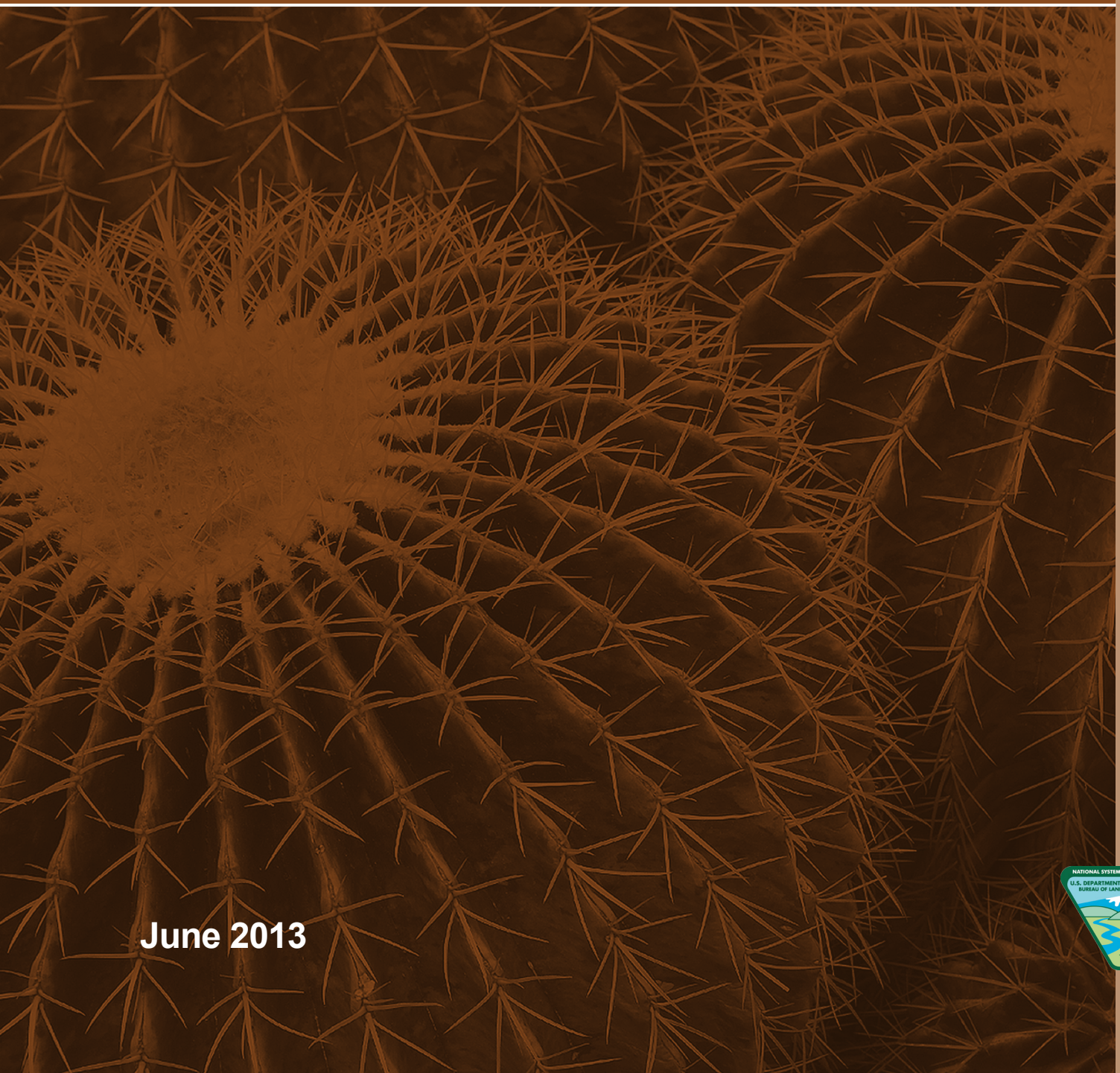
BLM

Final Environmental Impact Statement and Proposed Resource Management Plan Amendments for the SunZia Southwest Transmission Project



New Mexico • Arizona

June 2013

BLM MISSION

To sustain the health, diversity, and production of lands for the use and enjoyment of present and future generations.

Bureau of Land Management
BLM/NM/PL-13-04-1610

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
New Mexico State Office
301 Dinosaur Trail
Santa Fe, NM 87508-1560

In Reply Refer To:
2800 (9320)
NM–114438
AZA-35058

May 24, 2013

Dear Reader:

Attached is the Final Environmental Impact Statement (EIS) and Proposed Resource Management Plan (RMP) Amendments for the SunZia Southwest Transmission Project in New Mexico and Arizona. The Bureau of Land Management (BLM) prepared this Final EIS in consultation with cooperating agencies and in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended, Council on Environmental Quality (CEQ), and Department of the Interior regulations implementing NEPA (40 CFR Parts 1500-1508 for CEQ, 43 CFR Part 46 for the BLM, and BLM NEPA Handbook [H-1790-1]) to analyze the effects of authorizing SunZia Transmission, LLC (the Applicant) to construct and operate the SunZia Southwest Transmission Project. The New Mexico State Office is the lead BLM office for this Project.

General Information

The Final EIS analyzes the consequences of granting a right-of-way to the Applicant for locating two 500-kilovolt (kV) electric transmission lines from the proposed SunZia East Substation in Lincoln County, New Mexico, to the Pinal Central Substation in Pinal County, Arizona. The proposed Project would include two new, single-circuit 500 kV transmission lines located within a right-of-way located on BLM, state, private, and other lands. One of the 500 kV transmission lines would be constructed and operated as an alternating current (AC) facility; the other transmission line could be either an AC or DC (direct current) facility. The requested right-of-way width would typically be 400 feet, but could be up to 1,000 feet, depending on design variation with local conditions. In addition to the proposed SunZia East Substation, three new substations could be constructed and operated at intermediate sites: the proposed Midpoint Substation, near Deming, New Mexico in Luna County; the proposed Lordsburg Substation near Lordsburg, New Mexico in Hidalgo County; and the proposed Willow-500 kV Substation, near Willcox, Arizona in Graham County.

The lengths of various alternative routes considered and evaluated in the Final EIS range between approximately 460 miles and 530 miles; the length of the BLM preferred alternative is approximately 515 miles. It is estimated that approximately 185 miles, or 36 percent of the right-of-way for the BLM preferred alternative, would be located on federally administered lands in

New Mexico and Arizona. To the extent feasible and practicable, the proposed route would use existing transmission line corridors and designated utility corridors located on federal land. Once constructed, the Project would be in operation year-round, transporting electrical power to major substation hubs in Arizona and New Mexico.

This Final EIS includes responses to comments received on the Draft EIS, corrects and adds information obtained after preparation of the Draft EIS, and identifies the BLM preferred alternative for the Project. This Final EIS is a full reprint of the analysis presented in the Draft EIS and as such it assesses the environmental impacts of the Proposed Action and route alternatives, and includes an analysis of the No Action alternative.

Changes Between the Draft EIS and Final EIS

Additions and changes between the Draft EIS and Final EIS are as follows.

- Modification of the BLM preferred alternative route, specifically:
  - Subroute 1A1 was identified as the BLM preferred alternative for Route Group 1 in the Draft EIS. The subsequent selection of Subroute 1A2 as the BLM preferred alternative in this Final EIS was made in response to comments on the Draft EIS that requested an increase in the proposed distance between the transmission lines and testing facilities, located 30 miles north of the White Sands Missile Range, and in response to comments on the Draft EIS regarding views from Gran Quivira unit of the Salinas Pueblo Missions National Monument.
  - Subroute 3A1 was identified as the BLM preferred alternative for Route Group 3 in the Draft EIS. The subsequent selection of Subroute 3A2 as the BLM preferred alternative in this Final EIS was made in response to comments on the Draft EIS that requested a modification of the alignment in order to avoid the Lordsburg Playa and the Hot Well Dunes Recreation Area.
- Analysis of Access Conditions and Potential Ground Disturbance (Appendix I)
- BLM response to comments received on the Draft EIS (Appendix J)
- SunZia Preliminary EMF and Corona Effects Study (Appendix K)
- National Scenic and Historic Trails Inventory and Assessment (Appendix L)
- A Draft Programmatic Agreement regarding the National Historic Preservation Act (Appendix M)
- BLM Proposed Land Use Plan Amendments associated with the BLM preferred alternative routes. These proposed amendments may be protested, as discussed below.

Land Use Plan Amendments and the BLM Protest Process

The BLM has identified proposed plan amendments located in the Socorro Field Office and Las Cruces District Office planning areas that are needed in order for the preferred routes to conform to the approved plans. Details on each proposed plan amendment can be found in Section 2.6 of this Final EIS.

Pursuant to the BLM's planning regulations at 43 CFR 1610.5-2, any person who participated in the plan amendment process for this Project and who has an interest which is or may be adversely affected by the planning decisions may protest the approval of the planning decisions within 30 days of the date the Environmental Protection Agency publishes the Notice of Availability in the *Federal Register*. For further information on filing a protest, please see the protest regulations on the page following this letter (labeled as Attachment 1). The regulations specify the required elements of your protest. Take care to document all relevant facts. As much as possible, reference or cite the planning documents or available planning records (e.g., meeting minutes or summaries, correspondence, etc.).

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. If you wish to provide the BLM with such advance notification, please direct faxed protests to the attention of Brenda Hudgens-Williams, BLM protest coordinator, at (202) 245-0028; and direct emailed protests to bhudgens@blm.gov. All protests, including the follow-up letter to emails or faxes, must be in writing and mailed to one of the following addresses:

Regular Mail:
Director (210)
Attn: Brenda Hudgens-Williams
P.O. Box 71383
Washington, D.C. 20024-1383

Overnight Mail:
Director (210)
Attn: Brenda Hudgens-Williams
20 M Street SE, Room 2134LM
Washington, D.C. 20003

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 on each protest. Responses to protest issues will be compiled and formalized in a Director's Protest Resolution Report, made available following issuance of the decisions.

The BLM Decision and Appeal Processes

The BLM will decide whether to grant, grant with modifications, or deny the proposed action or other action alternative. The BLM's decision will be documented in a Record of Decision (ROD), issued before the Right-of-Way Permit is approved and upon resolution of all land use plan protests. The ROD will be available electronically to all who participated in the environmental analysis and planning process, or by mail upon request.

Unlike land use planning decisions, implementation decisions (i.e., granting or denying a right-of-way) are not subject to protest under the BLM planning regulations, but are subject to an administrative review process following the issuance of the ROD. Appeals are filed with the Office of Hearings and Appeals, Interior Board of Land Appeals pursuant to 43 CFR, Part 4 Subpart E. Implementation decisions generally constitute the BLM's final approval allowing on-the-ground actions to proceed. They are in full force and effect when the ROD is issued. The BLM ROD will contain the appropriate instructions for filing an appeal.

It is the BLM's practice to make comments and protests, including names and addresses of submitters, available for public review. Before including your address, phone number, email address, or other personal identifying information with your comments or protest, be advised that your entire comment or protest, including your personal identifying information, may be made publicly available at any time. Although you may ask us in your submission to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. All submissions from organizations and businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be available for public inspection in their entirety.

Final EIS Documents Availability

The Final EIS and supporting documents are available electronically on the BLM project website (www.blm.gov/nm/sunzia), and are also available for public inspection during normal business hours at the following BLM district and field offices:

- Bureau of Land Management, Las Cruces District Office, 1800 Marquess Street, Las Cruces, New Mexico 88005-3370
- Bureau of Land Management, Socorro Field Office, 901 S. Highway 85, Socorro, New Mexico 87801-4168
- Bureau of Land Management, Roswell Field Office, 2909 W. Second Street, Roswell, New Mexico 88201-2019
- Bureau of Land Management, Tucson Field Office, 3201 E. Universal Way, Tucson, Arizona 85756
- Bureau of Land Management, Safford Field Office, 711 14th Avenue, Safford, Arizona 85546-3337
- Bureau of Land Management, Gila District Office, 1763 Paseo San Luis, Sierra Vista, Arizona 85635-4611
- Bureau of Land Management, Rio Puerco Field Office, 435 Montano N.E., Albuquerque, New Mexico 87107-4935
- Arizona State Land Department, 1616 West Adams, Phoenix, Arizona 85007-2614
- Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, Arizona 85086-5000
- New Mexico State Land Office, 310 Old Santa Fe Trail, Santa Fe, New Mexico 87504-1148
- U.S. Army Corps of Engineers, Regulatory Division, 4101 Jefferson Plaza, N.E., Albuquerque, New Mexico 87109-3435
- U.S. Fish and Wildlife Service, Ecological Services, 500 Gold Avenue S.W., Albuquerque, New Mexico 87102-3118

A limited number of copies of the document will be available, as supplies last. To request a copy, or if you have any questions regarding the Final EIS or need additional information regarding the Project please contact:

Adrian Garcia, Project Manager
c/o Bureau of Land Management
New Mexico State Office, 301 Dinosaur Trail
Santa Fe, New Mexico 87508-1560
(505) 954-2199

Any persons wishing to be added to a mailing list of interested parties may write or call the Project Manager at this address or phone number.

Sincerely,

Jesse Juen
State Director

Attachment 1

Regulations for Filing a Valid Protest

[Code of Federal Regulations]
[Title 43, Volume 2]
[Revised as of October 1, 2002]
From the U.S. Government Printing Office via GPO Access
[CITE: 43CFR1610.5-2]

[Page 20]
TITLE 43--PUBLIC LANDS: INTERIOR
CHAPTER II--BUREAU OF LAND MANAGEMENT, DEPARTMENT OF THE INTERIOR
PART 1600--PLANNING, PROGRAMMING, BUDGETING--Table of Contents
Subpart 1610--Resource Management Planning
Sec. 1610.5-2--Protest procedures.

(a) Any person who participated in the planning process and has an interest which is or may be adversely affected by the approval or amendment of a resource management plan may protest such approval or amendment. A protest may raise only those issues which were submitted for the record during the planning process.

(1) The protest shall be in writing and shall be filed with the Director. The protest shall be filed within 30 days of the date the Environmental Protection Agency published the notice of receipt of the final environmental impact statement containing the plan or amendment in the Federal Register. For an amendment not requiring the preparation of an environmental impact statement, the protest shall be filed within 30 days of the publication of the notice of its effective date.

(2) The protest shall contain:

(i) The name, mailing address, telephone number and interest of the person filing the protest;
(ii) A statement of the issue or issues being protested;
(iii) A statement of the part or parts of the plan or amendment being protested;
(iv) A copy of all documents addressing the issue or issues that were submitted during the planning process by the protesting party or an indication of the date the issue or issues were discussed for the record; and
(v) A concise statement explaining why the State Director's decision is believed to be wrong.

(3) The Director shall promptly render a decision on the protest. The decision shall be in writing and shall set forth the reasons for the decision. The decision shall be sent to the protesting party by certified mail, return receipt requested.

(b) The decision of the Director shall be the final decision of the Department of the Interior.

Final Environmental Impact Statement and Proposed Resource Management Plan Amendments for the SunZia Southwest Transmission Project

Lead Agency:	U.S. Department of the Interior, Bureau of Land Management, New Mexico State Office
Cooperating Agencies:	U.S. Army Corps of Engineers; Department of the Army, Fort Bliss; Department of the Army, White Sands Missile Range; U.S. Air Force, Holloman Air Force Base; U.S. Fish and Wildlife Service; U.S. National Park Service; Department of Defense Siting Clearinghouse, Office of the Deputy Under Secretary (Installations and Environment); New Mexico State Land Office; New Mexico Spaceport Authority; Arizona State Land Department; Arizona Game and Fish Department; Arizona Department of Transportation; Department of the Army, Fort Huachuca; and Bureau of Indian Affairs
Type of Action:	Two proposed 500 kV transmission lines originating at the proposed SunZia East Substation in New Mexico, and terminating at the permitted Pinal Central Substation in Arizona
Project Location:	Federal, state, and private lands between central New Mexico and central Arizona
For More Information on this Final EIS, Contact:	Bureau of Land Management New Mexico State Office Attention: Adrian Garcia PO Box 27115 Santa Fe, NM 87502–0115 (505) 954-2199 **Courier or hand delivery:** 301 Dinosaur Trail Santa Fe, NM 87508-1560
Or Email:	NMSunZiaProject@blm.gov
Land Use Plan Amendment Protest Period:	30 days from the publication of the Notice of Availability in the *Federal Register*

ABSTRACT

This final environmental impact statement and proposed resource management plan amendments document analyzes the impacts related to the development of the SunZia Southwest Transmission Project proposed by SunZia Transmission, LLC. The company plans to construct and operate two new single-circuit overhead 500-kilovolt transmission lines originating at a new substation in Lincoln County, New Mexico, and terminating at the Pinal Central Substation in Pinal County, Arizona. The transmission line route alternatives would pass through Socorro, Sierra, Luna, Grant, and Hidalgo counties in New Mexico; and Cochise, Greenlee, Graham, and Pima counties in Arizona. Proposed new substations could also be constructed in Luna, Hidalgo, and Graham counties. The proposed transmission line route alternatives would range between approximately 460 and 530 miles in length, and would require right-of-way, crossing approximately 163 to 205 miles of BLM lands in Arizona and New Mexico. The remainder of the route would cross lands owned by state, private, or other entities. This document also includes the analysis of proposed and alternative BLM resource management plan amendments.

This page intentionally left blank.

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

Final Environmental Impact Statement and Proposed Resource Management Plan Amendments for the SunZia Southwest Transmission Project

New Mexico State Office
Attention: Adrian Garcia
PO Box 27115
Santa Fe, NM 87502–0115

Cooperating Agencies

U.S. Army Corps of Engineers · Department of the Army, Fort Bliss · Department of the Army, White Sands Missile Range · U.S. Air Force, Holloman Air Force Base · U.S. Fish and Wildlife Service · U.S. National Park Service · Department of Defense Siting Clearinghouse, Office of the Deputy Under Secretary (Installations and Environment) · New Mexico State Land Office · New Mexico Spaceport Authority · Arizona State Land Department · Arizona Game and Fish Department · Arizona Department of Transportation · Department of the Army, Fort Huachuca · Bureau of Indian Affairs

June 2013

This page intentionally left blank.

TABLE OF CONTENTS

Acronyms and Abbreviations

Executive Summary E-1

Chapter 1 – Introduction 1-1
1.1 Overview 1-1
1.2 Project Description and Location 1-1
1.3 BLM's Purpose and Need 1-5
1.4 Applicant's Objectives 1-6
1.5 Scoping and Public Involvement 1-9
1.6 Lead and Cooperating Agencies 1-12
1.7 Government-to-Government, Tribal Consultation 1-12
1.8 Major Authorizing Laws and Regulations 1-13
1.9 Relationship to Other Policies, Plans, and Programs 1-14
1.9.1 Policies, Plans, and Programs on Federal Lands 1-14
1.9.2 BLM Resource Management Plans 1-15
1.9.3 Local, Regional, and State Policies, Plans, and Programs 1-17
1.10 Decisions to be Made 1-19
1.10.1 BLM 1-19
1.10.2 Bureau of Reclamation 1-19
1.10.3 Department of the Army 1-20
1.10.4 New Mexico Department of Transportation 1-20
1.10.5 Arizona Department of Transportation 1-20
1.10.6 Bureau of Indian Affairs 1-21
1.11 BLM Plan Amendments 1-21
1.12 Permits, Licenses, and Other Entitlements 1-22

Chapter 2 – Proposed Action and Alternatives 2-1
2.1 Introduction 2-1
2.1.1 Study Process Completed to Date 2-1
2.2 Development of Proposed Action and Alternatives 2-2
2.2.1 Study Area Definition 2-3
2.2.2 Evaluation of Opportunities and Constraints 2-3
2.3 Alternatives 2-10
2.3.1 No Action Alternative 2-11
2.3.2 Alternative Transmission Line Routes 2-11
2.3.3 Alternatives Considered but Eliminated 2-27
2.4 Description of Proposed Action and Plan of Development 2-47
2.4.1 Overhead Transmission Lines 2-49
2.4.2 Structures 2-51
2.4.3 Foundations 2-60
2.4.4 Conductors 2-60
2.4.5 Insulators and Associated Hardware 2-61
2.4.6 Overhead Groundwire and Electrodes 2-61

TABLE OF CONTENTS

2.4.7 Fiber Optic Regeneration Station 2-62
2.4.8 Substations 2-62
2.4.9 Preconstruction Activities 2-64
2.4.10 Construction Activities 2-73
2.4.11 Operation, Maintenance, and Decommissioning 2-82
2.4.12 Mitigation 2-88
2.5 Comparison of Alternatives 2-101
2.5.1 Route Group 1: SunZia East Substation to Midpoint Substation 2-101
2.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation 2-103
2.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 2-105
2.5.4 Selection of the BLM Preferred Alternative 2-106
2.6 Proposed Plan Amendments 2-129
2.6.1 Socorro RMP: Proposed Plan Amendment 2-130
2.6.2 Las Cruces District Office, Mimbres RMP: Proposed Plan Amendment 2-131

Chapter 3 – Affected Environment 3-1
3.1 Introduction 3-1
3.2 Climate and Air Quality 3-2
3.2.1 Introduction, Methods, and Regulatory Framework 3-2
3.2.2 Regional Overview 3-7
3.2.3 Climate 3-8
3.2.4 Air Quality 3-11
3.2.5 Climate Variability 3-13
3.2.6 Summary of Inventory Results 3-14
3.3 Earth Resources 3-22
3.3.1 Introduction, Methods, and Regulatory Framework 3-22
3.3.2 Regional Overview 3-25
3.3.3 Geology and Geological Hazards 3-26
3.3.4 Mineral Resources 3-29
3.3.5 Soil Resources 3-30
3.3.6 Summary of Inventory Results 3-33
3.4 Paleontological Resources 3-44
3.4.1 Introduction, Methods, and Regulatory Framework 3-44
3.4.2 Regional Overview 3-49
3.4.3 Paleontological Potential and Fossil Localities 3-50
3.4.4 Potential Fossil Yield Classification 3-53
3.4.5 Summary of Inventory Results 3-54
3.5 Water Resources 3-57
3.5.1 Introduction, Methods, and Regulatory Framework 3-57
3.5.2 Regional Overview by Watershed 3-60
3.5.3 Regional Overview by Groundwater Area 3-63
3.5.4 State-listed Impaired Waters and Unique or Outstanding Waters 3-66

TABLE OF CONTENTS

3.5.5 Summary of Inventory Results 3-67
3.6 Biological Resources 3-73
3.6.1 Introduction, Methods, and Regulatory Framework 3-73
3.6.2 Regional Overview 3-77
3.6.3 Vegetation 3-79
3.6.4 Noxious and Invasive Weeds 3-83
3.6.5 Wildlife 3-85
3.6.6 Special-Status Species 3-88
3.6.7 Biological Resource Conservation Areas 3-110
3.6.8 Agency-identified and Other Biological Resource Areas 3-115
3.6.9 Summary of Inventory Results 3-119
3.7 Wildland Fire Ecology and Management 3-136
3.7.1 Introduction, Methods, and Regulatory Framework 3-136
3.7.2 Regional Overview 3-140
3.7.3 Inventory 3-141
3.8 Cultural Resources and Tribal Concerns 3-146
3.8.1 Introduction, Methods, and Regulatory Framework 3-146
3.8.2 Cultural History 3-154
3.8.3 Summary of Inventory Results 3-182
3.8.4 Tribal Consultation Meetings 3-198
3.9 Visual Resources 3-199
3.9.1 Introduction, Inventory Methods, and Regulatory Framework 3-199
3.9.2 Regional Overview 3-206
3.9.3 Summary of Inventory Results 3-208
3.10 Land Use and Recreation Resources 3-242
3.10.1 Introduction, Methods, and Regulatory Framework 3-242
3.10.2 Regional Overview 3-250
3.10.3 Existing Land Use and Recreation 3-252
3.10.4 Planned Land Use 3-262
3.10.5 Summary of Inventory Results 3-263
3.11 Special Designations 3-285
3.11.1 Introduction 3-285
3.11.2 Areas of Critical Environmental Concern 3-286
3.11.3 BLM National Back Country Byways 3-287
3.11.4 Research Natural Areas 3-287
3.11.5 Special Management Areas 3-287
3.11.6 Wild Horse Management Areas 3-288
3.11.7 Special Recreation Management Areas 3-288
3.11.8 National Monuments 3-288
3.11.9 National Trails 3-289
3.11.10 National Wildlife Refuges 3-290
3.11.11 Summary of Inventory Results 3-290
3.12 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics 3-299
3.12.1 Introduction 3-299

TABLE OF CONTENTS

3.12.2 Wilderness Areas 3-300
3.12.3 Wilderness Study Areas 3-300
3.12.4 Lands with Wilderness Characteristics 3-301
3.13 Social and Economic Conditions 3-306
3.13.1 Introduction 3-306
3.13.2 Regional Overview 3-307
3.13.3 Jurisdiction and Ownership 3-311
3.13.4 Population and Demographics 3-312
3.13.5 Housing 3-317
3.13.6 Employment and the Economy 3-317
3.13.7 Fiscal Conditions: Tax Rates and Revenues 3-326
3.13.8 Emergency Services 3-326
3.13.9 Summary of Inventory Results 3-331
3.14 Environmental Justice Conditions 3-333
3.14.1 Introduction 3-333
3.14.2 Study Area Overview 3-334
3.14.3 Summary of Inventory Results 3-335
3.15 Health and Safety/Hazardous Materials 3-340
3.15.1 Introduction, Methods, and Regulatory Framework 3-340
3.15.2 Electric and Magnetic Fields 3-342
3.15.3 Audible Noise 3-344
3.15.4 Summary of Inventory Results 3-345

