased truck traffic and that traffic flow would not be adversely impacted. This plan will incorporate measures such as informational signs, flaggers when equipment may result in blocked throughways, and traffic cones to identify any necessary changes in temporary lane configuration.

- Where possible, access roads will be located to follow natural contours and minimize side hill cuts and fills. Excessive grades on roads, road embankments, ditches, and drainages will be avoided, especially in areas with erodible soils.
- Roads will be designed so that changes to surface water runoff are minimized and new erosion is not initiated.
- Access roads will be located to minimize stream crossings. All structures crossing streams will be located and constructed so that they do not decrease channel stability or increase water velocity. Operators will obtain all applicable federal and state water crossing permits.
- Roads will be located away from drainage bottoms and avoid wetlands, if practicable.

Geotechnical Analysis

- The operator will perform a detailed geotechnical analysis prior to the construction of any structures; so they will be sited to avoid any hazards from subsidence or liquefaction (i.e., the changing of a saturated soil from a relatively stable solid state to a liquid during earthquakes or nearby blasting).

Visual Mitigation

- The operator will incorporate visual design considerations into the planning and design of the project to minimize potential visual impacts of the proposal and to meet the VRM objectives of the area and the agency.

Visual Design Considerations

- Construct low-profile structures whenever possible to reduce structure visibility.
- Select and design materials and surface treatments to repeat or blend with landscape elements.
- Site projects outside of the viewsheds of publically accessible vantage points, or if this cannot be avoided, as far away as possible.
- Site projects to take advantage of both topography and vegetation as screening devices to restrict views of projects from visually sensitive areas.

- Site facilities away from and not adjacent to prominent landscape features (e.g., knobs and water features).
- Avoid placing facilities on ridgelines, summits, or other locations such that they will be silhouetted against the sky from important viewing locations.
- Collocate facilities to the extent possible to use existing and shared rights-of-way, existing and shared access and maintenance roads, and other infrastructure to reduce visual they do not bisect ridge tops or run down the center of valley bottoms.
- Site linear features (aboveground pipelines, rights-of-way, and roads) to follow natural land contours rather than straight lines (particularly up slopes) when possible. Fall-line cuts should be avoided.
- Site facilities, especially linear facilities, to take advantage of natural topographic breaks (i.e., pronounced changes in slope) to avoid siting facilities on steep side slopes.
- Where available, site linear features such as rights-of-way and roads to follow the edges of clearings (where they will be less conspicuous) rather than passing through the centers of clearings.
- Site facilities to take advantage of existing clearings to reduce vegetation clearing and ground disturbance, where possible.
- Site linear features (e.g., trails, roads, rivers) to cross other linear features at right angles whenever possible to minimize viewing area and duration.
- Site and design structures and roads to minimize and balance cuts and fills and to preserve existing rocks, vegetation, and drainage patterns to the maximum extent possible.
- Use appropriately colored materials for structures or appropriate stains and coatings to blend with the project's backdrop. Refer to the Standard Environmental Colors chart available from the BLM.
- Use non-reflective or low-reflectivity materials, coatings, or paints whenever possible.
- Paint grouped structures the same color to reduce visual complexity and color contrast.
- Design and install efficient facility lighting so that the minimum amount of lighting required for safety and security is provided but not exceeded and so that upward light scattering (light pollution) is minimized. This may include, for example, installing

shrouds to minimize light from straying off-site, properly directing light to only illuminate necessary areas, and installing motion sensors to only illuminate areas when necessary.

- Site construction staging areas and laydown areas outside of the viewsheds of publically accessible vantage points and visually sensitive areas, where possible, including siting in swales, around bends, and behind ridges and vegetative screens.
- Discuss visual impact mitigation objectives and activities with equipment operators prior to commencement of construction activities.
- Mulch or scatter slash from vegetation removal and spread it to cover fresh soil disturbances or, if not possible, bury or compost slash.
- If slash piles are necessary, stage them out of sight of sensitive viewing areas.
- Avoid installing gravel and pavement where possible to reduce color and texture contrasts with existing landscape.
- Use excess fill to fill uphill-side swales resulting from road construction in order to reduce unnatural-appearing slope interruption and to reduce fill piles.
- Avoid downslope wasting of excess fill material.
- Round road-cut slopes, vary cut and fill pitch to reduce contrasts in form and line, and vary slope to preserve specimen trees and nonhazardous rock outcroppings.
- Leave planting pockets on slopes where feasible.
- Combine methods of re-establishing native vegetation through seeding, planting of nursery stock, transplanting of local vegetation within the proposed disturbance areas and staging of construction enabling direct transplanting.
- Revegetate with native vegetation establishing a composition consistent with the form, line, color, and texture of the surrounding undisturbed landscape."
- Provide benches in rock cuts to accent natural strata.
- Use split-face rock blasting to minimize unnatural form and texture resulting from blasting.
- Segregate topsoil from cut and fill activities and spread it on freshly disturbed areas to reduce color contrast and to aid rapid revegetation.
- Bury utility cables in or adjacent to the road where feasible.

- Minimize signage and paint or coat reverse sides of signs and mounts to reduce color contrast with existing landscape.
- Prohibit trash burning; store trash in containers to be hauled off-site for disposal.
- Undertake interim restoration during the operating life of the project as soon as possible after disturbances. During road maintenance activities, avoid blading existing forbs and grasses in ditches and along roads.
- Randomly scarify cut slopes to reduce texture contrast with existing landscape and to aid in revegetation.
- Cover disturbed areas with stockpiled topsoil or mulch, and revegetate with a mix of native species selected for visual compatibility with existing vegetation.
- Restore rocks, brush, and natural debris whenever possible to approximate preexisting visual conditions.

Air Quality and Climate

- The operator will prepare and submit to the agency an Equipment Emissions Mitigation Plan for managing diesel exhaust, An Equipment Emissions Mitigation Plan will identify actions to reduce diesel particulate, carbon monoxide, hydrocarbons, and nitrogen oxides associated with construction and drilling activities. The Equipment Emissions Mitigation Plan will require that all drilling/construction-related engines are maintained and operated as follows:

– Are tuned to the engine manufacturer's specification in accordance with an appropriate time frame.

– Do not idle for more than five minutes (unless, in the case of certain drilling engines, it is necessary for the operating scope).

– Are not tampered with in order to increase engine horsepower.

– Include particulate traps, oxidation catalysts, and other suitable control devices on all drilling/construction equipment used at the project site.

– Use diesel fuel having a sulfur content of 15 parts per million or less, or other suitable alternative diesel fuel, unless such fuel cannot be reasonably procured in the market area.

– Include control devices to reduce air emissions. The determination of which equipment is suitable for control devices should be made by an independent Licensed Mechanical Engineer. Equipment suitable for control devices may include drilling

equipment, work over and service rigs, mud pumps, generators, compressors, graders, bulldozers, and dump trucks.

Health and Safety

- Operators will develop a hazardous materials management plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used at the site. The plan will identify all hazardous materials that would be used, stored, or transported at the site. It will establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials. The plan will also identify requirements for notices to federal and local emergency response authorities and include emergency response plans.
- Operators will develop a waste management plan identifying the waste streams that are expected to be generated at the site and addressing hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. This plan will address all solid and liquid wastes that may be generated at the site.
- • Operators will develop a spill prevention and response plan identifying where hazardous materials and wastes are stored on site, spill prevention measures to be implemented, training requirements, appropriate spill response actions for each material or waste, the locations of spill response kits on site, a procedure for ensuring that the spill response kits are adequately stocked at all times, and procedures for making timely notifications to authorities.
- A safety assessment will be conducted to describe potential safety issues and the means that would be taken to mitigate them, including issues such as site access, construction, safe work practices, security, heavy equipment transportation, traffic management, emergency procedures, and fire control.
- A health and safety program will be developed to protect both workers and the general public during construction and operation of geothermal projects.
- Regarding occupational health and safety, the program will identify all applicable federal and state occupational safety standards; establish safe work practices for each task (e.g., requirements for personal protective equipment and safety harnesses; Occupational Safety and Health Administration standard practices for safe use of explosives and blasting agents; and measures for reducing occupational electric and magnetic

fields exposures); establish fire safety evacuation procedures; and define safety performance standards (e.g., electrical system standards and lightning protection standards). The program will include a training program to identify hazard training requirements for workers for each task and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies will be established.

- Regarding public health and safety, the health and safety program will establish a safety zone or setback for generators from residences and occupied buildings, roads, rights-of-way, and other public access areas that is sufficient to prevent accidents resulting from the operation of generators. It will identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or rehabilitation activities. It will also identify measures to be taken during the operation phase to limit public access to hazardous facilities (e.g., permanent fencing would be installed only around electrical substations, and facility access doors would be locked).
- Operators will consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) will be identified and addressed in the traffic management plan.
- Operators will develop a fire management strategy to implement measures to minimize the potential for a human-caused fire.

Livestock Grazing

- The operator will coordinate with livestock operators to minimize impacts on livestock operations.

Noxious Weeds and Pesticides

- Operators will develop a plan for control of noxious weeds and invasive species, which could occur as a result of new surface disturbance activities at the site. The most recent recommendations at the state and local level should be incorporated into any operating plan for the geothermal exploration and development. The plan will address monitoring, education of personnel on weed identification, the manner in which weeds spread, and methods for treating infestations. The use of certified weed-free mulching will be required. If trucks and construction equipment are arriving from locations with

known invasive vegetation problems, a controlled inspection and cleaning area will be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.

- If pesticides are used on the site, an integrated pest management plan will be developed to ensure that applications would be conducted within the framework of all federal, state, and local laws and regulations and entail only the use EPA-registered pesticides.

Vegetation and Fish and Wildlife

- The operator will prepare a habitat restoration plan to avoid (if possible), minimize, or mitigate negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. The plan will identify revegetation, soil stabilization, and erosion reduction measures that will be implemented to ensure that all temporary use areas are restored. The plan will require that restoration occur as soon as possible after completion of activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

CONSTRUCTION

Traffic Management

- Traffic will be restricted to the roads developed for the project. Use of other unimproved roads will be restricted to emergency situations.
- Signs will be placed along roads to identify speed limits, travel restrictions, and other standard traffic control information. Signs directing vehicles to alternative park access and parking will be posted in the event construction temporarily obstructs recreational parking areas near trailheads. Whenever active work is being performed, the area will be posted with "construction ahead" signs on any adjacent access roads or trails that might be affected.
- Project personnel and contractors will be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and fugitive dust.
- When practical, construction activities will be avoided during high recreational use periods.

Roads and Pads

- The operator will obtain agency authorization prior to borrowing soil or rock material from agency lands.
- Road use will be restricted during the wet season if road surfacing is not adequate to prevent soil displacement, rutting, etc., and resultant stream sedimentation.
- Access roads and on-site roads will be surfaced with aggregate materials where necessary to provide a stable road surface, support anticipated traffic, reduce fugitive dust, and prevent erosion.
- Dust abatement techniques will be used before and during surface clearing, excavation, or blasting activities. Dust abatement techniques will be used on unpaved, unvegetated surfaces to minimize fugitive dust. Speed limits (e.g., 25 miles per hour) will be posted and enforced to reduce fugitive dust. Construction materials and stockpiled soils will be covered if they are a source of fugitive dust.
- Culvert outlets will be rip-rapped to dissipate water energy at the outlet and reduce erosion. Catch basins, roadway ditches, and culverts will be cleaned and maintained regularly.

Pipelines

- Pipelines constructed above ground due to thermal gradient induced expansion and contraction will rest on cradles above ground level, allowing small animals to pass underneath. Projects should be analyzed to ensure adequate passage for all wildlife species. The pipeline will be raised higher to allow wildlife passage where needed. Because pipeline corridors through certain habitat types can alter local predator-prey dynamics by providing predators with lines of sight and travel corridors, large projects should be analyzed to ensure there will be no significant changes to predator-prey balance.

Utilities

- Underground utilities will be installed to minimize the amount of open trenches at any given time, keeping trenching and backfilling crews close together. Avoid leaving trenches open overnight. Where trenches cannot be back-filled immediately, escape ramps should be constructed at least every 100 feet.

SPECIFIC RESOURCES

Cultural and Paleontological Resources

- Unexpected discovery of cultural or paleontological resources during construction will be brought to the attention of the

responsible BLM authorized officer immediately. Work will be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.

Noise

- The operator will take measurements to assess the existing background noise levels at a given site and compare them with the anticipated noise levels associated with the proposed project.
- Within [2] miles of existing, occupied residences, geothermal well drilling or major facility construction operations will be restricted to non-sleeping hours (7:00 am to 10:00 pm).
- All equipment will have sound-control devices no less effective than those provided on the original equipment. All construction equipment used will be adequately muffled and maintained.
- All stationary construction equipment (i.e., compressors and generators) will be located as far as practicable from nearby residences.
- If blasting or other noisy activities are required during the construction period, nearby residents will be notified by the operator at least one hour in advance.
- Explosives will be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the federal and state agencies.

Noxious Weeds and Pesticides

- The use of certified, weed-free mulch will be required when stabilizing areas of disturbed soil.
- If trucks and construction equipment are arriving from locations with known invasive vegetation problems, a controlled inspection and cleaning area will be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.
- Fill materials and road surfacing materials that originate from areas with known invasive vegetation problems will not be used.
- Revegetation, habitat restoration and weed control activities will be initiated as soon as possible after construction activities are completed.
- Use of pesticides must be approved by the agency. Pesticide use will be limited agency approved pesticides and will only be

applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

Waste Management

- All refueling will occur in a designated fueling area that includes a temporary berm to limit the spread of any spill.
- Drip pans will be used during refueling to contain accidental releases.
- Drip pans will be used under fuel pump and valve mechanisms of any bulk fueling vehicles parked at the construction site.
- Any containers used to collect liquids will be enclosed or screened to prevent access to contaminants by wildlife, livestock, and migratory birds.
- Spills will be immediately addressed per the spill management plan, and soil cleanup and removal initiated as soon as feasible.

Wildlife

- The operator will ensure that employees, contractors, and site visitors avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. In addition, pets will be controlled or excluded to avoid harassment and disturbance of wildlife.
- Ponds, tanks and impoundments (including but not limited to drill pits) containing liquids can present hazards to wildlife. Standing water around geothermal facilities will be kept to a minimum. Any liquids contaminated by substances which may be harmful due to toxicity, or fouling of the fur or feathers (detergents, oils), should be excluded from wildlife access by fencing, netting or covering at all times when not in active use. Liquids at excessive temperature should likewise be excluded. If exclusion is not feasible, such as a large pond, a hazing program based on radar or visual detection, in conjunction with formal monitoring, should be implemented. Clean water impoundments can also present a trapping hazard if they are steep-sided or lined with smooth material. All pits, ponds and tanks should have escape ramps functional at any reasonably anticipated water level, down to almost empty. Escape ramps can take various forms depending on the configuration of the impoundment. Earthen pits may be constructed with one side sloped 3:1 or greater lined ponds can use textured material; straight-sided tanks can be fitted with expanded metal escape ladders.

OPERATIONS/UTILIZATION

- "Good housekeeping" procedures will be developed by the operator to ensure that during all phases of exploration and operation the site will be kept clean of standing water, noxious weeds, debris, litter, garbage, fugitive trash or waste, and graffiti. Scrap heaps and dumps are prohibited. Storage yards are to be minimized to that which is absolutely necessary.

- A Lighting Plan shall be prepared that documents how lighting will be designed and installed to minimize night-sky impacts during facility construction and operations phases. Lighting for facilities shall not exceed the minimum number of lights and brightness required for safety and security and shall not cause excessive reflected glare. Full cut-off luminaires shall be utilized to minimize uplighting. Lights shall be directed downward or toward the area to be illuminated. Light fixtures shall not spill light beyond the project boundary. Lights in high-illumination areas not occupied on a continuous basis shall have switches, timer switches, or motion detectors so that the lights operate only when the area is occupied. Where feasible, vehicle-mounted lights shall be used for night maintenance activities. Wherever feasible, consistent with safety and security, lighting shall be kept off when not in use. The Lighting Plan shall include a process for promptly addressing and mitigating complaints about potential lighting impacts.

RECLAMATION

The following objectives, performance standards, and recommended reclamation BMPs and mitigation measures are based on the standards and guidelines found in the BLM and USFS Gold Book, 4th Edition, updated in 2007.

[ ] Indicates site-specific values to be filled in by the authorized officer.

Reclamation Objectives

- The objective of interim reclamation is to restore vegetative cover and a portion of the landform sufficient to maintain healthy, biologically active topsoil; control erosion; and minimize habitat, visual, and forage loss during the life of the well or facilities.

- The long-term objective of final reclamation is to return the land to a condition approximating that which existed prior to disturbance. This includes restoration of the landform and natural vegetative community, hydrologic systems, visual resources, and wildlife habitats. To ensure that the long-term objective will be reached through human and natural processes, actions will be taken to ensure standards are met for site

stability, visual quality, hydrological functioning, and vegetative productivity.

Reclamation Performance Standards

The following reclamation performance standards will be met:

Interim Reclamation

Includes disturbed areas that may be redisturbed during operations and will be redisturbed at final reclamation to achieve restoration of the original landform and a natural vegetative community.

- Disturbed areas not needed for active, long-term production operations or vehicle travel have been recontoured, protected from erosion, and revegetated with a self-sustaining, vigorous, diverse, native (or as otherwise approved) plant community sufficient to minimize visual impacts, provide forage, stabilize soils, and impede the invasion of noxious, invasive, and non-native weeds.

Final Reclamation

- Includes disturbed areas where the original landform and a natural vegetative community have been restored.
- The original landform has been restored for all disturbed areas including well pads, production facilities, roads, pipelines, and utility corridors.
- General: A self-sustaining, vigorous, diverse, native (or otherwise approved) plant community is established on the site, with a density sufficient to control erosion and invasion by non-native plants and to reestablish wildlife habitat or forage production. At a minimum, the established plant community will consist of species included in the seed mix and/or desirable species occurring in the surrounding natural vegetation.
- Specific: No single species will account for more than [30] percent total vegetative composition unless it is evident at higher levels in the adjacent landscape. Permanent vegetative cover will be determined successful when the basal cover of desirable perennial species is at least [80] percent of the basal cover on adjacent or nearby undisturbed areas where vegetation is in a healthy condition; or [80] percent of the potential basal cover as defined in the National Resource Conservation Service Ecological Site(s) for the area. Plants must be resilient as evidenced by well-developed root systems and flowers. [Shrubs, will be well established and in a "young" age class at a minimum (therefore, not comprised mainly of seedlings that may not survive until the following year).]

- In agricultural areas, irrigation systems and soil conditions are reestablished in such a way as to ensure successful cultivation and harvesting of crops.
- Erosion features are equal to or less than surrounding area and erosion control is sufficient so that water naturally infiltrates into the soil and gullying, headcutting, slumping, and deep or excessive rills (greater than three inches) are not observed.
- The site is free of state- or county-listed noxious weeds, oil field debris and equipment, and contaminated soil. Invasive and non-native weeds are controlled.

Reclamation Actions

- During initial well pad, production facility, road, pipeline, and utility corridor construction and prior to completion of the final well on the well pad, pre-interim reclamation stormwater management actions will be taken to ensure disturbed areas are quickly stabilized to control surface water flow and to protect both the disturbed and adjacent areas from erosion and siltation. This may involve construction and maintenance of temporary silt ponds, silt fences, berms, ditches, and mulching.
- When the last well on the pad has been completed, some portions of the well location will undergo interim reclamation and some portions of the well pad will usually undergo final reclamation. Most well locations will have limited areas of bare ground, such as a small area around production facilities or the surface of a rocked road. Other areas will have interim reclamation where workover rigs and fracturing tanks may need a level area to set up in the future. Some areas will undergo final reclamation where portions of the well pad will no longer be needed for production operations and can be recontoured to restore the original landform.
- The following minimum reclamation actions will be taken to ensure that the reclamation objectives and standards are met. It may be necessary to take additional reclamation actions beyond the minimum in order to achieve the Reclamation Standards.

Reclamation – General

Procedure:

- The agency will be notified 24 hours prior to commencement of any reclamation operations.

Housekeeping:

- Immediately upon well completion, the well location and surrounding areas(s) will be cleared of, and maintained free of,

all debris, materials, trash, and equipment not required for production.

- No hazardous substances, trash, or litter will be buried or placed in pits. Upon well completion, any hydrocarbons in the pit will be remediated or removed.

Vegetation Clearing:

- Vegetation removal and the degree of surface disturbance will be minimized wherever possible.
- [Example of site-specific requirement: During vegetation clearing activities, trees and woody vegetation removed from the well pad and access road will be moved aside prior to any soil disturbing activities. Care will be taken to avoid mixing soil with the trees and woody vegetation. Trees left for wood gathering will be cut [twelve inches or less from the ground], delimbed, and the trunks, six (6) inches or more in diameter will be removed and placed either by the uphill side of the access road, or moved to the end of the road, or to a road junction for easy access for wood gatherers and to reduce vehicle traffic on the well pad. Trees with a trunk diameter less than six (6) inches and woody vegetation will be used to trap sediment, slow runoff, or scattered on reclaimed areas to stabilize slopes, control erosion, and improve visual resources.]

Topsoil Management:

- Operations will disturb the minimum amount of surface area necessary to conduct safe and efficient operations. When possible, equipment will be stored and operated on top of vegetated ground to minimize surface disturbance.
- In areas to be heavily disturbed, the top [eight (8)] inches of soil material, will be stripped and stockpiled around the perimeter of the well location to control run-on and run-off, and to make redistribution of topsoil more efficient during interim reclamation. Stockpiled topsoil may include vegetative material. Topsoil will be clearly segregated and stored separately from subsoils.
- Earthwork for interim and final reclamation will be completed within six months of well completion or plugging unless a delay is approved in writing by the BLM authorized officer.
- Salvaging and spreading topsoil will not be performed when the ground or topsoil is frozen or too wet to adequately support construction equipment. If such equipment creates ruts in excess of four (4) inches deep, the soil will be deemed too wet.

- No major depressions will be left that would trap water and cause ponding.

Seeding:

- Seedbed Preparation. Initial seedbed preparation will consist of recontouring to the appropriate interim or final reclamation standard. All compacted areas to be seeded will be ripped to a minimum depth of 18 inches with a minimum furrow spacing of two feet, followed by recontouring the surface and then evenly spreading the stockpiled topsoil. Prior to seeding, the seedbed will be scarified and left with a rough surface.
- If broadcast seeding is to be used and is delayed, final seedbed preparation will consist of contour cultivating to a depth of four to six inches within 24 hours prior to seeding, dozer tracking, or other imprinting in order to loosen up the soil and create seed germination micro-sites.
- Seed Application. Seeding will be conducted no more than 24 hours following completion of final seedbed preparation. A certified weed-free seed mix designed by BLM to meet reclamation standards will be used.
- No seeding will occur from [May 15 to September 15]. Fall seeding is preferred and will be conducted after [September 15] and prior to ground freezing. [Shrub species will be seeded separately and will be seeded during the winter.] Spring seeding will be conducted after the frost leaves the ground and no later than [May 15].