Chapter 4 – Environmental Impacts 4-1
4.1 Introduction 4-1
4.1.1 Methods 4-1
4.1.1.1 Assessment of Initial Impacts 4-2
4.1.1.2 Mitigation Planning 4-4
4.1.1.3 Assessment of Residual Impacts 4-5
4.1.1.4 Impacts of Decommissioning 4-5
4.2 Climate and Air Quality 4-6
4.2.1 Introduction 4-6
4.2.2 Impact Assessment Methodology 4-7
4.2.2.1 Significant Impacts 4-7
4.2.2.2 Emission Calculation Methods 4-7
4.2.2.3 Impact Analysis Methods 4-12
4.2.2.4 Regulatory Requirements 4-14
4.2.2.5 Mitigation Measures 4-17
4.2.3 Impact Analysis Results 4-20
4.2.3.1 No Action Alternative 4-20
4.2.3.2 Impacts Common to All Alternatives 4-20
4.2.3.3 Route Group 1: SunZia East Substation to Midpoint Substation 4-22
4.2.3.4 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-23

TABLE OF CONTENTS

4.2.3.5 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-23
4.3 Earth Resources 4-24
4.3.1 Introduction 4-24
4.3.2 Impact Assessment Methodology 4-24
4.3.2.1 Geological Hazards 4-24
4.3.2.2 Mineral Resources 4-26
4.3.2.3 Soil Resources 4-28
4.3.2.4 Significant Impacts 4-31
4.3.3 Impact Analysis Results 4-31
4.3.3.1 No Action Alternative 4-31
4.3.3.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-31
4.3.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-38
4.3.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-40
4.3.3.5 Summary of BLM Preferred Alternative 4-48
4.4 Paleontological Resources 4-48
4.4.1 Introduction 4-48
4.4.2 Sensitivity Assessment Methodology 4-48
4.4.2.1 Types of Potential Environmental Impacts 4-49
4.4.2.2 Sensitivity Assessment Criteria 4-49
4.4.2.3 Mitigation of Impacts 4-50
4.4.3 Sensitivity Analysis Results 4-50
4.4.3.1 No Action Alternative 4-50
4.4.3.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-50
4.4.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-52
4.4.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-52
4.4.3.5 Summary of BLM Preferred Alternative 4-53
4.5 Water Resources 4-54
4.5.1 Introduction 4-54
4.5.1.1 Impacts to Surface Water 4-54
4.5.1.2 Impacts to Groundwater 4-55
4.5.2 Impact Assessment Methods 4-56
4.5.2.1 Mitigation of Impacts 4-57
4.5.3 Impact Analysis Results 4-58
4.5.3.1 No Action Alternative 4-58
4.5.3.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-58
4.5.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-59

TABLE OF CONTENTS

4.5.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-60
4.5.3.5 Summary of BLM Preferred Alternative 4-62
4.6 Biological Resources 4-63
4.6.1 Introduction 4-63
4.6.2 Overview of Potential Impacts 4-63
4.6.2.1 Vegetation 4-63
4.6.2.2 Wildlife 4-64
4.6.3 Impact Assessment Methods 4-67
4.6.5.1 No Action Alternative 4-101
4.6.5.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-101
4.6.5.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-107
4.6.5.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-109
4.6.5.5 Summary of BLM Preferred Alternative 4-116
4.7 Wildland Fire Ecology and Management 4-117
4.7.1 Introduction 4-117
4.7.2 Impact Assessment Methods 4-117
4.7.3 Impact Analysis Results 4-117
4.7.3.1 Effects on Fire Risk 4-117
4.7.3.2 Effects if the Proposed Project Contributes to Fire Ignition 4-119
4.7.3.3 Effects on Fire Management Planning in New Mexico And Arizona 4-120
4.7.3.4 Effects of the Proposed Project on Fire Suppression 4-120
4.8 Cultural Resources 4-122
4.8.1 Introduction 4-122
4.8.1.1 Tribal Concerns 4-123
4.8.2 Impact Assessment Methodology 4-123
4.8.3 Impact Analysis Results 4-128
4.8.3.1 No Action Alternative 4-128
4.8.3.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-128
4.8.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-134
4.8.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-137
4.8.4 Mitigation of Impacts 4-145
4.9 Visual Resources 4-148
4.9.1 Introduction 4-148
4.9.2 Impact Assessment Methodology 4-149
4.9.2.1 Assessment Techniques 4-149
4.9.2.2 Conformance with Applicable RMPs 4-152

TABLE OF CONTENTS

4.9.2.3 Mitigation Planning 4-153
4.9.3 Impact Analysis Results 4-153
4.9.3.1 Route Group 1: SunZia East Substation to Midpoint Substation 4-153
4.9.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-174
4.9.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-180
4.9.3.4 Conformance with Applicable RMPs 4-201
4.9.3.5 Summary of BLM Preferred Alternative 4-201
4.10 Land Use and Recreation Resources 4-206
4.10.1 Introduction 4-206
4.10.1.1 Impact Assessment Methodology 4-206
4.10.2 Impact Criteria 4-206
4.10.3 Conformance with Applicable BLM Resource Management Plans 4-207
4.10.4 Mitigation Planning 4-207
4.10.5 Summary of Impact Analysis Results 4-207
4.10.5.1 No Action Alternative 4-208
4.10.5.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-208
4.10.5.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-212
4.10.5.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-215
4.10.5.5 Summary 4-220
4.10.6 Impacts to Military Operations 4-221
4.10.6.1 Introduction 4-221
4.10.6.2 Summary of Impacts to Military Operations by Subroute 4-222
4.11 BLM Special Designations 4-225
4.11.1 Introduction 4-225
4.11.2 Impact Assessment Methodology 4-225
4.11.2.1 No Action Alternative 4-226
4.11.2.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-226
4.11.2.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-226
4.11.2.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-227
4.12 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics 4-227
4.12.1 Introduction 4-227
4.12.2 Impact Assessment Methodology 4-228
4.12.3 Summary of Impact Analysis Results for Wilderness Areas 4-228

4.12.3.1 Route Group 1: SunZia East Substation to Midpoint Substation 4-228
4.12.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-229
4.12.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-230
4.12.4 Summary of Impact Analysis Results for Wilderness Study Areas 4-231
4.12.4.1 Route Group 1: SunZia East Substation to Midpoint Substation 4-231
4.12.4.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-233
4.12.4.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-233
4.12.5 Summary of Impact Analysis Results for Lands with Wilderness Characteristics 4-233
4.12.5.1 Route Group 1: SunZia East Substation to Midpoint Substation 4-233
4.12.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-234
4.12.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-235
4.13 Social and Economic Conditions 4-236
4.13.1 Introduction 4-236
4.13.2 Impact Assessment Methodology 4-237
4.13.2.1 Significant Impacts 4-238
4.13.3 Mitigation Planning 4-238
4.13.4 Summary of Impact Analysis Results 4-238
4.13.4.1 Population Impacts 4-238
4.13.4.2 Housing Impacts 4-239
4.13.4.3 Economic Impacts 4-240
4.13.4.4 Emergency Services 4-244
4.13.4.5 Other Impacts 4-245
4.13.4.6 Summary of Impacts for the BLM Preferred Alternative 4-246
4.14 Environmental Justice 4-247
4.14.1 Introduction 4-247
4.14.2 Impact Assessment Methodology 4-248
4.14.3 Summary of Impact Analysis Results 4-249
4.14.3.1 No Action Alternative 4-249
4.14.3.2 Route Group 1: SunZia East Substation to Midpoint Substation 4-249
4.14.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation 4-250

TABLE OF CONTENTS

4.14.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation 4-251
4.14.3.5 Overhead Transmission Line Options and Substations 4-256
4.14.3.6 Summary of BLM Preferred Alternative 4-256
4.15 Health and Safety/Hazardous Materials 4-257
4.15.1 Introduction 4-257
4.15.2 Impact Assessment Methodology 4-257
4.15.2.1 Significant Impacts 4-257
4.15.3 Impact Analysis Results 4-258
4.15.3.1 No Action Alternative 4-258
4.15.3.2 Action Alternatives 4-258
4.16 Effects of the Underground Mitigation Alternative 4-262
4.16.1 Introduction 4-262
4.16.2 Soil Resources 4-265
4.16.3 Paleontological Resources 4-265
4.16.4 Water Resources 4-266
4.16.5 Biological Resources 4-266
4.16.6 Cultural Resources 4-268
4.16.7 Visual Resources 4-269
4.16.8 Land Use 4-270
4.17 Cumulative Effects 4-271
4.17.1 Introduction 4-271
4.17.2 Process and Methods of Analysis 4-272
4.17.2.1 Scoping and Project Issues 4-273
4.17.3 Past, Present, Future, and Reasonably Foreseeable Future Actions 4-274
4.17.3.1 Parameters 4-274
4.17.3.2 Identification of Past, Present, Future, and Reasonably Foreseeable Future Actions, Land Uses, and Projects 4-275
4.17.3.3 Energy Development Forecast Analysis 4-297
4.17.4 Cumulative Effects by Resource 4-304
4.17.4.1 Introduction 4-304
4.17.4.2 Climate and Air Quality 4-305
4.17.4.3 Earth Resources 4-311
4.17.4.4 Paleontological Resources 4-316
4.17.4.5 Water Resources 4-318
4.17.4.6 Biological Resources 4-321
4.17.4.7 Wildland Fire Ecology and Management 4-328
4.17.4.8 Cultural Resources 4-330
4.17.4.9 Visual Resources 4-336
4.17.4.10 Land Use and Recreation Resources 4-339
4.17.4.11 Special Designations 4-344
4.17.4.12 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics 4-345

TABLE OF CONTENTS

4.17.4.13 Social and Economic Conditions 4-347
4.17.4.14 Environmental Justice Conditions 4-350
4.17.4.15 Health and Safety/Hazardous Materials 4-351
4.17.5 Cumulative Effects from RMP Amendments 4-352
4.18 Environmental Effects of RMP Amendments 4-353
4.18.1 Air Quality 4-353
4.18.2 Earth Resources 4-354
4.18.3 Paleontological Resources 4-355
4.18.4 Water Resources 4-355
4.18.5 Biological Resources 4-355
4.18.6 Wildland Fire Ecology and Management 4-358
4.18.7 Cultural Resources 4-358
4.18.8 Visual Resources 4-358
4.18.9 Land Use and Recreation Resources 4-358
4.18.10 Special Designations 4-359
4.18.11 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics 4-359
4.18.12 Social and Economic Conditions 4-359
4.18.13 Environmental Justice Conditions 4-359
4.18.14 Health and Safety/Hazardous Materials 4-359
4.19 Irreversible and Irretrievable Commitment of Resources 4-360

Chapter 5 – Consultation and Coordination 5-1
5.1 Introduction 5-1
5.2 Scoping Process 5-1
5.2.1 Notice of Intent 5-1
5.2.2 Scoping Meetings 5-2
5.2.3 Comments Received during Scoping 5-3
5.2.4 Meetings with Interested Stakeholder Groups, Organizations, and Cooperating Agencies 5-4
5.3 Consultation and Coordination 5-5
5.3.1 Cooperating Agencies 5-5
5.3.2 Tribes 5-6
5.3.3 Agency Communications 5-7
5.3.4 Interest Groups and Other Stakeholders 5-8
5.3.5 Applicant Participation 5-9
5.4 Formal Consultation 5-9
5.4.1 Section 7 of the Endangered Species Act 5-10
5.4.2 Section 106 of the National Historic Preservation Act 5-10
5.5 Public Review of the EIS 5-12
5.5.1 Comment Analysis Process 5-13
5.5.2 General Summary of Comments 5-14
5.5.3 Responses to Key Issues and Concerns 5-14
5.6 Preparers and Contributors 5-19

TABLE OF CONTENTS

References

Glossary

Index

Map Sleeve – Figure M1-1 Jurisdiction and Ownership (East Panel, West Panel)

DVD Contents (*inside back cover*):

- Front Matter
- Executive Summary
- Chapters 1–5
- References
- Glossary
- Index
- Map Volume
- Appendices A–M

APPENDICES
Bound Separately

Appendix A: Opportunities and Contraints Analysis

Appendix B: Biological Resources

- B1 Biological Technical Report (Addendum)
- B2 Analysis of Potential Avian Collisions with Transmission Lines at Four Locations on the Rio Grande in New Mexico
- B3 Estimated Distribution of Special-status Species

Appendix C: Cultural Resources

Appendix D: Visual Resources

- D1 Scenic Quality Rating Units (SQRU)
- D2 Contrast Rating Worksheets
- D3 Visual Resource Inventory (VRI) Tables
- D4 Viewing Locations
- D5 Key Observation Points (KOPs) and Simulation Locations
- D6 Simulations

Appendix E: Land Use Data

Appendix F: Climate and Air Quality

Appendix G: Social and Economic Resources

- G1 SunZia Economic Impact Assessment And EIA Supplement: Impacts of Potential Renewable Generation Facilities
- G2 Social and Economic Resources

Appendix H: Resource Impact Analysis Data

Appendix I: Analysis of Access Conditions and Potential Ground Disturbance

Appendix J: Comments on the Draft EIS

Appendix K: SunZia Project Preliminary EMF and Corona Efects Study

Appendix L: National Scenic and Historic Trails Assessment

Appendix M: Draft Programmatic Agreement

MAP VOLUME – CONTENTS

Bound Separately

Figure M 1-1. Jurisdiction and Ownership (*also included in the map sleeve of the Final EIS*)

Figure M 3-1. Geological Hazards and Mineral Resources

Figure M 3-2. Soil Resources

Figure M 4-1. Paleontological Resources

Figure M 5-1. Water Resources

Figure M 6-1. Vegetation

Figure M 6-2. Endangered Species Act: Threatened, Endangered, Proposed, and Candidate Species, Designated and Proposed Critical Habitat

Figure M 6-3. Special Status Species and Biological Resource Areas

Figure M 8-1. Cultural Resources

Figure M 9-1. Scenery

Figure M 9-2. Viewing Locations Key Observation Points: Recreation and Travel Routes

Figure M 9-3. Viewing Locations and Key Observation Points: Residences and Other Land Use Types

Figure M 9-4. Visual Resource Inventory Classification

Figure M 9-5. Visual Resource Management Compliance

Figure M 10-1. Existing Land Use and Special Designations

Figure M 10-2. Planned Land Use

Figure M 10-3. Military Designations

Figure M 10-4. Utilities

LIST OF FIGURES

Figure 1-1. Study Area 1-3
Figure 2-1. Environmental Study Process 2-1
Figure 2-2. Study Area Expansion 2-8
Figure 2-3. Alternative Routes 2-15
Figure 2-4. Route Group 1: SunZia East Substation to Midpoint Substation 2-17
Figure 2-5. Route Group 3: Midpoint Substation to Willow-500 kV Substation 2-19
Figure 2-6. Route Group 4: Willow-500 kV Substation to Pinal Central Substation 2-21
Figure 2-7. Alternatives Considered but Eliminated 2-29
Figure 2-8. Comparison of Typical Structures Replacing Lower Voltage Facilities with Higher Voltage Facilities 2-45
Figure 2-9. Typical 500 kV Transmission Line and Right-of-Way Configuration 2-49
Figure 2-10. Typical 500 kV Structure Diagram 2-53
Figure 2-11. Typical AC Guyed "V" Lattice Tangent Structure 2-53
Figure 2-12. Typical AC Guyed "V" Tubular Tangent Structure 2-54
Figure 2-13. Typical AC Self-Supporting Lattice Tangent Structure 2-54
Figure 2-14. Typical AC Self-Supporting Tubular Tangent Structure 2-55
Figure 2-15. Typical AC Self-Supporting Dead-End Lattice Structure 2-55
Figure 2-16. Typical AC Self-Supporting Dead-End Tubular Structure 2-56
Figure 2-17. Typical AC Self-Supporting Dead-End Tubular, 3-Pole Structure 2-56
Figure 2-18. Typical DC Guyed Lattice Tangent Structure 2-57
Figure 2-19. Typical DC Guyed Tubular Tangent Structure 2-57
Figure 2-20. Typical DC Self-Supporting Lattice Tangent Structure 2-58
Figure 2-21. Typical DC Self-Supporting Tubular Tangent Structure 2-58
Figure 2-22. Typical DC Self-Supporting Dead-End Lattice Structure 2-59
Figure 2-23. Typical DC Self-Supporting Dead-End Tubular Structure 2-59
Figure 2-24. Proposed Substation Layout: SunZia East 2-66
Figure 2-25. Proposed Substation Layout: Midpoint 2-67
Figure 2-26. Proposed Substation Layout: Lordsburg 2-68
Figure 2-27. Proposed Substation Layout: Willow-500 kV 2-69
Figure 2-28. Proposed Expansion: Pinal Central Substation 2-70
Figure 2-29. Typical 500 kV Substation Schematic – Elevation View 2-71
Figure 2-30. Typical 500 kV DC Converter Station. 2-72
Figure 2-31. Typical Right-of-Way Configuration 2-75
Figure 2-32. Typical Roadway Cut and Fill Conditions 2-76
Figure 2-33. Key Issue Areas – Route Group 1 2-123
Figure 2-34. Key Issue Areas – Route Group 3 2-125
Figure 2-35. Key Issue Areas – Route Group 4 2-127
Figure 2-36. Proposed Socorro RMP Amendments 2-133
Figure 2-37. Proposed Mimbres (Las Cruces) RMP Amendments 2-135
Figure 2-38. Proposed Safford RMP Amendments 2-137
Figure 4-1. Cumulative Effects 4-277
Figure 4-2. Qualified Resource Areas for Wind 4-301
Figure 4-3. Qualified Resource Areas for Solar 4-302

LIST OF TABLES

Table 1-1. Renewable Energy and Transfer Capability Needed to Meet State RPS 1-7
Table 1-2. Summary of Generation Interconnection Requests to Existing Transmission Owners within the Project Area 1-9
Table 1-3. Summary of Issues from Scoping 1-10
Table 1-4. Major Federal Authorizing Laws, Regulations, and Guidelines 1-13
Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation 1-23
Table 2-1. Environmental Sensitivity Summary 2-5
Table 2-2. Subroutes by Link 2-12
Table 2-3. Typical Transmission Line Transfer Capabilities and Rights-of-Way 2-43
Table 2-4. Typical Design Characteristics of the Proposed 500 kV Transmission Line Project 2-50
Table 2-5. Typical Design Characteristics of a 500 kV Substation 2-63
Table 2-6. Substations: Estimated Temporary and Permanent Ground Disturbance (in acres) 2-63
Table 2-7. Access Levels and Associated Potential Ground Disturbance 2-77
Table 2-8. Estimated Personnel and Equipment for Transmission Line Construction 2-83
Table 2-9. Estimated Personnel and Equipment for Substation Construction 2-85
Table 2-10. Standard Mitigation Measures 2-89
Table 2-11. SunZia Selective Mitigation Measures 2-95
Table 2-12. Alternative Route Comparison 2-111
Table 2-13. Resource Comparison Summary for Route Group 1: SunZia East Substation to Midpoint Substation 2-112
Table 2-14. Resource Comparison Summary for Route Group 3: Midpoint Substation to Willow-500 kV Substation 2-115
Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson 2-117
Table 2-16. Proposed Plan Amendments – VRM Classifications 2-130
Table 2-17. Proposed Plan Amendments – Right-of-Way Avoidance 2-131
Table 2-18. Proposed Plan Amendments – Right-of-Way Avoidance Mimbres RMP 2-131
Table 3-1. Study Corridors by Resource 3-2
Table 3-2. Ambient Air Quality Standards 3-4
Table 3-3. Climate Statistics for Route Group 1: SunZia East Substation to Midpoint Substation 3-15
Table 3-4. New Mexico Air Quality Data 3-16
Table 3-5. Climate Statistics for Route Group 3: Midpoint Substation to Willow-500 kV Substation 3-17
Table 3-6. Arizona Air Quality Data 3-18
Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation 3-19
Table 3-8. SSURGO Soil Surveys in the Project Study Area 3-23
Table 3-9. Geological Units in the Study Corridors 3-27
Table 3-10. Geological Hazards along Route Group 1 3-33

LIST OF TABLES

Table 3-11. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 1 3-34
Table 3-12. Miles of Soil Limitations along Route Group 1 3-34
Table 3-13. Geological Hazards along Route Group 3 3-37
Table 3-14. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 3 3-37
Table 3-15. Miles of Soil Limitations along Route Group 3 3-37
Table 3-16. Geological Hazards along Route Group 4 3-39
Table 3-17. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 4 3-40
Table 3-18. Soil Limitations along Route Group 4 (in miles) 3-40
Table 3-19. Soil Limitations along Local Alternative Links for Routes 4C1 and 4C2 and Crossover Links for Routes 4A or 4B/4C1 or 4C2 (in miles) 3-43
Table 3-20. Institutions that Contributed to the Paleontological Record Search 3-46
Table 3-21. Geological Units and Paleontological Resources in the Study Corridors 3-49
Table 3-22. Summary of Paleontological Resource Inventory Data 3-54
Table 3-23. Regional Surface-Water Features within the Study Corridors 3-61
Table 3-24. Named Bodies of Water within the Study Corridors 3-63
Table 3-25. Impaired Waters within Study Corridor 3-66
Table 3-26. Water Resources within Route Group 1 3-68
Table 3-27. Water Resources within Route Group 3 3-69
Table 3-28. Water Resources along Route Group 4 3-70
Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor 3-83
Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor 3-89
Table 3-31. Vegetation Communities Crossed by Each Subroute 3-123
Table 3-32. Percent of Land Assigned to FRCC Classes within the Study Area[1] 3-142
Table 3-33. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in New Mexico 3-144
Table 3-34. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in Arizona 3-145
Table 3-35. Federal and State Laws and Regulations for Cultural Resources 3-150
Table 3-36. Percentage of Previously Inventoried Areas within Study Corridors 3-183
Table 3-37. Summary of Site Density by Subroute 3-183
Table 3-38. Cultural Resources within Route Group 1 Study Corridors 3-184
Table 3-39. Cultural Resources within Route Group 3 Study Corridors 3-188
Table 3-40. Cultural Resources within Route Group 4 Study Corridors 3-189
Table 3-41. Sensitivity of Previously Recorded Sites by Subroute 3-195
Table 3-42. Site Density of Class II Inventory Areas by Subroute 3-196
Table 3-43. Sensitivity of Sites Recorded during Class II Inventories 3-197
Table 3-44. BLM Visual Resource Management Objectives 3-204
Table 3-45. Counties and Towns in the Vicinity of the Study Corridors 3-252
Table 3-46. Federal Land Management Agencies within the Study Corridors 3-253
Table 3-47. State Land Management Agencies within Study Corridor 3-253

LIST OF TABLES

Table 3-48. Public and Military Air Facilities within the Study Area 3-256
Table 3-49. Communication Facilities within the Study Corridors 3-282
Table 3-50. Route Groups Breakdown by County 3-307
Table 3-51. Geographic Characteristics of Study Corridors: New Mexico 3-308
Table 3-52. Geographic Characteristics of Study Corridors: Arizona 3-310
Table 3-53. Land Ownership in New Mexico Counties within the Study Area (Percent of Total County Acreage[1]) 3-311
Table 3-54. Land Ownership in Arizona Counties within the Study Area (Percent of Total County Acreage[1]) 3-312
Table 3-55. Population Estimates and Growth: New Mexico 3-313
Table 3-56. Population Projections: New Mexico Counties[1] 3-313
Table 3-57. Population Estimates and Growth: Arizona 3-314
Table 3-58. Population Projections: Arizona Counties [1] 3-315
Table 3-59. New Mexico: Resident Population by Race [1] 3-318
Table 3-60. Arizona: Resident Population by Race [1] 3-319
Table 3-61. New Mexico: Housing and Occupancy Costs (2010) 3-320
Table 3-62. Arizona: Housing and Occupancy Costs (2010) 3-321
Table 3-63. Unemployment Rates: New Mexico (percentage) 3-325
Table 3-64. Unemployment Rates: Arizona (percentage) 3-325
Table 3-65. New Mexico: Revenue and Income Summary (2009) 3-326
Table 3-66. Arizona: Revenue and Income Summary (2010) 3-326
Table 3-67. Fire Services: New Mexico 3-327
Table 3-68. Fire Services: Arizona 3-328
Table 3-69. Emergency Medical Services: New Mexico 3-329
Table 3-70. Emergency Medical Services: Arizona 3-331
Table 3-71. Race, Ethnicity, and Poverty: New Mexico and Arizona (Percent of total population) 3-334
Table 3-72. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (within 1 mile of the Proposed Route) 3-338
Table 3-73. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (between 1 and 3 miles of the Proposed Route) 3-339
Table 3-74. Typical 60 Hz Magnetic Levels of Common Household Products 3-343
Table 3-75. Typical 60 Hz EMF Levels from Overhead Power Lines 3-343
Table 3-76. Commonly Encountered Acoustic and Audible Noise Levels 3-344
Table 3-77. CERCLIS Sites within the Study Corridors in Arizona 3-345
Table 3-78. Underground Storage Tanks within 600 Feet of the Project Centerline 3-346
Table 4-1. Ground Disturbance 4-3
Table 4-2. Conformity Analysis Results 4-22
Table 4-3. Criteria for Assessing Intensity of Impacts Resulting from Geological Hazards 4-24
Table 4-4. Summary of Sensitivity Level Impacts by Geological Hazards 4-26
Table 4-5. Criteria for Assessing Intensity of Impacts to Mineral Resources 4-26
Table 4-6. Summary of Sensitivity Level and Residual Impacts on Mineral Resources 4-27
Table 4-7. Criteria for Assessing Intensity of Impacts to Soil Resources 4-29
Table 4-8. Summary of Sensitivity Level and Residual Impacts on Soil Resources 4-30