Erosion Control and Mulching:

- Mulch, silt fencing, waddles, hay bales, and other erosion control devices will be used on areas at risk of soil movement from wind and water erosion.
- Mulch will be used if necessary to control erosion, create vegetation micro-sites, and retain soil moisture and may include hay, small-grain straw, wood fiber, live mulch, cotton, jute, or synthetic netting. Mulch will be free from mold, fungi, and certified free of noxious or invasive weed seeds.
- If straw mulch is used, it will contain fibers long enough to facilitate crimping and provide the greatest cover.

Pit Closure:

- Reserve pits will be closed and backfilled within sixty (60) days of release of the rig. All reserve pits remaining open after sixty (60) days will require written authorization of the authorized officer. Immediately upon well completion, any hydrocarbons or

trash in the pit will be removed. Pits will be allowed to dry, be pumped dry, or solidified in-situ prior to backfilling.

- Following completion activities, pit liners will be completely removed or removed down to the solids level and disposed of at an approved landfill, or treated to prevent their reemergence to the surface and interference with long-term successful revegetation. If it was necessary to line the pit with a synthetic liner, the pit will not be trenched (cut) or filled (squeezed) while containing fluids. When dry, the pit will be backfilled with a minimum of five feet of soil material. In relatively flat areas the pit area will be slightly mounded above the surrounding grade to allow for settling and to promote surface drainage away from the backfilled pit.

Management of Invasive, Noxious, and Non-Native Species:

- All reclamation equipment will be cleaned prior to use to reduce the potential for introduction of noxious weeds or other undesirable non-native species.
- An intensive weed monitoring and control program will be implemented prior to site preparation for planting and will continue until interim or final reclamation is approved by the authorized officer.
- Monitoring will be conducted at least annually during the growing season to determine the presence of any invasive, noxious, and non-native species. Invasive, noxious, and non-native species that have been identified during monitoring will be promptly treated and controlled. A Pesticide Use Proposal will be submitted to the BLM for approval prior to the use of herbicides.

Interim Reclamation Procedures – Additional

Recontouring:

- Interim reclamation actions will be completed no later than 6 months from when the final well on the location has been completed, weather permitting. The portions of the cleared well site not needed for active operational and safety purposes will be recontoured to the original contour if feasible, or if not feasible, to an interim contour that blends with the surrounding topography as much as possible. Sufficient semi-level area will remain for setup of a workover rig and to park equipment. In some cases, rig anchors may need to be pulled and reset after recontouring to allow for maximum interim reclamation.

- If the well is a producer, the interim cut and fill slopes prior to re-seeding will not be steeper than a 3:1 ratio, unless the adjacent native topography is steeper. Note: Constructed slopes may be much steeper during drilling, but will be recontoured to the above ratios during interim reclamation.
- Roads and well production equipment will be placed on location so as to permit maximum interim reclamation of disturbed areas. If equipment is found to interfere with the proper interim reclamation of disturbed areas, the equipment will be moved so proper recontouring and revegetation can occur.

Application of Topsoil & Revegetation:

- Topsoil will be evenly respread and aggressively revegetated over the entire disturbed area not needed for all-weather operations including road cuts & fills and to within a few feet of the production facilities, unless an all-weather, surfaced, access route or small "teardrop" turnaround is needed on the well pad.
- In order to inspect and operate the well or complete workover operations, it may be necessary to drive, park, and operate equipment on restored, interim vegetation within the previously disturbed area. Damage to soils and interim vegetation will be repaired and reclaimed following use. To prevent soil compaction, under some situations, such as the presence of moist, clay soils, the vegetation and topsoil will be removed prior to workover operations and restored and reclaimed following workover operations.

Visual Resources Mitigation for Reclamation:

- Trees, if present, and vegetation will be left along the edges of the pads whenever feasible to provide screening.
- To help mitigate the contrast of recontoured slopes, reclamation will include measures to feather cleared lines of vegetation and to save and redistribute cleared trees, debris, and rock over recontoured cut and fill slopes.
- To reduce the view of production facilities from visibility corridors and private residences, facilities will not be placed in visually exposed locations (such as ridgelines and hilltops).
- Production facilities will be clustered and placed away from cut slopes and fill slopes to allow the maximum recontouring of the cut and fill slopes.
- All long-term above ground structures will be painted [Covert Green] (from the "Standard Environmental Colors" chart) to

blend with the natural color of the late summer landscape background.

Final Reclamation Procedures – Additional

- Final reclamation actions will be completed within 6 months of well plugging, weather permitting.
- All disturbed areas, including roads, pipelines, pads, production facilities, and interim reclaimed areas will be recontoured to the contour existing prior to initial construction or a contour that blends indistinguishably with the surrounding landscape. Resalvaged topsoil will be respread evenly over the entire disturbed site to ensure successful revegetation. To help mitigate the contrast of recontoured slopes, reclamation will include measures to feather cleared lines of vegetation and to save and redistribute cleared trees, woody debris, and large rocks over recontoured cut and fill slopes.
- Water breaks and terracing will only be installed when absolutely necessary to prevent erosion of fill material. Water breaks and terracing are not permanent features and will be removed and reseeded when the rest of the site is successfully revegetated and stabilized.
- If necessary to ensure timely revegetation, the pad will be fenced to BLM standards to exclude livestock grazing for the first two growing seasons or until seeded species become firmly established, whichever comes later. Fencing will meet standards found on page 18 of the BLM/FS Gold Book, 4th Edition, or will be fenced with operational electric fencing.
- Final abandonment of pipelines and flowlines will involve flushing and properly disposing of any fluids in the lines. All surface lines and any lines that are buried close to the surface that may become exposed in the foreseeable future due to water or wind erosion, soil movement, or anticipated subsequent use, must be removed. Deeply buried lines may remain in place unless otherwise directed by the authorized officer.

Reclamation Monitoring and Final Abandonment Approval

- Reclaimed areas will be monitored annually. Actions will be taken to ensure that reclamation standards are met as quickly as reasonably practical.
- Reclamation monitoring will be documented in an annual reclamation report submitted to the authorized officer by [March 1]. The report will document compliance with all aspects of the reclamation objectives and standards, identify whether the reclamation objectives and standards are likely to

be achieved in the near future without additional actions, and identify actions that have been or will be taken to meet the objectives and standards. The report will also include acreage figures for: Initial Disturbed Acres; Successful Interim Reclaimed Acres; Successful Final Reclaimed Acres. Annual reports will not be submitted for sites approved by the authorized officer in writing as having met interim or final reclamation standards. Monitoring and reporting continues annually until interim or final reclamation is approved. Any time 30 percent or more of a reclaimed area is redisturbed, monitoring will be reinitiated.

- The authorized officer will be informed when reclamation has been completed, appears to be successful, and the site is ready for final inspection.

This page intentionally left blank.

Appendix D

Waivers, Exceptions, and Modifications

This page intentionally left blank.

APPENDIX D
WAIVERS, EXCEPTIONS, AND MODIFICATIONS

PROCEDURES FOR HANDLING REQUESTS FOR WAIVER, EXCEPTION OR MODIFICATION

Any formal request for exception, waiver or modification must be submitted in writing by the proponent. When requested concurrently with an application (typical for situations involving lease stipulations), the exception, modification, or waiver is considered as part of the project proposal in RMP and NEPA compliance review. For separate requests, the request is considered as a unique action and is analyzed and documented individually for RMP and NEPA compliance.

Analyses of requests include review of potential mitigation measures and alternatives (e.g., traffic restrictions, alternative scheduling, staged activity, proposals for offsite mitigation, scientific studies) as they relate to waiver, exception, and modification criteria. These procedures will be applied to any request for waiver, exception, or modification for a surface disturbing or disruptive activity.

BLM will make the final determination for granting an exception, modification, or waiver to stipulations.

CRITERIA FOR CONSIDERING WAIVER, EXCEPTIONS OR MODIFICATIONS

Consideration of waivers, exceptions or modifications for geothermal leases follow the same procedure and criteria as those for oil and gas leases identified in 43 CFR 3101.1-4. An exception, waiver, or modification must be based on one of two criteria; a lease shall be subject to modification or waiver only if:

1. the authorized officer determines that the factors leading to its inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified, or
2. the proposed operations would not cause unacceptable impacts.

An exception is a one-time exemption for a particular site within the leasehold; exceptions are determined on a case-by-case basis; the stipulation continues to apply to all other sites within the leasehold. An exception is a limited type of waiver.

A waiver is a permanent exemption from a lease stipulation. The stipulation no longer applies anywhere within the leasehold.

A modification is a change to the provisions of a lease stipulation, either temporarily or for the term of the lease. Depending on the specific modification, the stipulation may or may not apply to all sites within the leasehold to which the restrictive criteria are applied.

The project lead, operators, and lease holders must initiate requests for exceptions in writing, and this documentation must be received by the BLM at least two weeks prior to the potential activity start date. The request must include the following information:

- WHY the operator or lease holder needs the exception. Please include the reason(s) why the action could not be completed within the original stipulation period, any evidence of why the action will not adversely affect the species being protected, or any other information (additional mitigation measures or alternatives) that will help BLM (and CPW) in reviewing the request.
- WHO is filing the exception request. This must include the company name, the name of the contact person, and the address, telephone number, e-mail address (if available), and fax number of the contact person.
- WHAT is being requested. This must include a detailed description of the activity; the approval dates of the Application for Permit to Drill, sundry or right-of-way number, lease number, and the American Petroleum Institute number.
- WHERE the activity will take place. This must include the legal description (including footage measurements of the well) of the activity, the location of the access roads and pipelines, and a map clearly depicting these areas.
- WHEN the activity will occur. This must include the start date, end date, and time of day/night when activities will occur.

Requests will be accepted by fax at (719) 852-6250 or hard copy letter (mail or hand-delivery acceptable). Hard copy requests should be mailed to the following address:

Field Manager
Bureau of Land Management
San Luis Valley Public Lands Center
1803 West Highway 160
Monte Vista, CO 81144
ATTN: Wildlife Exception Request

All requests for exceptions will require two weeks for processing. Following BLM review, the operator or lease holder will receive a response granting the request, denying the request, or delaying the action (with a recommendation of what needs to be completed before the request can be granted). These surveys may require additional surveys and field work before a recommendation can be made. These surveys must be coordinated and authorized by BLM biologists in advance. Field surveys for exceptions may not be initiated before the BLM directs their completion, and the results of surveys completed prior to direction from a BLM biologist will not be used or considered adequate to grant an exception. BLM biologists will determine whether field surveys are required.

Exception requests will not be granted for stipulations or operating standards designed to protect threatened and endangered species, unless the BLM consults with the USFWS and reinitiates consultation over the RMP, if appropriate. Additionally, exceptions will not be granted for stipulations or COAs resulting from Section 7 consultation unless a biological assessment is completed and re-initiation of Section 7 consultation occurs. This process, depending on the potential impacts and whether incidental take is involved, typically will require three to six months for completion. The operator or lease holder is responsible for the biological assessment, which must be satisfactorily completed in accordance with the requirements of BLM.

EXCEPTIONS TO SEASONAL RESTRICTIONS

Activities within the planning area are managed with seasonal restrictions, NSO, or distance restrictions for sensitive and crucial habitats. Protective wildlife seasonal restrictions are consistent with statewide dates and/or distances. For example, mule deer critical winter ranges are protected from January 1 through March 31. This restriction is intended to protect big game if weather or other habitat needs dictate.

The BLM can and does grant exceptions to seasonal restrictions if the BLM, in consultation with the CPW, feels that granting an exception would not adversely impact the population being protected. Exceptions are for critical situations that may cause the applicant to be out of compliance with the timing stipulations attached to the COAs of their Application for Permit to Drill, Right-of-Way Grant, or other contract. They are NOT intended to be used to extend normal operations into the timing stipulation period. The BLM uses a set of criteria when considering a request for an exception. Professional judgment

plays a key part in the BLM's decision on whether to grant exceptions. No clear formula exists.

The following section is an example of factors considered by the BLM when determining whether a request for an exception to crucial big game winter range should be granted. Similar criteria and/or data are used when considering granting exceptions for other protected species, such as Gunnison's sage-grouse and elk calving areas.

GENERAL GUIDELINES FOR TIMING STIPULATION AND SURFACE USE RESTRICTIONS

Professional judgment plays a key part in a biologist's recommendation to the BLM Field Manager, and there is no clear formula for arriving at these biological recommendations. Wildlife biologists will consider the general criteria below when evaluating an exception request. These factors will be considered as a whole and not individually. Please remember that animal presence/absence based on one site visit will not be the sole criterion for granting an exception request.

Factors Considered

1. Resource Concerns
    - Animal presence or absence
    - Additional or new resource concerns
    - Potential for increased wildlife accidents or poaching
    - CPW coordination and recommendations
2. Animal Conditions
    - Physical condition of individual animals (e.g., fat reserves)
    - Local animal population condition (animal density)
    - Potential for additive mortality
    - Likelihood of introduction or increased incidence of disease
    - Likelihood of decreased recruitment/birth rate
3. Climate/Weather
    - Snow conditions (depth, crusting, longevity)
    - Current and historic local precipitation patterns
    - Current and historical seasonal weather patterns
    - Recent and current wind chill factors (indication of animals energy use)

- Duration of condition
- Short- and long-range forecasts

4. Habitat Condition and Availability

    - Water and forage condition (availability, quality, and quantity)
    - Competition (interspecific, intraspecific)
    - Animal use of available forage
    - Suitable and ample forage immediately available and accessible

5. Spatial Considerations

    - Migration/travel corridors
    - Winter range, foraging, parturition or breeding
    - Topography (plains vs. mountains)
    - Topographic/geographic limitations (barriers)
    - Presence of thermal cover (e.g., protection from wind)
    - Proportion of range impacted
    - Juxtaposition and density of other activities/disturbances in the vicinity
    - Cumulative impacts

6. Timing

    - When proposed activity would occur in the stipulation period (i.e., early or late in the stipulation period, length of activity, time of day, how much winter is remaining)
    - Kind and duration of potentially disruptive activity
    - Likelihood of animals habituating to the proposed activity
    - Are the factors that led to the seasonal stipulations or COA for wildlife still valid?
    - Will granting the exception cause less long-term impact on the resource than whatever short-term impact might occur?
    - Are there other mitigation measures or alternatives that would allow for granting the exception and still meet the intended objective of the stipulation/COA?
    - What is the severity of the proposed action and the potential impact?

MODIFICATION OR WAIVER OF LEASE STIPULATIONS

Procedures for granting modifications or waivers to geothermal lease stipulations are as stated below:

A stipulation included in a geothermal lease shall be subject to modification or waiver only if the authorized officer determines that the factors leading to its inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified or if proposed operations would not cause unacceptable impacts. If the authorized officer has determined, prior to lease issuance, that a stipulation involves an issue of major concern to the public, modification or waiver of the stipulation shall be subject to public review for at least a 30-day period. In such cases, the stipulation shall indicate that public review is required before modification or waiver. If subsequent to lease issuance the authorized officer determines that a modification or waiver of a lease term or stipulation is substantial, the modification or waiver shall be subject to public review for at least a 30-day period.

The modification or waiver of a geothermal lease stipulation implies that the sensitive resource for which the protective measure was considered is in some way not present in the area or in some way no longer in need of the protective measure. In either case, consideration of a modification or waiver of a lease stipulation would require environmental analysis and may result in an amendment to the land use plan.

Appendix E

Scoping Report

Appendix E is available on the BLM website as a separate downloadable document.

This page intentionally left blank.

Appendix F

United State Geological Survey Report

This page intentionally left blank.

United States Department of the Interior
U.S. Geological Survey
Box 25046 MS 964
Denver, Colorado, 80225

Ms. Nancy Keohane, NEPA Specialist
Colorado Renewable Energy Team
1803 West Hwy. 160
Monte Vista, CO 81144
719-852-6270

July 3, 2012

Dear Ms. Keohane,

As per your letter of June 5, 2012 the following provides a scientific review of public comments on the draft *Bureau of Land Management (BLM) San Luis Valley Geothermal Leasing Environmental Assessment and Resource Management Plan Amendment (BLM EA RMP)*. The scope of this review only provides insight into the scientific validity of stated public concerns related to 'proposed BLM geothermal land use allocation decisions near Valley View Hot Springs (VVHS), Joyful Journey Hot Springs (JJHS), and other geothermal features in the project planning area including but not limited to: Sangre de Cristo fault line geology, induced seismicity, adverse impact risk to geothermal heat-water mixing between deep heat source and surface expression from exploration and development of geothermal fluid near the Valley View and Joyful Journey Hot Springs.

The specific documents reviewed include a letter from Paul Morgan identified as DOI-BLM-CO-140-2010-014-EA-0012.pdf, a letter from James McCalpin identified as DOI-BLM-CO-140-2010-014-EA-0007.pdf, a letter from Suzanne Ewy identified as DOI-BLM-CO-140-2010-014-EA-0020.pdf, and a letter from Steven Jeffers identified as DOI-BLM-CO-140-2010-014-EA-0015.pdf. A very brief review of the BLM EA RMP was also completed.

General Comments

All of the documents and comments raise a number of scientifically valid concerns. All of the documents and comments also share in a lack of site-specific data upon which the various concerns are predicated. The lack of data does not invalidate the concerns. However, the lack of data highlights a high degree of uncertainty in understanding the hydrogeology of the geothermal systems in question and moreover if there will be any deleterious consequences should any of the various alternatives in the BLM EA RMP be implemented. The treatment of the public comments provided here is general. Making specific point, counter-point arguments may not be appropriate given the lack of scientific data. Rather, a description of the various concerns and alternative ways of thinking about them are provided. Published or new information was compiled into new diagrams used to briefly outline the state of knowledge of the physical controls on the hydrogeothermal system in the vicinity of VVHS with some elements being relevant to JJHS. A brief reference list of relevant, peer-reviewed publications is also provided.

The essential scientific issue is that the physical hydrogeology controlling the discharge and temperature of the hot springs in question is poorly understood. Although it can be inferred that that the flow of geothermal spring waters in question are controlled by faults, faults commonly have complex internal structure (Figure 1). Moreover, the geological data available show a package of different rock types that are also likely quite heterogeneous with regard to their hydrogeological properties (Figure 2). The juxtaposition of such different lithological units by faulting further imparts hydrogeological heterogeneity. At present there is little data (e.g. site specific, rock unit hydraulic aquifer test data) on the actual permeability structure of the reservoir in which the geothermal resources are hosted. Nor are there site-specific data regarding the source of heat driving the geothermal system. Concerns regarding hydrogeological processes that may trigger earthquakes are also poorly understood and are current topic of robust research (e.g., Kanamori and Brodsky, 2004; Horton, 2012).

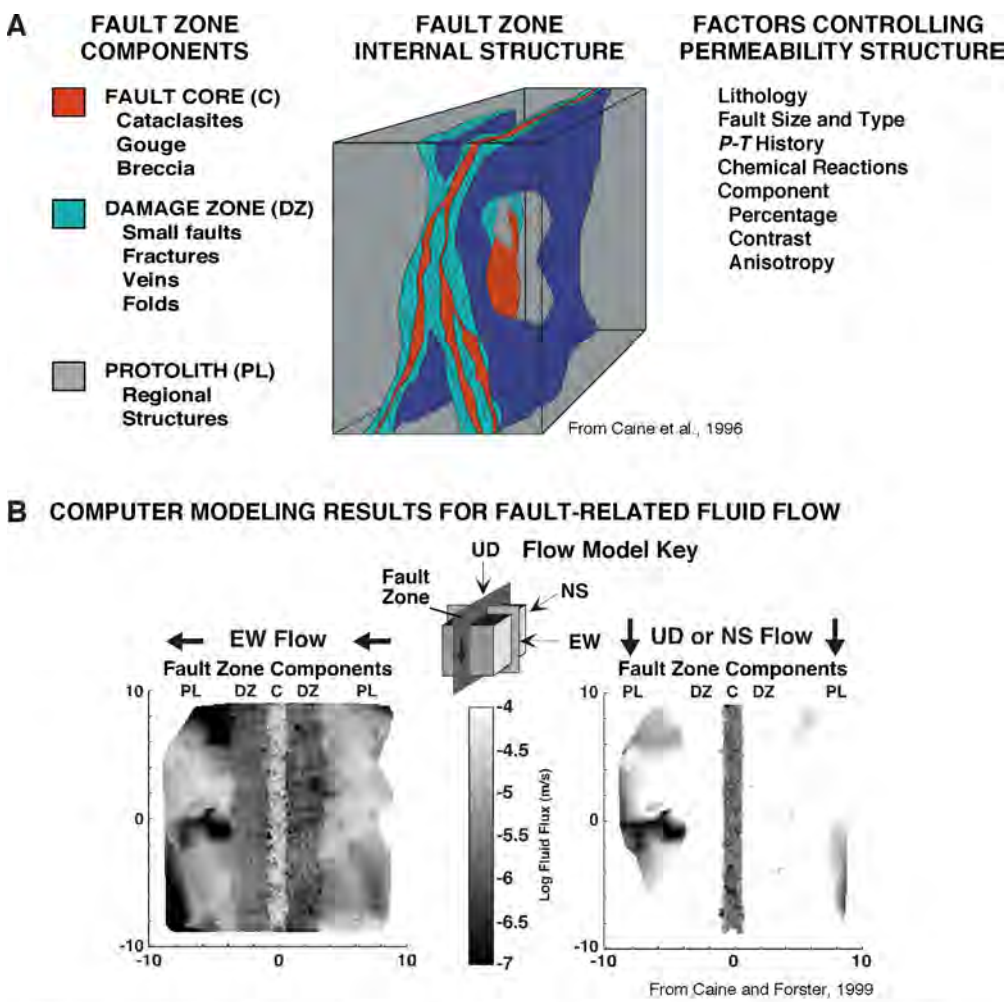


Figure 1. A) Brittle fault zone conceptual model and definition of fault zone component structures with processes that control fault zone permeability structure. B) Computer generated discrete fracture network model of a combined conduit-barrier fault zone and associated fluid flow simulation results. Two end member cases for fault-related flow and different directions of the maximum hydraulic gradient are shown: 1) flow across the fault zone (east to west, EW in the case of the Sangre de Cristo Mountain Front fault zone) and 2) flow parallel to the fault zone up-down (UD) or north to south (NS). Darker gray areas in the flow models results are areas where flow velocities are relatively slow compared with lighter gray to white areas.

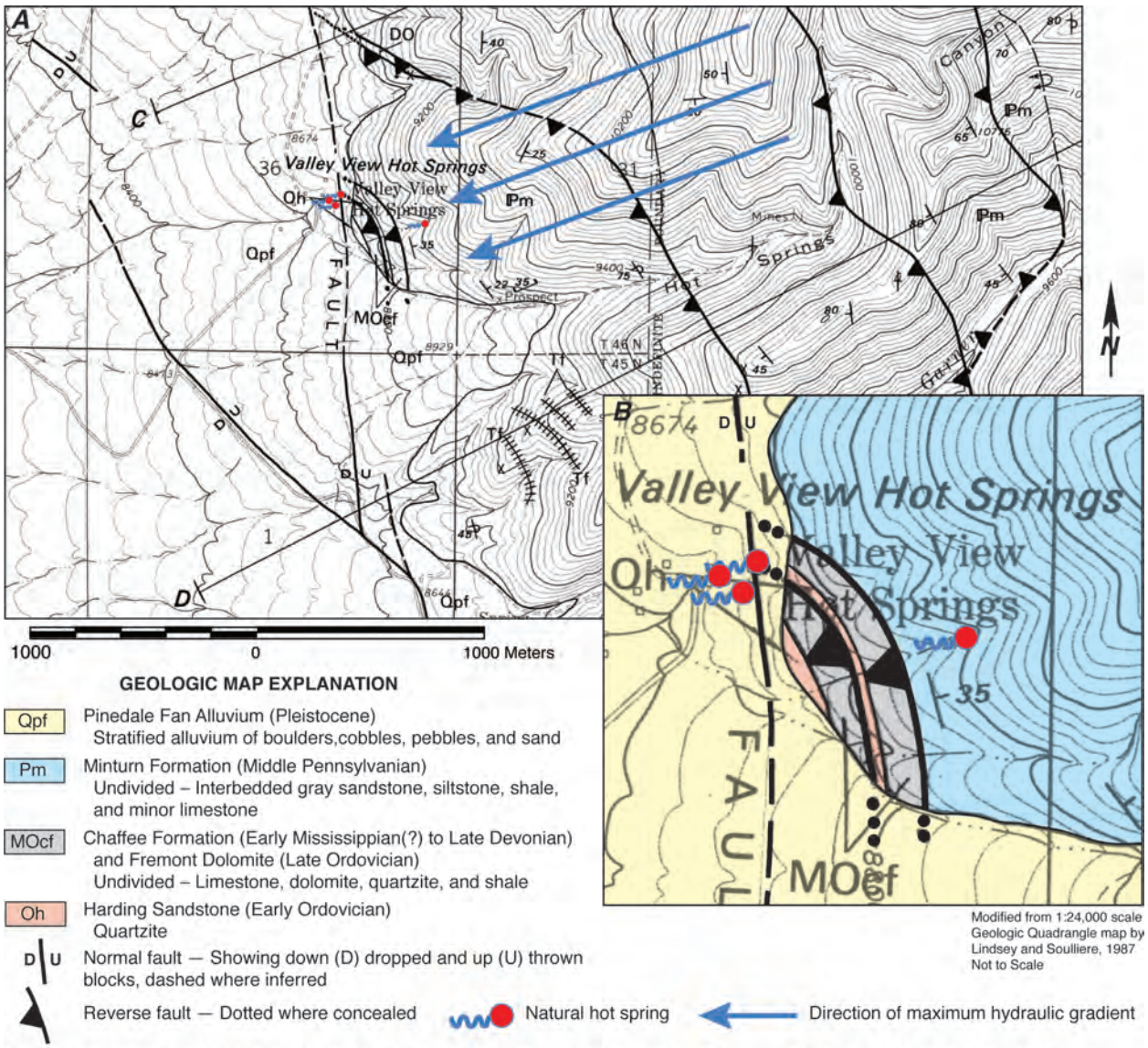


Figure 2. A) Portion of the geologic map of the Valley View Hot Springs Quadrangle showing the locations of hot springs and the cross section lines C and D. The light blue arrow shows the direction of the maximum, local potential hydraulic gradient based on topography. B) Detailed inset of the geologic map in A colored to show rock types, faults and springs. Modified from Lindsey and Soulliere, 1987.

The public comments contain a number of hydrogeothermal conceptual models. None of the models are validated by data directly from the locations of concern as presented in the letters. Hydrogeothermal conceptual models are based on scientifically reasonable ideas often partially validated by data and observations from numerous representative localities other than those in question. However, the conceptual models presented in the comments are not unique and a series of other conceptual models may be just as valid. A set of such equally valid, alternative conceptual models are presented in Figure 3.

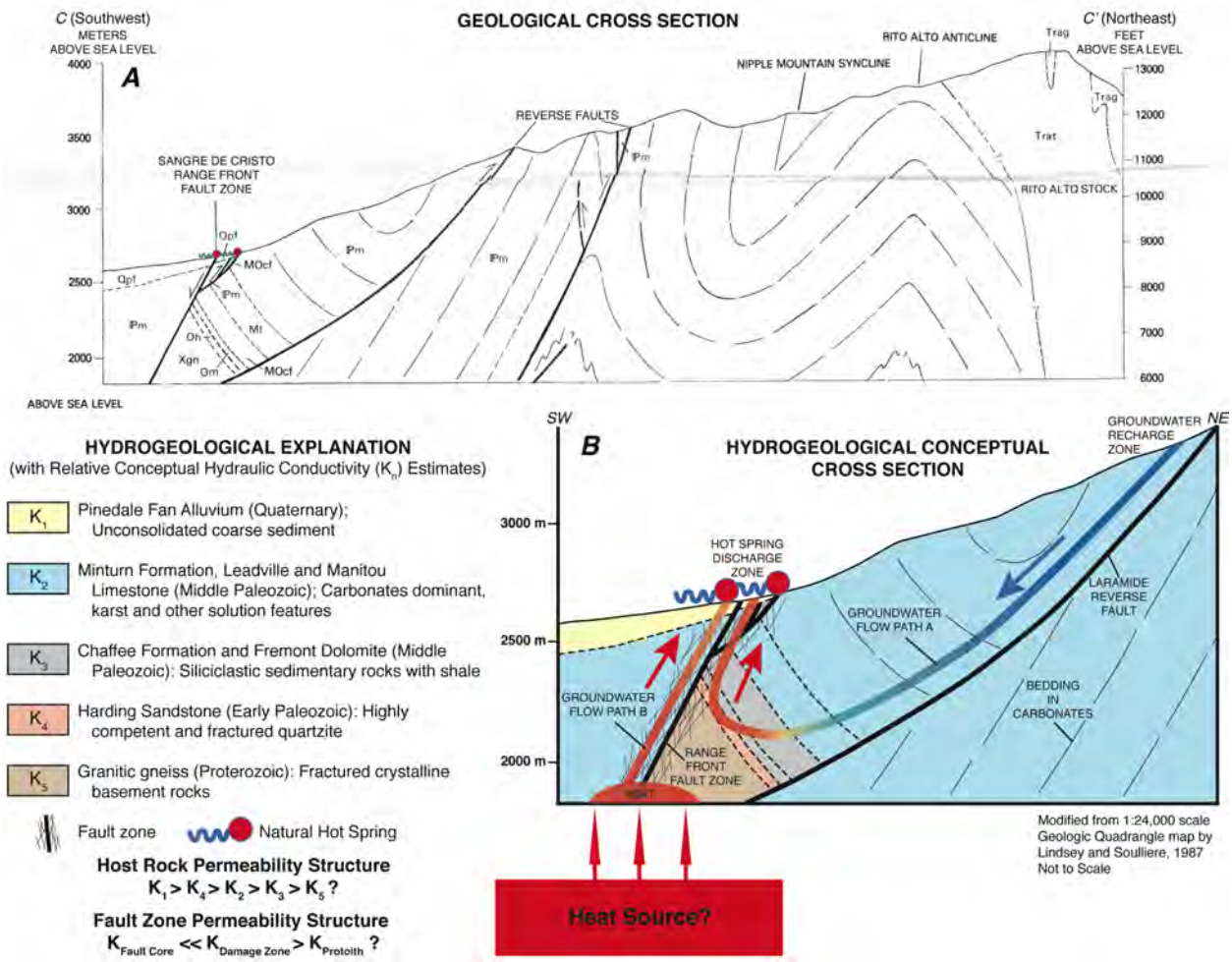


Figure 3. A) Geologic cross section from Figure 2, section line C showing the Valley View hot springs. B) Inset of the cross section in A colored to show details of rock types, faults and springs. Conceptual groundwater flow paths are shown and are colored to indicate water temperature from cold (blue) to hot (red); arrows show groundwater flow direction. Red box depicts uncertainty in the source of heat driving the geothermal resource. Modified from Lindsey and Soulliere, 1987.

Fault Zone Architecture, Permeability Structure, and Fluid Flow

Brittle fault zones in bedrock of the Earth's upper crust are typically composed of distinct components with differing mechanical and hydraulic properties (Figure 1; Caine et al., 1996). These components include a fault core where most of the strain is accommodated and where fault rocks such as clay-rich gouge and breccia form. Such fault rocks are typically incohesive unless they are cemented by mineral precipitation, which may be the result of fluid flow, particularly common in areas of geothermal activity (e.g., Caine et al., 2010). Fault cores are commonly enveloped by a damage zone composed of a variety of subsidiary structures that are related to the growth of a fault zone and can include small faults, open joints, veins, and folds. The fault core and damage zone are surrounded by host rock or protolith characterized by regional structures such as joints.

Because clay-rich gouge or cemented breccia commonly have very low permeability they can act as barriers to flow. In contrast, damage zones commonly contain open fractures that enhance permeability. When combined, fault cores and damage zones can impede flow across and

enhance flow parallel to a fault zone, forming a complex combined conduit-barrier flow system. However, flow across a fault zone is also subject to the direction of the maximum hydraulic gradient as described by Darcy's law (see Appendix). The driving force for groundwater flow is most commonly gravity as governed by topography and the difference in groundwater elevations from high to low areas of elevation. However, hydraulic conductivity (*K*) includes properties of the media (commonly called intrinsic permeability) in which a fluid is flowing as well as the properties of the fluid such as density (see Appendix). Changes in fluid density from a geothermal heat source can also drive groundwater flow by changes in buoyancy that can ultimately redirect gravity driven flow (e.g., Forster and Smith, 1989).

Part A of Figure 1 shows a conceptual model for fault zone internal structure commonly found in nature. Figure 1, Part B shows the results of computer simulations of groundwater flow in a discrete fracture network model of a fault zone similar to that shown in Part A. Part B highlights that when the maximum hydraulic gradient is perpendicular to the strike of the fault zone, even with a low *K* fault core, flow will cross the fault zone. Lateral flow parallel to the strike of the fault zone, up or down dip or subhorizontally, occurs regardless of the orientation of hydraulic gradient with respect to the orientation of the fault. In the two end member cases, flow is focused in the damage zone to one degree or another and its velocity is increased when the maximum gradient is parallel to the strike of the fault (Caine and Forster, 1999). The model results indicate that the combined conduit-barrier behavior of fault-related flow is plausible and that the direction of the primary driving force, be it gravity or heat, plays a key role.

Geology and Hydrogeothermal Conceptual Models for San Luis Basin Geothermal Springs

In the case of Valley View hot springs (VVHS), Figure 2 shows the most detailed geological map available (Lindsey and Soulliere, 1987). The map shows a clear spatial coincidence between mapped faults and the discharge locations of hot springs. However, there is more than one type of fault and there are lithological heterogeneities that likely also play a role in localization of the thermal springs.

The geology at VVHS includes early to middle Paleozoic sedimentary rocks. The rock types include limestone, dolostone, sandstone, siltstone, shale, and highly indurated quartzite. The primary permeability (intergranular permeability that does not include secondary features such as joints, faults, veins, or karst) of these rock types ranges over nearly six orders of magnitude (Gleeson et al., 2011). There are two steeply west dipping reverse faults just east of the springs that repeat the layered and tilted sedimentary section at VVHS (Figure 3). A relatively shallow mantle of unconsolidated Quaternary sediments overlies the bedrock at VVHS. These sediments are cut by a range bounding normal fault that also cuts the bedrock and reverse faults in the subsurface (Figure 3A). It is important to note that the range bounding normal fault is not a single fault, but an array of numerous faults that extend from depth and that have ruptured the Earth's surface (e.g., McCalpin, 1986; Figures 2 and 3). The permeability structure of faults that cut unconsolidated sediments is quite different and more poorly understood than faults that cut rock (e.g., Caine and Minor, 2009).

Although there is a spatial coincidence between the spring locations and the faults, it is also important to note that virtually nothing is known about the actual permeability structure of the array of range bounding normal faults, or reverse faults that are cut by them, and the ability for these faults to host fluid flow. In fact, at least one of the mapped hot spring discharge points lies well above any mapped faults (Figure 2B). There are also deeper, very large-scale subsurface

features revealed by geophysical data that may also play an important role in delivering heat and fluid from the deep subsurface to the spring discharge points that may be largely independent of the range bounding fault zone (Figure 4).

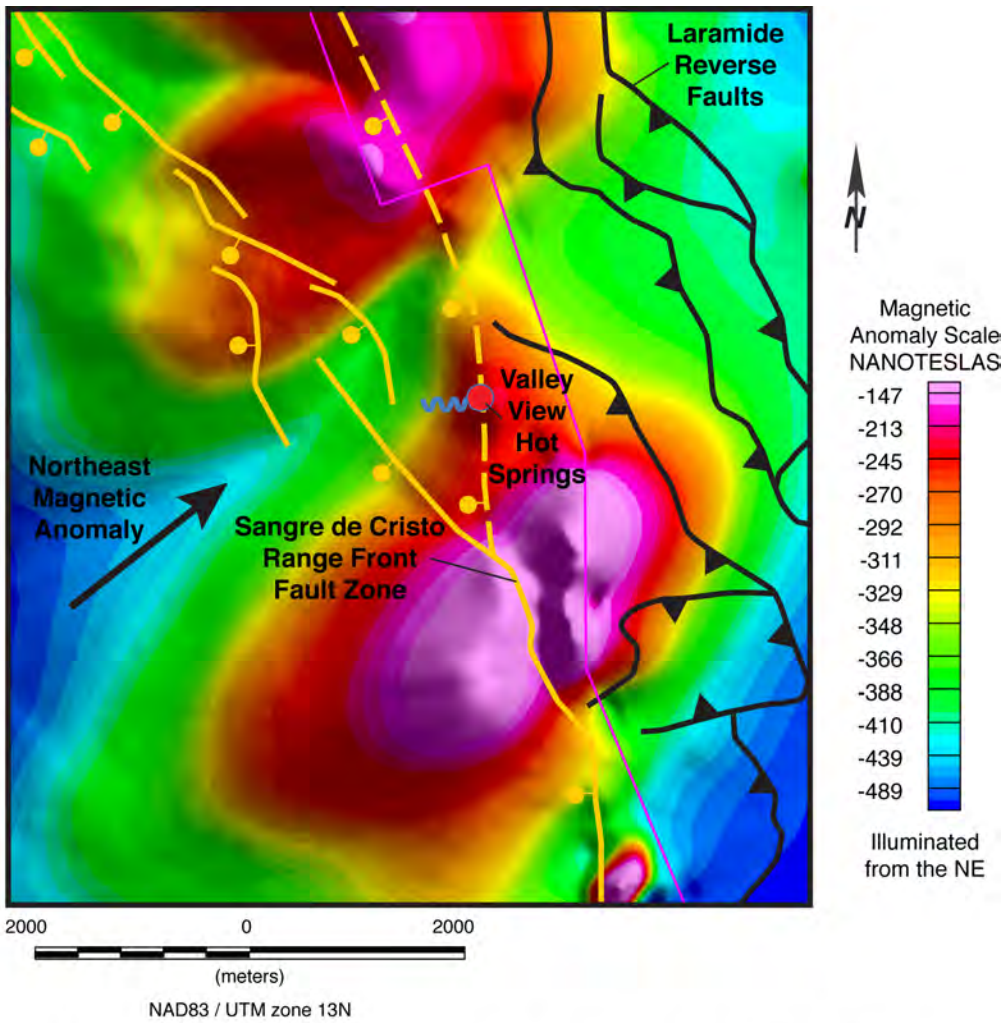


Figure 4. Reduced-to-pole aeromagnetic anomaly map (from USGS, unpublished data, 2012, courtesy of V.J.S. Grauch) showing the Valley View Hot Springs, normal faults (orange lines, ball and bars on down dropped side, dashed where inferred), reverse faults (black lines, triangles on the hanging wall), and the boundary (pink line) between high- versus low-resolution data on west versus east, respectively. The image shows a NE-trending linear anomaly of lower values, displayed as green and blue colors (black arrow) and smaller, approximately N-S semi-linear disruptions (shadows within the red-magenta colors parallel to the range front fault zone). These features suggest that Precambrian basement underlying the VVHS and vicinity has heterogeneities that trend both across and along strike of the Sangre de Cristo range front fault zone.

Figure 3B provides alternative conceptual models that also include some elements of the models presented in the public comments. When developing a hydrogeological conceptual model, particularly one that has little hydraulic data associated with it, all elements of the flow system must be considered and permeability contrasts from primary and secondary features

observable at the surface as well as subsurface features are of prime importance.

To develop the conceptual models of Figure 3B, the geological cross section (Figure 3A) from Lindsey and Soulliere (1987) was modified to show the potential permeability structure of the shallow, subsurface geothermal system. The rock types mapped in Figure 2 have been recast in terms of hydraulic conductivity (*K*) and the commonly observed combined conduit-barrier fault zone architecture for a Range Front fault zone has been applied to the bedrock (Figure 3B). Relative values of *K* have been assigned based on published values (e.g., Huntley, 1979; Gleeson et al., 2011) as well as on brief field observations of secondary structures in bedrock outcrops. Note that the potentially greatest hydraulic contrasts occur where the Harding sandstone, a highly faulted and fractured competent quartzite, is in contact with or near shales of the Chaffee Formation and crystalline Proterozoic basement rocks and where the Range Front fault zone cuts the local rock package (Figure 3). The hydraulic conductivity of the damage zone of the bedrock portion of the Range Front fault zone may be as high as that of the Harding sandstone and the fault core hydraulic conductivity maybe as low as that of the shales or the basement rocks.

To demonstrate the conceptual models, two theoretically plausible, groundwater flow paths have been inferred in Figure 3B (Groundwater Flow Paths A and B). Groundwater Flow Path A shows recharge occurring at elevations above VVHS, where cool (blue portion of the flow path in Figure 3B) groundwater flows down the hydraulic gradient as governed by Darcy's law (Appendix, Equation 1). Near the contact of the Harding sandstone and basement rocks, upflow may occur due to the relatively high *K* of the Harding compared with that of the basement below and shales of the Chaffee above the Harding forming a confined aquifer and artesian flow upward (see Freeze and Cherry, 1979). This upflow may also be enhanced due to heating of cool groundwater originally recharged from elevation as it flows to depth and encounters higher temperatures. Conductive heating of groundwater at depth causes decreased density and increased buoyancy that can cause the water to flow upwards (Appendix, Equation 2 and the red portion of the flow line in Figure 3B. Conduction refers to heat transport due to a temperature gradient and does not require a fluid.). Flow of such heated groundwater may then be further guided up the relatively high *K* fault damage zone to discharge at the surface.

Groundwater recharge in mountainous terrain generally occurs at elevation and recharged water flows down gradient in the mountain block to basins below (e.g., Manning, 2009). Recharge can also occur at the mountain front where surface water in streams transition from running along relatively low *K* bedrock and shallow surficial deposits in the mountain block to relatively high *K* basin sediments thus allowing the surface water to drain into the basin aquifer. Conceivably such mountain front recharge could also drain into the Mountain Front fault zone. However, shallow mountain front recharge into the Range Front fault zone may be unlikely because; a) faults in sediments have different permeability structure than those in rocks and typically do not have well developed, high *K* damage zones (see Caine and Minor, 2009); and b) the hydraulic gradient may likely be one to two orders of magnitude lower parallel to the mountain front (north to south) than it is perpendicular (east to west) to the mountain front which would tend to drive flow across the fault zone rather than down it (Figures 1, 2, 3). If such groundwater were to recharge into the fault zone at the mountain front it may also be unlikely to circulate to any appreciable depth even if the fault zone has high *K* as the fault parallel hydraulic gradient is likely not large enough to drive such recharge or subsequent lateral flow.

Although no groundwater monitoring wells are located at elevations above the VVHS, it is likely that there is full groundwater saturation to subsurface elevations similar to at least the base of the roughest topography. Evidence for such groundwater saturation and associated high

hydraulic gradients from mountain block to basin are provided from data elsewhere in the intermountain west (Caine et al., 2006; Manning, 2009) as well as mountain-basin aquifer characterization and numerical modeling results (e.g., Huntley, 1979; Gleeson and Manning, 2008). These data and model results highlight the importance of understanding groundwater recharge processes, depth of circulation, and mountain block recharge versus mountain front recharge in addition to physical hydrogeology and heat flow for which there are virtually no published data at VVHS or Joyful Journey hot springs (JJHS).

A second conceptual model is demonstrated by Groundwater Flow Path B in Figure 3B. Flow Path B shows a case where deep, naturally heated and buoyant groundwater flows up the relatively high *K* damage zone in the hanging wall (east side of the Mountain Front fault zone and discharges at the springs. This process may also be happening along the footwall (west side of the Mountain Front fault zone) of the fault zone where advection of deeply derived geothermally heated waters mixes with and transports cooler shallow groundwater. Advection refers to the transport of mass (e.g., solutes) or energy (e.g., heat) by the motion of a fluid. Thus, heat may be "carried" by the motion of heated fluid (also called thermal conduction, e.g., Morgan and Witcher, 2011). A combination of conductive and advective heat and fluid transport, and mixing, processes may be happening in the hanging wall and footwall of the Mountain Front fault, any of its associated faults, and(or) the various reverse faults.

Just as advected heat maybe "carried" by natural groundwater flow processes, such heat may also be "carried" by the installation and pumping of geothermal resource wells. However, the thermal budget, reservoir hydraulic properties, heat source and many other parameters are unknown at this time to adequately demonstrate likely changes associated with resource utilization. Any pumping may lead to changes in groundwater elevations, but the degree to which this may occur, the locations and shapes of such changes are also speculative at this time.

A final point is also raised by the theoretical hydrogeological conceptual models presented in Figure 3. Details regarding the source of heat driving the geothermal system at VVHS or JJHS are only known in a general manner and inferences regarding the depth of circulation of groundwater (as opposed to geothermal waters) are based on assumptions that may not be applicable locally. This lack of data further leads to uncertainty in the development of unique hydrogeothermal conceptual models.

Without new data and further analysis the conceptual models presented here are no more or less viable than those presented in the public comments. The geological, hydrological and thermal features found at VVHS (and likely at JJHS) comprise a highly heterogeneous system that is not currently conducive to the development of a unique hydrogeological conceptual model. The alternative conceptual models are presented to highlight the level of uncertainty and yet possible physical controls on the VVHS with some elements being applicable to JJHS. The models provide a foundation of testable hypotheses to be refined should further research be pursued.

Suggested Data for Refinement of Hydrogeothermal Conceptual Models

In order to reduce the uncertainty associated with understating the geothermal springs in the San Luis Valley a number of scientific approaches of varying degrees of invasiveness and expense may be undertaken. A number of these are listed here for consideration should advancement of the current state of knowledge be desired.

- Drilling of research wells to determine the continuity of the geothermal resource, the local

geothermal gradient, the geochemistry of deeper groundwater in relation to the geochemistry of thermal spring waters, and better characterization of the subsurface geology and flow system of the geothermal reservoir. Added advantages of such well drilling include a) the ability to carry out borehole geophysical logging that could be compared to surface and aerial geophysical data to allow more robust characterization of the geophysical data sets and b) completion of appropriate aquifer testing to characterize the hydraulic properties of the geothermal reservoir rocks.