LIST OF TABLES

Table 4-9. Alternative Route Comparison: Earth Resource Inventory Data and Residual Impacts 4-33
Table 4-10. Paleontological Sensitivity Levels based on PFYC and Paleontology Density 4-51
Table 4-11. Impact Levels for Water Resources 4-56
Table 4-12. Route Group 1 Water Resource Inventory Data and Residual Impacts 4-59
Table 4-13. Route Group 3 Water Resource Inventory Data and Residual Impacts 4-60
Table 4-14. Route Group 4 Water Resource Inventory Data and Residual Impacts 4-60
Table 4-15. Estimated Ground Disturbance by Each Subroute and Vegetation Type 4-70
Table 4-16. Estimated Miles of Special-status Species Habitat Crossed by Subroute 1A2 4-104
Table 4-17. Estimated Miles of Special-status Species Habitat Crossed by Subroute 3A2 4-108
Table 4-18. Estimated Miles of Special-status Species Habitat Crossed by Subroute 4C2C 4-112
Table 4-19. Anticipated Number of Sites per Subroute Based on Existing Site Density ... 4-125
Table 4-20. Summary of Anticipated Sites and Impact Levels for Alternative Subroutes . 4-128
Table 4-21. Visual Resource Management Classifications 4-152
Table 4-22. VRM Resource Compliance 4-203
Table 4-23. Proposed Plan Amendments for VRI Classifications and VRM Classifications 4-205
Table 4-24. Impact Criteria for Land Use and Recreation Resources 4-206
Table 4-25. Impact Criteria Summary 4-248
Table 4-26. Impacts to Environmental Justice Populations – Route Group 1 4-250
Table 4-27. Impacts to Environmental Justice Populations – Route Group 3 4-251
Table 4-28. Impacts to Environmental Justice Populations – Subroutes 4A, 4B, 4C1, 4C2, 4C2c 4-252
Table 4-29. Impacts to Environmental Justice Populations within 1 mile of Subroute 4C3 4-253
Table 4-30. Impacts to Environmental Justice Populations between 1 and 3 miles of Subroute 4C3 4-254
Table 4-31. Typical Noise Levels for Construction Equipment 4-259
Table 4-32. Cost Estimate Ranges 4-263
Table 4-33. Ground Disturbance for Rio Grande Crossing Alternatives 4-264
Table 4-34. Affected Southwestern Willow Flycatcher Critical Habitat 4-267
Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis 4-279
Table 4-36. Present, Future, and Reasonably Foreseeable Future Renewable Energy Projects 4-296
Table 4-37. Potential Renewable Energy Resource Capacity by QRA in MW 4-299
Table 4-38. Existing Renewable Energy Projects within the Project Area[1,2] 4-300
Table 4-39. Potentially Affected Land Area for the Energy Development Scenario 4-304
Table 4-40. Annual Emissions from Combustion-related Power Generation 4-311
Table 4-41. Annual Emissions for Various Power Generation Types (ton/MW)1 4-311
Table 4-42. Land Area of Disturbance for Linear Facilities 4-315
Table 4-43. Land Uses in Study Area (acres) 4-339
Table 4-44. Reasonably Foreseeable Future Projects 4-341

LIST OF TABLES

Table 4-45. Proposed Resource Management Plan Amendments 4-356
Table 4-46. Irreversible and Irretrievable Commitment of Resources 4-360
Table 5-1. Scoping Period 1 Meetings – June and July 2009 5-2
Table 5-2. Scoping Period 2 Meetings – October 2009 5-3
Table 5-3. Scoping Period 3 Meetings – April 2010 5-3
Table 5-4. Meetings with Interested Stakeholder Groups and Organizations during Scoping Period 5-4
Table 5-5. Meetings with Cooperating Agencies during Scoping Period 5-4
Table 5-6. Cooperating Agencies 5-5
Table 5-7. Tribal Consultation Meetings 5-7
Table 5-8. Contacts with Other Agencies 5-8
Table 5-9. Interest Groups and Other Stakeholders 5-9
Table 5-10. Public Meetings – June and July 2012 5-12
Table 5-11. BLM SunZia EIS Interdisciplinary Team 5-19
Table 5-12. Consultant Preparers and Contributors 5-22

ACRONYMS AND ABBREVIATIONS

AAC	Arizona Administrative Code
AC	alternating current
ACC	Arizona Corporation Commission
ACEC	area of critical environmental concern
ACHP	Advisory Council on Historic Preservation
ADA	Arizona Department of Agriculture
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
AFB	Air Force Base
ALRIS	Arizona Land Resource Information System
AMA	Active Management Area
APE	area of potential effect
APLIC	Avian Power Line Interaction Committee
Applicant, or SunZia	SunZia Transmission, LLC
ARS	Arizona Revised Statutes
ASLD	Arizona State Land Department
ASM	Arizona State Museum
ATV	all-terrain vehicle
AUM	Animal Unit Month
AZGFD	Arizona Game and Fish Department
AZGS	Arizona Geological Survey
AZPDES	Arizona Pollutant Discharge Elimination System
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BGEPA	Bald and Golden Eagle Protection Act
BHCA	Bird Habitat Conservation Area
BIA	Bureau of Indian Affairs
BISON-M	Biota Information System of New Mexico
BLM	Bureau of Land Management
BMPs	best management practices
BOR	Bureau of Reclamation
BPP	Biological Protection Plan
BSETR	Buffalo Soldier Electronic Test Range
CAP	Central Arizona Project
CDNST	Continental Divide National Scenic Trail

ACRONYMS AND ABBREVIATIONS

CDPHE	Colorado Department of Public Health and Environment
CDTS	Continental Divide Trail Society
CEC	Certificate of Environmental Compatibility
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CH_4	methane
CHU	critical habitat unit
CIC	Compliance Inspection Contractor
CLS	Conservation Land System
CMA	cooperative management area
CNF	Coronado National Forest
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalent
CPUC	California Public Utilities Commission
CWA	Clean Water Act
dB	decibel
dBµV/m	microvolt per meter
dBA	A-weighted decibel
DC	direct current
DEL	dead-end lattice
DET	dead-end tubular
DET3	dead-end tubular, 3-pole
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DPS	distinct population segment
DSM	demand-side management
EDU	energy development unit
EHV	extra-high voltage
EIA	Economic Impact Assessment
EIS	environmental impact statement
EMF	electric and magnetic field
EMRTC	Energetic Materials Research and Testing Center

ACRONYMS AND ABBREVIATIONS

EO	Executive Order
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FERC, or Commission	Federal Energy Regulatory Commission
FLAP	Floodprone Land Acquisition Program
FLPMA	Federal Land Policy and Management Act of 1976
FMP	Fire Management Plan
FMU	fire management unit
FPPA	Farmland Protection Policy Act of 1981
FR	Forest Road
FRCC	Fire Regime Condition Class
GeoMAC	Geospatial Multi-Agency Coordination Group
GHG	greenhouse gas
GIL	gas-insulated line
GIS	geographic information system
GLO	General Land Office
Gran Quivira	Gran Quivira unit of Salinas Pueblo Missions National Monument
GRIC	Gila River Indian Community
GVL	guyed “V” lattice
GVT	guyed “V” tubular
HCP	Habitat Conservation Plan
HDD	horizontal directional drilling
HMA	herd management area
HPFF	high-pressure fluid-filled
HPTP	Historic Properties Treatment Plan
HTS	high temperature superconducting
HVTL	high-voltage transmission line
I-10	Interstate 10
IBA	Important Bird Area
IC	internal combustion
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
IM	Instruction Memorandum

kHz	kilohertz
KOP	key observation point
kV	kilovolt
kV/m	kilovolt per meter
LC 94	launch complex 94
LUST	leaking underground storage tank
MBTA	Migratory Bird Treaty Act
mG	milligauss
MOU	Memorandum of Understanding
mph	miles per hour
MW	megawatt
N_2	nitrogen
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEAP	Natural Events Action Plan
NEP	nonessential experimental population
NEPA	National Environmental Policy Act of 1969
NERC	North American Reliability Council
NESC	National Electric Safety Code
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act of 1966
NHT	National Historic Trail
NMAC	New Mexico Administrative Code
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMCRIS	New Mexico Cultural Resources Information System
NMDGF	New Mexico Department of Game and Fish
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMHC	nonmethane hydrocarbon
NMPDES	New Mexico Pollutant Discharge Elimination System
NMSA	New Mexico Statutes Annotated
NMSLO	New Mexico State Land Office
NMSU	New Mexico State University
NMWQCC	New Mexico Water Quality Control Commission
NO_2	nitrogen dioxide
NO_x	nitrogen oxide

NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPO	Neighborhood Preservation Ordinance
NPS	U.S. National Park Service
NRCD	Natural Resource Conservation District
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
O_3	ozone
OATT	Open Access Transmission Tariffs
OAW	Outstanding Arizona Water
OHGW	overhead groundwire
OHV	off-highway vehicle
OPGW	fiber optic groundwire
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PCAQCD	Pinal County Air Quality Control District
PFYC	Potential Fossil Yield Classification
PL	Public Law
PM	particulate matter
POD	Plan of Development
ppm	parts per million
Project	SunZia Southwest Transmission Project
proposed action	SunZia Southwest Transmission Project, or Project
PRPA	Paleontological Resources Preservation Act of 2009
PRTP	Paleontological Resources Treatment Plan
PV	photovoltaic
QRA	Qualified Resource Area
RCRA	Resource Conservation and Recovery Act
RES	renewable energy standards
RGIS	Resource Geographic Information System
RMP	resource management plan
RNA	research natural area
ROD	Record of Decision

RPS	renewable portfolio standards
SCFF	self-contained fluid-filled
Scoping Report	SunZia Southwest Transmission Project EIS Scoping Report
SDCP	Sonoran Desert Conservation Plan
SDWA	Safe Drinking Water Act
SE	selective mitigation
SEZ	solar energy zone
SF_6	sulfur hexafluoride
SGCN	species of greatest conservation need
SHPO	State Historic Preservation Office
SIL	significant impact level
SIP	State Implementation Plan
SMA	special management area
SO_2	sulfur dioxide
SR	State Route
SRMA	special recreation management area
SRP	Salt River Project
SSL	self-supporting lattice
SST	self-supporting tubular
SSURGO	Soil Survey Geographic
ST	standard mitigation
STATSGO	State Soil Geographic
SVP	Society of Vertebrate Paleontology
TEP	Tucson Electric Power
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
tpy	tons per year
UA	University of Arizona
UAS	unmanned air system
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank

VCC	Vegetation Condition Class
VMT	vehicle miles travelled
VOC	volatile organic compound
VRI	visual resource inventory
VRM	visual resource management
WEG	wind erodibility group
WFLC	Wildland Fire Leadership Council
WGA	Western Governors' Association
WMA	wildlife management area
WQCC	Water Quality Control Commission
WRAP	Western Regional Air Partnership
WRCC	Western Regional Climate Center
WSA	Wilderness Study Area
WSC	wildlife species of concern
WSMR	White Sands Missile Range
WUI	wildland-urban interface
XLPE	cross linked polyethylene

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

This final environmental impact statement and proposed resource management plan amendments (EIS) document has been prepared to analyze and disclose the potential effects of the proposed SunZia Southwest Transmission Project (Project). The Project would include two 500-kilovolt (kV) transmission lines located on federal, state, and private lands between central New Mexico and central Arizona. SunZia Transmission, LLC (Applicant, or SunZia) has submitted an application for right-of-way to construct, operate, and maintain the Project on public land administered by the Bureau of Land Management (BLM).

The BLM serves as the lead federal agency for preparing the EIS, and published its notice of intent to prepare the EIS in the Federal Register on May 29, 2009. Fourteen cooperating agencies have participated in the preparation of this EIS, including the U.S. Army Corps of Engineers; Department of the Army, Fort Bliss; Department of the Army, White Sands Missile Range (WSMR); U.S. Air Force, Holloman Air Force Base (AFB); U.S. Fish and Wildlife Service; U.S. National Park Service; Department of Defense (DOD) Siting Clearinghouse, Office of the Deputy Under Secretary (Installations and Environment); New Mexico State Land Office (NMSLO); New Mexico Spaceport Authority; Arizona State Land Department (ASLD); Arizona Game and Fish Department; Arizona Department of Transportation; Department of the Army, Fort Huachuca; and Bureau of Indian Affairs (BIA).

The BLM's purpose and need for the proposed Project is established by regulatory obligations and directives, and current energy development trends. The purpose and need is used to formulate a reasonable range of alternatives to be considered in the EIS. The need for the BLM's proposed action arises from the Federal Land Policy and Management Act of 1976 (FLPMA), which establishes a multiple use mandate for management of federal lands, including energy generation and transmission facilities as outlined in Title V of the FLPMA. The BLM's action in considering the Applicant's right-of-way application is provided under the authority of the Secretary of the Interior to "grant, issue, or renew rights-of-way…for generation, transmission, and distribution of electric energy" (43 Code of Federal Regulations [CFR] 2800).

Pursuant to 43 CFR 2801.2, it is the BLM's objective to grant rights-of-way and to control their use on public lands in a manner that: (a) protects the natural resources associated with public lands and adjacent lands, whether private or administered by a government entity; (b) prevents unnecessary or undue degradation to public lands; (c) promotes the use of rights-of-way in common, considering engineering and technological compatibility, national security, and land use plans; and (d) coordinates, to the fullest extent possible, all BLM actions under the regulations in this part with state and local governments, interested individuals, and appropriate quasi-public entities.

The BLM must consider existing resource management plans (RMP) in the decision to issue a right-of-way grant, in accordance with 43 CFR Part 1610.0-5(b). RMPs allocate public land resource use and establish management objectives. Portions of the proposed transmission line alternatives are not in conformance with several RMPs; therefore, amendments to these plans are

analyzed as part of the route alternatives. To the extent practicable and consistent with the laws governing the administration of the public lands, the BLM must coordinate the land use inventory, planning, and management activities with other federal departments and agencies and of the states and local governments, in accordance with the FLPMA (Public Law 94–579, Section 202 (c) 9).

ES.2 APPLICANTS PROPOSED ACTION

The Applicant's objectives are to increase transfer capability, thereby relieving existing transmission congestion and allowing additional electricity to be generated and transported to western power markets and load centers in the Desert Southwest. The Project would be colocated with areas of undeveloped renewable resource potential to provide a path for energy delivery, and would provide power to help meet growing demand in the western United States and enhance domestic energy security. The Applicant group comprises load-serving utilities and independent developers. The Project would assist load-serving utilities in meeting the requirements to address energy delivery obligations to meet state renewable portfolio standards; while the independent developers' purpose for the Project is to create a market opportunity to satisfy transmission needs that have been identified at local, regional, and national levels.

The proposed Project would include two new, single-circuit 500 kV transmission lines located within a right-of-way up to 1,000 feet wide. At least one of the two 500 kV transmission lines would be constructed and operated as an alternating current (AC) facility; the other transmission line could be either an AC or direct current (DC) facility. Depending on the configuration, the Project could provide up to 4,500 megawatts (MW) of additional transfer capability on the regional electrical grid. Based on a typical span of 1,400 feet, three to four transmission line structures per mile would be required for each of the two lines, with typical structure heights of 135 feet that range between 100 and 175 feet.

The transmission line route would originate at a new substation (SunZia East) in Lincoln County, New Mexico, and terminate at the Pinal Central Substation in Pinal County, Arizona. The Project would be located within Lincoln, Socorro, Sierra, Luna, Grant, Hidalgo, and/or Torrance counties in New Mexico; and Graham, Greenlee, Cochise, Pinal, and/or Pima counties in Arizona. The BLM preferred alternative is approximately 515 miles long, and alternative routes range between 460 and 542 miles in length.

The proposed Project would include the construction of the SunZia East 500 kV Substation at the Project's eastern terminus in Lincoln County, and up to three intermediate substations on private or state lands:

- Midpoint Substation, located in Luna County, New Mexico
- Lordsburg Substation, located in Hidalgo County, New Mexico
- Willow-500 kV Substation, located in Graham County, Arizona

The Pinal Central Substation, at the Project's western terminus, has already received its regulatory permits and approvals and will be constructed by Salt River Project and other entities.

ES.3 ALTERNATIVES

A range of alternative routes were analyzed in the Draft EIS, including the BLM preferred alternative and the No Action alternative. The BLM preferred alternative route was modified in response to comments received on the Draft EIS, as described in this Final EIS (see ES3.4). For study purposes and comparison of alternatives, alternative routes are organized into three route groups or segments that correspond to areas between the proposed SunZia East Substation and the permitted Pinal Central Substation. Route Group 1 includes the alternatives between the SunZia East Substation site and the proposed Midpoint Substation site; Route Group 3 includes alternatives between the Midpoint Substation site and the proposed Willow-500 kV Substation site; and Route Group 4 includes alternatives between the Willow-500 kV Substation site and the Pinal Central Substation site. (Route Group 2, which included alternatives located east of the WSMR, was eliminated from study for this EIS). Each of the three route groups is composed of individual subroutes that are formed by a series of interconnected segments.

ES.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Seven alternative subroutes connect the SunZia East Substation to the Midpoint Substation site, ranging from 206 miles to 230 miles in length. The alternatives in this route group cross portions of Lincoln, Torrance, Socorro, Sierra, Grant, and Luna counties within New Mexico.

ES.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Three alternative routes connect the Midpoint Substation site to the Willow-500 kV Substation site, ranging from 123 miles to 129 miles in length. The alternatives in this route group cross portions of Luna, Grant, and Hidalgo counties in New Mexico, and portions of Greenlee, Graham, and Cochise counties in Arizona.

ES.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Eight alternative routes connect the Willow-500 kV Substation site to the Pinal Central Substation site, ranging from 133 miles to 173 miles in length. The alternatives in this route group cross portions of Graham, Cochise, Pima, and Pinal counties in Arizona.

ES.3.4 Selection of the BLM Preferred Alternative Route

The BLM preferred alternative consists of the combination of three subroutes—**1A2, 3A2, and 4C2c—**one from each of the route groups.

The BLM preferred alternative route (Route Group 1) starts at the SunZia East Substation site in Lincoln County, New Mexico, heads in a northwesterly direction, approximately 5 miles north of the Gran Quivira Unit of the Salinas Pueblo Missions National Monument (Gran Quivira), into Torrance County. The route then heads southeasterly into Socorro County, crossing the Rio Grande approximately 4 miles to the north of the town of Socorro. Nine miles west of the Rio Grande, the route turns south along a 345 kV transmission line corridor into Sierra County, generally parallel to I-25 and the Rio Grande. The route continues south into Luna County along

a 345/115 kV transmission line corridor, then turns west approximately 8 miles northeast of Deming at the proposed Midpoint Substation site. Continuing in a westerly direction, the route (Route Group 3) crosses Grant and Hidalgo counties north of Lordsburg. The route continues west, north of the Peloncillo Mountains, to the Arizona border.

Crossing into Greenlee County, the route continues west across the San Simon Valley to the proposed Willow-500 kV Substation site located in Graham County. From the Willow-500 kV Substation site, the route (Route Group 4) heads southwest and crosses the Sulphur Springs Valley 7 miles north of Willcox, and continues southeasterly along a 345 kV transmission line corridor generally parallel to and north of the I-10. The route crosses the San Pedro River approximately 11 miles north of Benson, turns northwest, and continues at a distance ranging from 2 to 6 miles west of the San Pedro River through portions of Cochise and Pima counties. The route continues northwest along a pipeline corridor into Pinal County, turns west at a point 5 miles northwest of San Manuel, then proceeds westerly, north of Oracle and the Santa Catalina Mountains and along portions of 115 and 500 kV transmission line corridors, north of the Tortolita Mountains. The route turns north from a point near the Tortolita Substation toward State Route (SR) 79, and then west, north of the Picacho Mountains, to its termination at the Pinal Central Substation located 8 miles north of Eloy, in Pinal County.

This route was selected as the BLM preferred alternative because it would:

- maximize use of existing utility corridors and infrastructure
- minimize impacts to sensitive resources
- minimize impacts at river crossings
- minimize impacts to residential and commercial uses, and
- minimize impacts to military operations within the restricted airspace north of the WSMR

A major portion of the preferred alternative would be constructed along established utility corridors where existing access is available. Approximately 53 percent (273 miles) of the route would be parallel to existing or designated utility corridors, including 229 miles parallel to existing transmission lines.

ES.4 AFFECTED ENVIRONMENT, ISSUES, AND ENVIRONMENTAL IMPACTS

ES.4.1 Climate and Air Quality

Emissions of air pollutants would occur during construction of the transmission lines and substations and, to a lesser extent, during Project operations. Emissions would be transient as construction progresses, so emissions would not occur in one area for a long duration, thereby limiting their impact.

With the exception of 24-hour $PM_{10,}$ climate and air quality impacts resulting from construction and operation of any of the alternative subroutes, including the BLM preferred alternative, were predicted to be within regulatory limits (below the applicable National, Arizona, and/or New Mexico Ambient Air Quality Standards). Because of high background concentrations of PM_{10} within the West Pinal County PM_{10} nonattainment area, maximum total 24-hour PM_{10} impacts

could potentially exceed PM_{10} standards temporarily for alternatives in Route Group 4, including the BLM preferred alternative, during construction related activities. However, mitigation would likely be effective in reducing significant impacts.

ES.4.2 Earth Resources

Potential impacts to the Project could result from geological hazards, and impacts to mineral and soil resources could result from the Project. Geological hazards include potential ground rupture from Quaternary faults, destabilization of the land surface by fissures, and flooding. Potential impacts to mineral resources include the restriction of access to locatable, leasable, and salable mineral resources; while potential impacts to soil resources include accelerated rates of erosion by water or wind, and the conversion of designated Prime or Unique Farmland soils to nonagricultural uses.

No significant impacts to mineral and soil resources are expected. Mitigation measures, including best management practices (BMP) to control erosion, would minimize the effects of soil erosion during construction and operation of the Project. Site-specific design of roads and structures using standard and selective mitigation measures would minimize restrictions to mineral development. A determination would be made regarding the presence of pre-1955 mining claims; if such claims are found, the BLM would need to receive authorization from the claimant prior to grant of right-of-way.

ES.4.3 Paleontological Resources

The loss of scientifically significant fossils and their contextual data is the primary concern regarding impacts to paleontological resources. Impacts could occur if unique paleontological resources were to be destroyed. Mitigation of impacts to paleontological resources includes preconstruction surveys, personnel education, monitoring ground disturbance for fossils, preparation and curation of any discovered fossils, and deposition of collected fossils in a paleontological repository. With the use of these mitigation measures, impacts to paleontological resources are not likely to be significant.

ES.4.4 Water Resources

Impacts to surface water could result from placement of structures, construction of access roads, or temporary work areas. Direct impacts to perennial surface water features could include sedimentation from fugitive dust deposition or access road construction, removal of riparian vegetation, bank alteration, accidental contamination associated with spills of environmentally harmful material, damage to wetlands, or the introduction of invasive species. BMPs and mitigation measures would be effective in minimizing impacts to surface water resources, and no significant impacts are expected to result from the construction and operation of the Project.

Potential impacts to groundwater resources could include accidental contamination during construction or accidental spills of environmentally harmful liquids that could percolate into shallow groundwater. The Project would not impede the flow or depth of groundwater.

Mitigation measures would be effective to limit the potential for contamination during construction and operation.

ES.4.5 Biological Resources

Direct impacts to vegetation include removal of plants during construction of new or modified access and spur roads, and at structure and substation sites. Vegetation removal for structure foundations and at substation sites would be permanent. Indirect impacts associated with vegetation removal may include erosion, reduction of soil water retention, invasive plant colonization, loss of wildlife habitat, and habitat fragmentation.

Mitigation measures would be applied to reduce, avoid, or otherwise provide compensation for impacts to sensitive vegetation. Where vegetation is disturbed or cleared, vegetation loss would be minimized by (1) reducing the area to the extent practicable, (2) plant salvage and revegetation in areas of temporary disturbance, and (3) closure and restoration of any access roads not required for Project maintenance or access. Closure of temporary access roads and the limiting of access through gating or other means would reduce indirect impacts to vegetation caused by recreational travel, including off-road vehicle travel beyond the Project right-of-way. Tree-cutting would be conducted to meet the National Electric Safety Code and an appropriate level of safety, but would be minimized to the extent possible.

Linear features such as access roads could fragment wildlife habitat, adversely affecting species that are reluctant to cross areas of open ground due to threat of predation. Related to this are edge effects, which may reduce the effective size of habitat blocks for those species, limiting connectivity and dispersal between blocks.

The following impacts to general wildlife and special status species may occur with construction and operation of the BLM preferred alternative:

- Transmission lines may interfere with Sandhill Crane and waterfowl migration routes and lead to increased bird–power line collision risk at the Rio Grande crossing and within the Sulphur Springs Valley. An avian impact study was conducted in the Rio Grande Valley to assess the effects of potential collisions. Results of the study predicted that while potentially fatal collisions of Sandhill Cranes and other large birds are likely to occur, a substantial effect at the population level is unlikely for any species.
- Impacts may occur to Southwestern Willow Flycatcher designated critical habitat at the Rio Grande crossing, and future impacts may occur to proposed critical habitat at the San Pedro River crossing.
- Impacts may occur to the Yellow-billed Cuckoo, Rio Grande Silvery Minnow, and designated critical habitat for the Rio Grande Silvery Minnow as a result of vegetation management or erosion.
- Disturbance associated with construction and maintenance could impact a movement corridor for the Desert Bighorn Sheep west of the Rio Grande in Socorro County.
- Habitat for the Northern Aplomado Falcon may be affected west of the Rio Grande in New Mexico.

- The Chihuahua scurfpea may be impacted by ground disturbance in western New Mexico and the San Simon Valley, Arizona.
- A small population of Pronghorn is present on Allen Flat, and may be impacted by construction or maintenance activities.
- Road construction and habitat loss may impact the Sonoran Desert Tortoise from the San Pedro River Valley to the vicinity of the Tortolita Substation, and near the Picacho Mountains.
- Habitat for the Tucson Shovel-nosed Snake may be impacted near the Tortolita Substation and Picacho Mountains.