- New geological mapping aimed at fault zone and hydrogeological characterization.
- Acquisition of new electromagnetic and self-potential geophysical data that can help characterize the reservoir and potential flow directions of geothermal waters.
- Compilation of existing and acquisition of new aqueous geochemical and temperature data to systematically characterize the thermal waters. Use of geochemical tracers such as noble gasses could be used to date the thermal waters. Tritium and helium can also sometimes be used to characterize deeply derived versus shallowly recharged water and provide an estimate of recharge elevation. Mixing of deep versus shallow waters can potentially also be modeled using the noble gasses.
- Coupled heat and fluid flow numerical modeling could be used to integrate the various existing data and any new data and to test plausibility of existing conceptual models and hypotheses.
- Numerical modeling of ground shaking and associated damage should seismic events of various magnitudes take place in the areas of concern.

References Cited in this Review

Caine, J. S., Evans, J. P., and Forster, C. B., 1996, Fault-zone architecture and permeability structure: Geology, v. 24, p. 1025-1028.

Caine, J. S., and Forster, C. B., 1999, Fault Zone Architecture and Fluid Flow: Insights from Field Data and Numerical Modeling: *in* Haneberg et al., editors, Faults and Subsurface Fluid Flow in the Upper Crust: AGU Geophysical Monograph 113, p. 101-127.

Caine, J. S., Manning, A. H., Verplanck, P. L., Bove, D. J., Kahn, K. G., and Ge, S., 2006, Well construction information, lithologic logs, water level data, and overview of research in Handcart Gulch, Colorado: An alpine watershed affected by metalliferous hydrothermal alteration: U.S. Geological Survey Open-File Report 2006-1189, 14 p.

Caine, J. S. and Minor S. A., 2009, Structural and geochemical characteristics of faulted sediments and inferences on the role of water in deformation, Rio Grande Rift, New Mexico, Geological Society of America Bulletin, v. 121, p. 1325-1340.

Caine, J. S., Bruhn, R. L., and Forster, C. B., 2010, Internal Structure, Fault Rocks, and Inferences Regarding Deformation, Fluid Flow, and Mineralization in the Seismogenic Stillwater Normal Fault, Dixie Valley, Nevada: Journal of Structural Geology, v. 32, p. 1576-1589.

Forster, C. and Smith, L., 1989, The influence of groundwater flow on thermal regimes in mountainous terrain: A model study: Journal of Geophysical Research, v. 94, p. 9439-9451.

Freeze, R. A. and Cherry, J.A., 1979, Groundwater: New York, Prentice-Hall.

Gleeson, T. and Manning, A. H., 2008, Regional groundwater flow in mountainous terrain: simulating topographic and hydrogeologic controls: Water Resources Research, v. 44, W10403, doi:10.1029/2008WR006848.

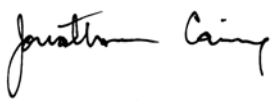
Gleeson, T., Smith, L. Moosdorf, N., Hartmann, J., Durr, H. H., Manning, A. H., van Beek, L. P. H., and Jellinek, A.M., 2011, Mapping permeability over the surface of the Earth: Geophysical Research Letters, v. 38, L02401, doi:10.1029/2010GL045565.

Horton, S., 2012, Disposal of hydrofracking waste fluid by injection into subsurface aquifers triggers earthquake swarm in central Arkansas with potential for damaging earthquake: Seismological Research Letters, v. 83, p. 250-260.

Huntley, D., 1979, Ground-water recharge to the aquifers of northern San Luis Valley, Colorado: Geological Society of America Bulletin: v. 90, p. 1196–1281.
Kanamori, H. and Brodsky, E. E., 2004, The physics of earthquakes: Reports on Progress in Physics, v. 67, p. 1429-1496.
Lindsey, D. A. and Soulliere, S. J., 1987, Geologic map and sections of the Valley View Hot Springs quadrangle, Custer and Saguache counties, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-1942, 1:24,000 scale.
Manning, A. H., 2009, Ground-water temperature, noble gas, and carbon isotope data from the Española Basin, New Mexico: U.S. Geological Survey Scientific Investigations Report 2008–5200, 69 p.
McCalpin, J., 1986, Quaternary tectonics of the Sangre de Cristo and Villa Grove Fault Zones, *in* Rogers, W. P. and Kirkham, R. M. (eds.), Contributions to Colorado Seismicity and Tectonics - A 1986 update: Colorado Geological Survey Special Publication 28, p. 59-64.
Morgan, P. and Witcher, J. C., 2011, Geothermal resources along the southern Rocky Mountains and the Rio Grande Rift: The Mountain Geologist, v. 48, p. 81-94.

Thank you for the opportunity to contribute my thoughts to this review process. Please contact me should you have any questions or need clarification of any statements made in this review.

Sincerely,



Jonathan Saul Caine, Ph.D.
Research Geologist
U.S. Geological Survey
Phone: 303 236 1822
E-mail: jscaine@usgs.gov

Appendix

Darcy's Law:

$$q = -K\frac{dh}{dl} \qquad (1)$$

where q = specific discharge also known as the Darcy velocity [L/T], K = hydraulic conductivity which is negative reflecting the fact that water flows down the local hydraulic gradient *dh/dl* [dimensionless] (L = length and T = time; for example, Freeze and Cherry, 1979). Hydraulic conductivity is described as:

$$K = k\frac{\rho g}{\mu} \qquad (2)$$

where k = intrinsic permeability [L^2], ρ is the fluid density [M/L^3], g is the acceleration due to gravity [L/T^2], and μ is the dynamic fluid viscosity [M/LT] (M = mass).

Appendix G

San Luis Valley Field Office Wilderness Characteristics Inventory: 2012 Update

This page intentionally left blank.

SAN LUIS VALLEY FIELD OFFICE WILDERNESS CHARACTERISTICS INVENTORY: 2012 UPDATE

INTRODUCTION

As part of BLM's requirement to maintain an updated inventory of Lands with Wilderness Characteristics (LWCs), the San Luis Valley Field Office (Field Office) assessed public lands within the Field Office in 2012 to determine whether wilderness characteristics are present outside of existing wilderness study areas (WSAs), and the congressionally-designated Rio Grande Natural Area. The BLM reviewed original 1980 wilderness inventories, as well as lands identified by BLM staff and lands proposed by the public, in order to identify lands with potential wilderness characteristics. Of the eleven areas identified through the review, one was found to possess wilderness characteristics.

BLM Authority and the Land Use Planning Process

Land use plans identify broad-scale decisions to guide future land management actions and subsequent site-specific implementation decisions. The BLM Land Use Planning Handbook (1601-1) provides guidance to BLM employees for implementing BLM land use planning requirements. In addition, Appendix C, Section 1.K of BLM Handbook 1610-1 (Wilderness Characteristics) directs BLM Field Offices to identify decisions to protect or preserve wilderness characteristics (including sufficient size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation). Specific guidance for assessing wilderness characteristics is provided through Washington Office Instructional Memorandum 2012-154.

While BLM authority to conduct wilderness reviews and establish new wilderness study areas under FLPMA Section 603 expired in 1993, the BLM has authority under FLPMA sections 102 and 201 to maintain a current inventory of all public lands and their resources, including wilderness characteristics. Through the land use planning process, the BLM must consider all available information to determine the mix of resource use and protection that best serves the FLPMA multiple-use mandate.

The management of areas found to possess wilderness characteristics is addressed through the development of a range of RMP (or RMP amendment) alternatives. Within each alternative, the BLM identifies appropriate portions of land and develops effective management strategies (including management prescriptions, stipulations, and allowable uses).

The three existing WSAs within the Field Office (San Luis Hills, Papa Keal and Black Canyon) will continue to be managed to protect their wilderness characteristics under the BLM Interim Management Policy for Lands under Wilderness Review (H-8550-1) until Congress designates them as wilderness or releases them for other uses.

Scope of Assessment

The BLM considered and evaluated wilderness characteristics for all BLM lands within the Field Office outside of existing WSAs and the Rio Grande Natural Area. The assessment did not include adjacent National Forest System, National Park Service, or Colorado State lands.

FLPMA requires that the BLM maintain a current inventory of conditions and resources on public lands, including wilderness characteristics. The last inventory of wilderness characteristics was completed more than thirty years prior to this 2012 update to the inventory. This update of the San Luis Valley Field Office (SLVFO) wilderness characteristics inventory takes into consideration the possibility that conditions on the ground may have changed during this interval.

In performing this assessment, the SLVFO:

1) Reviewed the 1980 BLM Intensive Wilderness Inventory and updated information when necessary to ensure that information was current and accurate.

2) Reviewed proposals to inventory and protect BLM lands with wilderness characteristics submitted by the public.

3) Assessed potential lands in the Field Office identified through BLM staff and public wilderness proposals.

WILDERNESS CHARACTERISTICS

BLM Manual 6300-1 defines wilderness characteristics as consisting of: 1) sufficient size, 2) naturalness, 3) outstanding opportunities for solitude or primitive and unconfined recreation, and 4) supplemental values. To have wilderness characteristics, an area must meet each of the first three criteria as described below.

Sufficient Size

The area is roadless and has over 5,000 acres of contiguous BLM lands, or is of sufficient size to make practicable its use in an unimpaired condition. Areas adjacent to wilderness areas or WSAs that are less than 5,000 acres may have wilderness characteristics. State or private lands are not included in making this acreage determination.

Roadless Definitions

For purposes of conducting wilderness characteristics inventories, the BLM uses definitions found on page 17 of House Report 94-1163 (May 15, 1976), released prior to the enactment of FLPMA. In the report, roadless refers to:

> ...the absence of roads which have been improved and maintained by mechanical means to insure relatively regular and continuous use. A way maintained solely by the passage of vehicles does not constitute a road.

The BLM adopted the following sub-definitions of words and phrases related to roads:

- Improved and maintained: Actions taken physically by people to keep the road open to vehicle traffic. "Improved" does not necessarily mean formal construction. "Maintained" does not necessarily mean annual maintenance.
- Mechanical means: Use of hand or power machinery or tools.
- Relatively regular and continuous use: Vehicular use that has occurred and will continue to occur on a relatively regular basis. Examples are: access roads for equipment to maintain a stock water tank or other established water sources, which

may entail lengthy return intervals for this purpose; access roads to maintained recreation sites or facilities; or access roads to mining claims.

A route established or maintained solely by the passage of vehicles would not be considered a road, even if it is used on a relatively regular and continuous basis. Vehicle routes constructed by mechanical means but that are no longer being maintained by mechanical methods are not roads. Sole use of hands and feet to move rocks or dirt without the use of tools or machinery does not meet the definition of "mechanical means." Roads need not be "maintained" on a regular basis but rather "maintained" when road conditions warrant actions to keep it in a usable condition. A dead-end (cherry-stem) road can form the boundary of an inventory area and does not by itself disqualify an area from being considered "roadless."

Naturalness

Lands and resources exhibit a high degree of naturalness when affected primarily by the forces of nature and where the imprint of human activity is substantially unnoticeable (BLM IM 2003-275).

The naturalness of an area may be influenced by the presence or absence of roads and trails, fences or other developments; the nature and extent of landscape modifications; the presence of native vegetation communities; and the connectivity of habitats. The presence and diversity of wildlife species are recognized as an indicator of naturalness.

Examples of human-made features that may be considered substantially unnoticeable in certain cases are: trails, trail signs, bridges, fire towers, fire breaks, fire pre-suppression facilities, pit toilets, fisheries enhancement facilities, fire rings, hitching posts, snow gauges, water quantity and quality measuring devices, research monitoring markers and devices, radio repeater sites, air quality monitoring devices, fencing, spring developments, overgrown and barely visible two-track ways, and small reservoirs.

Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation

Solitude

Visitors may have outstanding opportunities for solitude when the sights, sounds, and evidence of other people are rare or infrequent, or where visitors can feel isolated, alone or secluded from others.

Primitive and Unconfined Recreation

Visitors may have outstanding opportunities for primitive and unconfined types of recreation where the use of the area is through non-motorized, non-mechanical means, and where no or minimal developed recreation facilities are encountered.

Supplemental Values

The area may contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Supplemental values may be present within the inventory units but are not a required component of wilderness character; they will be described but not used as a mechanism to impact a final finding.

ASSESSMENT PROCESS

In accordance with BLM policy outlined in IM-2012-154, the BLM assessment team:

- Analyzed GIS data to identify blocks of BLM land (1) greater than 5,000 acres or adjacent to a WSA, designated wilderness, or the Rio Grande Natural Area and (2) that do not contain improved and maintained BLM roads, county roads, or highways (wilderness inventory roads).
- Consulted with field staff familiar with assessment areas to elicit additional information related to identified or proposed inventory areas.
- Conducted field visits in order to verify preliminary findings and complete inventories for qualifying areas.
- The primary assessment team consisted of the San Luis Valley Field Office Outdoor Recreation Planner (with a background in wildland recreation, natural resources management, parks and recreation management, and experience with wilderness management of both the Sangre de Cristo and La Garita Wilderness areas), and two Recreation Assistants (one with experience as a wilderness ranger for the U.S. Forest Service and wildland recreation management, and the other with experience in rangeland management and invasive species management as well as wildland recreation management). The team regularly consulted with various other members of the Field Office in such disciplines as: Archaeology and Heritage, Lands and Realty, Minerals and Geology, Biological Sciences and Natural Resources Management.

Assessment Tools

The BLM assessment team utilized the following tools in evaluating areas for consideration and in completing the wilderness characteristics assessment:

Past Wilderness Inventories

The BLM reviewed the 1980 BLM Intensive Wilderness Inventory, Final Wilderness Study Areas report and maps for areas that had been assessed for the presence of wilderness characteristics, but were not included within a WSA. Because the original report documentation was not available, all aspects of an area were considered in this assessment, making it more comprehensive than a simple update.

This review enabled the BLM to determine whether any new information is available that was not considered as part of the original inventories. As the larger landscape experiences population growth and increased development, perceptions regarding what constitutes solitude and outstanding opportunities for primitive and unconfined recreation change. Interest in arid and low elevation environments has also increased. Therefore, some information related to social values submitted by the public was considered "new information" based on changed physical conditions of the land and social perceptions of wilderness characteristics that may have occurred over time.

Public Wilderness Proposals

External groups advocate for wilderness designation through legislation and participation in the land use planning process. The BLM considered the most recent proposals for protection of

wilderness characteristics submitted by the Colorado Wilderness Network, The Wilderness Society, and Rocky Mountain Wild (all located in the San Luis Hills area of the Field Office).

Other Documents and Data

The following information sources were considered in drafting the assessment:

- Field investigation notes
- Range improvement records (SLVFO Range Management Specialist and GIS – Incomplete Range Improvement Inventory, especially in the southern half of the Field Office)
- Colorado Natural Heritage Program databases (including cover types and associated wildlife, potential conservation areas, rare plants, natural plant communities, raptors, etc.)
- Colorado Wilderness Network proposed wilderness GIS data layer (2007)
- BLM LR2000 databases (including rights-of-way, mining claims, and oil and gas leasing)
- SLVFO Travel Management Plan (2009)
- SLVFO road maintenance records
- SLVFO range allotment management records
- SLVFO cultural database
- SLVFO oil and gas lease and mining claim GIS data sets
- SLVFO travel and transportation GIS data sets

ASSESSMENT AREAS

The wilderness characteristics assessment describes known valid existing rights, grandfathered uses, and public land investments within the survey areas. BLM staff verified new information during field surveys.

Table 1 below and **Figure 1** on page 6 identify the Field Office lands detailed within this assessment.

Table 1
Field Office Lands Assessed for Wilderness Characteristics

Name	Total Inventoried Acreage	Acreage with Wilderness Characteristics	Acreage without Wilderness Characteristics
Trickle Mountain	5,502	0	5,502
Middle Creek	6,188	0	6,188
Vista Grande	7,260	0	7,260
Alexander Mountain	6,805	0	6,805
Greenie Mountain	11,011	0	11,011
Mogote North	7,563	0	7,563
Mogote Middle	8,820	0	8,820
Mogote South	5,503	0	5,503

Flat Top*	**8,080**	**0**	**8,080**
San Luis Hills WSA*	**10,784**	**10,784**	**0**
Rio Grande*	**10,242**	**0**	**10,242**

*Reflects total BLM acreage within the Field Office submitted by the Colorado Wilderness Network, The Wilderness Society, and Rocky Mountain Wild through citizen wilderness proposals, including acreage within existing WSAs. Acreages generated through GIS mapping may vary due to rounding inconsistencies and different mapping techniques.

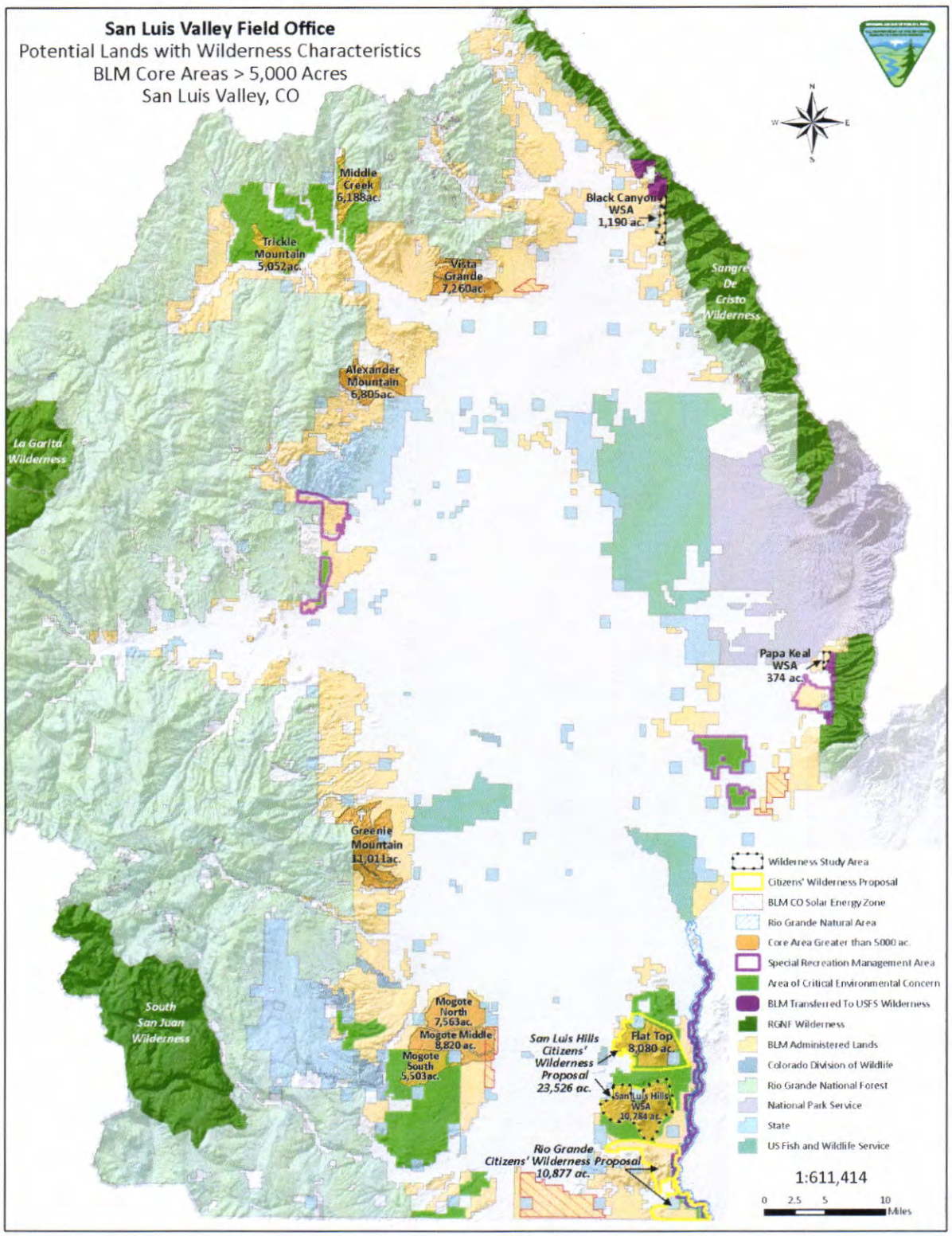


Figure 1 – Overview of Wilderness Characteristics Inventory Areas

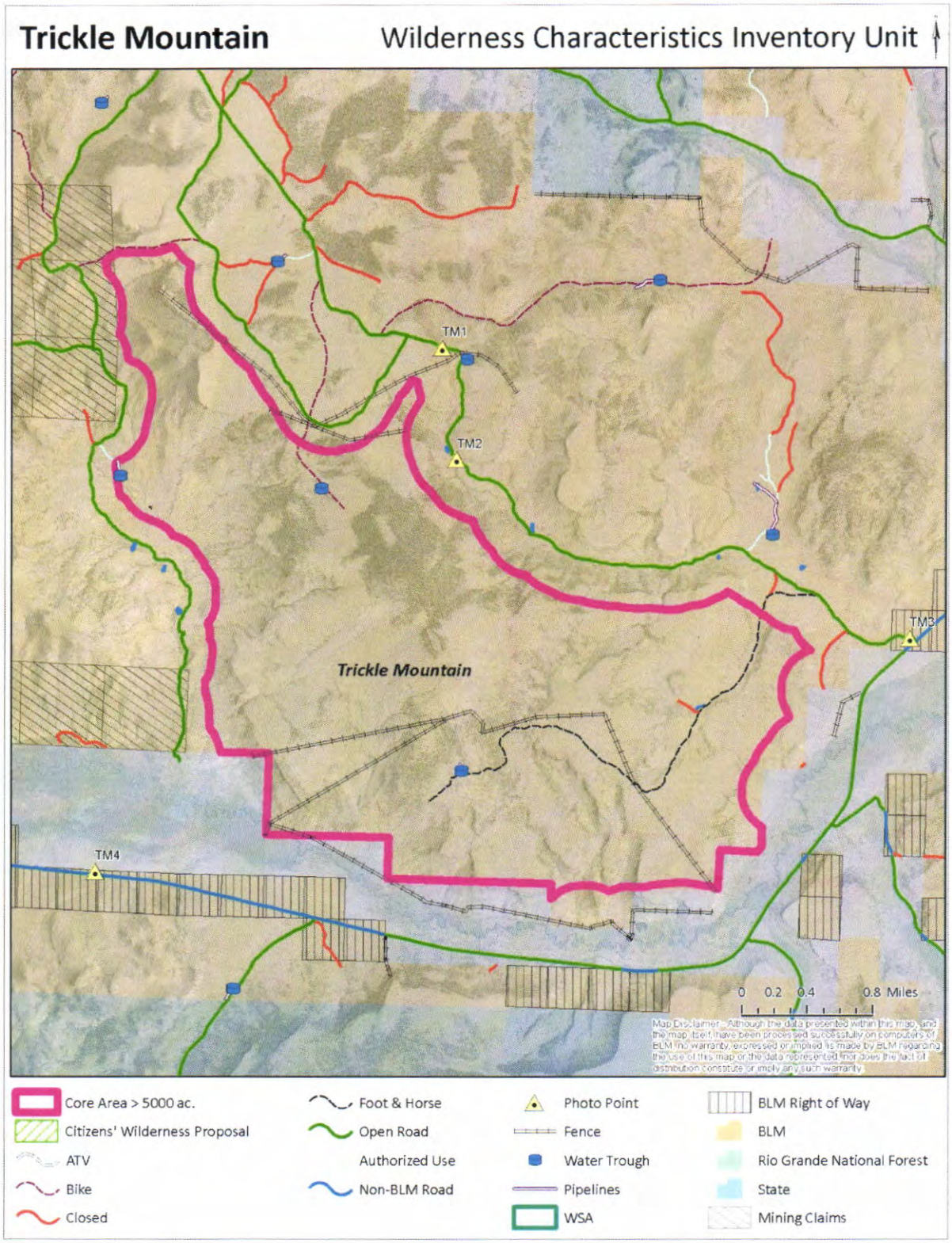


Figure 2 – Trickle Mountain

TRICKLE MOUNTAIN

Photo Point TM3 – From *E* Looking *W* to Trickle Mountain

Photo Point TM2 – From *NE* Looking *SE* to Alexander Mountain

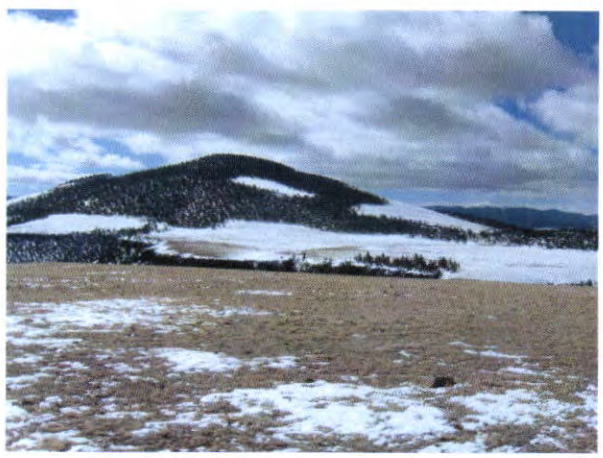


Photo Point TM1 – From *N* Looking *SW* to Trickle Mountain

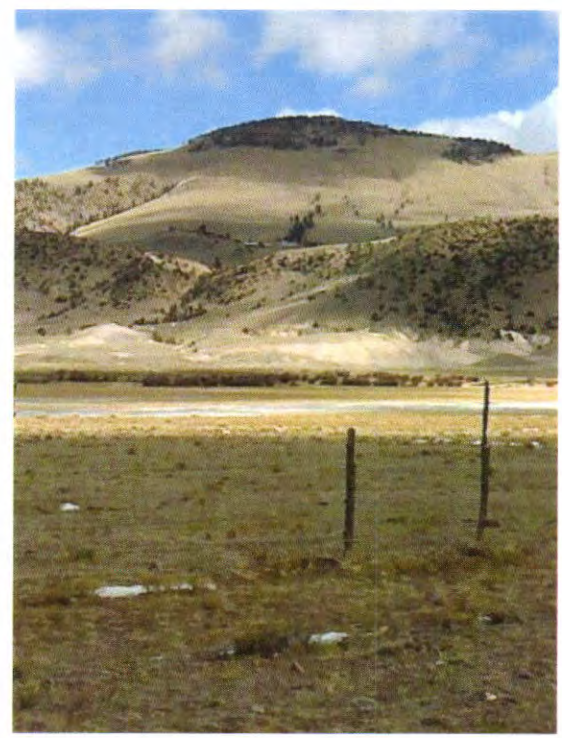


Photo Point TM4 – From *SW* Looking *NE* to Trickle Mountain

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No___**X**_____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Trickle Mountain

Acreage: 5,052

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Trickle Mountain inventory area is located entirely on BLM lands within the Trickle Mountain Area of Critical Environmental Concern (ACEC), and is located approximately 12 miles west of the Town of Saguache in Saguache County, CO. It is bordered by Colorado Highway 114 on the south, BLM roads 5255 and 5216 on the east and northeast, and BLM road 5247 and 5251S on the northwest and west. There are 2 active grazing leases and 2 mining claims in the Trickle Mountain Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The Trickle Mountain inventory area is located entirely on BLM lands within the Trickle Mountain Area of Critical Environmental Concern (ACEC), and is located west of the Town of Saguache on the north side of Colorado Highway 114. Access to the unit is readily available directly from Colorado Highway 114, a single county road stemming from the highway, and subsequent BLM open system roads.

The Trickle Mountain unit is typified by relatively open, rolling hills approaching the summit of Trickle Mountain proper, which is largely un-forested on the south side and densely forested on the north side. Lands within the Trickle Mountain unit are classified primarily as Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Montane Sagebrush Steppe, Southern

Rocky Mountain Piñon-Juniper Woodland, and Rocky Mountain Dry-Mesic and Mesic Mixed Conifer Forest and Woodland.

Local area residents and visitors (especially during the fall big game hunting seasons) also utilize the area recreationally for such purposes as; OHV and backcountry driving, hunting and horseback riding. Several ways exist throughout the area, as well as two mechanized trails and one foot and horse trail, but are considered minor imprints of man due to their generally low visibility throughout the broader landscape. Throughout the Trickle Mountain landscape, the obvious and visible remains of a Civilian Conservation Corps soil conservation project from the 1930's in the form of uniformly spaced contour terraces extending the length of the mountain, represents a significant imprint of man within the Trickle Mountain area. However, the presence of those terraces is less obvious in the inventory unit than in other parts of the ACEC and does not dramatically affect the naturalness of the unit.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the popularity of Trickle Mountain for off-highway vehicle recreation (the LWC inventory unit is also designated in the SLVFO Travel Management Plan as the Trickle OHV subunit) during the summer camping months and during the very busy fall big game hunting seasons, and despite the scale of the Trickle landscape, visitors are frequently exposed to the sights and sounds of motorized recreation. Similarly, the unit's popularity with firewood collectors also exposes visitors to the frequent sounds of chainsaws used for that activity.

The unit is known for its backcountry experience, however, because of a lack of cover necessary to screen visitors from each other, with only a small, finite area covered by timber, opportunities for solitude exist within the unit, however, they cannot be considered 'outstanding.'

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the Trickle Mountain area is by motorized vehicle. Primary activities include; driving for pleasure, camping, firewood collecting, and hunting. Access to Trickle Mountain is through a combination of OHV's, foot, horse, and bike, with frequent off-

road incursions into the area, primarily from ATV use related to hunting. There are 3 trails in the area, but no other recreational facilities. All use is self-directed and requires moderate backcountry skills, such as map-reading or GPS familiarity, and basic survival skills. Similar to 'solitude', opportunities exist for primitive and unconfined recreation, however, they cannot be considered 'outstanding.'

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Trickle Mountain

Results of analysis:
Of the 5,052 acres analyzed, 0 acres have wilderness characteristics.

The Trickle Mountain unit is characterized in the lowlands by mostly open, rolling hills and a forested north slope of Trickle Mountain itself. Despite its generally natural appearance, the terrain lacks the vegetative diversity and density necessary to screen visitors from each other, and the unit's primary human activities ensure that visitors are essentially never free from the sights, sounds and works of man. Though the area is known for its backcountry experience, primarily related to big game hunting habitat, and the setting offers opportunities for both solitude and primitive and unconfined recreation, those experiences cannot be considered 'outstanding.'

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)

Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

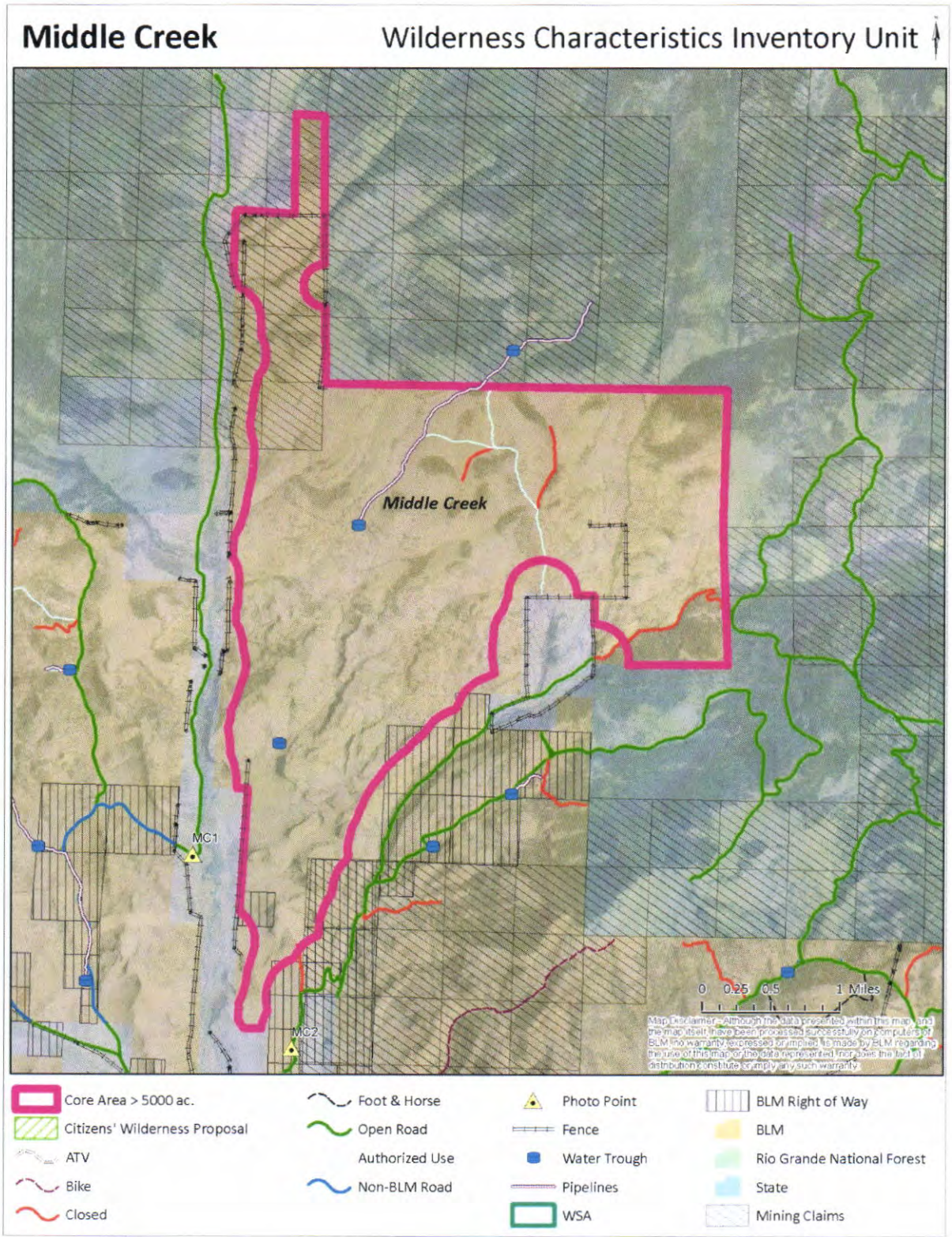


Figure 3 – Middle Creek

MIDDLE CREEK

Photo Point MC1 – From *SW* Looking *NW*

Photo Point MC2 – From *S* Looking *NNW*

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No___**X**____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Middle Creek

Acreage: 6,188

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Middle Creek inventory unit is located entirely on BLM lands mostly within the Trickle Mountain Area of Critical Environmental Concern (ACEC), and is located approximately 12 miles west of the Town of Saguache in Saguache County, CO. It is bordered by Colorado Highway 114 on the south, Saguache County Road 38FF on the west, National Forest System lands on the north and northeast, and an un-numbered BLM road (Ford Creek) on the east and southeast. There are 2 active grazing leases and 9 mining claims in the Middle Creek Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The Middle Creek inventory area is located entirely on BLM lands and mostly within the Trickle Mountain Area of Critical Environmental Concern (ACEC), and is located west of the Town of Saguache on the north side of Colorado Highway 114. Access to the unit is readily available directly from Colorado Highway 114, and subsequent BLM open system roads.

The Middle Creek unit is part of the larger Trickle Mountain landscape and shares the same terrain and vegetative cover types as the Trickle Mountain wilderness characteristics inventory unit. The Middle Creek unit is typified by relatively open, rolling hills that are sparsely forested, primarily on the north side of hill-tops. Lands within the Middle Creek unit are classified

primarily as Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Montane Sagebrush Steppe, Southern Rocky Mountain Piñon-Juniper Woodland, and Rocky Mountain Dry-Mesic and Mesic Mixed Conifer Forest and Woodland.

Local area residents and visitors (especially during the fall big game hunting seasons) also utilize the area recreationally for such purposes as; OHV and backcountry driving, hunting and horseback riding.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the popularity of the Middle Creek unit for off-highway vehicle recreation (the LWC inventory unit is also designated in the SLVFO Travel Management Plan as the Trickle OHV subunit) during the summer camping months and during the very busy fall big game hunting seasons, and despite the scale of the Trickle landscape (which Middle Creek belongs to), visitors are frequently exposed to the sights and sounds of motorized recreation, firewood collecting, and camping and hunting with mechanized and motorized equipment.

The unit is known for its backcountry experience, however, because of a lack of cover necessary to screen visitors from each other, opportunities for solitude exist within the unit, however, they cannot be considered 'outstanding.'

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use in the Middle Creek unit is fall big game hunting. Other activities include driving for pleasure, camping, and firewood collecting. Access to Middle Creek is through a combination of OHV's, foot, and horse, with frequent off-road incursions into the area, primarily from ATV use related to hunting. There are no trails or recreational facilities in the area. All use is self-directed and requires moderate backcountry skills, such as map-reading or GPS familiarity, and basic survival skills. Similar to 'solitude', opportunities exist for primitive and unconfined recreation, however, they cannot be considered 'outstanding.'

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ No ☐ N/A ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Middle Creek

Results of analysis:
Of the 6,188 acres analyzed, 0 acres have wilderness characteristics.

The Middle Creek unit is characterized by mostly open, rolling hills and sparsely forested hillsides. Despite its generally natural appearance, the terrain lacks the vegetative diversity and density necessary to screen visitors from each other, and the unit's primary human activities ensure that visitors are essentially never free from the sights, sounds and works of man. Though the area is known for its backcountry experience, primarily related to big game hunting habitat, and the setting offers opportunities for both solitude and primitive and unconfined recreation, those experiences cannot be considered 'outstanding.'

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012 Andrew Archuleta

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

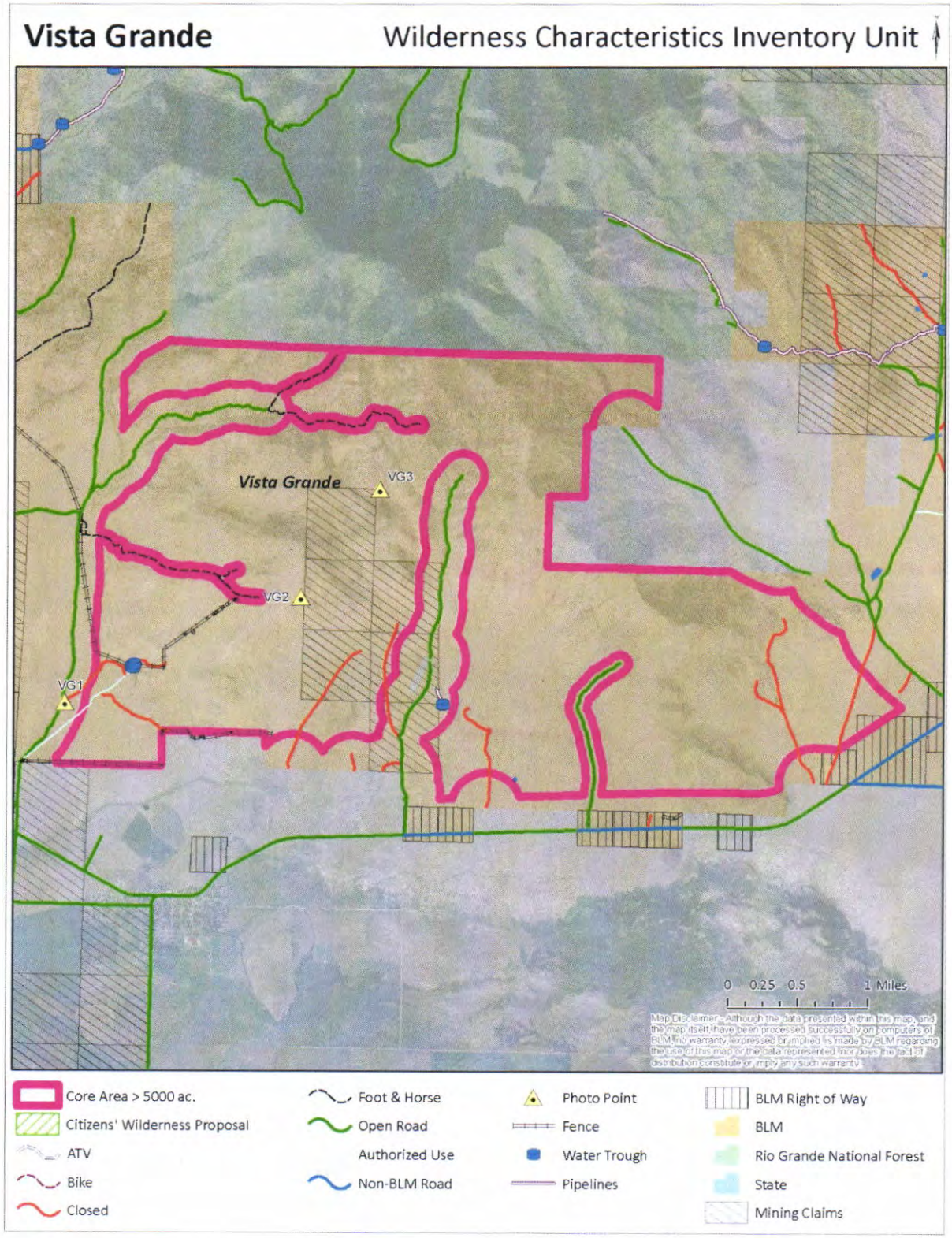


Figure 4 – Vista Grande

VISTA GRANDE

Photo Point VG2 – From Middle Looking *N*

Photo Point VG1 – From *SW* Looking *E*

Photo Point VG – From North-Central Looking *SE* Toward Blanca Peak

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No____**X**____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Vista Grande

Acreage: 7,260

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Vista Grande inventory area is located entirely on BLM lands adjacent to the Town of Saguache in Saguache County, Co. It is bordered by Colorado Highway 114 on the south, BLM Road 5295 on the west, National Forest System and private lands on the north and an un-numbered BLM road on the east. There are 3 active grazing leases and 5 mining claims in the Vista Grande unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The Vista Grande unit is located entirely on BLM lands, just to the north of the Town of Saguache. Access to the unit is readily available via Colorado Highway 114 (which represents the southern boundary on BLM lands) and subsequent BLM open system roads.

The unit is typified by open, sparsely vegetated terrain that continually rises to the north toward Saguache Peak on National Forest System lands. Lands within the Vista Grande unit are classified primarily as Inter-Mountain Basins Semi-Desert Shrub Steppe, Inter-Mountain Basins

Semi-Desert Grassland, Southern Rocky Mountain Piñon-Juniper Woodland, and Rocky Mountain Dry-Mesic and Mesic Mixed Conifer Forest and Woodland.

The principal human activities and imprints of man within the Vista Grande unit include livestock grazing and related facilities, such as water improvements and fences. Local area residents and seasonal visitors also utilize the area recreationally for such purposes as OHV and backcountry driving, hunting and horseback riding.

As part of a cooperative effort with the Town of Saguache to develop a community recreation area, BLM is currently planning for the development of a singletrack mechanized trail system throughout the unit.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the close proximity to the Town of Saguache and major highways in the San Luis Valley, as well as increasing popularity among mountain bikers, in addition to more traditional uses of this area (which include driving for pleasure, camping, firewood collecting and hunting), combined with the area's minimal topographic relief, lack of vegetation suitable for screening, open terrain, and easy vehicular access throughout the area, *outstanding* opportunities for solitude do not exist in this unit. The area's higher, more forested elevations offer more screening and a greater sense of solitude; however, at essentially no time is a visitor to this landscape free from the sights, sounds and works of man.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the Vista Grande unit is currently motorized use related to traditional activities, such as: hunting, firewood collecting, and camping. Mechanized use is increasing in the area, though, relative to current planning efforts for the mechanized trail system. There are 2 trails currently associated with the unit and no other recreational facilities. Similar to 'solitude', opportunities exist for primitive and unconfined recreation, however, they cannot be considered 'outstanding.

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Vista Grande

Results of analysis:
Of the 7,260 acres analyzed, 0 acres have wilderness characteristics.

The Vista Grande unit is characterized by open, uniform terrain that lacks vegetative diversity and density necessary to screen visitors from each other, has numerous user-created roads throughout, as well as range improvements for livestock operations. The unit is easily accessible by motorized vehicle and heavily utilized by local citizens and seasonal hunters for OHV recreation, hunting and firewood collecting, and increasingly for mountain biking. The lack of 'outstanding' opportunities for either solitude or primitive and unconfined recreation decisively prevents this unit from possessing wilderness characteristics.

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

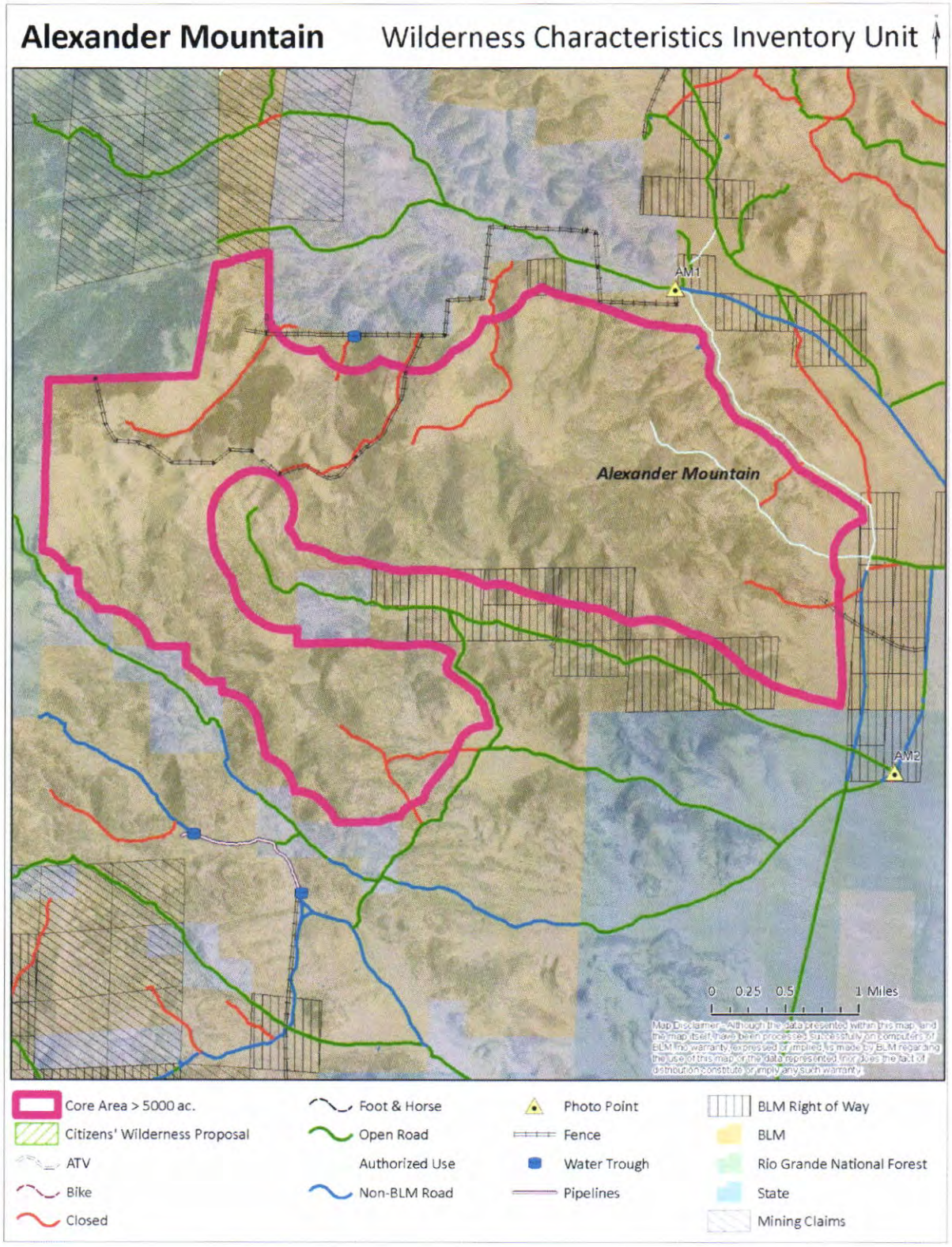


Figure 5 – Alexander Mountain

ALEXANDER MOUNTAIN

Photo Point AM1 – From *NE* Looking *SW* to Alexander Mountain

Photo Point AM2 – From *SE* Looking *W* to Alexander Mountain

Photo Point AM2 – From *SE* Looking *NW* to Alexander Mountain

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No___**X**_____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Alexander Mountain

Acreage: 6,805

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Alexander Mountain inventory area is located entirely on BLM lands approximately halfway between the towns of La Garita and Saguache in Saguache County, CO. It is bordered by Saguache County Road T45.5 on the northeast and north and by the private land boundary of Lime Creek Estates. The unit is bordered on the west by National Forest System lands, the south by Saguache County Road R44.8 and a BLM system road, and on the east by Saguache County Roads 47V and T. Unlike the other inventory units on the Field Office, the Alexander Mountain unit wraps around a private inholding and system roads, which are in the middle of the unit. There are 2 active grazing leases, 7 Rights-Of-Way, and one mining claim in the Alexander Mountain Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The Alexander Mountain unit is located entirely on BLM lands. It is located approximately halfway between the towns of La Garita and Saguache in Saguache County on the west side of US Highway 285. Access to the unit is readily available via 3 county roads from nearby US Highway 285 and subsequent BLM open system roads.