Selective mitigation measures addressing the reduction of ground disturbance, noxious weed and erosion control, and restoration of vegetation would help reduce effects to wildlife. A posted reasonable construction speed limit could minimize potential collision risk to wildlife in road areas, and construction activities may be constrained during certain seasons to address needs of special-status species at specified locations. Debris and trash would be properly contained and regularly removed from the Project to an appropriate landfill site. Construction excavations would be fenced or covered to preclude injury or trapping of wildlife or livestock. Post construction access may be controlled by various means.

Mitigation measures to reduce the collision risk for large birds include methods to improve visibility, such as the use of bird diverters on groundwires and guywires. Since the transmission line would span most aquatic habitats, there should be no significant impacts to aquatic and shorebird nesting habitat. Structures may need to be placed in wider portions of the Rio Grande floodplain, but they would not be located near shore habitat and would not permanently affect these species. The Project would have minimal effect on prey and forage availability for these species. Timing of construction to avoid avian nesting or breeding times would help minimize impacts to birds.

ES.4.6 Wildland Fire Ecology and Management

The operation of 500 kV transmission lines generally presents a very low risk of fire ignition, as the scale of the structures minimizes the risk of vegetation contact. However, unforeseen events do have the potential to occur. Transmission structures may fail or be accidentally damaged as a result of human activity such as vehicle or aircraft collisions and vandalism, or from severe weather, geological hazards, and other natural events. However, 500 kV conductors and structures are of sufficient size to be somewhat resistant to physical damage.

A Fire Protection Plan would be implemented during Project construction. A Fire Marshal would be responsible for ensuring compliance with all mitigation measures for fire safety, as well as coordination and communication with agencies and emergency responders.

ES.4.7 Cultural Resource

The anticipated impacts to cultural and historic resources result from a loss of integrity on prehistoric and historic sites. Four types of impacts that could affect archaeological sites during and after construction of the proposed Project are:

- direct and permanent ground disturbance during construction
- direct and permanent visual and auditory intrusions
- indirect and temporary visual intrusions during construction
- indirect and permanent disturbances due to changes in public accessibility

Intensive pedestrian inventories of the selected route, associated access roads, substations, and associated ancillary facilities will be conducted. All cultural and historic resources identified during the inventory will be evaluated for eligibility to the National Register of Historic Places.

Consultation with appropriate land management agencies, tribes, and State Historic Preservation Offices is ongoing. A Programmatic Agreement, which establishes a project-specific procedure for complying with the National Historic Preservation Act, including procedures to follow during the execution of the Project, has been drafted.

Construction and operation of the BLM preferred alternative could impact seven known habitation sites and the McClellan Wash Archaeological District. The Project would cross the El Camino Real, Butterfield, Gila, Janos Copper, Zuniga, Southern Pacific Mail, and General Cooke's Wagon Road/Mormon Battalion trails. Potential impacts to National Scenic and Historic Trails have been documented in this Final EIS (also see Appendix L).

Impacts to the Gran Quivira unit of the Salinas Pueblo Missions National Monument were evaluated to assess effects on the setting and feeling of the cultural landscape. Impacts to the views from Gran Quivira are anticipated to be low, and selective mitigation measures such as special tower design or placement could further minimize these impacts.

Direct impacts to significant cultural resources can be effectively minimized, if not eliminated, through mitigation planning and implementation. In designated areas, structures would be placed to avoid and or span sensitive cultural resource sites or features. Cultural resources would continue to be considered during post-EIS phases of Project implementation, in accordance with an executed agreement. This would involve intensive surveys to inventory and evaluate cultural resources within the selected corridor and any appurtenant impact zones beyond the corridor, such as access roads and construction equipment yards. This would also require a Historic Properties Treatment Plan to ensure proper data recovery and recordation prior to construction in the sensitive areas identified in the plan. Monitoring of construction activities will be required to ensure that cultural sites that are to be avoided during construction remain undisturbed.

ES.4.8 Visual Resources

A concern for changes to existing viewsheds and modifications that would alter the landscape character of natural lands is the primary factor considered for identifying and characterizing impacts related to visual resources. Impacts to residential, travel, and recreational viewers were

assessed. In addition, compliance with the BLM's visual resource management (VRM) system was assessed to identify areas where the Project would conflict with VRM objectives, and where RMP amendments may be required. Standard and selective mitigation measures and BMPs would reduce impacts to scenery and viewers (viewing locations or key observation points).

Visual impacts that may occur with construction and operation of the BLM preferred alternative include the following:

- In Socorro County, high to moderate-high impacts would occur for residential viewers near Socorro, Willow Springs, and other dispersed residences immediately adjacent to the BLM preferred alternative. Limited areas of high impacts are anticipated for residences near Deming, New Mexico, and in the vicinity of San Simon (Cochise County, Arizona) and La Palma, near the Pinal Central Substation.
- Recreation viewers associated with the Stallion and Veranito wilderness study areas (WSA), Sevilleta National Wildlife Refuge, Johnson (Gordy's) Hill Special Recreation Management Area (SRMA), and the Rio Grande would have high to moderate-high impacts. High impacts to recreation viewers associated with the Peloncillo Mountains Wilderness are anticipated. Recreation viewers would have moderate-high impacts associated with the Arizona National Scenic Trail and Buehman Canyon Trail.
- High to moderate-high impacts would occur for viewers in New Mexico along Salt Missions Trail Scenic Byway, WSMR Route 3607, WSMR P 5, US Route 54, SR 55, Quebradas Back Country Byway SRMA, El Camino Real (SR 408 and I-25), Geronimo National Scenic Byway, Lake Valley Back Country Byway, and US Route 180.
- High to moderate-high impacts would occur for viewers in Arizona along Cascabel Road, Redington Road, SR 77, Muleshoe Ranch Road, Black Hills Mine Road/Catalina Ridge, Webb Road, and Park Link Drive.
- Noncompliance with BLM VRM Classifications is anticipated for Class II designations in Socorro County.

Mitigation measures and BMPs would be applied to reduce visual impacts where effective and feasible. After the implementation of selective mitigation measures at various locations throughout the Project, residual impacts would be reduced to varying degrees. Mitigation measures would include site-specific structure placement, structure selection, road restoration, or other methods to minimize visual contrast in the landscape setting. In certain conditions, mitigation measures can be effective to achieve compliance with VRM objectives.

ES.4.9 Land Use and Recreation Resources

The Project would be constructed across lands owned by federal, state, private, or other entities. Approximately 36 percent of the BLM preferred alternative route would cross public lands managed by the BLM (185 miles); state lands in New Mexico and Arizona comprise approximately 43 percent (220 miles) of the route; and the remaining 21 percent (110 miles) would cross private or other land owners. Right-of-way would be acquired on these lands that are generally used for grazing, farming, recreation, and open space. BLM and state lands are

primarily used for grazing or recreation in open space areas. Residential uses are located on private lands in rural areas and near small cities and towns within the study area.

The Rio Grande Valley supports farming, tourism, and the population centers of Socorro, San Antonio, Truth or Consequences, and Elephant Butte. Other population centers within the study area include Corona, Deming, and Lordsburg. The WSMR and other military installations conduct operations in the air space surrounding the range.

In the Arizona portion of the study area, population centers include San Simon, Safford, Willcox, Benson, Vail, San Manuel, Oracle, Marana, Tucson, and Eloy. Farming is concentrated in the Sulphur Springs Valley, San Pedro River Valley, Santa Cruz River Valley, and in Pinal County. Davis-Monthan AFB, Fort Huachuca, the Western Army National Guard Aviation Training Site, and other military installations conduct training and testing operations in air space within the study area.

A major interstate utility corridor that contains transmission lines, communication facilities, and pipelines is located generally along I-10 through southern New Mexico and southeastern Arizona. Other utility corridors are located within the Rio Grande Valley, and a pipeline corridor crosses the San Pedro River Valley between Cochise and Pinal counties. Approximately 229 miles of the route would be parallel to existing transmission lines, and an additional 102 miles would be parallel to existing pipelines or designated utility corridors, including the Department of Energy West-wide Energy Corridor.

In general, land use impacts are minimized where linear utilities are constructed within established or designated corridors. The alignment of the BLM preferred alternative route was sited to maximize the use of established utility corridors, and to avoid conflicts with incompatible land uses such as wilderness, national parks and monuments, special management areas, wildlife refuges and other conservation areas, densely populated areas, and military installations. Impacts to land uses would occur along portions of the route that cross irrigated agricultural lands, residential subdivisions, and areas used for industrial or military testing and training. Mitigation measures and BMPs would be effective in avoiding or minimizing direct impacts with land uses in most conditions. There would be no direct displacement of residential, business, or industrial structures. There would be a minimal loss of grazing land.

RMPs outline BLM management guidelines, including right-of-way exclusion or avoidance designations. A proposal to construct a new utility crossing a right-of-way avoidance area could require an RMP amendment where there is no viable alternative. The BLM preferred alternative crosses avoidance areas that could require amendments within the Socorro Field Office and Mimbres (Las Cruces District Office) planning areas in New Mexico. The proposed RMP amendments provide a 400-foot-wide corridor where the Project would cross right-of-way avoidance or noncompliant VRM land classification areas.

ES.4.10 Special Designations

BLM special designations include congressionally designated national wild and/or scenic rivers; national conservation areas; national byways; and national scenic, historic, or recreation trails. Administrative designations include areas of critical environmental concern and SRMAs.

The BLM preferred alternative crosses two portions of the Johnson (Gordy's) Hill SRMA, located in the Socorro Field Office, which is used for off-highway vehicle recreation. No direct impacts to other special designations associated with the construction and operation of the Project would occur. Indirect impacts to special designations may include impacts to air quality, earth, water, visual, or other resources.

ES.4.11 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics

The BLM preferred alternative route would not cross wilderness areas or WSAs, and therefore no direct impacts would occur. Impacts to lands with wilderness characteristics inventory units for the BLM preferred alternative are not expected. Indirect or cumulative impacts may occur to air quality, earth, water, visual, or other resources, but would not be significant.

Impacts to views from Peloncillo Mountains and Rincon Mountains wilderness areas could occur. Portions of the Stallion, Veranito, Presilla, and Peloncillo mountains WSAs in New Mexico could be impacted by the Project, but due to the size and rugged terrain of these areas, there would still be ample opportunity for solitude.

ES.4.12 Social and Economic Conditions

There would be no substantial impacts to population or housing as a result of construction or operation of the Project. More than 2,800 jobs could be created (in job years) in New Mexico and Arizona during the 2- to 3-year construction period. In addition, the Project could generate revenue from increased local spending, and more than 2,200 indirect jobs could be created to supply related goods and services. During operations, approximately 150 jobs could be created.

The Project would generate revenues from income taxes and property taxes. In New Mexico, between $45 million and $46 million would be generated by income taxes, and between $13 million and $17 million could be generated in property tax revenues during construction. During operations, annual income tax revenues would be between $200,000 and $400,000, and property tax revenues would range between $35 million and $59 million.

In Arizona, between $18 million and $19 million would be generated by income taxes, and between $6 million and $13 million would be generated in property tax revenues during construction. During operations, annual income tax revenues would be between $300,000 and $700,000, and property tax revenues would range between $10 million and $25 million.

ES.4.13 Environmental Justice Conditions

Executive Order 12898 (U.S. Department of Housing and Urban Development 1994) requires federal agencies to address high and disproportionate environmental impacts on minority and low-income populations. Should potentially significant and adverse impacts attributable to the proposed Project fall disproportionately on these populations, environmental justice impacts would result. The results of the analysis for this Project indicated that no significant impacts to

environmental justice populations are expected as a result of the construction or operation of the BLM preferred alternative.

ES.4.14 Health and Safety/Hazardous Materials

An analysis was conducted to evaluate potential impacts from electrical and magnetic fields, audible noise, radio and television interference, environmental contamination, and hazardous materials related to construction, operation, and decommissioning of the proposed Project were assessed.

The study results indicated that electric field levels anticipated to occur at the Project right-of-way are projected to be below the reference levels for general public exposure, based on the International Commission on Non-Ionizing Radiation Protection. The maximum potential magnetic field levels within the right-of way would also be under the reference levels for general public exposure.

Audible noise may result from equipment and vehicles used during Project construction. Where construction would occur near populated areas, noise might be audible and result in temporary impacts and possibly considered only as a nuisance. During operation of the transmission lines and substations, audible noise levels would not exceed the Environmental Protection Agency recommended levels of 55 dBA at the right-of-way limits.

Projected levels of radio and television interference, resulting from the operation of transmission lines at the right-of-way limits for the Project, would be below the recommended levels established by the Radio Noise Design Guide and Federal Communication Commission.

Construction and operations activities would comply with all applicable federal, state, and local regulations regarding the use of hazardous substances. BMPs would be applied to ensure that applicable federal, state, and local laws are obeyed. Further, the Project owner and construction team would coordinate with land management agencies to incorporate health and safety requirements in response to accidental release of hazardous materials.

ES.4.15 Cumulative Effects

The cumulative effects analysis was conducted to identify the impacts from actions taking place in the past, present, and reasonably foreseeable future. The analysis included impacts to resources within cumulative analysis areas relevant to each resource. An energy development scenario was developed to estimate the cumulative impacts resulting from construction and operation of other energy generation and transmission projects that could benefit from increased transfer capability. This energy development scenario is based on the potential for renewable energy resource development within the cumulative analysis areas, and future demand for electricity in the Southwest.

A measure of the incremental effects of renewable energy generation is the amount of land area required for wind and solar energy development projects. Presently, it is estimated that up to 17,000 acres are used for wind generation, and up to 500 acres for solar generation in the New Mexico portion of the cumulative analysis study area. A very small amount of land area is

presently used in southeastern Arizona for renewable energy generation. It is estimated that up to 40,000 acres could be used for a combination of wind, solar, and geothermal energy development to generate the equivalent of 4,200 MW. The locations of future energy development projects are, for the most part, unknown; therefore, environmental effects would depend on the specific location of developments and the potential for mitigation.

ES.5 SCOPING, CONSULTATION, AND COORDINATION

As required by the National Environmental Policy Act of 1969 (NEPA), the BLM (in coordination with cooperating agencies) conducted scoping in the early stages of the EIS preparation, to encourage public participation and solicit agency and public comments on the scope and significance of the proposed action (40 CFR 1501.7). This scoping process was initiated in May 2009 with the announcement of upcoming public scoping meetings that requested comments or issues that should be addressed in the EIS.

Consultation and coordination with federal and intergovernmental agencies, organizations, American Indian tribes, and interested groups of individuals are important to ensure that the most appropriate data have been gathered and employed for analyses, and that agency and public sentiment and values are considered and incorporated into decision making. Throughout the preparation of the EIS, formal and informal efforts were made by the BLM to involve these groups in the scoping process and in subsequent public involvement activities, formal consultation, and review of the EIS.

ES.6 DECISIONS TO BE MADE

Approximately one-third of the Project would be located on BLM-administered public land. Other portions of the Project may be located on federal land or facilities administered by the Bureau of Reclamation (BOR), BIA, state, and private lands. Alternative routes have been considered that would include small portions of right-of-way crossing DOD land.

Where the Project would cross private and state lands, it would be subject to applicable land use planning regulations, zoning ordinances, or other requirements enforced by the state, county, or local jurisdiction, and the Applicant would need to secure any necessary permits. Acquisition of right-of-way on state lands would require application to the NMSLO or ASLD for right-of-entry and easements. Legal access or easements crossing private lands would need to be obtained from private landowners.

ES.6.1 Bureau of Land Management

The BLM must decide whether to grant or deny the right-of-way on BLM-administered public land for the construction and operation of the proposed transmission facilities, access roads, or ancillary facilities. If the decision is made to grant the right-of-way, the BLM would also decide which alternative to select; mitigation requirements, if any; and the terms, conditions, and stipulations of the grant.

The BLM must decide whether or not to amend any of the existing RMPs to achieve conformity with land use plans and allow for a grant of a major utility right-of-way for this proposed transmission line. The BLM's decision on the right-of-way grant and any associated RMP amendments would be outlined in a Record of Decision, based on the findings identified in the EIS. RMP amendments are proposed for the Socorro RMP, Socorro Field Office (2010), and the Mimbres RMP, Las Cruces District Office (1993).

ES.6.2 Bureau of Reclamation

The Project may cross federal lands administered by the BOR, including lands along the Rio Grande in New Mexico, and along the Central Arizona Project (CAP) canal in Arizona. The CAP and the Middle Gila Conservation District would require separate NEPA decisions to grant right-of-way crossing on lands under the jurisdiction of the BOR.

The BOR, with concurrence from the Middle Rio Grande Conservation District, manages conservation district land, including the Rio Grande Conveyance Channel along the Rio Grande in New Mexico. The CAP is owned by the BOR, and the Central Arizona Water Conservation District is responsible for managing land associated with the CAP.

ES.6.3 Department of Defense

The BLM preferred alternative would not require rights-of-way across DOD lands. However, alternatives have been considered that could cross DOD lands used by the Army National Guard, or BLM-administered public land that has been withdrawn from the public domain for exclusive military use by the Department of the Army. Any applications for use of rights-of-way or easements on DOD lands would require DOD approval.

ES.6.4 Bureau of Indian Affairs

The Project may cross portions of the San Carlos Irrigation Project canal system, located in the vicinity of the Picacho Reservoir in Pinal County. An encroachment permit would be required by the BIA where the proposed transmission lines cross canal rights-of-way or related facilities. A separate NEPA decision by the BIA would be required to grant right-of-way crossing a San Carlos Irrigation Project canal or other facilities.

CHAPTER 1 – INTRODUCTION

1.1 OVERVIEW

This final environmental impact statement and proposed resource management plan amendments (EIS) document has been prepared to analyze and disclose the potential effects of the proposed SunZia Southwest Transmission Project (Project). The Project would include two 500-kilovolt (kV) transmission lines and ancillary facilities that would be located on federal, state, and private lands between central New Mexico and central Arizona. SunZia Transmission, LLC (Applicant, or SunZia) has submitted an application for right-of-way to construct, operate, and maintain the Project on public land administered by the Bureau of Land Management (BLM).

Consideration of this right-of-way application is a major federal action requiring compliance with the National Environmental Policy Act of 1969 (NEPA). The BLM New Mexico State Office, as lead federal agency for this EIS, will decide whether or not to grant right-of-way for the Project based on the analyses in this EIS and on the BLM's authority to grant right-of-way on public land as established by Title V of the Federal Land Policy and Management Act of 1976 (FLPMA) (43 United States Code [USC] 1761-1771).

Cooperating agencies that contributed to the preparation of this EIS include the U.S. Army Corps of Engineers (USACE); Department of the Army, Fort Bliss; Department of the Army, White Sands Missile Range (WSMR); U.S. Air Force, Holloman Air Force Base (AFB); U.S. Fish and Wildlife Service (USFWS); U.S. National Park Service (NPS); Department of Defense (DOD) Siting Clearinghouse, Office of the Deputy Under Secretary (Installations and Environment); New Mexico State Land Office (NMSLO); New Mexico Spaceport Authority; Arizona State Land Department (ASLD); Arizona Game and Fish Department (AZGFD); Arizona Department of Transportation (ADOT); Department of the Army, Fort Huachuca; and Bureau of Indian Affairs (BIA).

The EIS includes the following documents:

- Front matter, Executive Summary, chapters 1–5, References, Glossary, and Index
- Appendices A–M (separate volume)
- Map Volume

Following the publication of the Draft EIS (May 2012), comments were received by the BLM from agencies and the public as noted in Section 1.5. Those comments, along with the BLM's responses, are summarized in Chapter 5 of this Final EIS and are included in their entirety in Appendix J. Revisions and modifications to the EIS were made, including responses to substantive comments received, and are indicated by a vertical black line in the margin of this document.

1.2 PROJECT DESCRIPTION AND LOCATION

The proposed Project would include two new, single-circuit 500 kV transmission lines located within a right-of-way up to 1,000 feet wide. The approximately 500-mile-long transmission line

route would originate at a new substation (SunZia East) in Lincoln County, New Mexico, and terminate at the Pinal Central Substation in Pinal County, Arizona. The Project may be located within Lincoln, Socorro, Sierra, Luna, Grant, Hidalgo, and/or Torrance counties in New Mexico; and Graham, Greenlee, Cochise, Pinal, and/or Pima counties in Arizona (Figure 1-1).

The Project would require new rights-of-way on federal, state, and private lands for the transmission lines; rights-of-way for new roads to access the transmission facilities may be required outside the transmission right-of-way. The Applicant applied for a lease term from the BLM for 50 years, and is evaluating options for a lease term of 50 years or greater on state and private lands. Typically, the right-of-way width would be approximately 400 feet, in order to accommodate a separation of 200 feet between the two transmission lines, but could be up to 1,000 feet wide in areas where terrain poses engineering or construction constraints. In other constrained areas, the right-of-way width could be less than 400 feet. Based on a typical span of 1,400 feet, three to four transmission line structures per mile would be required for each of the two lines; with typical structure heights of 135 feet, ranging from 100 to 170 feet. Project description details and design features are included in Chapter 2, Section 2.4.

The proposed Project would include the construction of the SunZia East Substation at the Project's eastern terminus in Lincoln County, and up to three intermediate substations on private or state lands, as follows:

- Midpoint Substation[1], located in Luna County, New Mexico
- Lordsburg Substation, located in Hidalgo County, New Mexico
- Willow-500 kV Substation, located in Graham County, Arizona

The general locations of the proposed substation sites are indicated on the study area map (Figure 1-1). These substations would provide local utilities and load centers with access to the energy transmitted on the lines. Other intermediate substations may also be considered. The Pinal Central Substation, at the Project's western terminus, has already received its regulatory permits and approvals and will be constructed by Salt River Project (SRP) and other entities.

[1] Midpoint Substation may also be referred to as SunZia South in other planning documents.

SUNZIA SOUTHWEST TRANSMISSION PROJECT

Project Features

- Study Area
- Proposed SunZia 500 kV Substation Site
- Other 500 kV Substation

General Reference Features

- City
- State Highway
- U.S. Highway
- Interstate
- Lake/Reservoir

Land Ownership

- Bureau of Land Management
- U.S. Department of Defense
- McGregor Range Withdrawal
- National Park Service
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- U.S. Bureau of Reclamation
- Federal (Other)
- Indian Reservation
- State
- Private/Other

Sources

Arizona Bureau of Land Management 2010
Arizona State Land Department and ALRIS 2010
New Mexico Bureau of Land Management 2009
ESRI StreetMap 2010
EPG, Inc. 2010

Scale in Miles
0 5 10 20 30 40

N

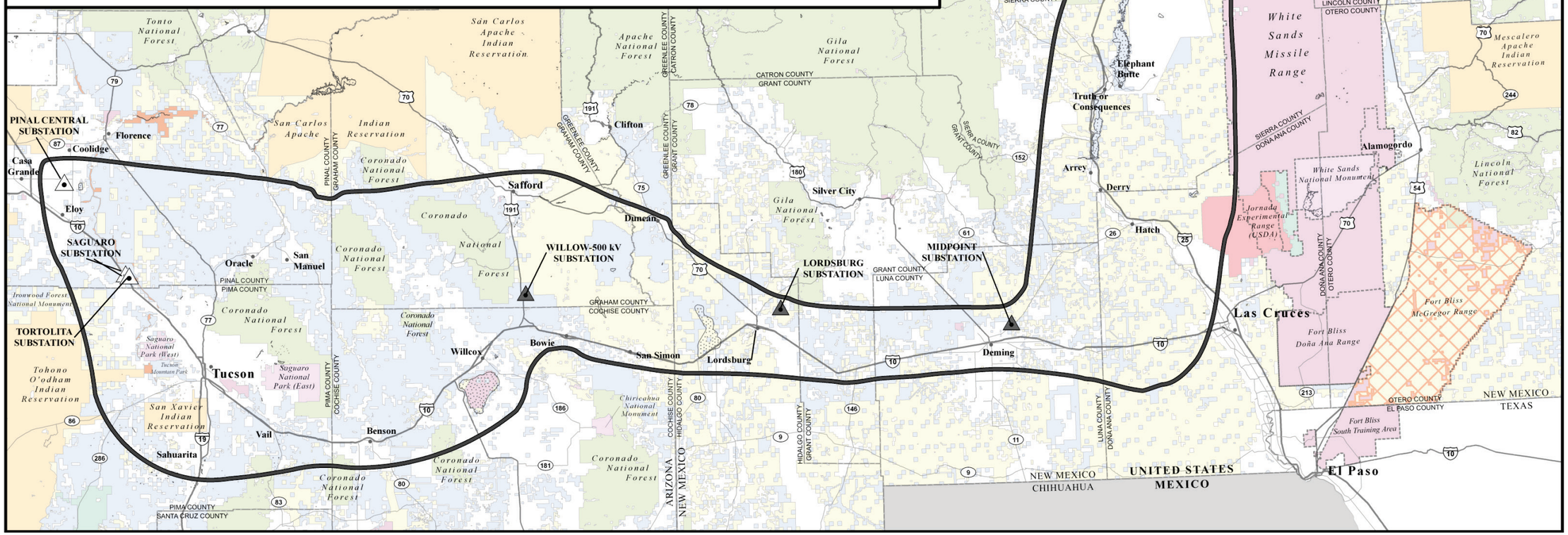


Figure 1-1. Study Area

This page intentionally left blank.

At least one of the two 500 kV transmission lines would be constructed and operated as an alternating current (AC) facility; the other transmission line could be either an AC or direct current (DC) facility. The sequence of whether the first line will be constructed and operated as a DC facility will depend on the power transfer requests made on the Project by SunZia's transmission service customers. Depending on the configuration, the Project could provide up to 4,500 megawatts (MW) of additional transfer capability on the regional electrical grid[1].

1.3 BLM'S PURPOSE AND NEED

The BLM's purpose and need for the proposed Project is established by regulatory obligations and directives, and current energy development trends. The purpose and need is used to formulate a reasonable range of alternatives to be considered in the EIS. The need for the BLM's proposed action arises from the FLPMA, which establishes a multiple use mandate for management of federal lands, including energy generation and transmission facilities as outlined in Title V of the FLPMA. The BLM's action in considering the Applicant's right-of-way application is provided under the authority of the Secretary of the Interior to "grant, issue, or renew rights-of-way…for generation, transmission, and distribution of electric energy" (43 Code of Federal Regulations [CFR] 2800). Specifically, the need for the BLM's proposed action is established by the BLM's responsibility under FLPMA to respond to SunZia's application for a new utility right-of-way.

Pursuant to 43 CFR 2801.2, it is the BLM's objective to grant rights-of-way and to control their use on public lands in a manner that: (a) protects the natural resources associated with public lands and adjacent lands, whether private or administered by a government entity; (b) prevents unnecessary or undue degradation to public lands; (c) promotes the use of rights-of-way in common, considering engineering and technological compatibility, national security, and land use plans; and (d) coordinates, to the fullest extent possible, all BLM actions under the regulations in this part with state and local governments, interested individuals, and appropriate quasi-public entities.

Government and industry experts have long recognized the need for the transmission siting and permitting process to better keep pace with the necessary infrastructure upgrades associated with projected development and electrical load growth. The Energy Policy Act of 2005 (EPAct) recognizes the disparity between energy supply and demand and the need for additional transfer capability, and establishes a number of associated agency directives and deadlines. The EPAct addresses the need for transmission facilities, through agency directives, to (1) establish designated energy right-of-way corridors on federal land (sometimes now referred to as Section 368 corridors), via interagency collaboration; (2) ensure ongoing efforts to identify and designate additional corridors, as needed; (3) expedite applications to construct or modify transmission facilities; (4) identify areas of transmission congestion; and (5) amend relevant land use plans and resource management plans (RMP) to include new and existing energy right-of-way corridors.

[1] A 500 kV AC transmission line would provide approximately 1,500 MW of transfer capability; a 500 kV DC line would provide approximately 3,000 MW.

The need for upgraded infrastructure to carry renewable and traditional energy also has been a focus of recent economic stimulus legislation and debate. As President Obama discussed the proposed American Recovery and Reinvestment Plan that was signed into law[1], he stated that "to accelerate the creation of a clean energy economy, we will double our capacity to generate alternative sources of energy like wind, solar, and biofuels over the next three years" [and build] "transmission lines to convey this new energy from coast to coast" (Obama 2009). The Renewable Energy Order (Secretarial Order 3285A [Salazar 2010])—which makes the production, development, and delivery of renewable energy a top priority—along with the energy goals of the EPAct, supports the need for the Project because its implementation would encourage the development of additional renewable generation sources. The BLM recognizes the need for upgraded and new electricity transmission and distribution facilities to improve reliability, relieve congestion, and enhance the capability of the national grid to deliver electricity, as directed in the EPAct.

The BLM must consider existing RMPs in the decision to issue a right-of-way grant, in accordance with 43 CFR Part 1610.0-5(b). RMPs allocate public land resource use and establish management objectives (applicable RMPs are listed in Chapter 2, Table 2-16). Portions of the proposed transmission line alternatives are not in conformance with several RMPs; therefore, amendments to these plans are analyzed as part of the route alternatives. To the extent practicable and consistent with the laws governing the administration of public lands, the BLM must coordinate the land use inventory, planning, and management activities with other federal departments and agencies, and with the states and local governments, in accordance with the FLPMA (Public Law [PL] 94–579, Section 202 (c) 9).

1.4 APPLICANT'S OBJECTIVES

The Applicant's objectives are to increase transfer capability, thereby relieving existing transmission congestion and allowing additional electricity to be generated and transported to western power markets and load centers in the Desert Southwest. The Project would be colocated with areas of undeveloped renewable resource potential to provide a path for energy delivery, and would provide power to help meet growing demand in the western United States and enhance domestic energy security.

The Applicant group comprises load-serving utilities and independent developers. The Project would assist load-serving utilities in meeting the requirements to address energy delivery obligations and meet state renewable portfolio standards (RPS). The independent developers' purpose for the Project is to create a market opportunity to satisfy transmission needs that have been identified at local, regional, and national levels.

In 2009, the U.S. Department of Energy (DOE) studied transmission corridors to identify areas of congestion, including areas where development of new renewable generation resources was inhibited by insufficient transmission facilities or transfer capability. The report identified the key transmission path in southern New Mexico as one of the most heavily used and congested transmission paths in the West (DOE 2009).

[1] American Recovery and Reinvestment Act of 2009 (26 USC 1)

New Mexico and Arizona are characterized as regional power exporting areas, due to the availability of power from renewable resources in excess of the power consumption in each state. The DOE reported that the transmission path in southern New Mexico was highly congested in 2006, and remained highly congested at publication of their National Electric Congestion Study in 2009 (*ibid*). Power flows and congestion would be expected to increase with the development of additional resources and a lack of additional transmission facilities. This congestion is anticipated with the implementation of RPS, which many states have established to help promote the development of renewable energy by requiring electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date. Within the Desert Southwest, Arizona's RPS is 15 percent by 2025; California's RPS is 20 percent by 2010 and 33 percent by 2020; Nevada's RPS is 20 percent by 2015; and New Mexico's RPS is 20 percent by 2020 (California Public Utilities Commission [CPUC] 2011; DOE 2011). Table 1-1 provides the forecast of additional energy that would be required to meet the RPS in these states (identified as Net Short), and the transfer capability that would be needed if these energy standards were to be met entirely by solar or wind projects for the forecast years 2015, 2020, and 2025, respectively.

Table 1-1. Renewable Energy and Transfer Capability Needed to Meet State RPS

State	RPS (%)	Forecast "Net Short" Renewable Energy (GWh[1,2])	Necessary Transfer Capability (100% of "Net Short" Developed as Solar [MW[3]])	Necessary Transfer Capability (100% of "Net Short" Developed as Wind [MW[4]])
2015				
Arizona	5	6	3	2
California	25	26,066	11,902	8,502
Nevada	20	93	42	30
New Mexico	15	2,122	969	692
2015 Total		**28,287**	**12,916**	**9,226**
2020				
Arizona	10	791	361	258
California	33	53,030	24,215	17,296
Nevada	22	1,178	538	384
New Mexico	20	3,655	1,669	1,192
2020 Total		**58,654**	**26,783**	**19,130**
2025				
Arizona	15	4,702	2,147	1,534
California	33	59,048	26,963	19,259
Nevada	25	2,855	1,304	931
New Mexico	20	4,189	1,913	1,366
2025 Total		**70,794**	**32,327**	**23,090**

[1] Based on forecasts of major utilities' retail sales in the indicated year (data obtained in October 2010)
[2] On average, major utilities in Arizona, Nevada, and New Mexico account for approximately 85% of total retail sales
[3] Assumes average capacity factor of 25%
[4] Assumes average capacity factor of 35%
Note: Necessary transfer capability could be provided through the existing transmission system, if available, or through new transmission system additions.
Source: SunZia 2010

The DOE report characterizes the need to resolve current transmission congestion as "urgent," as demonstrated by the large number of both wind and solar projects that have applied for interconnection to the transmission grid, but that cannot be built due to insufficient transfer capability (DOE 2009). The Western Renewable Energy Zone study identified 11,300 MW of potential wind resources near the eastern terminus of the Project and 10,500 MW of solar potential in southeast Arizona and southwest New Mexico, but notes that "lack of cost effective transmission access was, and remains, the greatest impediment to the rapid development" of these resources (Western Governors' Association [WGA] and DOE 2009). In 2006, the Southwest Area Transmission presented the concept that new 500 kV transmission would be required between southern New Mexico and southern Arizona, to support New Mexico's potential as an energy exporting state, based on abundant wind and solar potential (SWAT 2006).

The need for increased available transfer capability has been identified at federal, regional, and state levels. New regional transmission lines could facilitate renewable resource development and the distribution of power to load centers throughout the Desert Southwest, helping to meet federal objectives to relieve transmission congestion, increase renewable energy production on public land by 2015 (EPAct 2005), and meet various state RPS.

The Project is needed to increase available transfer capability in an electrical grid that is currently insufficient to support the development, access, and transport of additional energy-generating resources, including renewable energy, in New Mexico and Arizona. The Applicant submitted an application for a right-of-way from central New Mexico to southeastern Arizona, and thus the purpose and need outlined herein are within that general geographical frame of reference. Federal Energy Regulatory Commission (FERC, or Commission) Order 888 provides that owners of transmission facilities make such services available on the open market. Transmission facility services are to be provided on a nondiscriminatory, comparable basis to others seeking similar services, including ancillary services (as defined by the North American Electric Reliability Corporation [NERC]) such as: scheduling, system control, dispatching, reactive supply, voltage control, frequency response, regulation, energy imbalance, spinning reserve, and supplemental reserve (FERC 2005).

SunZia's merchant owners, in the Order on Petition for Declaratory Order (May 24, 2011), have been allowed to negotiate how ancillary services are to be provided within its transmission service agreements. SunZia is not obligated to provide firming[1] and other ancillary services, and may provide in its transmission service agreements that the buyer of the transmission service provide other ancillary services. Paragraph 31 of this Order states:

Under the Commission's policies, transmission providers must offer or provide ancillary services under their Open Access Transmission Tariffs (OATT). However, the Commission has recognized that this may not be practical in some instances, such as when a merchant transmission developer does not own generation and therefore lacks the means to offer or provide generation-based ancillary services. Thus, the Commission has found that to the extent a merchant transmission developer is not in a position to offer or provide ancillary services, it should negotiate in the transmission service agreements it enters into with its customers as to

[1] The act or process of ensuring that a given amount of energy is available for consumption or transmission at a given moment.

how ancillary services for the project will be supplied. SW Power, ECP SunZia, and Shell WindEnergy commit to do so (135 FERC ¶61169).

The Project would be open to all interconnection requests; however, it is the intent of the Applicant to provide infrastructure to increase transfer capability in areas of potential renewable energy generation. Increasing interstate transfer capability and access to renewable resources is needed to meet federal energy policy objectives, such as the EPAct of 2005, as well as state RPS.

Several proposed generation projects have provided interconnection requests to existing transmission owners (utilities) within the Project area. Table 1-2 summarizes the generation interconnection requests that were in the queue for several local utilities as of September 15, 2011. These interconnection requests include future generation projects that would have an option to connect to the existing transmission system operated by the local utilities, or connect to the Project. This information is representative of the interest to develop generation projects, including primarily renewable energy, within the Project area.

Table 1-2. Summary of Generation Interconnection Requests to Existing Transmission Owners within the Project Area

Transmission Owner	Total Amount of Proposed Generation (MW)	Type of Generation
El Paso Electric Company	771	Wind and Solar
Public Service Company of New Mexico	5,614	Wind and Solar
Tucson Electric Power	1,250	Wind, Solar, and Natural Gas
Tri-State Generation and Transmission Cooperative	50	Wind and Solar
Total	**7,685**	

Source: WestConnect 2011

Note: Interconnection request queue information gathered on September 15, 2011 from www.westconnect.com and individual OASIS information for the respective transmission owners. These generators filed requests for interconnection with existing transmission owners with the full knowledge that FERC could and would compel provision of transmission interconnection and service by such transmission owners to requesting generators subject to FERC Order 888.

Pursuant to FERC Order 888, it is noted that the locations of individual proposed projects or transmission line interconnections cannot be identified to third parties by transmission owners.

1.5 SCOPING AND PUBLIC INVOLVEMENT

The EIS process was formally initiated on May 29, 2009, with a publication in the *Federal Register* of the Notice of Intent (NOI) to prepare an EIS. Publication of the NOI also marked the beginning of a 45-day public scoping period, during which time nine public scoping meetings were held. In response to public comments, the Project study area was expanded twice, and additional scoping periods and public meetings were held in October 2009 and April 2010. Overall, approximately 500 people attended the three sets of scoping meetings and approximately 1,400 comment submittals were received. The scoping process is described in

detail in Chapter 5 of this EIS, and in the *SunZia Southwest Transmission Project EIS Scoping Report* (Scoping Report), which is available on the BLM Project website[1].

The intent of scoping is to identify important issues related to a proposed action and its alternatives. The identification of issues helps agencies to focus their analysis and often facilitates in the development of alternatives. During Project scoping, issues related to engineering and design, land use and recreation, social and economic conditions, and biological, visual, cultural, and earth and water resources were identified and used to locate, refine, and evaluate alternative routes and substation sites. Table 1-3 provides a representation of issues identified during scoping, and indicates where these issues are addressed in the EIS. A complete summary of issues identified during scoping, including those issues that are not addressed in the EIS, is provided in the Project Scoping Report (BLM 2010a).

Table 1-3. Summary of Issues from Scoping

Issues	Where Addressed in EIS
Purpose and Need • BLM's purpose and need • Applicant's objectives	Chapter 1, Sections 1.3, 1.4
Project Engineering and Design • Issues with engineering and construction constraints, including construction on mountainous terrain, proximity to gas lines and other hazards, and line burial	Chapter 2, Section 2.4.12 Chapter 3, Section 3.3 Chapter 4, Section 4.3
Corridor Alignment and Alternatives • Concerns regarding routes in and near to the following areas (for various resource concerns): Eloy, San Pedro River Valley, Galiuro Wilderness, Sunset Mountain, Sulphur Springs Valley, Aravaipa Valley/Klondyke, Cluff Ranch, Mt. Graham/Safford, US Route 191 south of Safford, Deming, Bosque del Apache National Wildlife Refuge/San Antonio, and Rio Grande Corridor, WSMR, Fort Bliss, Buffalo Soldier Electronic Proving Ground*	Chapter 2, Sections 2.2, 2.3 Chapter 3, all Chapter 4, all
Earth and Water Resources • Increase of sedimentation in rivers • Potential impacts from soil erosion • Alteration of watersheds and associated habitat and wildlife	Chapter 3, Sections 3.3, 3.5, 3.6 Chapter 4, Sections 4.3, 4.5, 4.6
Biological Resources • Impacts on wildlife habitat, particularly on raptor nesting habitat • Impacts on migratory birds and waterfowl near the Rio Grande corridor, Bosque del Apache National Wildlife Refuge, and San Pedro River • Impacts to Sandhill Cranes through Sulphur Springs • Impacts to Chihuahuan Desert and Nutt Grasslands • Invasive and noxious weed species and mitigation measures • Habitat loss and fragmentation • Wildlife mortality associated with construction activities and vehicle traffic • Creation of avian collision hazards • Increased public access on access roads • Impacts to Aravaipa Canyon and fish (Spikedace and Loach Minnow are	Chapter 3, Section 3.6 Chapter 4, Section 4.6

[1] http://www.blm.gov/nm/st/en/prog/more/lands_realty/sunzia_southwest_transmission.html

Table 1-3. Summary of Issues from Scoping	
Issues	**Where Addressed in EIS**
federally threatened fish located in Aravaipa creek), bird, tortoise, and Bighorn Sheep species that exist in its watershed • Impacts to Silvery Minnow in the Rio Grande • Impact on breeding habitat for Southwestern Willow Flycatcher	
Cultural Resources • Potential impacts on cultural resources, including prehistoric and historic sites and districts, historic structures and trails, cemeteries, national parks and monuments, and state parks • Impacts to archaeological sites in San Pedro River Valley, Aravaipa Valley, and along the Rio Grande • Concern regarding San Pedro River Valley as a "low" sensitivity area • Religious significance of Sunset Mountain	Chapter 3, Section 3.8 Chapter 4, Section 4.8
Tribal Concerns • Tribal values, traditional cultural properties • Impacts on tribal ruins, burial grounds, plant gathering, and traditional use areas near Mt. Graham and Safford • Impacts to tribal pueblo ruins along the Rio Grande	Chapter 3, Section 3.8.4 Chapter 4, Section 4.8
Visual/Scenic Resources • Impacts to sensitive viewing areas, including travel routes, National Park and Monument units, recreation areas, residences, and the aesthetic values in San Pedro River Valley, Aravaipa Canyon, Socorro Valley, Picacho Mountains, Coronado National Forest, US Route 191 south of Safford	Chapter 3, Section 3.9 Chapter 4, Section 4.9
Land Use and Recreation • Conflicts with current land use plans • Impacts to wilderness areas (including Bosque del Apache Wilderness Area and Galiuro Mountains) for recreationists and wildlife • Impacts to livestock grazing and ranching • Impacts to property values • Conflicts with increased off-highway vehicle use along construction access roads • Conformance with municipal/county general plans and master plans • Impacts to rangeland infrastructure • Impacts to military training, testing, and the operational readiness of the White Sands Missile Range, Holloman AFB, Fort Bliss, and Fort Huachuca (Buffalo Soldier Electronic Proving Ground)	Chapter 3, Sections 3.10, 3.11, 3.12 Chapter 4, Sections 4.10, 4.11, 4.12
Social and Economic Conditions • Impacts to rural lifestyle and livelihood for ranchers, recreationists, hikers, and photographers, et al. • Impacts to tourism industry and economy along the Rio Grande and Aravaipa Valley and San Pedro River Valley • Job creation and economic activity • Impacts on the desire for people to live in central New Mexico	Chapter 3, Section 3.13 Chapter 4, Section 4.13
Environmental Justice • Impacts to potential environmental justice populations in San Antonio, New Mexico or other areas	Chapter 3, Section 3.14 Chapter 4, Section 4.14
*also called the Buffalo Soldier Electronic Test Range or BSETR	

After the Draft EIS was completed, the Notice of Availability (NOA) was published in the *Federal Register* by the U.S. Environmental Protection Agency (EPA) on May 15, 2012, and by

the BLM on May 29, 2012, requesting that the public review and comment on the Draft EIS/RMP Amendment. The documents and supporting information were made available for access on the BLM Project website, and printed copies were distributed to BLM and cooperating agency offices, libraries, and individuals who requested copies. Ten open-house meetings were hosted by the BLM in New Mexico and Arizona in June and July of 2012 that allowed the public to learn about the proposed Project, participate in the BLM's decision-making process, and develop substantive written comments. Comments were received by the BLM New Mexico State Office during a 90-day review period that ended on August 22, 2012. Additionally, substantive comments that were received through March 2013 were considered in preparation of the Final EIS. The summary of comments and responses is included in Chapter 5 – Consultation and Coordination.

1.6 LEAD AND COOPERATING AGENCIES

The BLM, through its New Mexico State Office, is the lead federal agency responsible for preparing this EIS and associated analyses. As lead agency, the State Office is responsible for consultations required by Section 7 of the Endangered Species Act of 1973 (ESA), as amended, and Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended, and all other relevant federal laws.

The Project area includes lands administered by four BLM offices in New Mexico (Las Cruces District Office, Socorro Field Office, Rio Puerco Field Office, and Roswell Field Office) and two BLM offices in Arizona (Tucson Field Office and Safford Field Office).

Cooperating agencies include those federal, state, or local agencies that have jurisdiction by law and/or special expertise (CFR 40 Section 1508.5). Those with jurisdiction by law can make a decision to approve or deny all or part of the Project based on the analysis in this EIS, while those with special expertise or information will assist in development of the analysis. In April 2009, the BLM sent letters to various federal and state agencies, and tribal governments inviting participation as a cooperating agency in preparation of the EIS. A list of agencies is included in the April 2010 Scoping Report. Fourteen agencies have accepted: USACE; Department of the Army, Fort Bliss; Department of the Army, WSMR; U.S. Air Force, Holloman AFB; USFWS; NPS; DOD Siting Clearinghouse, Office of the Deputy Under Secretary (Installations and Environment); NMSLO; New Mexico Spaceport Authority; ASLD; AZGFD; ADOT; Department of the Army, Fort Huachuca; and the BIA.

1.7 GOVERNMENT-TO-GOVERNMENT, TRIBAL CONSULTATION

In May 2009, the BLM contacted 21 tribes to notify them of the Project, initiate consultation, and invite them to participate as cooperating agencies in preparation of the EIS (see Chapter 5, Section 5.3). Initial consultation meetings were held with the Four Southern Tribes of Arizona (Tohono O'odham Nation, Salt River Pima-Maricopa Indian Community, Gila River Indian Community [GRIC], and Ak-Chin Indian Community); Pueblo of Zuni; Pueblo of Isleta; and the Fort Sill, Mescalero, White Mountain Apache, and San Carlos Apache tribes. With the inclusion of alternatives north of the Gran Quivira unit of Salinas Pueblo Missions National Monument (Gran Quivira), additional tribes were contacted by the BLM in April 2012. In recognition of the special relationship with the United States government, the BLM will continue to consult with

the appropriate tribal governments at an official, executive level (government-to-government); in accordance with the NHPA, Executive Order (EO) 13175, and NEPA. The BLM will continue to provide opportunities for tribal involvement throughout the Project development process. As milestones occur within the Project, the BLM will be providing the tribes additional information and opportunities to participate.

The tribes were notified so that they could review the Draft EIS and provide comments, and subsequent to the release of the Draft EIS, additional consultation meetings were held. The project-specific Programmatic Agreement (PA) for the Project will provide opportunities for the tribes to review and comment on reports and on the Native American Graves Protection and Repatriation Act (NAGPRA) Plan of Action, and offer information about sensitive tribal resources. The Draft PA is provided in Appendix M of this Final EIS. Coordination addresses (1) consistency with tribal plans, as appropriate; and (2) observance of specific planning consultation authorities, including Section 101(d)(6) of the NHPA, American Indian Religious Freedom Act, EO 13007 (Indian Sacred Sites), EO 12898 (Environmental Justice), and Secretarial Order 3206 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the ESA).

1.8 MAJOR AUTHORIZING LAWS AND REGULATIONS

The FLPMA is the primary legal basis for authorizing a right-of-way grant on BLM land. This EIS is being prepared by the BLM in compliance with the NEPA; Council on Environmental Quality (CEQ) regulations for implementing the NEPA; FLPMA; and U.S. Department of the Interior (DOI) and BLM policies and manuals, including the BLM NEPA Handbook (BLM 2008a). Other applicable regulations and guidelines are listed in Table 1-4. Note that this list is not all-inclusive.

Table 1-4. Major Federal Authorizing Laws, Regulations, and Guidelines

Law and Regulation	Reference
American Indian Religious Freedom Act of 1978	42 USC 1996
Antiquities Act of 1906	16 USC 431 et seq.
Archaeological Resources Protection Act, as amended	16 USC 470aa et seq.
BLM NEPA Handbook H-1790-1 (2008)	BLM Manual Rel. 1-1710
BLM Planning Handbook H-1601-1 (2005)	BLM Manual Rel. 1-1693
BLM Planning Regulations	43 CFR 1600 et seq.
BLM Right-of-Way Regulations	43 CFR 2800
Canal Act of 1890	43 USC 945
Clean Air Act	42 USC 7401 et seq.
Clean Water Act	33 USC 1251 et seq.
Comprehensive Environmental Response, Compensation, and Liability Act	42 USC 9601-9675
Consultation and Coordination with Indian Tribal Governments	EO 13084
Consultation and Coordination with Indian Tribal Governments	EO 13175
Departmental Responsibilities for Indian Trust Resources	512 DM 2.1
Endangered Species Act	16 USC 1531 et seq.
Environmental Justice	EO 12898
Federal Compliance with Pollution Control Standards	EO 12088

Table 1-4. Major Federal Authorizing Laws, Regulations, and Guidelines	
Law and Regulation	**Reference**
Federal Land Policy and Management Act of 1976	USC 1701 et seq.
Floodplain Management	42 USC 4321 EO 11988
Bald and Golden Eagle Protection Act of 1940, as amended	16 USC 668-668c
Indian Sacred Sites	EO 13007
Memorandum for the Heads of Executive Departments and Agencies on Government-to-Government Relations with Native American Tribal Governments of 1994	Signed by President Clinton on April 29, 1994
Migratory Bird Treaty Act	16 USC 703-711; EO 13186
National Environmental Policy Act, Protection and Enhancement of Environmental Quality	42 USC 4321 et seq., CEQ; 40 CFR 1500-1508
National Historic Preservation	EO 11593
National Historic Preservation Act of 1966, as amended	16 USC 470 et seq., 36 CFR 800
National Trails System Act of 1968	USC § 1241 et seq., as amended
Native American Graves Protection and Repatriation Act of 1990	25 USC 3001-30013 et seq., 43 CFR 10
Noise Control Act of 1972, as amended	42 USC 4901 et seq.
Noxious Weeds and Invasive Species	EO 13112
Occupational Safety and Health Act of 1970	29 USC 651 et seq.
Pollution Prevention Act of 1990	42 USC 13101 et seq.
Protection of Wetlands	42 USC 4321 EO 11990
Resource Conservation and Recovery Act	42 USC 6901-6992k
Responsibilities and the Endangered Species Act, Secretarial Order 3206	June 5, 1997
Safe Drinking Water Act of 1974	42 USC 300f et seq.
U.S. DOI, NEPA implementing procedures and proposed revisions	73 FR 200
Wilderness Act of 1964	16 U.S.C. 1131-1136, 78 Stat. 890
DM – Department Manual et seq. – and the following FR – *Federal Register*	

1.9 RELATIONSHIP TO OTHER POLICIES, PLANS, AND PROGRAMS

1.9.1 Policies, Plans, and Programs on Federal Lands

Approximately one-third of the Project would be located on BLM-administered public land. Other portions of the Project may be located on federal land managed by the Bureau of Reclamation (BOR), Arizona and New Mexico state trust lands, and private lands. A Land Use License would be required for utility rights-of-way crossing canals managed by the Middle Rio Grande Conservation District and Central Arizona Project (CAP), in concurrence with the BOR as indicated in Section 1.10.2.