The Alexander Mountain unit is typified by open, relatively flat, terrain approaching Alexander Mountain proper, which is an intermittently forested hillside, primarily consisting of the Piñon-Juniper cover type (see photos). Lands within the Alexander Mountain unit are classified primarily as Inter-Mountain Basins Semi-Desert Shrub Steppe, Inter-Mountain Basins Semi-Desert Grassland, Southern Rocky Mountain Piñon-Juniper Woodland, and Rocky Mountain Dry-Mesic and Mesic Mixed Conifer Forest and Woodland.

The principal human activities and imprints of man within the Alexander Mountain unit include livestock grazing and related facilities, such as water improvements and fences. Local area residents and visitors also utilize the area for recreational purposes, primarily during the fall big game hunting seasons.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the rural nature of this part of the San Luis Valley, with small populations of year-round residents and typically low itinerant visitation for most of the year (with the notable exception of increased visitation throughout the length of the fall big game hunting seasons, which can be significant at times), opportunities for solitude do exist within the Alexander Mountain area, however, they cannot be considered 'outstanding.' With the lowland area's minimal topographic relief, lack of vegetation suitable for screening, open terrain, and easy vehicular access throughout the area, *outstanding* opportunities for solitude do not exist in this unit. The area's higher, forested elevations offer more screening and a greater sense of solitude; however, at essentially no time is a visitor to this landscape free from the sights, sounds and works of man.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the unit is seasonal big game hunting. Access to Alexander Mountain is through a combination of foot and horse and OHV, with constant off-road incursions into the area, primarily from ATV use related to hunting. There are no trails, and no recreational facilities in the area. All use is self-directed and requires moderate

backcountry skills, such as map-reading or GPS familiarity, and basic survival skills. Similar to 'solitude', opportunities exist for primitive and unconfined recreation, however, they cannot be considered 'outstanding.'

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Alexander Mountain

Results of analysis:
Of the 6,805 acres analyzed, 0 acres have wilderness characteristics.

The Alexander Mountain unit is characterized in the lowlands by open, uniform terrain that lacks topographic and vegetative diversity and intermittently forested areas in the uplands of the unit. The area is generally natural in appearance; however, visitors are essentially never free from the sights, sounds and works of man. Though the area is known for its backcountry experience, primarily related to big game hunting habitat, and the fairly typical setting offers opportunities for both solitude and primitive and unconfined recreation, those experiences cannot be considered 'outstanding.'

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: [illegible] Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

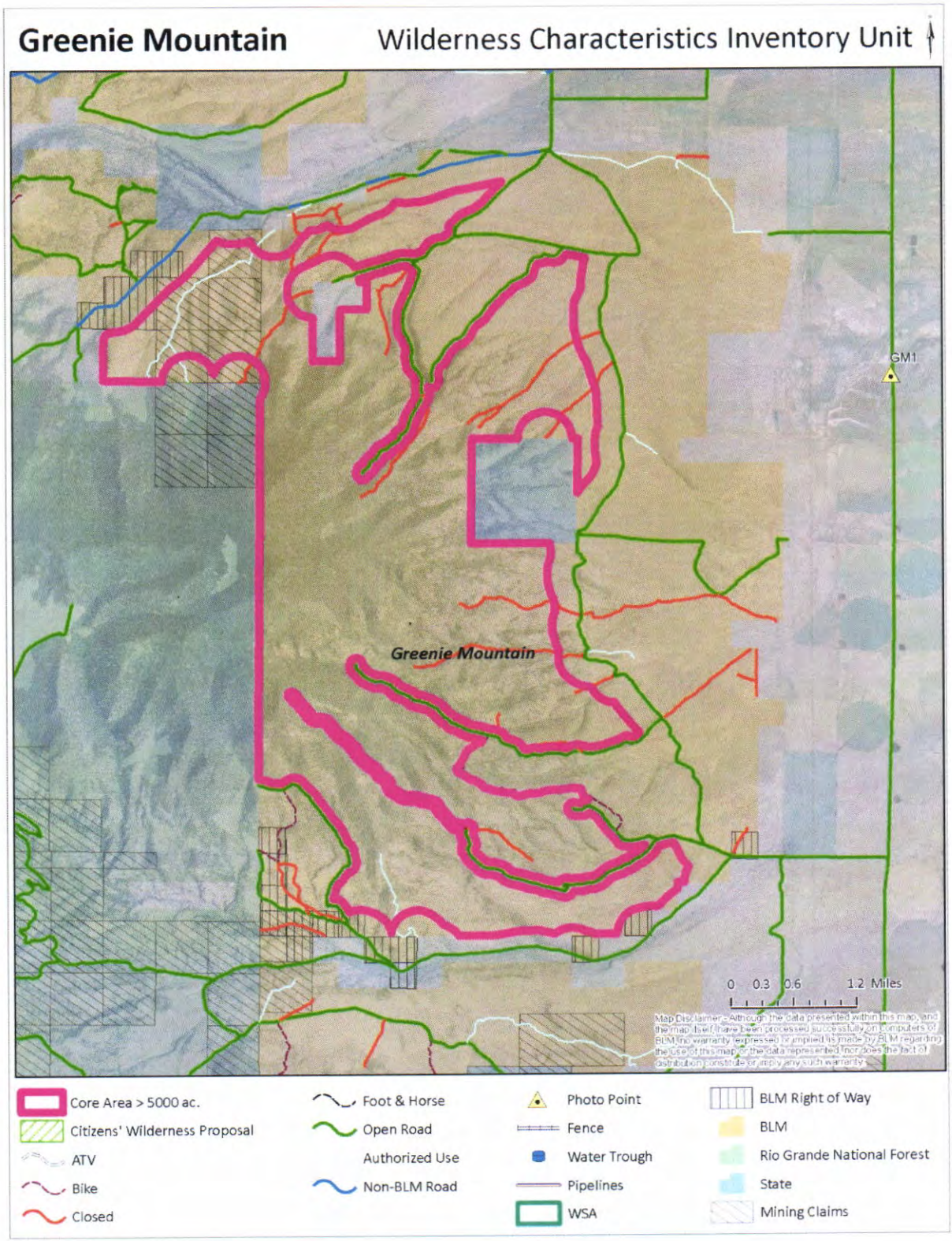


Figure 6 – Greenie Mountain

GREENIE MOUNTAIN

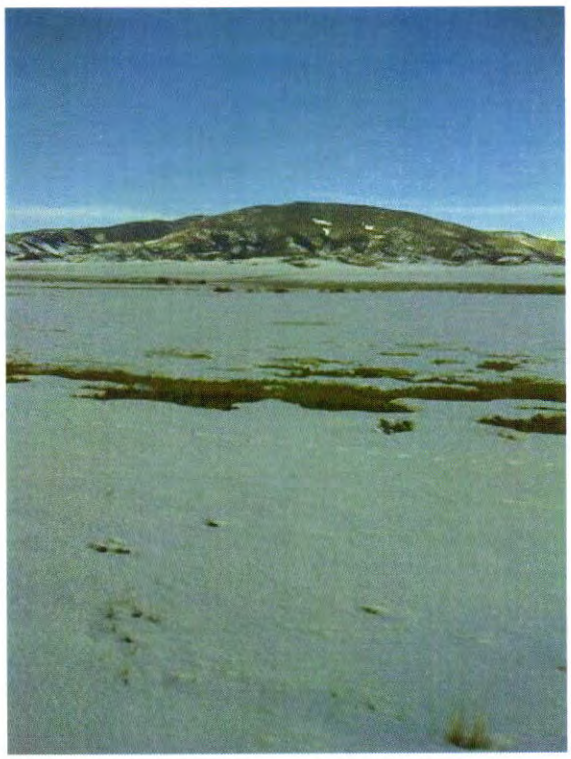


Photo Point GM1 – From *E* Hwy 15 Looking *W* to Greenie Mountain

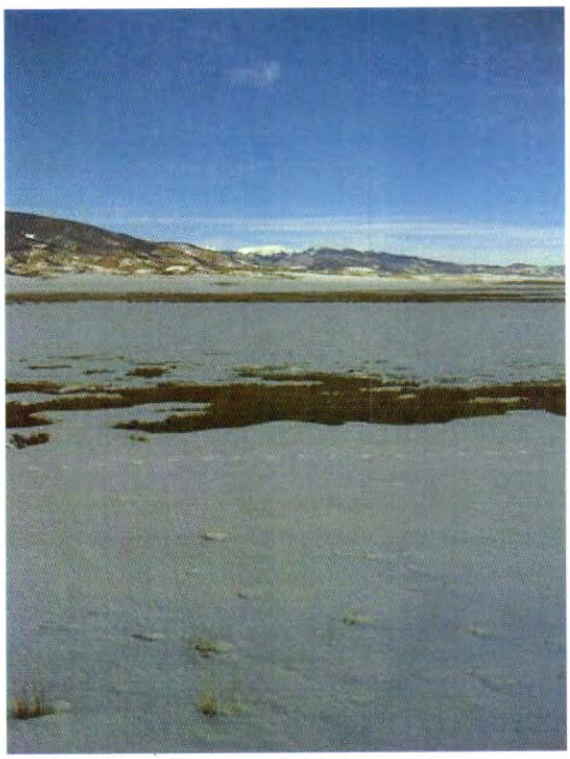


Photo Point GM1 – From *E* Hwy 15 Looking *NW*

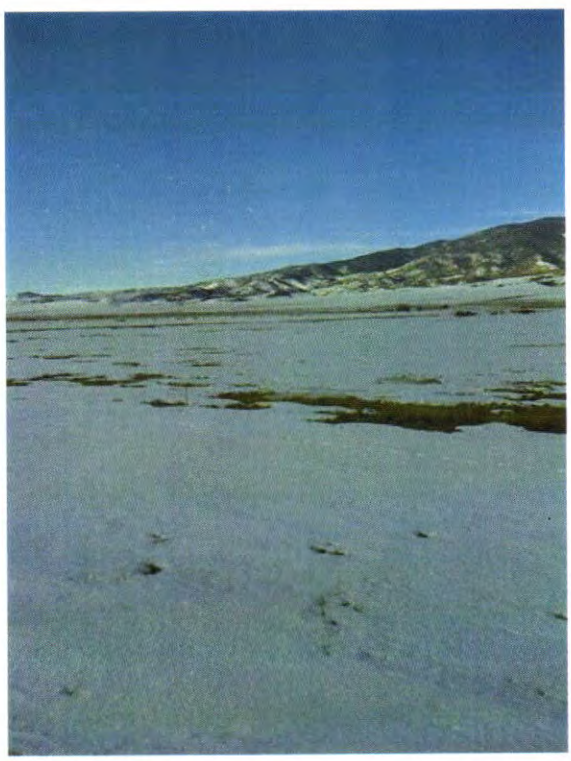


Photo Point GM1 – From *E* Hwy 15 Looking *SW*

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No ___**X**_____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Greenie Mountain

Acreage: 11,011

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Greenie Mountain inventory area is located entirely on BLM lands west of the Monte Vista National Wildlife Refuge and approximately 6 miles SSW of the City of Monte Vista. It is bordered by Rio Grande County Road 28 on the north and northwest and by a mixture of private, BLM and State lands. The unit is bordered on the west by National Forest System lands, Rio Grande County Road 250 and private lands on the south, and BLM lands and one State section on the east. There are 3 active grazing leases, 3 Rights-Of-Way (one is pending), and 5 mining claims in the Greenie Mountain Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The Greenie Mountain unit is located entirely on BLM lands. At its northeastern most tip, the Greenie Mountain unit is located about 6 mi south of the town of Monte Vista, which is located at the junction of Colorado Highway 15 and US Highway 285 in Rio Grande County, CO. Access to the unit is readily available via 2 county roads from nearby Colorado Highway 15 and subsequent BLM open system roads.

Greenie Mountain is a large inventory unit typified by open, relatively flat, terrain approaching Greenie Mountain proper, which is a prominent, forested hillside (see photos). Lands within the Greenie Mountain unit are classified primarily as Inter-Mountain Basins Semi-Desert Shrub Steppe, Inter-Mountain Basins Semi-Desert Grassland, Southern Rocky Mountain Piñon-Juniper Woodland, and Rocky Mountain Dry-Mesic and Mesic Mixed Conifer Forest and Woodland.

The principal human activities and imprints of man within the Greenie Mountain unit include livestock grazing and related facilities, such as water improvements and fences. Local area residents also utilize the area recreationally for such purposes as; OHV and backcountry driving, hunting and horseback riding. Increasingly, however, the unit is substantially (if not primarily) used for mountain biking (one of the fastest growing sports world-wide) and the BLM is currently analyzing citizen proposals for a mechanized, singletrack trail system in this same area. In the upper, forested section of Greenie Mountain, a hydro-axe thinning project was recently conducted in May 2012. Because of its proximity to some of the major population centers of the San Luis Valley (Monte Vista, Alamosa and Del Norte) and US Highways 160 and 285, and the area's popularity with motorized recreationists and hunters, a number of user-created roads noticeably exist across the landscape.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the close proximity to population centers and major highways in the San Luis Valley, as well as increasing popularity among mountain bikers, in addition to more traditional uses of this area (which include driving for pleasure, camping, firewood collecting and hunting), combined with the lowland area's minimal topographic relief, lack of vegetation suitable for screening, open terrain, and easy vehicular access throughout the area, *outstanding* opportunities for solitude do not exist in this unit. The area's higher, forested elevations offer more screening and a greater sense of solitude; however, at essentially no time is a visitor to this landscape free from the sights, sounds and works of man.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the Greenie Mountain unit is currently a toss-up between motorized and mechanized uses. Primary activities include driving for pleasure, mountain biking, hunting, firewood collecting, and camping. There are several mechanized trails and a relatively high road density within the unit.

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Greenie Mountain

Results of analysis:
Of the 11,011 acres analyzed, 0 acres have wilderness characteristics.

The Greenie Mountain unit is characterized in the lowlands by open, uniform terrain that lacks topographic and vegetative diversity or relief and has numerous system and user-created roads throughout, as well as range improvements for livestock operations. The forested uplands of the unit are easily accessible by motorized vehicle and heavily utilized by mountain bikers, OHV enthusiasts, hunters and firewood collectors, among others. It could be argued that the unit is not sufficiently natural to warrant wilderness character suitability, however, the lack of 'outstanding' opportunities for either solitude or primitive and unconfined recreation decisively prevent this unit from possessing wilderness characteristics.

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

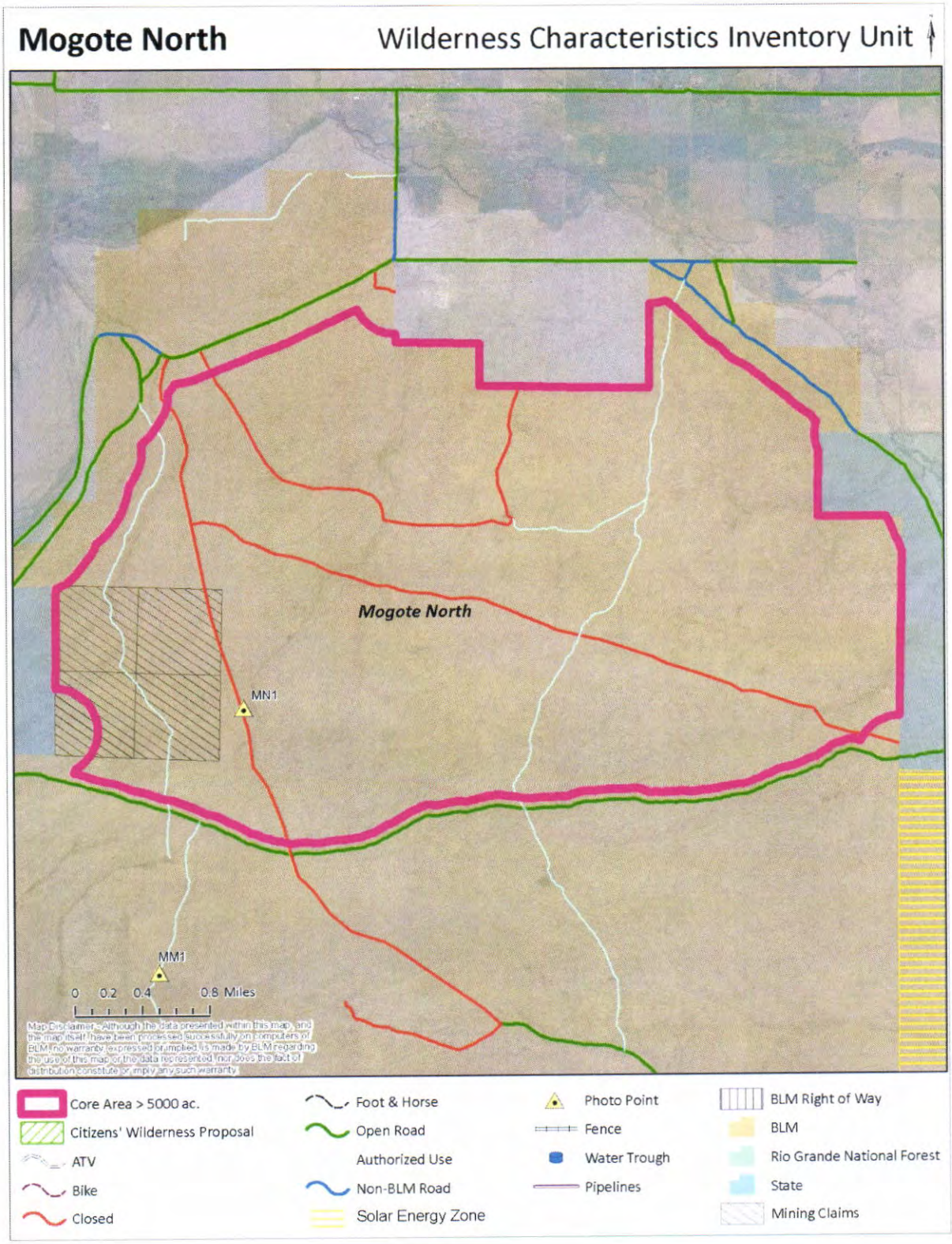


Figure 7 – Mogote North

MOGOTE NORTH

Photo Point MN1 – From W Looking NW Toward Blanca Peak

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No___**X**_____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Mogote North

Acreage: 7,563

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Mogote North inventory area is located entirely on BLM lands south of the community of Capulin in a landscape-level area generally referred to as 'Los Mogotes.' It is bordered on the north and west by private lands, BLM system road 5055 and a portion of a section of State land, on the north and east by Conejos County Road 12 and a parcel of State land, and on the south by BLM system road 5059. There is one active grazing lease and 4 mining claims in the Mogote North Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

At its northernmost tip, the Mogote North unit is located about one mile south of the town of Capulin, which is located at the junction of Conejos County Road 8 and Colorado Highway 15 in Conejos County, CO. Mogote North is generally surrounded on all sides except the south by private lands that have mostly been developed for irrigated agriculture. Home sites are also scattered throughout the adjacent area. Access to the Mogotes is readily available via three county roads from nearby U.S. Highway 285 and subsequent BLM open system roads.

The terrain throughout the Mogotes is essentially uniform, open, relatively flat and lacks topographic and vegetative variation (see photos). Lands within the Mogotes are classified primarily as Inter-Mountain Basins Semi-Desert Shrub Steppe. Additional cover types within the Mogotes include Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Mixed Salt Desert Scrub, and Inter-Mountain Basins Greasewood Flat.

The principal human activities and imprints of man within the Mogotes include livestock grazing and related facilities, such as water improvements and fences. Local area residents also utilize the area recreationally for such purposes as OHV and backcountry driving, hunting and horseback riding. A number of illegal trash dumps exist primarily along the northern part of the area, related to the proximity of the town of Capulin and its outliers. Several ways exist throughout the area, but are considered minor imprints of man due to their generally low visibility throughout the broader landscape.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the rural nature of this part of the San Luis Valley, with small populations of year-round residents and typically low itinerant visitation (combined with a large, naturally appearing landscape) opportunities for solitude do exist within the Mogote North area, however, they cannot be considered 'outstanding.' With the area's low topographic relief, lack of vegetation suitable for screening, open terrain, and easy vehicular access throughout the area, *outstanding* opportunities for solitude do not exist in this unit.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the Mogotes is by motorized vehicle. Primary activities include driving for pleasure and hunting. There are no trails, and no recreational facilities in the area. All use is self-directed and requires few backcountry skills. Similar to 'solitude', opportunities exist for primitive and unconfined recreation, however, they cannot be considered 'outstanding.'

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Mogote North

Results of analysis:
Of the 7,563 acres analyzed, 0 acres have wilderness characteristics.

The Mogotes are characterized by open, uniform terrain that lacks topographic and vegetative diversity or relief, and does not offer visitors any screening from other visitors in an area used primarily for recreational motorized vehicle use and livestock grazing.