While the construction and operation of the BLM preferred alternative would not require rights-of-way across any other federal lands other than BLM and BOR; the policies, plans, and programs of other federal land management agencies have been reviewed with respect to their consistency with the proposed Project. Other federal agencies in proximity to the proposed Project include the NPS, USFWS, U.S. Forest Service (USFS), and the DOD (Departments of Army, Air Force, Marines, Navy, National Guard). Alternative routes have been considered that

would include small portions of right-of-way across DOD land, but the BLM preferred alternative would not require right-of-way across DOD land.

Although rights-of-way for the proposed Project would not be required on federal land managed by agencies other than the BLM and BOR, the impact assessment in this EIS addresses potential direct, indirect, and cumulative impacts to potentially affected agencies' plans, policies, and programs (Chapter 4 – Environmental Consequences). The results of this review indicate that construction and operation of the Project would be consistent with the policies, plans, and programs of the NPS, USFWS, BOR, and USFS.

Planning documents pertaining to military installation policies, plans, and programs were reviewed in consideration of the DOD's future mission and operational needs. These included WSMR, Holloman AFB, Fort Bliss, Fort Huachuca (Buffalo Soldier Electronic Proving Ground [also called the Buffalo Soldier Electronic Test Range, or BSETR]), and Davis-Monthan AFB. The Project would not directly affect any of the existing or planned uses within the boundaries of these military installations and DOD lands; however, the WSMR and BSETR have indicated that the Project could be inconsistent with future plans to conduct testing or training on, or within the airspace above, BLM, state, or private lands. The discussion of impacts to military operations and mitigation is included in Section 4.10.6 of this EIS.

1.9.2 BLM Resource Management Plans

Under the principles of the FLPMA, the BLM manages public land for both multiple use and sustained yield; meaning that both present and future needs are considered in the management of resources. The BLM's plans to achieve these goals are documented in land use plans or RMPs.

Utility corridors are designated as such by federal, state, or county agencies, but are usually determined through coordination between multiple agencies to help ensure continuity of the corridors between different jurisdictions or land ownership. The DOE West-wide Energy Corridors were created by Section 368 of the EPAct, which directs the secretaries of Agriculture, Commerce, Defense, Energy, and the Interior to designate corridors on federal land in 11 western states. Where applicable, West-wide Energy Corridors have been included in RMP amendments. Existing West-wide Energy Corridors and their proximity to the subroutes are described in Appendix E3.

Portions of the Project alternatives follow existing utility corridors established by the Las Cruces BLM Field Office, although BLM utility corridor designations have not been established in other RMP field office planning areas that contain the Project's preferred route or alternative corridors. Where construction and operation of the proposed Project could be inconsistent with BLM plans, RMP amendments have been proposed and are identified in Chapter 2, Section 2.6 of this EIS.

The BLM land use planning documents applicable to the proposed Project are summarized below.

1.9.2.1 New Mexico

- *Las Cruces District Office, Mimbres Resource Management Plan* (BLM 1993). This plan was prepared to formally record the BLM's decisions for managing approximately 3 million acres of public land in Doña Ana, Grant, Luna, and Hidalgo counties.[1]
- *Las Cruces District Office, White Sands Resource Area Resource Management Plan* (BLM 1986). This plan established land use decisions, terms, and conditions for guiding and controlling future management actions in Sierra and Otero counties.[2]
- *Rio Puerco (Albuquerque) Resource Management Plan Revision and Environmental Impact Statement* (BLM 1985). This plan was prepared to formally record the BLM's decisions for managing approximately 8.6 million acres of land, including 896,480 acres of public land in Bernalillo, Cibola, Torrance, Valencia, Sandoval, McKinley, and Santa Fe counties.
- *Roswell Field Office, Roswell Resource Management Plan and Record of Decision* (BLM 1997). This plan was prepared to address the management of all uses of approximately 1.5 million acres of public land within Chaves, Lincoln, De Baca, Roosevelt, Curry, Quay, and Guadalupe counties in southeastern and east-central New Mexico.
- *Socorro Field Office, Socorro Resource Management Plan and Record of Decision* (BLM 2010b). This plan was prepared to allocate resources and provide a comprehensive framework for the BLM's management of 1.5 million acres of public land within Socorro and Catron counties.

1.9.2.2 Arizona

- *Phoenix, Tucson, and Safford Field Offices, Phoenix Resource Management Plan and Final Environmental Impact Statement* (BLM 1988a). This plan was developed to guide the BLM in its management of the Phoenix Resource Area, which consists of approximately 911,000 acres of public land within two distinct geographic regions of Arizona, and includes portions of Pima and Pinal counties located within the Project study corridors.
- *Gila District Office, Safford District Resource Management Plan and Environmental Impact Statement* (BLM 1991). This plan was prepared to guide the management of 1.4 million acres of public land in the Gila District (southeastern Arizona), including Graham, Greenlee, Cochise, Pinal, Pima, and Gila counties.
- *Safford Field Office, Environmental Assessment/Gila Box Riparian National Conservation Area Management Plan* (BLM 1998a). This plan was prepared for the appropriate management of the Gila Box Riparian Area for a term of 15 years (from 1998). The planning area includes portions of Graham and Greenlee counties.

[1] The TriCounty RMP and Draft EIS was recently completed and, when approved, it will amend the 1993 Mimbres RMP.
[2] The TriCounty RMP and Draft EIS was recently completed and, when approved, it will revise the 1986 White Sands RMP.

- *Tucson Field Office, Muleshoe Ecosystem Management Plan and Environmental Assessment* (BLM 1998b). This plan was prepared to manage the riparian areas and associated aquatic, plant, and animal communities.

1.9.3 Local, Regional, and State Policies, Plans, and Programs

The BLM also identified and reviewed plans from other jurisdictions in New Mexico and Arizona. General and comprehensive plans for potentially affected cities, counties, or other jurisdictions within the Project area were reviewed to identify relevant policies and projected or future land uses (individual plans are listed in Chapter 3, Section 3.10.4). It is anticipated that construction and operation of the Project would be consistent with city or county policies, programs, and comprehensive or general plans that have been identified within the Project area. (Potential inconsistencies with private land use development plans were identified, and impacts to such future land uses have been documented in Section 4.10 of this EIS.)

The Sonoran Desert Conservation Plan (SDCP) and Conservation Lands System (CLS) were integrated with the Pima County Comprehensive Plan in 2001. The SDCP provides the framework for a multiple species conservation plan to support an incidental take permit for species listed under the ESA. The CLS is designed to protect biodiversity and provide land use guidelines consistent with the conservation goal of the SDCP, and policies and strategies under this plan element are designed to have county-wide applicability. The CLS identifies various conservation categories, including Important Riparian Areas, Biological Core Management Areas, and Multiple Use Management Areas. Potential impacts to biological resources and mitigation measures have been identified in Section 4.6 of this EIS. It is anticipated that mitigation measures would be implemented during construction and operation of the Project that would address the policies and programs of the SDCP, by incorporating SDCP objectives and guidelines in the Project's Plan of Development (POD).

In addition to city and county plans, the BLM reviewed the Redington Natural Resource Conservation District (NRCD) Plan (2010) and the Land Management Plan of the Winkelman NRCD (revised 2010). The majority of the land area potentially affected by the Project within the Redington and Winkelman NRCD boundaries is Arizona State Trust or private land, and a minimal amount of federal land. Although the NRCDs have no direct jurisdiction through land ownership, each offers guidance to private landowners, the ASLD, and federal agencies regarding the use of those lands through their planning and coordination process. The BLM coordinated with the Redington and Winkelman NRCDs during the Draft EIS process, including the review of scientific data, plans, and policies, and participation in seven meetings with the NRCDs (meeting dates are listed in Chapter 5, Section 5.2.4, Table 5-4).

The Redington NRCD's *Long Range Natural Resource Conservation Plan, 2010-2016*, includes management recommendations adopted in response to the NRCD's major concerns and objectives (Redington NRCD 2010). These include measures to control or mitigate the effects of soil erosion and sedimentation (design and construction practices), upland vegetation (grazing practices), water availability/quantity, water quality (best management practices [BMPs]), noxious and invasive plants, wildlife, and fish (discourage habitat fragmentation, education), and conservation planning/education. As stated by the NRCD, "Our present priorities are to improve water quality by reducing soil erosion and sedimentation; improve rangelands by planning and

applying better management practices; and by testing grasses and other planting programs; follow-up with cooperators to insure [sic] the effectiveness of the District program." The Redington NRCD also issued the Major Utility/Transportation/Communication Corridors Policy, which states that "(It) is the policy of the (Redington NRCD) to oppose the construction of any new major energy, transportation, or communication corridors through the Redington NRCD. In order to minimize impacts of such actions all future construction of such corridors should be along existing corridors of similar capabilities that would only require an upgrade from what currently exists." The Redington plan also includes the following management directive: "The District will invoke *coordination* with any federal or local agency and or federal/local government body connected with the Federal Land Policy and Management Act in order to coordinate future actions within the district. Those actions and management plans should coordinate and be consistent with this long range plan."

The Winkelman NRCD's *Land Management Plan* includes actions that provide guidance and assist rural property owners, farmers, and ranchers in the "protection, restoration, and conservation of land, water, and soil resources…" (Winkelman NRCD, revised 2010). The plan further states that "the District will assist private property owners in conserving natural resources, fish and wildlife and their habitat, rivers, and streams and associated riparian habitats, protecting the tax base, protecting public lands, and assisting private property owners to make viable and responsible use of their private lands." Several coordination actions are listed, including early involvement with agencies regarding issues that (1) pertain to natural resources and fish and wildlife, (2) insist on agency compliance with the NEPA and Data Quality Act, and (3) protect the economic base of the District. The Winkelman NRCD also issued the Policy 1 – Major Corridors Policy that pertains to the Land Management Plan (Adopted by the Winkelman NRCD January 6, 2010), and which includes the following statement: "It is the policy of the (Winkelman NRCD) to oppose the construction of any new major energy, transportation, or communication corridors through or across District lands."

By definition, construction of a new transmission line project would not be consistent with either the Redington or Winkelman NRCD policy of opposing construction of any new major energy corridors. However, construction and maintenance of the Project would be implemented to the extent possible to address the objectives, concerns, and recommendations stated in the Redington NRCD and Winkelman NRCD plans. BMPs and mitigation measures to control or mitigate the effects of soil erosion and other potential impacts to lands within the districts' boundaries are included in the Project EIS would be part of the Final POD. The BLM would continue to coordinate with the NRCDs and the Project owner representatives following the planning process and throughout Project implementation.

Information from the New Mexico and Arizona Departments of Transportation was provided to identify any inconsistencies with plans to construct new highways or improve existing highways within the Project area. These plans were identified in the Cumulative Impacts section of this EIS (Section 4.17.4.). The Project would be consistent with these plans.

Where the Project would cross private and state lands, it would be subject to applicable land use planning regulations, zoning ordinances, or other requirements enforced by the state, county, or local jurisdiction. The Applicant would also need to secure any necessary ministerial permits,

such as dust control, grading, or drainage permits. Legal right-of-entry or access permits also would need to be obtained from private landowners.

1.10 DECISIONS TO BE MADE

In addition to the BLM's action to grant right-of-way on public lands, other federal agencies require separate decisions to grant rights-of-way, easements, or encroachment permits for lands under their jurisdiction. Such federal decisions generally require compliance with the NEPA; in other words, a separate Record of Decision (ROD), Finding of No Significant Impact, or Categorical Exclusion may be required. The agencies may tier to or incorporate by reference this EIS, as appropriate, to fulfill their individual NEPA documentation requirements. State and local agencies also require separate right-of-way applications and permits, as listed in Section 1.12 – Permits, Licenses, and Other Entitlements.

1.10.1 BLM

The purpose of the BLM's action is to respond to SunZia's application for use of BLM-administered lands for a new utility right-of-way. Specifically, the BLM will decide whether to grant, grant with conditions, or deny the application for a new right-of-way. Pursuant to 43 CFR § 2805.10, if the BLM issues a grant, the BLM decision maker may include terms, conditions, and stipulations determined to be in the public interest. This includes modifying the proposed use or changing the route or location of the facilities on public land. If the decision is made to grant the right-of-way, the BLM also will decide which alternative to select, any mitigation requirements, and the terms, conditions, and stipulations of the grant.

The BLM also must decide whether or not to amend any of the existing RMPs to achieve conformity with the land use plan and allow for a grant of a major utility right-of-way for this proposed transmission line. The BLM's decision on the right-of-way grant and any associated RMP amendments would be outlined in a ROD, based on the findings identified in the EIS.

1.10.2 Bureau of Reclamation

The Project may cross federal land administered by the BOR, including land along the Rio Grande in New Mexico and the CAP canal in Arizona.

The BOR, with concurrence from the Middle Rio Grande Conservation District, manages conservation district land, including the Rio Grande Conveyance Channel along the Rio Grande in New Mexico. Most efforts for management include protection of habitat for the Southwestern Willow Flycatcher and the Rio Grande Silvery Minnow. Historically, the Middle Rio Grande region has been altered to meet various needs; namely irrigation for agricultural fields. Current management practices include the restoration and protection of conservation district lands.

The CAP, which is a 336-mile-long system of aqueducts, tunnels, pumping plants, and pipelines that carries water across portions of Arizona, is owned by the BOR. The Central Arizona Water Conservation District is responsible for managing land associated with the CAP.

The Applicant will need to file separate land use applications with the Middle Rio Grande Conservation District and the CAP; upon approval, a Land Use License would be granted for utility right-of-way prior to construction. Land Use Licenses are typically granted for 25 years, with an option to extend for an additional 25-year term. In addition, the CAP or the Middle Rio Grande Conservation District could adopt this EIS in compliance with NEPA and DOI regulations, but would require a separate decision informed by NEPA review, to grant right-of-way crossing land under the jurisdiction of the BOR.

1.10.3 Department of the Army

The WSMR and Fort Bliss include BLM-administered public land that has been withdrawn from the public domain for exclusive military use by the Department of the Army[1]. WSMR and the Doña Ana portion of Fort Bliss were withdrawn by Public Land Order 833 from all forms of appropriation under the public land laws, and were reserved for the use of the Department of the Army for military purposes.

Although the BLM preferred alternative would not require rights-of-way or easements across withdrawn public land on WSMR or Fort Bliss, if any applications for use of real property under Army jurisdiction were to be required, review and concurrence by the Department of the Army would be necessary. The procedure for granting use of real property under the jurisdiction or control of the Department of the Army is governed by Army Regulations 405-80 and 420-1. The WSMR Installation Commander and designated Commanders of the USACE have the exclusive responsibilities and authorities for granting use of such real property.

1.10.4 New Mexico Department of Transportation

New Mexico Department of Transportation (NMDOT) administers all state and interstate highways in New Mexico. An encroachment permit would be required in any location where the Project facilities would cross any NMDOT right-of-way. The Applicant would need to file a New Mexico Public Highway Utility Accommodation Permit Application subject to review and approval by NMDOT, in compliance with federal and state environmental laws and regulations.

1.10.5 Arizona Department of Transportation

ADOT administers all state and interstate highways in Arizona. An encroachment permit would be required in any location where the Project facilities would cross any ADOT right-of-way. The Applicant would need to file a Highway Encroachment Permit Application subject to review and approval by ADOT, in compliance with federal and state environmental laws and regulations.

[1]Lands within the WSMR and Fort Bliss McGregor Range were withdrawn for military use by Public Land Orders 833, issued May 21, 1952, and PL 106-65 issued October 5, 1999, respectively.

1.10.6 Bureau of Indian Affairs

The Project may cross portions of the San Carlos Irrigation Project canal system, located in the vicinity of the Picacho Reservoir in Pinal County. An encroachment permit would be required by the BIA where transmission lines cross canal rights-of-way. A separate decision by the BIA, informed by NEPA review, would be required to grant right-of-way crossing a San Carlos Irrigation Project canal or other facilities.

1.11 BLM PLAN AMENDMENTS

Management direction of public land and resources is provided in land use plans or RMPs for each BLM field or district office. The BLM must review relevant land use plans and RMPs to determine if a proposed project is in conformance with the management decisions and objectives of those plans. If a proposed project is not in conformance, the BLM can either choose to deny the project, adjust the project to conform to the RMP, or amend the plan to address nonconformance. In the Draft EIS, the BLM identified plan amendments that would be needed for any of the alternatives that are fully analyzed. There are two types of plan amendments identified in this EIS that may be required to conform to RMPs: (1) right-of-way exclusion or avoidance, and (2) visual resource management (VRM) objectives.

Alternatives may cross areas identified as right-of-way exclusion or avoidance areas. According to RMP direction, exclusion areas are closed to all forms of new right-of-way development, and avoidance areas could be used for future rights-of-way only when no feasible alternative route is available. In addition to exclusion and avoidance designations, the placement of new transmission facilities on BLM land within areas of restrictive VRM classifications may not conform to resource management objectives identified in RMPs.

As stated in the NOI to prepare the EIS for the Project (published May 29, 2009), this EIS includes the documentation that serves as the basis for plan amendment decisions. RMPs that may require an amendment due to the proposed action, including alternatives, are:

- New Mexico
  - Socorro RMP, Socorro Field Office (2010)
  - Mimbres RMP, Las Cruces District Office (1993)
- Arizona
  - Final Safford District RMP and EIS, Safford District Office (1991)

Section 202 of the FLPMA states: "The Secretary shall, with public involvement…develop, maintain, and when appropriate, revise land use plans that provide by tracts or areas for the use of the public lands" (43 USC 1712). The regulations for making and modifying land use plans and planning decisions are found in 43 CFR 1600. The proposed plan amendment shall follow the regulations as set forth in 43 CFR 1610, Resource Management Planning. The BLM uses a multiple step process when developing an RMP or RMP amendment, some of which may occur concurrently. Some situations may require the manager to supplement previous work as additional information becomes available. These steps have been fully integrated with the NEPA process and CEQ guidelines. Detailed descriptions of proposed RMP amendments can be found in Chapter 2, Section 2.6. The

public may protest the proposed RMP Amendments during the 30-day protest period following the publication of the Final EIS, and the BLM would resolve protests prior to issuing a ROD.

The BLM planning regulations (43 CFR 1610.5-2) provide for any person who participated in the planning and environmental analysis process and who has an interest that is or may be adversely affected by the planning decision (in this case any of the proposed plan amendments), may protest approval of the planning decision within 30 days from the date that the EPA publishes the NOA of the Final EIS in the *Federal Register*. Protests are filed with the Director of the BLM in Washington, DC, and must meet strict filing requirements, including (1) the name, mailing address, telephone number, and interest of the person filing the protest; (2) a statement of the issue or issues being protested; (3) a statement of the plan amendment being protested; (4) a copy of all documents addressing the issue or issues that were submitted during the EIS process by the protesting party or an indication of the date the issue or issues were discussed for the record; and (5) a concise statement explaining why the State Director's decision is believed to be wrong. Detailed information on filing protests is provided in the Attachment to the "Dear Reader" letter, located at the beginning of this Final EIS. More information on the protest process may be reviewed at the BLM Protest Resolution website: www.blm.gov/wo/st/en/prog/planning/planning_overview/protest_resolution.html.

1.12 PERMITS, LICENSES, AND OTHER ENTITLEMENTS

Table 1-5 provides a list of major federal, state, and local permits and approvals that could be required for construction and operation of the Project. Note that this list is not all-inclusive.

Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation			
Proposal Requiring Action	**Agency**	**Permit, License, Approval, Compliance, or Review**	**Relevant Laws and Regulations**
Federal			
Preconstruction surveys; construction, operation, and abandonment of transmission line on public land	BLM	EIS and ROD (evaluating right-of-way application)	NEPA (42 USC 4321); CEQ (40 CFR 1500-1508)
		Right-of-way grant and temporary use permit	FLPMA (43 USC 1761-1771); 43 CFR 2800
		RMP revision for land use plan conformance	43 CFR 1610.5-3
Construction, operation, and abandonment of transmission line across BOR-administered land	BOR	Easement or right-of-way use authorization	43 USC 387 of the Reclamation Project Act of 1939 and 43 CFR Part 429
Construction, operation, and abandonment of transmission line facilities across BIA-administered canals or other facilities, including San Carlos Irrigation Project	BIA and San Carlos Irrigation and Drainage District	Encroachment Permit within Rights-of-Way for Irrigation Facilities	43 USC 945, Canal Act of 1890
Construction, operation, and abandonment of transmission line across or within highway rights-of-way	Federal Highway Administration (also ADOT and NMDOT)	Permits to cross Federal Aid Highway; 4(f) compliance	Federal-Aid Highway Act (23 USC 101 et seq.); 23 CFR 1.23 and 1.27; 23 CFR 645; 23 CFR 771
Manage effects on species listed or critical habitat designated under the ESA and BLM sensitive species	BLM in consultation with USFWS	Compliance with the ESA	ESA, as amended (16 USC 1531 et seq.); BLM Manual H-6840 (Special-Status Species)
Protect and manage migratory birds	BLM in consultation with USFWS	Compliance	MBTA (16 USC 703-712); EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
Protect bald and golden eagles	BLM in consultation with USFWS	Compliance	BGEPA of 1972 (16 USC 668)
Disturbance of historic properties	BLM in consultation with SHPOs, Advisory Council on Historic Preservation, tribes, other federal, state, and local agencies, and consulting parties	Compliance with Section 106	NHPA (16 USC 470); 36 CFR 800)

Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation			
Proposal Requiring Action	**Agency**	**Permit, License, Approval, Compliance, or Review**	**Relevant Laws and Regulations**
Potential conflicts with freedom to practice traditional tribal religions	Federal lead agency, federal land management agency	Consultation with affected tribes	American Indian Religious Freedom Act (42 USC 1996), EO 13007, Religious Freedom Restoration Act of 1993 (42 USC 2000bb et seq.) Secretarial Order 3206
Disturbance of graves, associated funerary objects, sacred objects, and items of cultural patrimony	Federal land management agency	Consultation with affected tribes regarding treatment of remains and objects	NAGPRA (25 USC 3001)
Investigation of cultural and paleontological resources	Affected land management agency	Permit for study of historical, archaeological, and paleontological resources	American Antiquities Act of 1906 (16 USC 432-433)
Investigation of cultural resources	Affected land management agency	Permits to excavate and remove archaeological resources on federal land; tribes with interests in resources must be consulted prior to issuance of permits	ARPA of 1979 (16 USC 470aa to 470ee); 43 CFR 7
Ground disturbance on federal land or federal aid project	BLM	Compliance with BLM mitigation and planning standards for paleontological resources on public land	FLPMA (43 USC 1701-1771); Antiquities Act of 1906 (16 USC 431-433)
Collection of paleontological resources from federal land	BLM	Permit to collect paleontological resources from federal land	Omnibus Public Lands Management Act – Paleontological Resources Preservation. PL 111-11, Title VI, Subtitle D, Sections 6301-6312, 123 Stat. 1172, 16 USC 470aaa.
Protection of segments, sites, and features related to national trails	Affected land management agency	National Trails System Act compliance	National Trails System Act (PL 90-543) (16 USC 1241 to 1249)
Construction sites with greater than 5 acres of land disturbed	EPA	Section 402 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Construction Activities	CWA (33 USC 1342)
Potential pollutant discharge during construction and operation	EPA	Spill Prevention Control and Countermeasure Plan	Oil Pollution Act of 1990 (33 USC 2701 et seq.); 40 CFR 112
Construction across a Superfund site	EPA	Agreement or order of consent with EPA	CERCLA (42 USC 9601-9675)

Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation			
Proposal Requiring Action	**Agency**	**Permit, License, Approval, Compliance, or Review**	**Relevant Laws and Regulations**
Construction across water resources	USACE	Section 10 and/or Section 404 permits (see below)	33 USC 403, 1344(a); 33 CFR 320, 322, 323, 325
Placement of structures and construction work in navigable waters of the U.S.	USACE	Section 10 permit for construction of obstructions to navigable capacity of navigable waters	Rivers and Harbors Act of 1899 (33 USC 403)
Potential discharge into waters of the U.S. (including wetlands and washes)	USACE	Section 404 permit for discharge of dredged or fill material to waters of the U.S.	CWA (33 USC 1344)
Crossing 100-year floodplain, streams, and rivers	USACE	Floodplain use permit	40 USC 961
Construction, operation, and abandonment of transmission line across DOD-administered land	DOD – Department of the Army	Easement or right-of-way use authorization	10 USC § 2668 – Easements for rights-of-way Army Regulations 405-80 and 420-1
Construction in or modification of floodplains	Federal action agencies	Compliance; consider alternatives to avoid adverse effects and incompatible development in floodplains	42 USC 4321 EO 11988 Floodplains
Construction in or modification of wetlands	Federal action agencies	Compliance	42 USC 4321 EO 11990 Wetlands
Location of structures in regards to airport facilities and airspace	FAA	A "No-hazard Declaration" required if structure is more than 200 feet in height	FAA Act of 1958 (PL 85-726) (14 CFR 77)
		Section 1101 Air Space Permit for air space construction clearance	FAA Act of 1958 (PL 85-726) (14 CFR 77)
Sales for resale and transmission services	FERC	Federal Power Act compliance by power seller	Federal Power Act (16 USC 792)
Construction of transmission lines either crossing or in close proximity to pipelines.	USDOT	Pipeline safety regulations	49 USC Subtitle VIII Pipelines Chapter 601 Safety
State of Arizona			
Construction of a transmission line with a voltage of 115 kV or greater	ACC	Certificate of Environmental Compatibility	ARS 40-360.03; AAC R14-3, Corporation Commission Rules of Practice and Procedure

Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation			
Proposal Requiring Action	**Agency**	**Permit, License, Approval, Compliance, or Review**	**Relevant Laws and Regulations**
Stormwater management from potential discharges associated with industrial activity or construction of sites greater than 5 acres (cumulative)	ADEQ	Arizona Pollutant Discharge Elimination System permit	ARS 49-255; AAC R18-9-1, 2, AAC R18-11-1
Construction across water resources	ADEQ	State Water Quality Certification (state review required for all Federal Section 404 permits)	CWA (33 CFR Parts 320, 322, 323, 325)
Obtaining federal National Pollutant Discharge Elimination System Permit	ADEQ	Consistency Review Form to ensure that a proposed facility or use will be consistent with the existing Certified Regional Water Quality Management Plan	CWA (Section 303, et al.), Federal Water Pollution Control Act Section 208
Fugitive dust as a result of Project construction	ADEQ	Compliance with dust control measures and standards	AAC: R18-2-604, R18-2-605, R18-2-606, R18-2-607, R18-2-612
Construction, operation, and abandonment of transmission lines across or within state highway right-of-way	ADOT	Crossing or encroachment permit, permit for use of highway right-of-way	ARS 28-7053, AAC R17-3-501 through 509
Survey and construction of a transmission line within rights-of-way on State Trust Land	ASLD	Right-of-way/Right-of-entry permit	ARS 37-461
Loss of special-status plant species	Arizona Department of Agriculture	Permit to Remove Plants	Native Plant Law (ARS 3-901 through 916)
Disturbance to or loss of special-status animal species habitat	AZGFD	Coordination with USFWS/BLM/USACE	U.S. Fish and Wildlife Coordination Act
Potential disturbance to cultural resources on State Land	Arizona State Museum	Permit to investigate	ARS 41-841 through 847
Potential disturbance to cultural resources on State Land	SHPO	Review and approval of use of any State Trust Land	ARS 41-861 through 864
Potential disturbance to human remains or funerary objects	Arizona State Museum	Grant Permission to Disturb	ARS 41-865

Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation			
Proposal Requiring Action	**Agency**	**Permit, License, Approval, Compliance, or Review**	**Relevant Laws and Regulations**
State of New Mexico			
Construction of a transmission line with a voltage of 230 kV or greater	New Mexico Public Regulation Commission	Application for approval of location of transmission line	NMSA 62-9-3; 17.9.592 NMAC
Construction of a transmission line with a voltage of 230 kV or greater	New Mexico Public Regulation Commission	Certificate of Public Convenience and Necessity	NMSA 62-9-1; 17.1.2.9 NMAC
Upgrading gravel access roads and any additional highway entry/exit points.	NMDOT	Access Permit, including stipulations for any safety enhancements necessary to the highway	18.31.6 NMAC
Installation of transmission line within the right-of-way of state-managed roadways	NMDOT	New Mexico Public Highway Utility Accommodation Permit	17.4.2 NMAC
Protect water quality standards during construction and operation activities	NMED, Water Quality Bureau	National Pollutant Discharge Elimination System Construction Stormwater Permit and Stormwater Pollution Prevention Plan	NMSA 74-6; 20.6 NMAC
Management of hazardous waste onsite during construction/operation	NMED/HWB	Hazardous Waste Permit	NMSA 74-4; 20.4 NMAC
Storage and use of hazardous chemicals onsite during construction/operation	NMED/HWB	EPA Waste Activity EPA ID Number	NMSA 4-4E-1
Taking or transplanting of state endangered plant species (during construction, right-of-way clearing, etc.)	New Mexico Dept. of Energy, Minerals, and Natural Resources, Forestry Division	Collection permit	NMSA 75-6-1; 19.21.2 NMAC
Manage effects to threatened and endangered species	NMDGF	Survey permit and general consultation	NMSA 17-2-42; NMDGF Habitat Handbook
Construction of a transmission line on New Mexico State Lands	NMSLO	Right-of-way or easement on State Land	NMSA 19-7-57

Table 1-5. Summary of Potential Major Federal and State Permits or Licenses Required and Other Environmental Review Requirements for Transmission Line Construction and Operation

Proposal Requiring Action	Agency	Permit, License, Approval, Compliance, or Review	Relevant Laws and Regulations
Identification of, and potential disturbance to, cultural resources in Project area	New Mexico State Historic Preservation Division	Cultural Survey Permit; coordination with state SHPO	NMSA 18-6; 4.108, 4.10.15 NMAC
Local*			
Potential encroachment onto county or city rights-of-way	Public Works, Development Services	Right-of-way use permit, encroachment permit	County/local ordinance or municipal code
Construction activities, potential for fugitive dust from construction	Public Works, Building	Grading and excavation permit, dust control permit	County/local ordinance or municipal code
Amending zoning or land use to allow use (construction and operation of transmission line and substations)	Planning and Zoning, Community Development	Special use permit, conditional use permit	County/local ordinance or municipal code

* Local permits are examples only of permits that could be anticipated at the local (county and city) level, as local permitting agencies often defer to state authorities for projects of this scale.

AAC	Arizona Administrative Code	FAA	Federal Aviation Administration
ACC	Arizona Corporation Commission	HWB	Hazardous Waste Bureau
ADEQ	Arizona Department of Environmental Quality	MBTA	Migratory Bird Treaty Act
ARPA	Archaeological Resources Protection Act	NAGPRA	Native American Graves Protection and Repatriation Act of 1990
ARS	Arizona Revised Statute	NMAC	New Mexico Administrative Code
BGEPA	Bald and Gold Eagle Protection Act	NMDGF	New Mexico Department of Game and Fish
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	NMED	New Mexico Environment Department
CWA	Clean Water Act	NMSA	New Mexico Statutes Annotated
EPA	Environmental Protection Agency	PL	Public Law
et seq.	and the following	SHPO	State Historic Preservation Office

CHAPTER 2 – PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter provides a description of the proposed action (SunZia Southwest Transmission Project, or Project), the alternatives analyzed in this EIS, the process used to identify the alternatives, the alternatives that were considered but eliminated from detailed study, and the BLM preferred alternative.

The alternatives consist of different routes for placement of the two proposed 500 kV transmission lines that would originate at the proposed SunZia East Substation in New Mexico, and terminate at the permitted Pinal Central Substation in Arizona. The No Action alternative is also analyzed in this EIS, in which the right-of-way for the Project would not be granted. In order to facilitate characterization of the affected environment (Chapter 3) and potential environmental impacts (Chapter 4), the alternative transmission line routes have been divided into three groups of alternative subroutes. The alternative subroutes comprising each of the groups include combinations of the smallest linear units, or links.

The description of the proposed action provided in Section 2.4 is consistent among all alternatives. This Project description, including the design features of facilities, estimated area of ground disturbance, and construction activities, provides the basis for the assessment of impacts in Chapter 4. A summary comparison of all alternatives is provided in Section 1.1.

2.1.1 Study Process Completed to Date

This EIS has been developed through a comprehensive process, with contribution from a team of interdisciplinary resource specialists, and the consideration of issues and concerns raised by the public and agencies. The EIS process allows for identification of issues, refinement of alternatives, and disclosure of potential environmental effects that could result from the Project. Steps in the process are shown on Figure 2-1 and are summarized below.

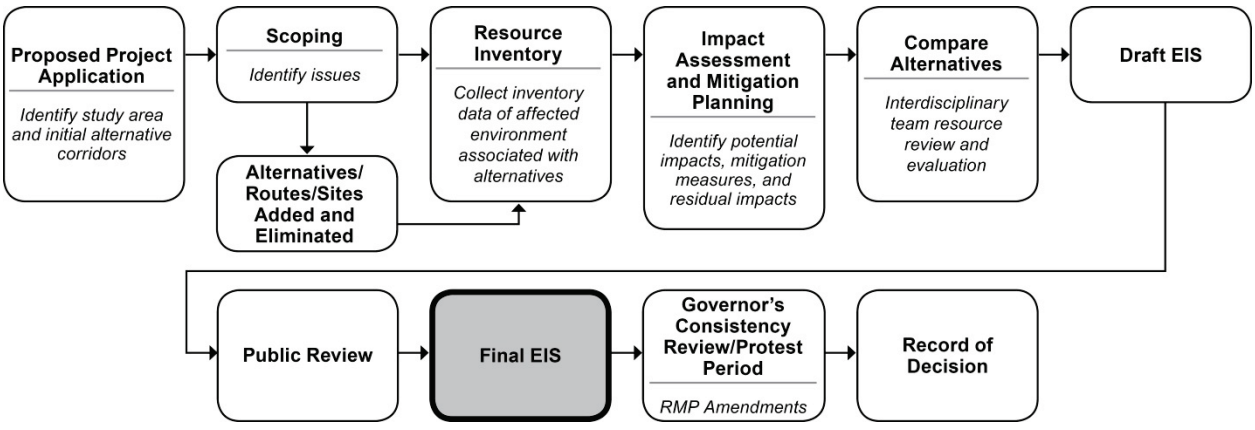


Figure 2-1. Environmental Study Process

Proposed Project Application – Environmental studies were initiated with SunZia's application to the BLM for right-of-way to construct the Project on BLM-administered land. In cooperation with the BLM and other land management agencies, the Applicant defined the Project study area and conducted a regional siting study to identify general corridors within which transmission lines could be constructed and operated to meet the Applicant's objectives.

Scoping – Scoping was held early in the process to identify environmental issues (Chapter 1, Table 1-3), which helped to determine the level of analysis and to refine Project alternatives (Chapter 2). The Project description, study area, and preliminary alternative transmission line routes were reviewed by the public and agencies through scoping, which initiated the EIS process. The process and results are documented in the Scoping Report (BLM 2010a) and in Chapter 5. In response to public comment, the Project study area was expanded to allow consideration of additional routes. Alternatives were added in New Mexico that would avoid impacts to military uses and sensitive resources in the Rio Grande Valley; and alternatives were added in Arizona that would avoid sensitive resources in the San Pedro River Valley and Sulphur Springs Valley.

Resource Inventory – Each alternative route and substation site was inventoried to characterize the Project area. Collection and review of existing data helped to establish the baseline environmental conditions (Chapter 3) from which potential Project impacts could be assessed.

Impact Assessment and Mitigation Planning – The alternative routes and substation sites were assessed to identify potential effects (initial impacts) on the environment that could result from the construction, operation, and decommissioning of the Project alternatives (Chapter 4). Where warranted, measures beyond standard mitigation were recommended to minimize impacts. (See tables 2-10 and 2-11 for a list of the standard and selective mitigation measures that could be employed.) The impacts remaining after mitigation are referred to as residual impacts.

Route Comparison and Selection of the Preferred Alternative – Through a systematic analysis, all of the alternative routes were evaluated and compared in order to identify the preferred alternative.

Public Review of Draft EIS – The Draft EIS was published and made available for public comment. Information on the public review process and comments on the Draft EIS are provided in Section 5.5 of this Final EIS.

Review Following Final EIS – Protest Period and Governor's Consistency Review related to RMP amendments.

Record of Decision – The BLM issues a ROD following the protest period and Governor's Consistency Review.

2.2 DEVELOPMENT OF PROPOSED ACTION AND ALTERNATIVES

In order to identify potential locations for the proposed transmission line routes, information was gathered to determine environmental, engineering, and agency/public/political opportunities and constraints within the study area. As a first step towards identifying feasible routes and

substation sites, potential alternatives were reviewed based on their ability to maximize opportunities to locate the proposed transmission lines within existing corridors, while avoiding areas of higher constraint or sensitivity. Results of this evaluation were used to identify alternatives that were reasonable and feasible in response to opportunity and constraint criteria. A phased approach was used in the development and refinement of the study area and the alternative routes within it. This study resulted in the identification of the alternatives evaluated in this EIS and described in Section 2.3. The alternatives screening process is described in the Opportunities and Constraints Analysis (Appendix A) was completed in November 2011.

2.2.1 Study Area Definition

The study area was defined to include an area within which potential routes for the proposed 500 kV transmission lines could be located between the terminal points in Lincoln County, New Mexico (proposed SunZia East Substation) and Pinal County, Arizona (permitted Pinal Central Substation). Construction and operation of the proposed SunZia 500 kV transmission lines along one of these routes would therefore respond to the purpose and need, as well as the Project objectives; i.e., to promote interconnections of existing and planned transmission and generation facilities in New Mexico and Arizona.

Using terrain data and maps depicting locations of existing linear facilities, a general study area boundary and potential alternative routes within it were identified. Major physiographic features, jurisdictional boundaries, specially designated areas, and existing utility corridors were then used to define the study area boundary. Generalized corridors within the study area were identified using similar rationale.

The initial study area encompassed 10 counties in New Mexico and 5 counties in Arizona. The eastern terminus of the study area is located in Lincoln County, New Mexico, south of the town of Corona; selected because of its strategic location to potential sources of renewable energy. The western terminus of the study area is located in Pinal County, near Eloy, Arizona; selected because it can provide direct access to the existing high-voltage electrical infrastructure in the region.

In order to identify potential locations for transmission line corridors and substation siting areas, inventoried and mapped data were used to determine environmental, engineering, and agency/public opportunities and constraints within the study area. The approach used to identify these opportunities and constraints and the results from this analysis are described below.

2.2.2 Evaluation of Opportunities and Constraints

The identification of opportunities and constraints was based on a sensitivity analysis. As used here, sensitivity is defined as a measure of the probable adverse response of each resource to direct and indirect impacts associated with the construction, operation, and decommissioning of the transmission lines, substations, and other Project facilities.

2.2.2.1 Siting Opportunities

Opportunities for new transmission lines and substation sites generally included locations consisting of, or in proximity to, existing or planned linear facilities, previously disturbed corridors, or corridors designated for future use as utility corridors or in conjunction with industrial use(s). Typically, these opportunities include existing transmission lines, major transportation corridors (interstate and state highways), pipeline corridors, railroads, and canals. These corridors provide potential access for construction and maintenance of transmission lines and substations. Existing linear corridors generally minimize ground disturbance, as well as biological, cultural, soil erosion, land use, and visual resources impacts. Linear features with high opportunity levels include:

- Transmission lines, 230 kV or greater
- Federally designated overhead transmission line corridors
- DOE West-wide Energy Corridors (EPAct Section 368)

Linear features with moderate opportunity levels include:

- Transmission lines, less than 230 kV
- Natural gas/petroleum pipelines, 6-inch diameter or greater
- Railroads
- Interstates, U.S. highways, state highways, and other primary roads

2.2.2.2 Siting Constraints and Environmental Sensitivity

Criteria used in making the determination of environmental sensitivity include consideration for the following:

- **Protective Status –** a measure of the formal concern expressed for a resource either through legal protection or by assignment of special-status species.
- **Resource Value –** a measure of rarity, high intrinsic worth, singularity, or diversity of a resource within an area.
- **Present and Future Use** – a measure of the level of conflict based on land management policies and/or use that also may include issues of specific concern to the agencies and public.

With consideration of the above criteria, the environmental data gathered during the regional inventory were evaluated and given relative sensitivity levels that were used to determine opportunities and constraints, as follows:

- **Exclusionary/Maximum Constraint Areas** – Areas where legal status (i.e., wilderness areas or jurisdictional policy [e.g., active airports]) would prohibit, or most likely prohibit, the location of transmission or substation facilities.
- **High Sensitivity/Constraint Areas** – Areas determined to be less suitable because of unique, highly valued, complex, historic, or protected resources and significant potential

conflict with use, or areas posing substantial hazards to construction and operation of the transmission lines and substations.

- **Moderate Sensitivity/Constraint Areas** – Areas of potential environmental effects due to impacts to important or valued resources, resources assigned special status, or some conflict with use. Locations of moderate sensitivity are considered to be moderate constraint areas and potentially suitable for siting the transmission lines and substations.
- **Low Sensitivity/Constraint Areas** – Areas where resource conflicts identified through the feasibility study process are minimal. These areas are considered to be of minimal constraint, or high opportunity for locating the proposed transmission lines and substations, particularly in association with existing transmission line corridors.

Levels of sensitivity were assigned based on different resource features and the above definitions. Table 2-1 and the tables included in Appendix A provided guidelines for regional data classification.

Once classifications were assigned, a geographic information system (GIS) was used to map sensitivity and constraint levels for each of the environmental resources inventoried within the study area. GIS was also used to create a composite constraints map for the study area, which served to identify potential overall levels of environmental constraint for the location of Project facilities.

Table 2-1. Environmental Sensitivity Summary

Data Layers	Sensitivity Level
Land Use	
Airports and Heliports (municipal and private runways less than 5,000 feet)	Exclusion
Federal Wilderness Area	Exclusion
National Parks and Monuments	Exclusion
BLM Right-of-Way Exclusion Area	Exclusion
Federal Wilderness Study Area	Exclusion
BLM Areas of Critical Environmental Concern	High
National or State Wildlife Refuge	High
National Conservation Area	High
BLM Right-of-Way Avoidance Area	High
State Park	High
Urban Areas (incorporated and unincorporated cities and towns)	Moderate
BLM Pending Solar Right-of-Way	Moderate
BLM Pending Wind Right-of-Way	Moderate
Research Natural Area	Moderate
Special Management Area	Moderate
Special Management Area (proposed)	Moderate
Vacant/Undeveloped	Low

Table 2-1. Environmental Sensitivity Summary	
Data Layers	**Sensitivity Level**
Visual and Recreation	
National Parks and Monuments	Exclusion
BLM VRM Objective Class I	Exclusion
BLM VRM Objective Class II	High
Scenic Trail (including National)	High
Scenic Roads or Byway	High
Concern Level Road I	High
BLM VRM Objective Class III	Moderate
USFS Visual Quality Objective Partial Retention	Moderate
Special Recreation Management Area	Moderate
Rest Area	Moderate
Concern Level Road II	Moderate
BLM VRM Objective Class IV	Low
USFS Visual Quality Objective Modification	Low
USFS Visual Quality Objective Maximum Modification	Low
Cultural Resources	
National Parks and Monuments	Exclusion
State Monument	High
National Register Site or District	High
Historic Trail (including National)	High
Cultural Resource Area (other sites)	Moderate
Biological Resources	
Designated Threatened and Endangered Species Critical Habitat	High
Wetlands	High
Desert Tortoise Habitat	–
BLM Category I	High
BLM Category II	Moderate
BLM Category III	Moderate
Sensitive Species	Moderate to High
General Native Vegetation	–
Arizona Upland Sonoran Desertscrub	Moderate
Coniferous and Mixed Woodland	Moderate
Desert Grassland (Ecotone)	Moderate
Great Basin Conifer Woodland	Moderate
Juniper Savanna (Ecotone)	Moderate
Madrean Evergreen Woodland	Moderate
Montane Coniferous Forest	Moderate
Petran Montane Conifer Forest	Moderate
Petran Subalpine Conifer Forest	Moderate
Plains and Great Basin Grassland	Moderate
Plains-Mesa Grassland	Moderate

Table 2-1. Environmental Sensitivity Summary	
Data Layers	**Sensitivity Level**
Semidesert Grassland	Moderate
Subalpine Coniferous Forest	Moderate
Chihuahuan Desertscrub	Low
Closed Basin Scrub	Low
Interior Chaparral	Low
Lava Beds	Low
Lower Colorado River Sonoran Desertscrub	Low
Montane Scrub	Low
Plains-Mesa Sand Scrub	Low
Urban, Farmland, or Open Water	Low

2.2.2.3 Identification of Alternative Routes and Substation Siting Areas

Once inventory data were compiled and the opportunities and constraints were clearly defined, the data were used to identify those areas that exhibited higher levels of opportunity combined with lower levels of constraint. In addition, a review of aerial imagery was combined with selected field reviews to make geographic adjustments to the routes within the general study corridors. The result was a set of refined alternative routes that were presented for review during the scoping process.

As part of this review, potential alternative transmission corridors and substation sites were grouped into smaller geographic areas to allow for localized comparisons among substation siting areas within the Project study area. The initial three areas included:

- Proposed SunZia East Substation (near Corona, New Mexico) to proposed Midpoint Substation (near Deming, New Mexico)
- Proposed Midpoint Substation[1] to proposed Willow-500 kV Substation (near Willcox, Arizona)
- Proposed Willow-500 kV Substation to permitted Pinal Central Substation

Alternatives within each of these routing areas were evaluated based on their ability to meet the Project objectives, taking into consideration both environmental and engineering factors. Environmental evaluation included the review of opportunities and constraints (sensitivities); and engineering evaluation included the consideration of engineering/construction constraints and reliability factors that were used to determine levels of potential risk. The characterizations of alternative routes vary on a case-by-case basis, depending on specific and local conditions, and on the potential to mitigate environmental and engineering concerns.

Through the scoping process, routes were further refined, deleted, and added based on the public's comments, cooperating agency input, and resource evaluations. A full discussion of the

[1] Midpoint Substation may also be referred to as SunZia South Substation.

scoping process can be found in the Project Scoping Report (BLM 2010a). Scoping meeting locations and dates are presented in Chapter 5, Section 5.2.2; a summary of the scoping process and its influence on the development of alternatives is provided in the following discussion.

Scoping Period 1

The BLM issued the NOI to prepare an EIS and possible RMP amendments for the Project in the *Federal Register*, Vol. 74, No. 102, dated May 29, 2009; initiating a 45-day public scoping period that was to end on July 13, 2009. In consideration of public input, the scoping period was extended to August 28, 2009, to allow additional time for comment.

During Scoping Period 1, several agency and public meetings were held to present the initial study area and routing suggestions. During this process, the BLM solicited agency and public input regarding the routes and study area.

Results of Scoping Period 1

Based on comments received by agencies and members of the public during Scoping Period 1, several modifications were made, including changes to the alignments of alternatives, the addition of new alternatives, and expansion of the study area (Figure 2-2).

Figure 2-2. Study Area Expansion

Numerous comments reflected concern regarding the location of the proposed route crossing the Rio Grande in the vicinity of the San Antonio community, north of the Bosque del Apache National Wildlife Refuge (NWR). In response to requests to avoid that location, two alternative transmission line routes were added for further study. Locations of alternative routes within the expanded study area were identified, based on an evaluation of environmental opportunities and constraints and engineering criteria, as follows:

- Route along the western boundary and in the northwest corner of the WSMR
- Routes along the eastern boundary of the WSMR in Otero and Lincoln counties, through Fort Bliss on the east and west sides of US Highway 54 in Otero County, and south of the WSMR in Doña Ana County

Scoping Period 2

Because of the modifications to the routes and expansion of the study area, a second scoping period was conducted. The BLM issued a news release on October 7, 2009, to announce the expanded study area and additional scoping meetings.

Results of Scoping Period 2

During Scoping Period 2, meetings with the military and agencies resulted in the addition of routing groups north of the WSMR, and alternative routes through Tucson, Arizona; while other links were recommended for deletion.

Routes were added in the following locations:

- Farther east from the WSMR and Holloman AFB, near Tularosa
- In Lincoln, Torrance, and Valencia counties, to avoid impacts to military training and testing operations
- West of the San Pedro River
- East of the San Pedro River, avoiding Nature Conservancy Lands and the Muleshoe Ranch Cooperative Management Area (CMA), and Swamp Springs-Hot Springs Watershed and Muleshoe Riparian areas of critical environmental concern (ACEC)
- Following Interstate 10 (I-10) through Tucson
- Following railroad alignment through Tucson
- Following I-10 and continuing west of Tucson
- Following drainage corridors (rivers and washes) through Pima County

Scoping Period 3

In response to scoping comments received during the two previous scoping periods, the preliminary study undertaken, and consultations with interested parties, the BLM expanded the Project study area to consider additional potential alternative transmission line routes in New Mexico and Arizona. Consequently, a third scoping period was conducted from March 31 to June 10, 2010. A news release dated March 31, 2010 announced the expanded study area and dates and locations of additional scoping meetings.

Additional routing options that were reviewed during this period included the following:

New Mexico – Alternative routes within Lincoln, Torrance, Valencia, and Socorro counties, north of Socorro, New Mexico, were suggested as options to the initially proposed and alternative routes north of the WSMR in the vicinity of US Route 380. The additional alternative routes were suggested to avoid impacts to military training and testing operations based at the WSMR; Holloman, Kirtland, and Cannon AFBs; and Fort Bliss. Some of these routes were later eliminated after further review (see Section 2.3.3.1).

Arizona – In addition to the initially proposed route and alternative routes that were presented during previous scoping, alternative routes within Pima County, in the Tucson area and west of the San Pedro River, were identified. Scoping comments included support for locating the proposed Project within the I-10 highway corridor and existing utility corridors. Other comments reflected concern for potential environmental impacts to grazing/ranching operations and private lands/property values; biological resources (especially waterfowl/migratory birds, special-status species, and wildlife corridors); cultural and visual resources; local economics; and unauthorized off-road traffic on the proposed access roads.

Results of Scoping Period 3

Following Scoping Period 3, a detailed engineering review was conducted to refine routing options and links. Based on this engineering review, public comments, and ongoing environmental studies, a final set of alternative routing options were identified to be carried forward for analysis in the EIS process.

2.3 ALTERNATIVES

The NEPA requires the consideration and evaluation of a range of reasonable alternatives, or alternatives that provide different ways of meeting the agency's purpose and need. Reasonable alternatives are defined as those that are practicable and feasible from a technical and economic standpoint. An EIS must also provide a description of alternatives eliminated from further analysis, along with the rationale for elimination (40 CFR 1502.14[a]). In addition, CEQ regulations direct that an EIS include a description of the No Action alternative (40 CFR 1502.14[d]). The No Action alternative is the only one that does not respond to the purpose and need for the action and that must be analyzed in an EIS. CEQ regulations direct that an EIS "…include reasonable alternatives not within the jurisdiction of the lead agency" (40 CFR 1502.14[c]).

Analyzing feasible alternatives provides decision makers with a clear basis for choice, by showing consideration of different and reasonable paths for accomplishing the same purpose and need for a proposed project. This section includes the description of the alternatives considered for this Project, including the No Action alternative, and the alternatives that were considered but eliminated from detailed study in this EIS.

2.3.1 No Action Alternative

NEPA requires that an EIS include the analysis of a No Action alternative, to provide a baseline for comparison of environmental effects that could occur with implementation of action alternatives, and to demonstrate potential consequences of not meeting the purpose and need of a proposed action.