1. **Does the area meet any of the size requirements?** ☒ **Yes** ☐ **No**
2. **Does the area appear to be natural?** ☒ **Yes** ☐ **No** ☐ **N/A**
3. **Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation?** ☐ **Yes** ☒ **No** ☐ **N/A**
4. **Does the area have supplemental values?** ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

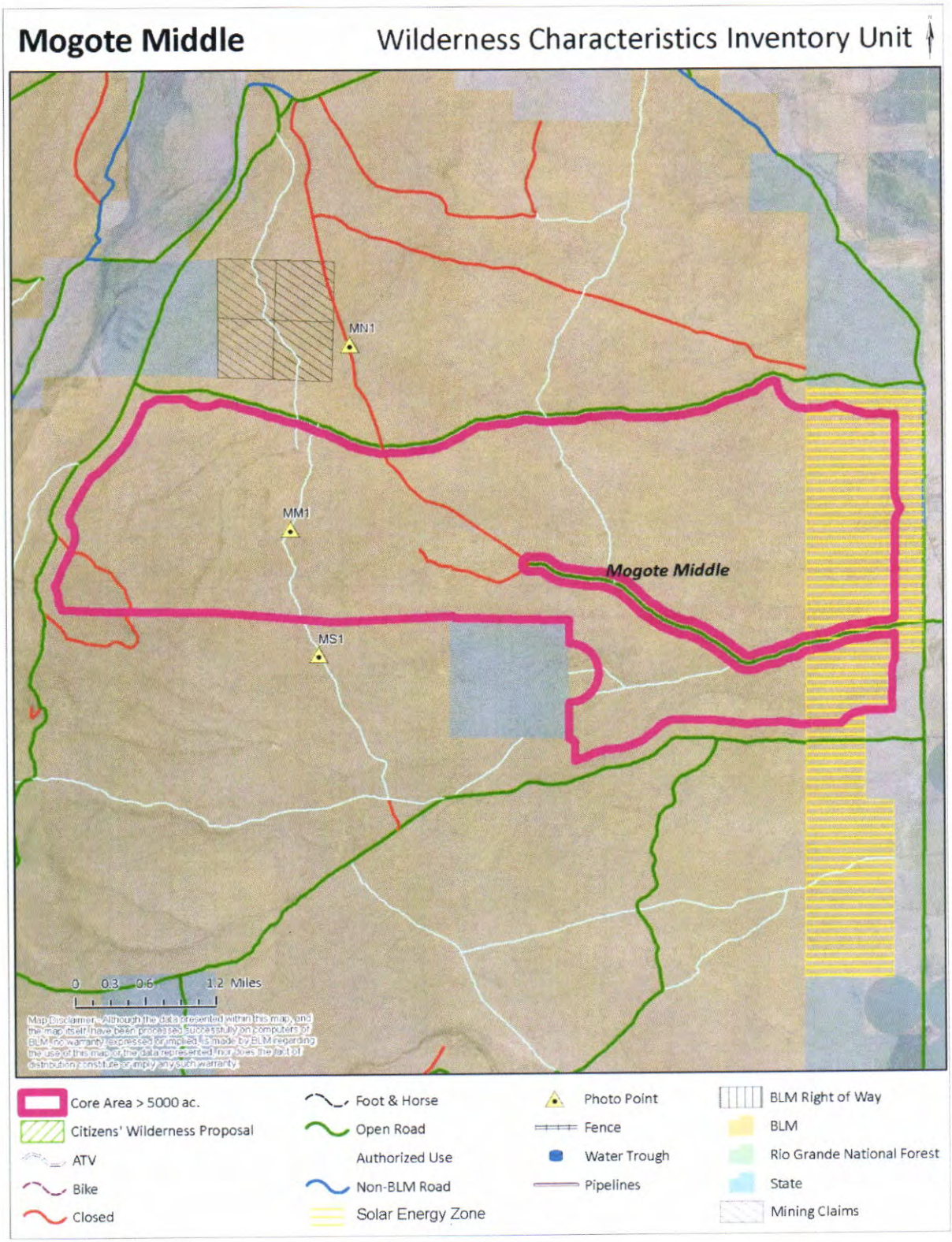


Figure 8 – Mogote Middle

MOGOTE MIDDLE

Photo Point MM1 – From *W* Looking *E* Toward San Luis Hills

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No___**X**_____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Mogote Middle

Acreage: 8,820

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Mogote Middle inventory area is located on BLM lands west of the community of Romeo in a landscape-level area generally referred to as 'Los Mogotes.' It is bordered on the north, south and west by BLM lands, and private lands on the east. The unit boundaries are encompassed by BLM system roads 5059 in the north, 5055 on the west, the administrative boundary of the Los Mogotes Area of Critical Environmental Concern (ACEC) and a section of State land on the south, and the BLM boundary to private lands on the east. The eastern portion of the unit is also identified as the Los Mogotes Solar Energy Zone. There are 3 active grazing leases in the Mogote Middle Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The landownership of the Mogote Middle unit is entirely BLM. The southwest boundary of the unit is adjacent to the northern edge of the Los Mogotes ACEC, which was established for critical winter and birthing habitat for big game and special status plant species. From its eastern edge, the Mogote Middle unit is located about 3 mi west of the town of Romeo, which is located at the junction of US Highway 285 and Colorado Highway 142. With the exception of the town of Romeo, private lands on the east of the unit are almost exclusively agricultural. Access to the Mogotes is readily available via three county roads from nearby U.S. Highway 285 and subsequent BLM open system roads.

The terrain throughout the Mogotes is essentially uniform, open, relatively flat and lacks topographic and vegetative variation (see photos). Lands within the Mogotes are classified primarily as Inter-Mountain Basins Semi-Desert Shrub Steppe. Additional cover types within the Mogotes include Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Mixed Salt Desert Scrub, and Inter-Mountain Basins Greasewood Flat.

The principal human activities and imprints of man within the Mogotes include livestock grazing and related facilities, such as water improvements and fences. Local area residents also utilize the area recreationally for such purposes as; OHV and backcountry driving, hunting and horseback riding. A number of significant trash dumps exist along the eastern edge of the unit, related to the proximity of the towns of Romeo, Manassa, Capulin and their associated rural community. Several ways exist throughout the area, but are considered minor imprints of man due to their generally low visibility throughout the broader landscape.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the rural nature of this part of the San Luis Valley, with small populations of year-round residents and typically low itinerant visitation (combined with a large, naturally appearing landscape) opportunities for solitude do exist within the Mogote Middle area, however, they cannot be considered 'outstanding.' With the area's low topographic relief, lack of vegetation suitable for screening, open terrain, and easy vehicular access throughout the area, *outstanding* opportunities for solitude do not exist in this unit.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the Mogotes is by motorized vehicle. Primary activities include driving for pleasure and hunting. There are no trails, and no recreational facilities in the area. All use is self-directed and requires few backcountry skills. Similar to 'solitude,' opportunities exist for primitive and unconfined recreation; however, they cannot be considered 'outstanding.'

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Mogote Middle

Results of analysis:
Of the 8,820 acres analyzed, 0 acres have wilderness characteristics.

The Mogotes are characterized by open, uniform terrain that lacks topographic and vegetative diversity or relief, and does not offer visitors any screening from other visitors in an area used primarily for recreational motorized vehicle use and livestock grazing.

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

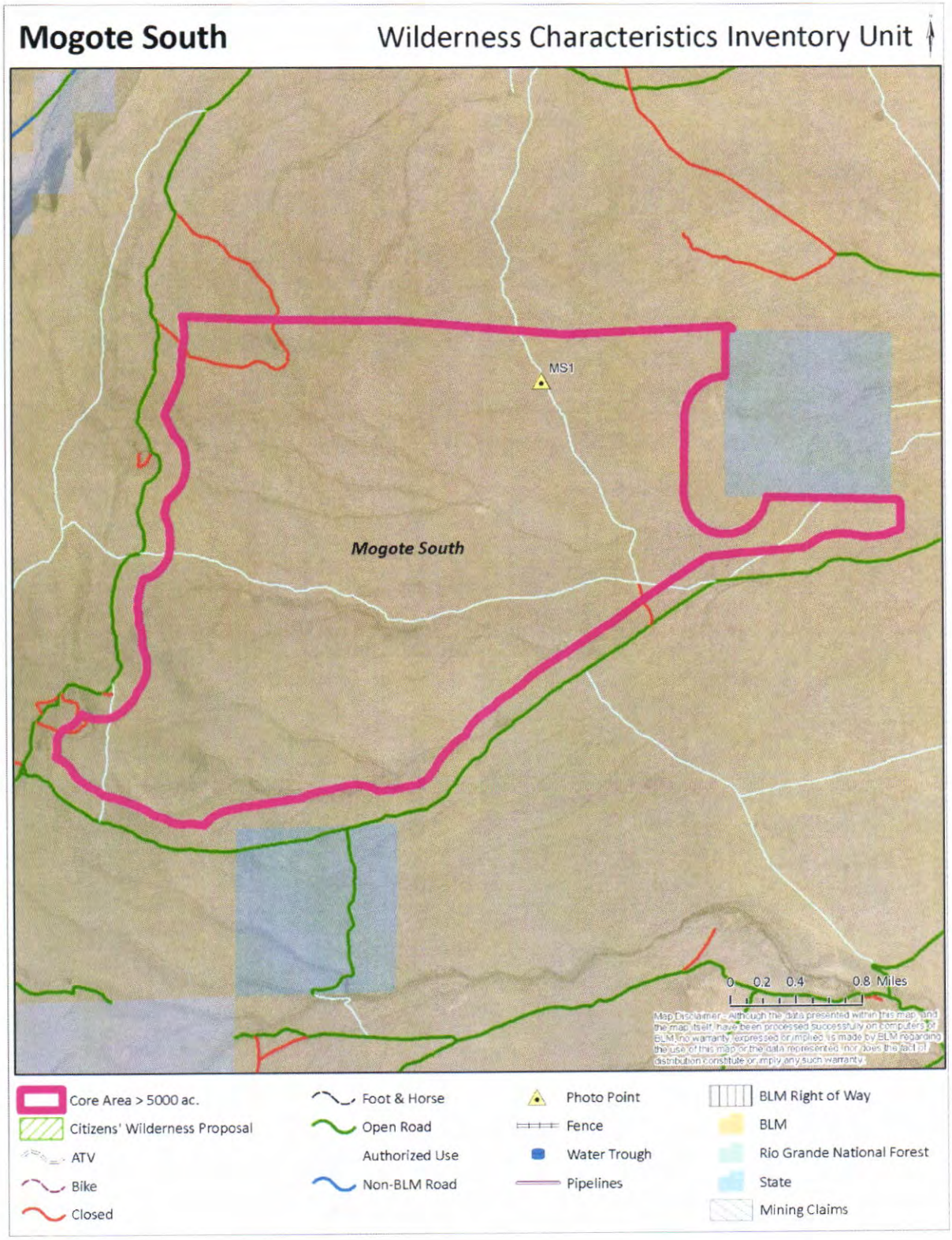


Figure 9 – Mogote South

MOGOTE SOUTH

Photo Point MS1 – From *N* Looking *S* Towards San Antonio Mountain

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No ___**X**_____ (Go to Form 2) **Yes** _____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Mogote South

Acreage: 5,503

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

The Mogote South inventory area is located entirely on BLM lands west of the community of Romeo in a landscape-level area generally referred to as 'Los Mogotes.' It is bordered on all sides by BLM lands, as well as a section of State land on the southernmost portion of the unit and a section of State land on the northeast corner of the unit. The unit boundaries are encompassed by the administrative boundary of the Los Mogotes Area of Critical Environmental Concern (ACEC) on the north, BLM system road 5055 on the west, south and east. There are 4 active grazing leases in the Mogote South Unit.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

The landownership of the Mogote South unit is entirely BLM and is also located entirely within the Los Mogotes ACEC, which was established for critical winter and birthing habitat for big game and special status plant species. Several small towns (Capulin, Romeo, Conejos, etc.) and their associated rural communities surround the BLM on the north, east and south sides of the Mogotes. The Mogote South unit is located in the very middle of the larger Mogote landscape and somewhat equidistant to all of those communities. Access to the Mogote South unit is readily available via county roads from Colorado Highway 15 in the north, U.S. Highway 285 to the east, Colorado Highway 17 to the south and subsequent BLM open system roads.

The terrain throughout the Mogotes is essentially uniform, open, relatively flat and lacks topographic and vegetative variation (see photos). Lands within the Mogotes are classified primarily as Inter-Mountain Basins Semi-Desert Shrub Steppe. Additional cover types within the Mogotes include Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Mixed Salt Desert Scrub, and Inter-Mountain Basins Greasewood Flat.

The principal human activities and imprints of man within the Mogotes include livestock grazing and related facilities, such as water improvements and fences. Local area residents also utilize the area recreationally for such purposes as OHV and backcountry driving, hunting and horseback riding. Several ways exist throughout the area, but are considered minor imprints of man due to their generally low visibility throughout the broader landscape.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Because of the rural nature of this part of the San Luis Valley, with small populations of year-round residents and typically low itinerant visitation (combined with a large, naturally appearing landscape) opportunities for solitude do exist within the Mogote South area; however, they cannot be considered 'outstanding.' With the area's low topographic relief, lack of vegetation suitable for screening, open terrain, and easy vehicular access throughout the area, *outstanding* opportunities for solitude do not exist in this unit.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

The primary recreational use throughout the Mogotes is by motorized vehicle. Primary activities include driving for pleasure and hunting. There are no trails, and no recreational facilities in the area. All use is self-directed and requires few backcountry skills. Similar to 'solitude,' opportunities exist for primitive and unconfined recreation; however, they cannot be considered 'outstanding.'

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Mogote South

Results of analysis:
Of the 5,503 acres analyzed, 0 acres have wilderness characteristics.

The Mogotes are characterized by open, uniform terrain that lacks topographic and vegetative diversity or relief, and does not offer visitors any screening from other visitors in an area used primarily for recreational motorized vehicle use and livestock grazing.

1. **Does the area meet any of the size requirements?** ☒ **Yes** ☐ **No**
2. **Does the area appear to be natural?** ☒ **Yes** ☐ **No** ☐ **N/A**
3. **Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation?** ☐ **Yes** ☒ **No** ☐ **N/A**
4. **Does the area have supplemental values?** ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

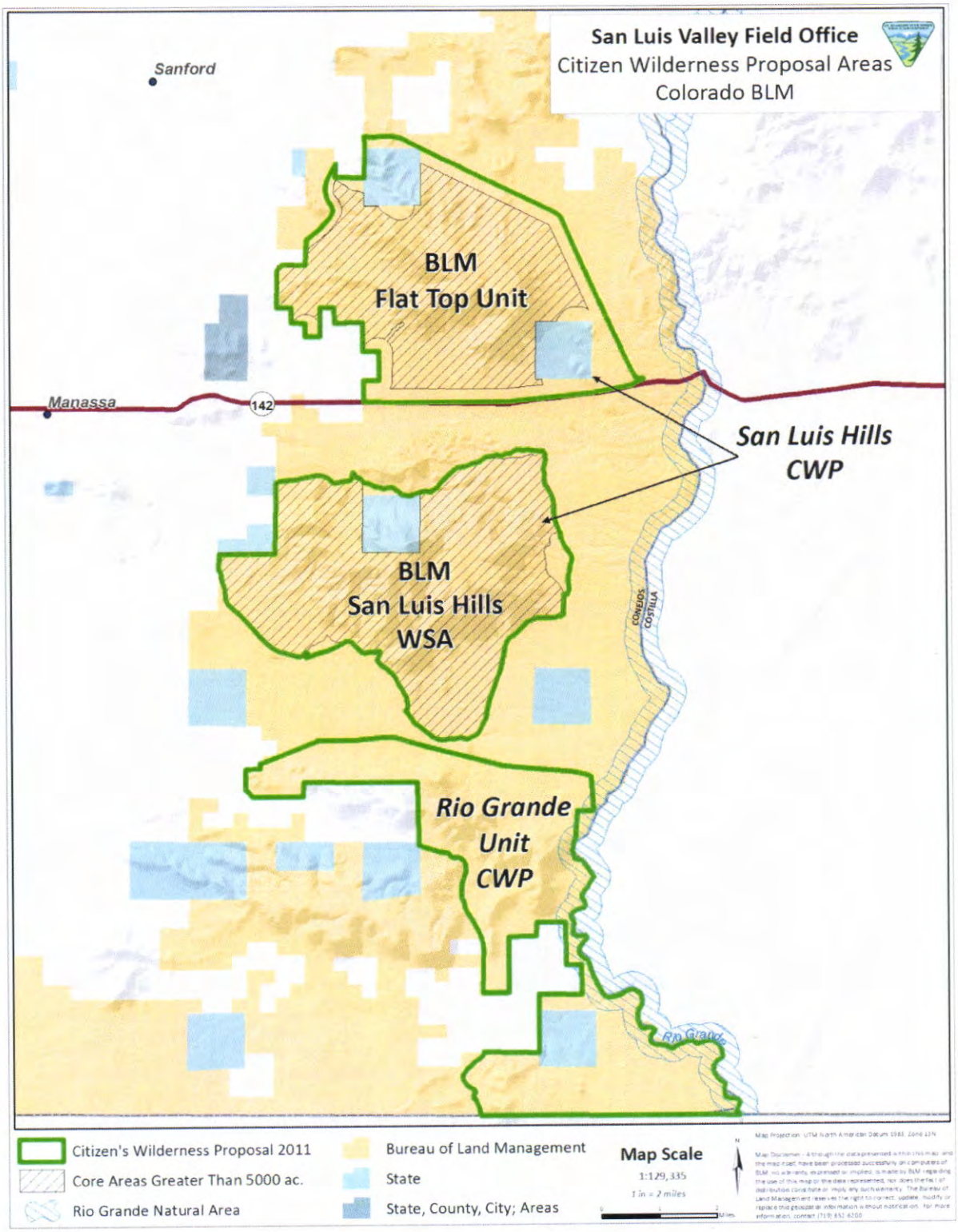


Figure 10 – Citizen Wilderness Proposal Areas

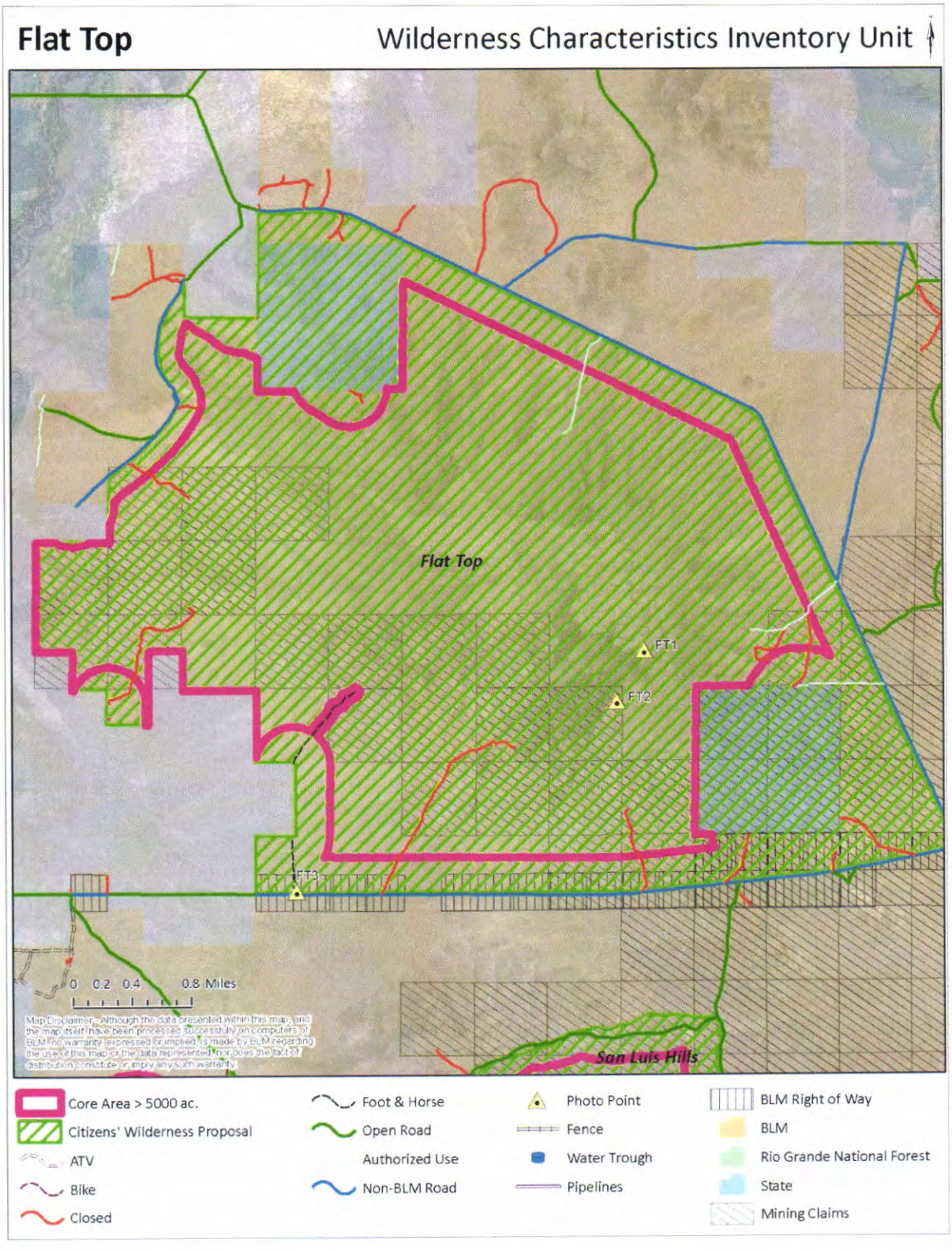


Figure 11 – Flat Top

FLAT TOP

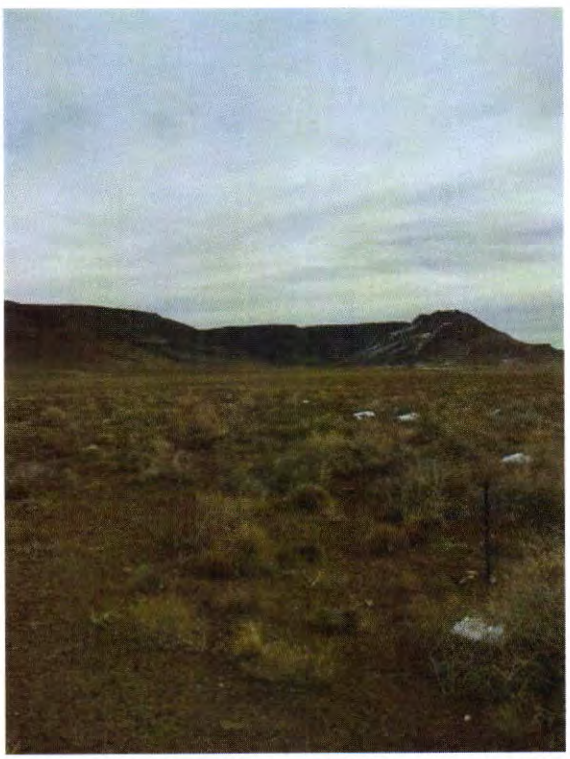


Photo Point FT3 – From *SW* Hwy 142 Looking *NE*

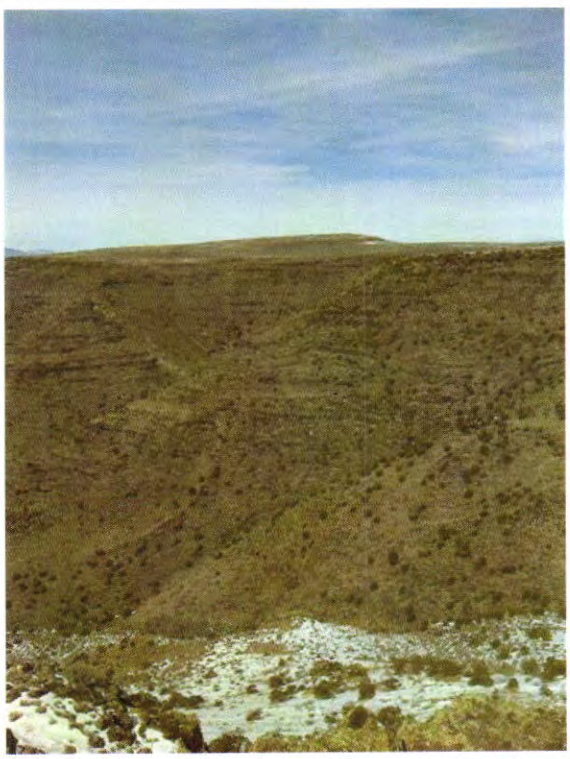


Photo Point FT2 – From *SE* Mesa Top Looking *W*

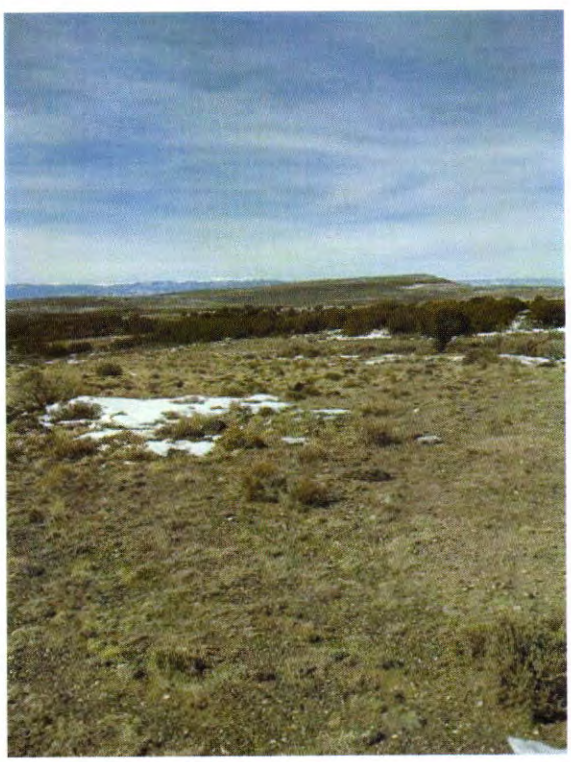


Photo Point FT1 – View of Mesa Top Looking *WSW*

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No_____ (Go to Form 2) **Yes** ___**X**____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

a) Inventory Source: 1980 BLM Colorado Intensive Wilderness Inventory

b) Inventory Area Unique Identifier(s): Flat Top CO-050-140

c) Map Name(s)/Number(s): Flat Top, p.322 1980 Inventory

d) BLM District(s)/Field Office(s): Cañon City District, San Luis Resource Area

(2) BLM Inventory Findings on Record:
Existing inventory information regarding wilderness characteristics (if more than one BLM inventory area is associated with the area, list each area and answer each question individually for each inventory area):
Inventory Source: 1980 BLM Colorado Intensive Wilderness Inventory.

Area Unique Identifier	Sufficient Size? Yes/No (acres)	Naturalness? Yes/No	Outstanding Solitude? Yes/No	Outstanding Primitive & Unconfined Recreation? Yes/No	Supplemental Values? Yes/No
CO-050-140	Yes	Yes	No	No	No

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Flat Top CO-050-140

Acreage: 8,080 (includes nearly all BLM lands in the Colorado Wilderness Network proposal (Colorado's Canyon Country Wilderness Proposal), primarily excluding 2 sections of State land included in the Citizen Wilderness Proposal not analyzed by BLM.

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

Same as the original 1980 inventory, with the following exceptions: there are now 3 active grazing leases instead of 1, 1 Right-Of-Way, and there are precisely 17 mining claims.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

Same as the original 1980 inventory, with the following exception: the 2012 re-evaluation of the Flat Top unit identified discrepancies in the naturalness of the area compared to the 1980 inventory's assessment, due to the obvious and noticeable removal of essentially all Rocky Mountain Juniper trees mostly from the first half of the last century. This was common practice in many other areas of the San Luis Valley at that time, especially related to fencing, many of which still stand to this day. During a thorough search conducted during the inventory, the evaluation team found only one small juniper hidden from plain view that managed to escape. In that sense, it is inaccurate to portray the area as a Piñon-Juniper vegetative type, when only Piñon trees exist there. The stumps of harvested trees are common throughout the unit and represent a fairly significant imprint of man. From a distance, though, the stumps are essentially unnoticeable.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☒ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Same as the original 1980 inventory.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

Same as the original 1980 inventory.

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Flat Top CO-050-140

Results of analysis:
Of the 8,080 acres analyzed, 0 acres have wilderness characteristics.

The Flat Top unit was originally evaluated in the 1980 BLM Colorado Intensive Wilderness Inventory and was not found to possess wilderness characteristics at that time. BLM re-evaluated this area in 2012 because it met the criteria as a core roadless area of 5,000 acres or greater, and also because the unit was included as part of a citizen's wilderness proposal. The evaluation team and consultants concurred with BLM's original findings from the 1980 inventory, which found the unit to not possess wilderness characteristics.

The 2012 re-evaluation characterizes the Flat Top unit as a sparsely vegetated mesa flanked on all sides by open, uniform terrain transitioning to fairly steep slopes that lead to the flat mesa top. The unit's lack of sufficient topographic and vegetative diversity, and proximity to the sights and sounds of man relative to Colorado Highway 142, prevent the area's solitude or primitive and unconfined recreational opportunities from being considered 'outstanding'. Additionally, the noticeable removal of essentially all Rocky Mountain Juniper trees from the first half of the last century represents an obvious imprint of man and raises doubts about the naturalness of the unit as well.

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☐ **No** ☒ **N/A**

Check one:

☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: Andrew Archuleta Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

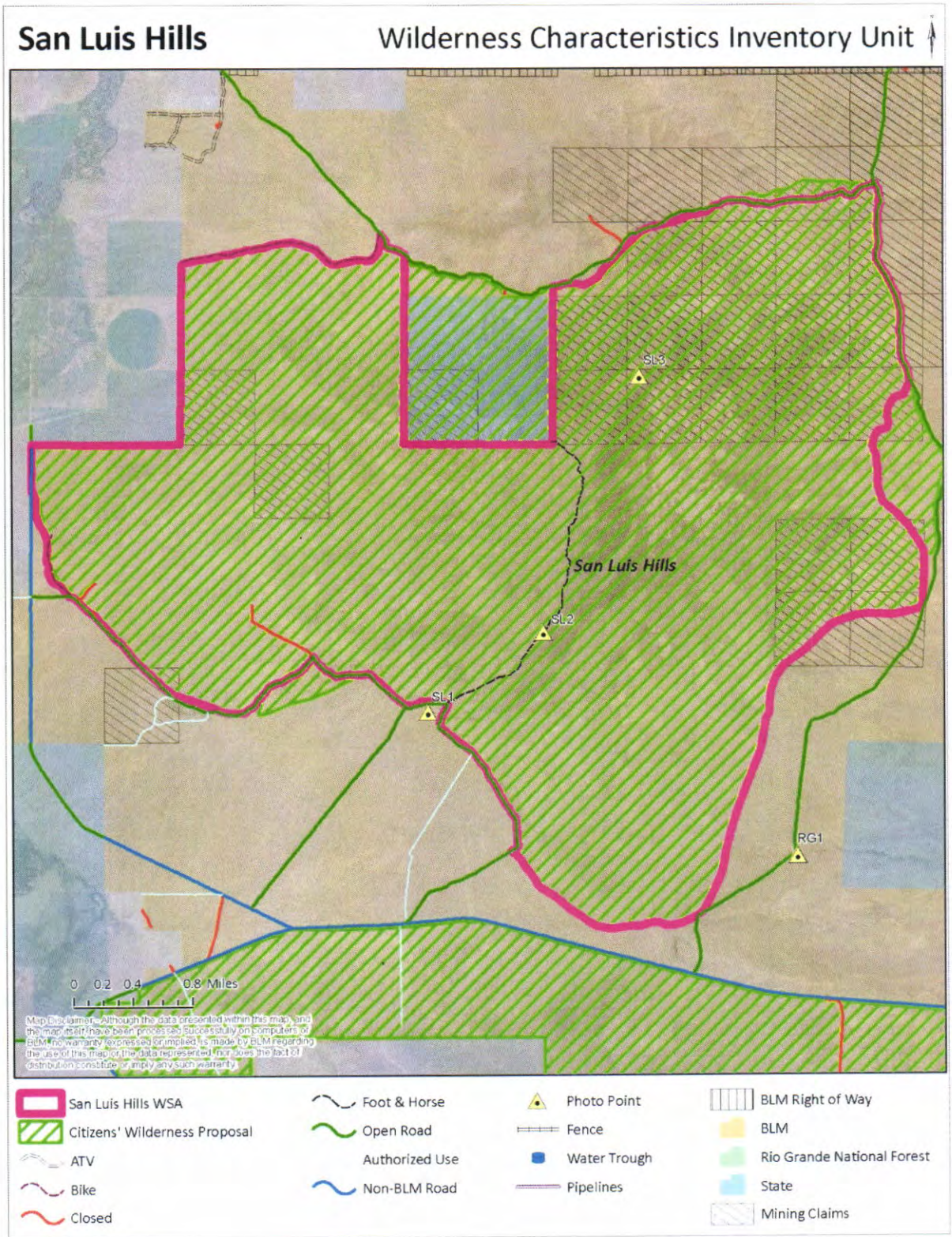


Figure 32 – San Luis Hills

SAN LUIS HILLS

Photo Point SL3 – From *N* Looking *SE* Toward Sangre de Cristo Range

Photo Point SL1 – From *S* Looking *E*

Photo Point SL2 – From *S* Looking *N*

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No_____ (Go to Form 2) **Yes** ___**X**____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

a) Inventory Source: 1980 BLM Colorado Intensive Wilderness Inventory

b) Inventory Area Unique Identifier(s): San Luis Hills CO-050-141

c) Map Name(s)/Number(s): San Luis Hills, p.308 1980 Inventory

d) BLM District(s)/Field Office(s): Cañon City District, San Luis Resource Area

(2) BLM Inventory Findings on Record:
Existing inventory information regarding wilderness characteristics (if more than one BLM inventory area is associated with the area, list each area and answer each question individually for each inventory area):
Inventory Source: 1980 BLM Colorado Intensive Wilderness Inventory.

Area Unique Identifier	Sufficient Size? Yes/No (acres)	Naturalness? Yes/No	Outstanding Solitude? Yes/No	Outstanding Primitive & Unconfined Recreation? Yes/No	Supplemental Values? Yes/No
CO-050-141	Yes	Yes	Yes	Yes	Yes

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: San Luis Hills CO-050-141

Acreage: 10,784 (represents the existing San Luis Hills WSA, which includes nearly all BLM lands in the Colorado Wilderness Network proposal (Colorado's Canyon Country Wilderness Proposal), and primarily excludes a section of State land included in the Citizen Wilderness Proposal not analyzed by BLM.

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☒ **No** ☐

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

Same as the original 1980 inventory.

(2) Does the area appear to be natural?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

Same as the original 1980 inventory.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☒ **No** ☐ **N/A** ☐

Description (describe the area's outstanding opportunities for solitude):

Same as the original 1980 inventory.

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☒ **No** ☐ **N/A** ☐

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

Same as the original 1980 inventory.

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☒ **No** ☐ **N/A** ☐

Description:

Same as the original 1980 inventory.

SUMMARY OF ANALYSIS*

Area Unique Identifier: San Luis Hills CO-050-141

Results of analysis:
Of the 10,784 acres analyzed, 10,784 acres have wilderness characteristics.

The San Luis Hills unit was originally evaluated in the 1980 BLM Colorado Intensive Wilderness Inventory and was found to possess wilderness characteristics at that time and was recommended as a Wilderness Study Area, which it remains to this day. BLM manages and monitors to preserve the wilderness character of the San Luis Hills WSA in accordance with the Interim Management Policy for Lands under Wilderness Review (H-8550-1), until Congress either designates the WSA as wilderness or releases it for other uses.

1. Does the area meet any of the size requirements? ☒ **Yes** ☐ **No**

2. Does the area appear to be natural? ☒ **Yes** ☐ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☒ **Yes** ☐ **No** ☐ **N/A**

4. Does the area have supplemental values? ☒ **Yes** ☐ **No** ☐ **N/A**

Check one:

☒ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☐ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: [signature] Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**

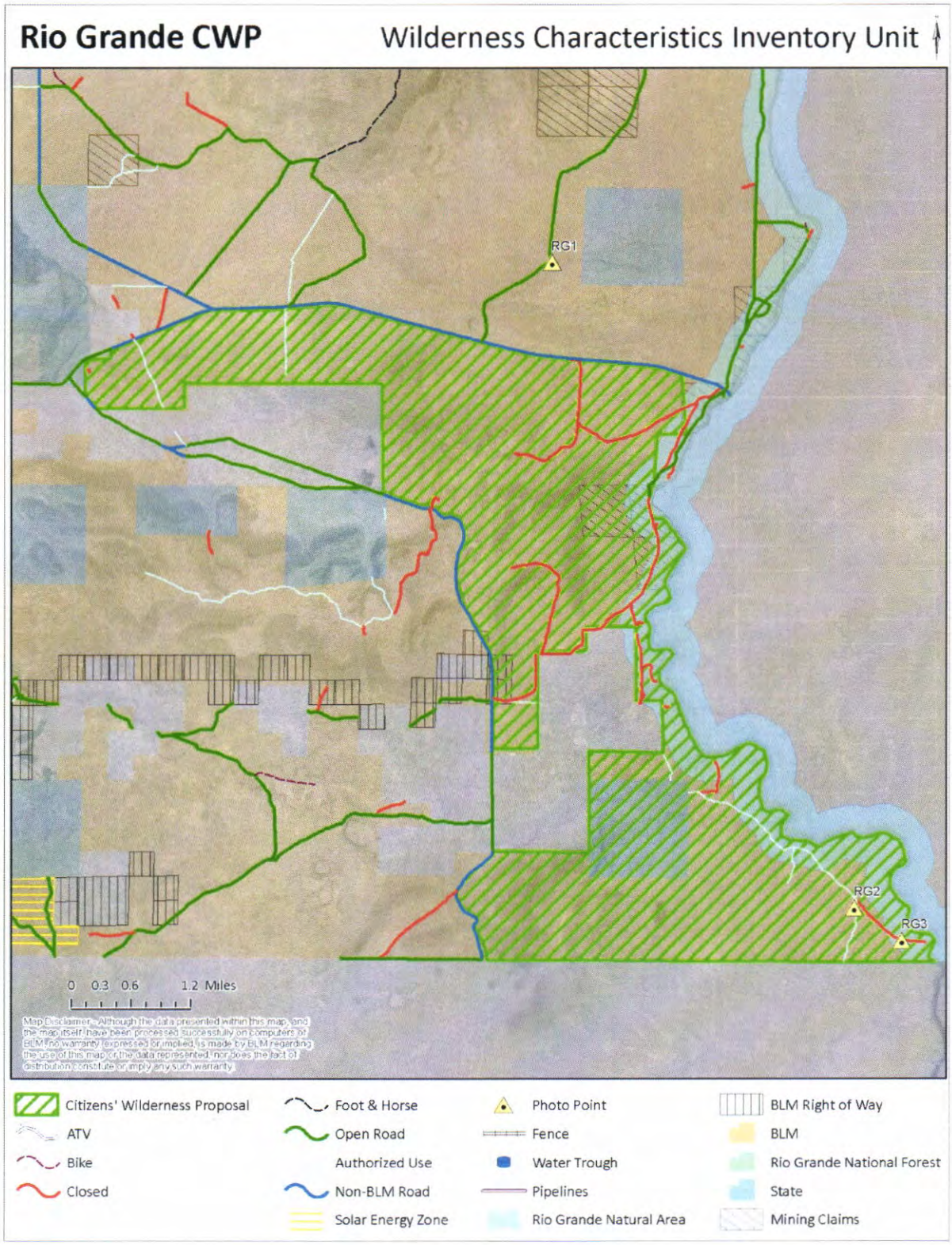


Figure 13 – Rio Grande

RIO GRANDE

Photo Point RG1 – From the *N* Side of Proposed Area Looking *SE*

Photo Point RG1 – From the *N* Side of Proposed Area Looking *S*

Photo Point RG2 – From the *SE* Side of Proposed Area Looking *S*

Photo Point RG3 – From the *SE* Side of Proposed Area Looking *W*

Form 1 – Documentation of BLM Wilderness Characteristics Inventory Findings from Previous Inventory on Record

(1) Is there existing BLM wilderness characteristics inventory information on all or part of this area?

No_____ (Go to Form 2) **Yes** ___**X**____ (If yes, and if more than one area is within the area, list the unique identifiers for those areas):

a) Inventory Source: 1980 BLM Colorado Intensive Wilderness Inventory

b) Inventory Area Unique Identifier(s): Twin Peaks CO-050-142

c) Map Name(s)/Number(s): Twin Peaks, p.326 1980 Inventory

d) BLM District(s)/Field Office(s): Cañon City District, San Luis Resource Area

(2) BLM Inventory Findings on Record:
Existing inventory information regarding wilderness characteristics (if more than one BLM inventory area is associated with the area, list each area and answer each question individually for each inventory area):
Inventory Source: 1980 BLM Colorado Intensive Wilderness Inventory.

Area Unique Identifier	Sufficient Size? Yes/No (acres)	Naturalness? Yes/No	Outstanding Solitude? Yes/No	Outstanding Primitive & Unconfined Recreation? Yes/No	Supplemental Values? Yes/No
CO-050-140	Yes	No	No	No	No

Form 2 - Current Conditions: Presence or Absence of Wilderness Characteristics

Area Unique Identifier: Rio Grande (Twin Peaks CO-050-142)

Acreage: 10,242. Proposed Area = 10,877 acres (includes BLM lands in the Colorado Wilderness Network proposal (Colorado's Canyon Country Wilderness Proposal) beyond the original acreage of the Twin Peaks Wilderness Inventory from 1980) plus one section of State land dropped from analysis.

(1) Is the area of sufficient size? (If the area meets one of the exceptions to the size criterion, check "Yes" and describe the exception in the space provided below)

Yes ☐ **No** ☒

Description (describe the boundaries of the area – wilderness inventory roads, property lines, etc.):

While the proposed area is well within the size requirement to consider for wilderness character, it is not located within any area that BLM recognizes as 'roadless' containing 5,000 acres or more (see overview map above). Furthermore, the proposed area actually consists of 2 parcels; a north and south parcel divided in the middle by lands that are located in the already congressionally-designated Rio Grande Natural Area. The proposed area also includes a section of State land within it not analyzed by BLM.

The Rio Grande inventory area is located on BLM lands (and one section of State land dropped from analysis) immediately west of the Rio Grande Natural Area from approximately the Lobatos bridge to the New Mexico border on the east, Conejos County Road G on the north, Conejos County Road F on the west (omitting private lands) and the New Mexico State line on the south. There are 5 active grazing leases and 3 mining claims in the Rio Grande Unit.

(2) Does the area appear to be natural?

Yes ☐ **No** ☒ **N/A** ☐

Note: If "No" is checked, the area does not have wilderness characteristics; check "NA" for the remaining questions below.

Description (include land ownership, location, topography, vegetation, and summary of major human uses/activities):

Besides not being located in an area that BLM recognizes as roadless containing 5,000 acres or more, the original assessment of naturalness by BLM in the 1980 Intensive Wilderness Inventory for the Twin Peaks unit (southern half of proposed area) remains valid in 2012. The north half of the proposed area can be considered unexceptional and lacks suitable topography and vegetation to warrant consideration as having 'outstanding' opportunities for either solitude or primitive and unconfined recreation. Substantial imprints of man are also present in the northern half of the proposed unit, including range improvements and the scars of past mining activities, as well as numerous user-created roads.

(3) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for solitude?

Yes ☐ **No** ☐ **N/A** ☒

Description (describe the area's outstanding opportunities for solitude):

(4) Does the area (or the remainder of the area if a portion has been excluded due to unnaturalness and the remainder is of sufficient size) have outstanding opportunities for primitive and unconfined recreation?

Yes ☐ **No** ☐ **N/A** ☒

Note: If "No" is checked for both 3 and 4, the area does not have wilderness characteristics; check "NA" for question 5.

Description (describe the area's outstanding opportunities for primitive and unconfined recreation):

(5) Does the area have supplemental values (ecological, geological, or other features of scientific, educational, scenic, or historical value)?

Yes ☐ **No** ☐ **N/A** ☒

Description:

SUMMARY OF ANALYSIS*

Area Unique Identifier: Rio Grande (Twin Peaks CO-050-142)

Results of analysis:
Of the 10,242 acres analyzed, 0 acres have wilderness characteristics.

The Twin Peaks unit (southern half of the Rio Grande citizen's proposed unit) was originally evaluated in the 1980 BLM Colorado Intensive Wilderness Inventory and was not found to possess wilderness characteristics at that time. BLM re-evaluated this area in 2012 as part of a citizen's wilderness proposal. The evaluation team and consultants concurred with BLM's original findings from the 1980 inventory (as well as similar findings for the northern half of the proposed area), which found the unit to not possess wilderness characteristics.

The 2012 re-evaluation characterizes the Rio Grande unit as a sparsely vegetated area upland from the Rio Grande river that lacks sufficient naturalness, lacks the topographic and vegetative diversity necessary to attain outstanding opportunities for either solitude or primitive and unconfined recreation, and is located outside of any area that BLM recognizes as being roadless and containing at least 5,000 acres.

1. Does the area meet any of the size requirements? ☐ **Yes** ☒ **No**

2. Does the area appear to be natural? ☐ **Yes** ☒ **No** ☐ **N/A**

3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? ☐ **Yes** ☒ **No** ☐ **N/A**

4. Does the area have supplemental values? ☐ **Yes** ☒ **No** ☐ **N/A**

Check one:
☐ **The area, or a portion of the area, has wilderness characteristics and is identified as lands with wilderness characteristics.**

☒ **The area does not have wilderness characteristics.**

Prepared by (team members):
Sean Noonan, BLM Outdoor Recreation Planner
Clayton Davey, BLM Recreation Assistant
Heather Salaz, BLM Recreation Assistant

(Name, Title, Date)
Reviewed by (District or Field Manager):

Name: [signature] Title: Field Manager

Date: 3 July 2012

***This form documents information that constitutes an inventory finding on wilderness characteristics. It does not represent a formal land use allocation or a final agency decision subject to administrative remedies under either 43 CFR parts 4 or 1610.5-3.**