Under the No Action alternative, the BLM would not grant right-of-way for construction and operation of the proposed Project and it would not amend any planning decisions. The Project facilities, including transmission lines and substations, would not be built and existing land uses and present activities in the Project study area would continue. The No Action alternative does not consider the potential for additional actions that could occur contingent on the denial of the proposed action or alternatives. Service by the existing transmission system within the study area would continue, including those proposed generation projects with existing, documented interconnection requests (Chapter 1, Table 1-2).

2.3.2 Alternative Transmission Line Routes

The proposed Project would include two new, single-circuit 500 kV transmission lines located within a right-of-way up to 1,000 feet wide. The approximately 500-mile-long transmission line route would originate at a new substation (proposed SunZia East) in Lincoln County, New Mexico, and terminate at the permitted Pinal Central Substation in Pinal County, Arizona. Project alternatives were divided into four route groups (three groups remain), based on geography and interconnection points (substations), as shown on Figure 2-3.

- Route Group 1: SunZia East Substation to Midpoint Substation
- Route Group 2 (eliminated): SunZia East Substation to Midpoint Substation – East of White Sands and through Fort Bliss
- Route Group 3: Midpoint Substation to Willow-500 kV Substation
- Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Each route group is composed of individual subroutes, which are formed by a series of interconnecting segments or links. Local alternatives have also been identified within each subroute to provide additional route options, while identified crossover links provide the opportunity to transition between subroutes. Subroutes, as well as local alternatives and crossover links, are listed in Table 2-2 and are illustrated on Figure 2-4 through Figure 2-6. These routes represent the most reasonable and feasible alternatives, as determined through the environmental study process described in Section 2.2. A description of each alternative subroute accompanies its corresponding figure. Following additional study and communications with the DOD, alternatives comprising Route Group 2 – East of White Sands, as well as Subroute 1C, were eliminated from consideration for the Project, as described in Section 2.3.3.

Table 2-2. Subroutes by Link		
Subroute Route	**Length (miles[1])**	**Links** ***Bold links*** *are unique to each subroute; unbold links are duplicated across subroutes*
Route Group 1: SunZia East Substation to Midpoint Substation		
Subroute 1A – North River Crossing		
Subroute 1A	219.5	A10-A21-A22-E80c-E80d-E101a-E101b-E133-E180-E200-E211-A161-A161a-A270-A330a-A330b-A400-A440-A530-A520
Subroute 1A1	228.8	A10-A21-E82-E84a-**E84b**-**E85**-E80d-E101a-E101b-E133-E180-E200-E211-A161-A161a-**A260**-A330a-A330b-A400-A440-A530-A520
Subroute 1A2 – BLM Preferred Alternative	230.3	A10-A21-E82-E84a-**E86a-E86b**-E101b-E133-E180-E200-E211-A161-A161a-A260-A330a-A330b-A400-A440-A530-A520
Subroute 1B – San Antonio Crossing		
Subroute 1B1	223.6	A10-A21-A22-E80c-E80d-**E90-A90-A111-A112-A140-A143-A160**-A161-A161a-A270-A330a-A330b-A400-A440-A530-A520
Subroute 1B2	209.2	A10-**A30-A50-A60**-A90-A111-A112-A140-A143-A160-A161-A161a-A270-A330a-A330b-A400-A440-A530-A520
Subroute 1B2a	212.8	A10-A30-A50-A60-A90-A111-A112-A140-A143-A160-A161-A161a-A260-A330a-A330b-A400-A440-A530-A520
Subroute 1B3	206.3	A10-A30-**A40-A41-A80**-A111-A112-A140-A143-A160-A161-A161a-**A270**-A330a-A330b-A400-A440-A530-A520
Local Alternative and Crossover Links for Route Group 1		
Local Alternative Links for 1A, 1A1	—	E81, E83, E82-E84a-E84b-E85
Local Alternative Links for 1A, 1A1, 1B1, 1B2, 1B3	—	A161b, A260, A361-A430-A481
Crossover Links 1B2, 1B3	—	A70
Route Group 3: Midpoint Substation to Willow-500 kV Substation		
Subroute 3A – North	123.4	B60-B90-B120a-B120b-B121-B160a-**B160b**-B160c-B170
Subroute 3A2 – BLM Preferred Alternative	123.9	B60-B90-B120a-B120b-B121-B160a-**B160d**-B160c-B170
Subroute 3B – South	128.6	B60-**B80-B110a-B110b-B112-B150a-B150b-B151**-B170
Local Alternative and Crossover Links for Route Group 3		
Crossover Links 3A, 3B	—	B111, B140
Route Group 4: Willow-500 kV Substation to Pinal Central Substation		
Subroute 4A – North of Mt. Graham	132.9	B153a-B153b-C170-C178-C173-C592-C595-C620-C760-C780-C830-C840-C850-C880-C880a
Subroute 4B – Sulphur Springs Valley	133.0	**C71-C72-C90-C130a-C130b**-C170-C178-C173-C592-C595-C620-C760-C780-C830-C840-C850-C880-C880a

Table 2-2. Subroutes by Link		
Subroute Route	**Length (miles[1])**	**Links** ***Bold links*** *are unique to each subroute; unbold links are duplicated across subroutes*
Subroute 4C – San Pedro Valley and Tucson		
Subroute 4C1 – East of San Pedro River	139.0	C71-C71a-C110-C212-C111-C270-C301-C331-C361-C470-C510-C660-C661-C670-C690-C691-C693-C760-C780-C830-C840-C850-C880-C880a
Subroute 4C2 – West of San Pedro River	151.8	C71-C71a-C110-C212-C111-C270-**C271-C266-C276-C441-C450**-C661-C670-C680-C818-C820-C830-C840-C850-C880-C880a
Subroute 4C2a – West of San Pedro River	137.8	C71-C71a-C110-C212-C111-C270-C271-C266-C276-C441-C450-C661-C670-**C690-C691-C693-C760-C780**-C830-C840-C850-C880-C880a
Subroute 4C2b – West of San Pedro River	147.2	C71-C71a-C110-C212-C260-C261-C201-C441-C450-C661-C670-C690-C691-C693-C760-C780-C830-C840-C850-C880-C880a
Subroute 4C2c – West of San Pedro River – BLM Preferred Alternative	161.2	C71-C71a-C110-C212-C260-C261-C201-C441-C450-C661-C670-C680-C818-C820-C830-C840-C850-C880-C880a
Subroute 4C3 – Tucson	172.9	C71-C71a-C110-C212-C260-C261-**F40a-F600-F60b-F82-F80-F111-F112-F510-F540-C810A-C810-C813-C816-C817**-C820-C830-C840-C850-C880-C880a
Local Alternative and Crossover Links for Route Group 4		
Local Alternative Link for 4A, 4B, 4C1	—	C790
Local Alternative Links for 4A, 4B, 4C1, 4C2, 4C3 (Pinal Central Substation)	—	C860, C870, C890
Local Alternative Link for 4C1	—	C692
Local Alternative Links for 4C2 – Winchester Substation	—	C260-C261-C201
Local Alternative Links for 4C2 –Tortolita Substation	—	C680, C815, C814, C816, C812, C813, C810, C810a, C817
Local Alternative Links for 4C3 (Pantano/Rillito)	—	F40b-F51-F60a, F81a-F81b
Local Alternative Links for 4C3 (Tortolita Substation)	—	F40b-F51-F60a, F81a-F81b, C812
Local Alternative Links for 4C1, 4C2, 4C3	—	C72-C90-C121-C211
Crossover Links for 4A, 4B, 4C1	—	C500, C501, C502, C174
Crossover Links for 4A, 4B, 4C1, 4C2	—	C671
[1] All mileages in the route descriptions are approximate.		

This page intentionally left blank.

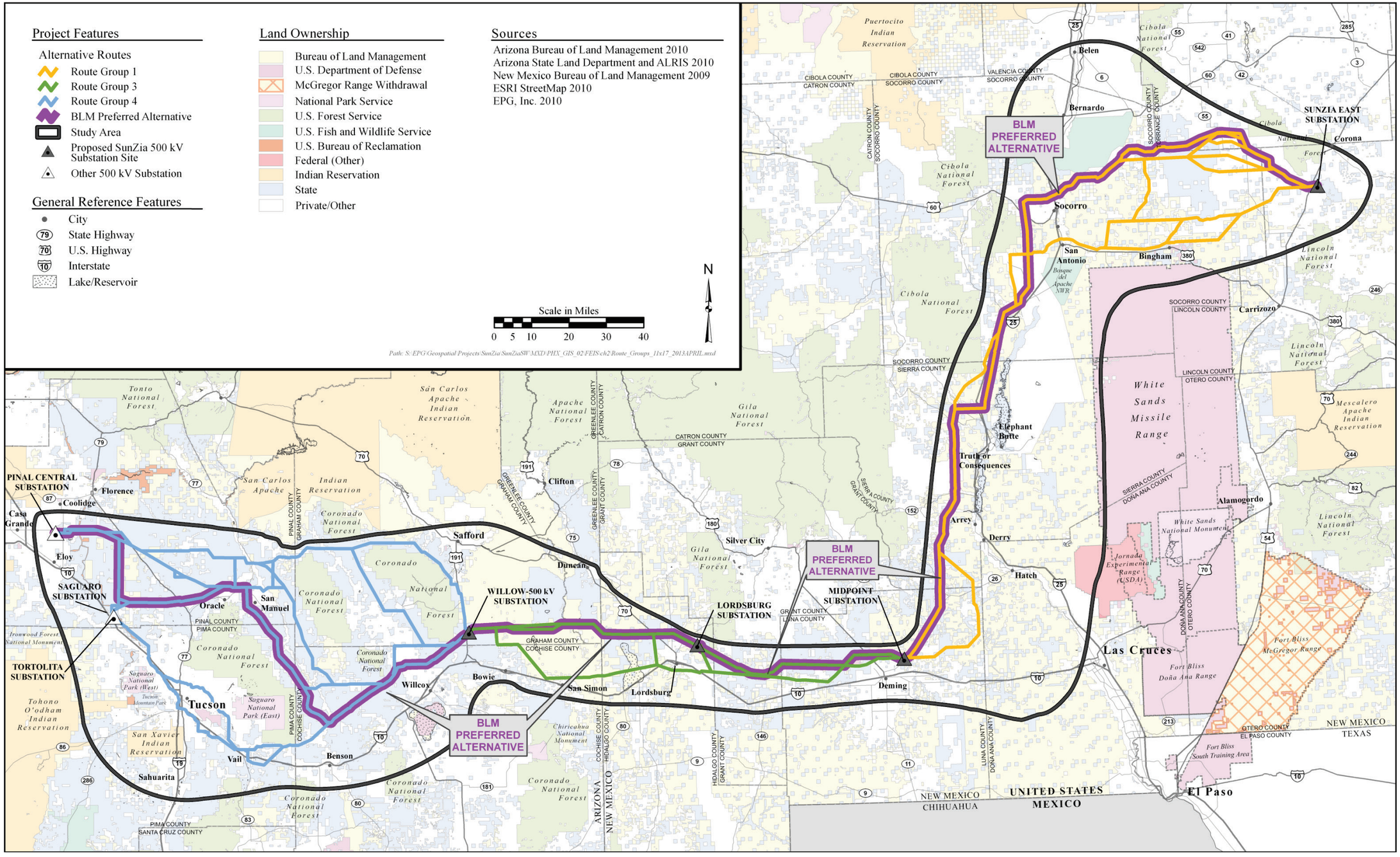
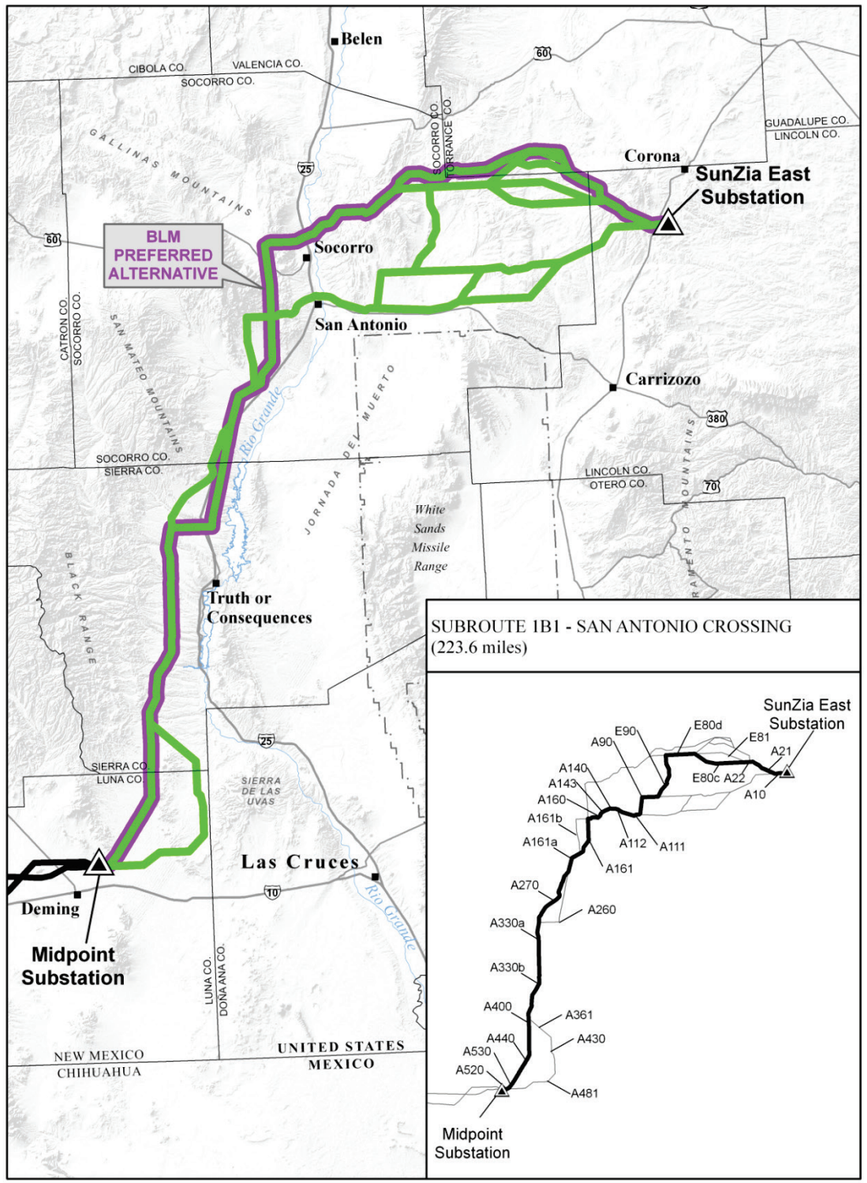


Figure 2-3. Alternative Routes

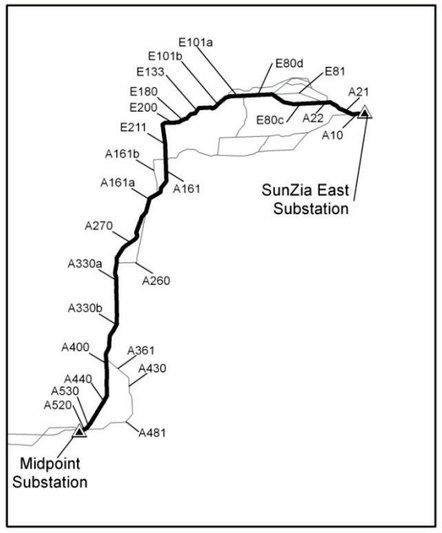
This page intentionally left blank.

ROUTE GROUP 1:

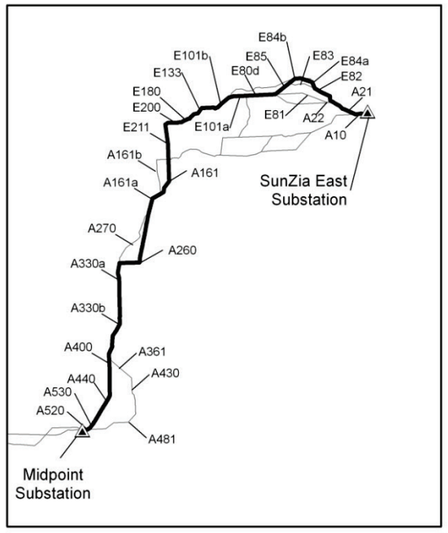
SunZia East Substation to Midpoint Substation



SUBROUTE 1A - NORTH RIVER CROSSING
(219.5 miles)



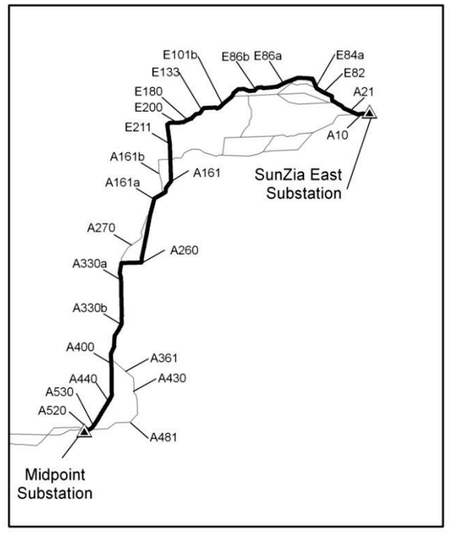
SUBROUTE 1A1 - NORTH RIVER CROSSING
(228.8 miles)



BLM PREFERRED ALTERNATIVE

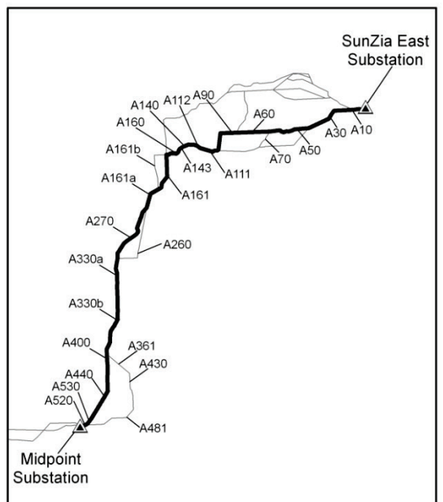
SUBROUTE 1A2 - NORTH RIVER CROSSING
(NORTHERN) - (230.3 miles)

A10, A21, E82, E84a, E86a, E86b, E101b, E133, E180, E200, E211, A161, A161a, A260, A330a, A330b, A400, A440, A530, A520

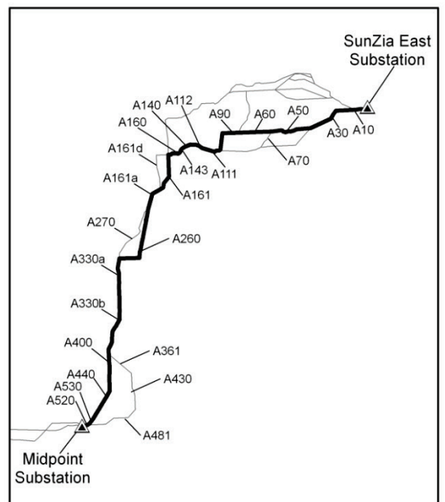


SUBROUTE 1B1 - SAN ANTONIO CROSSING
(223.6 miles)

SUBROUTE 1B2 - SAN ANTONIO CROSSING
(209.2 miles)



SUBROUTE 1B2a - SAN ANTONIO CROSSING
(212.8 miles)



SUBROUTE 1B3 - SAN ANTONIO CROSSING
(206.3 miles)

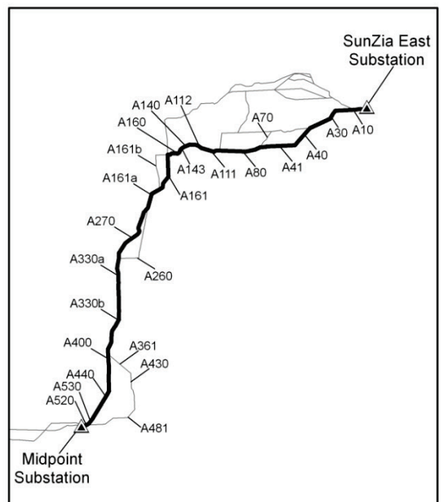
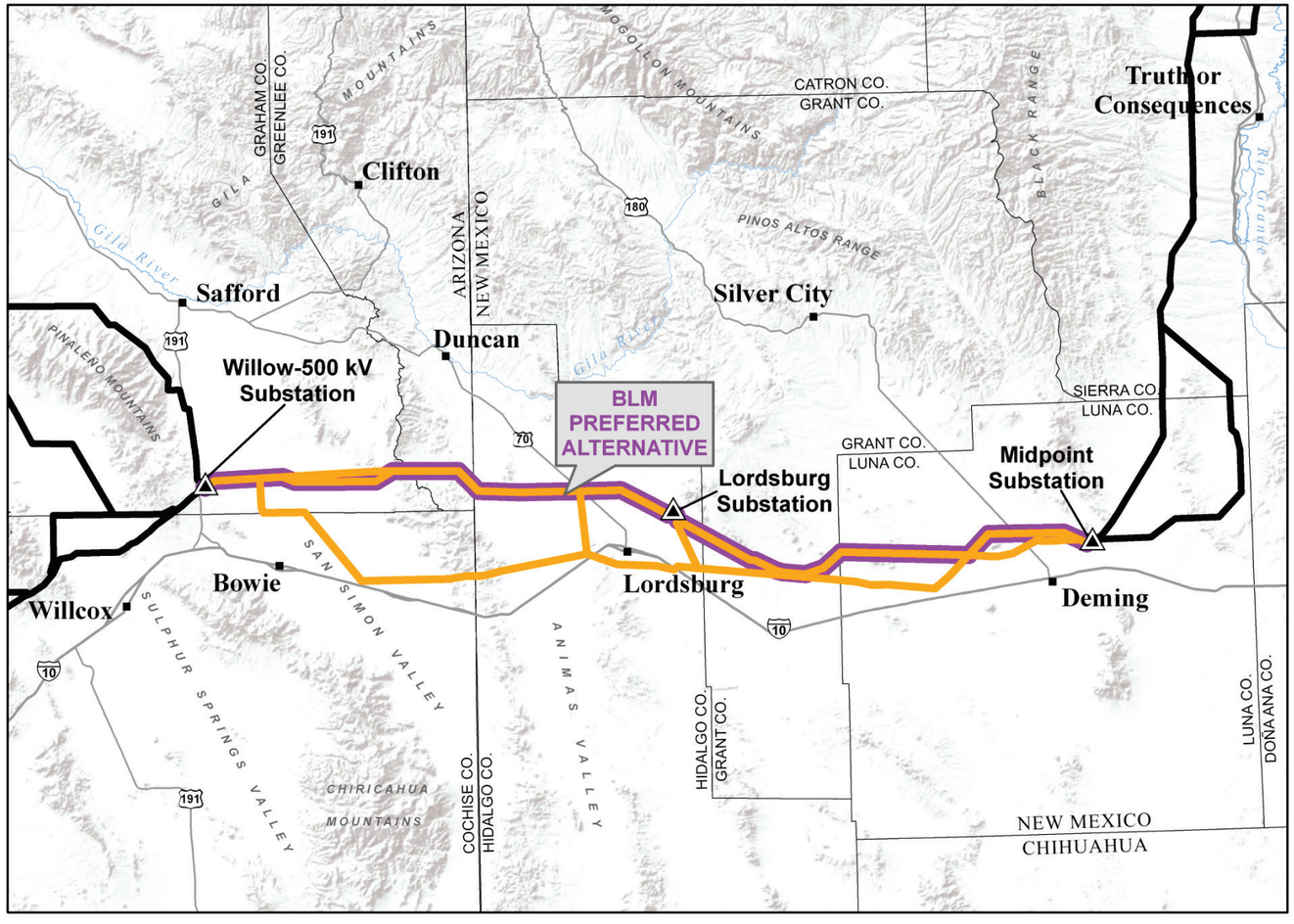


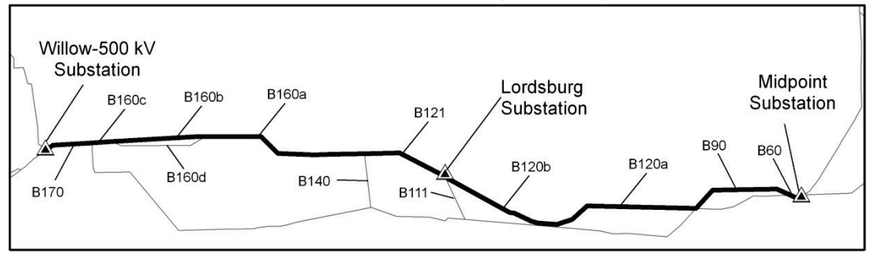
Figure 2-4. Route Group 1: SunZia East Substation to Midpoint Substation

This page intentionally left blank.

ROUTE GROUP 3: Midpoint Substation to Willow-500 kV Substation

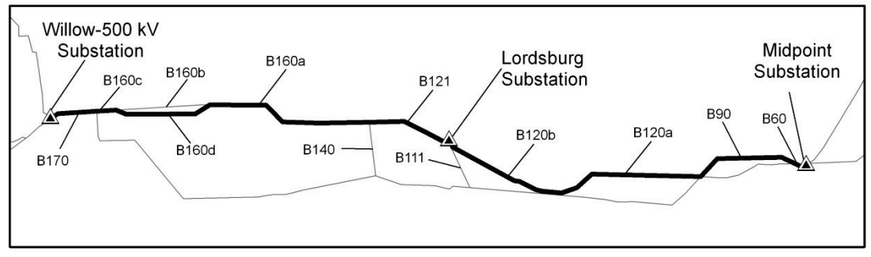


SUBROUTE 3A - NORTH (123.4 miles)



BLM PREFERRED ALTERNATIVE

SUBROUTE 3A2 - (123.9 miles)



SUBROUTE 3B - SOUTH (128.6 miles)

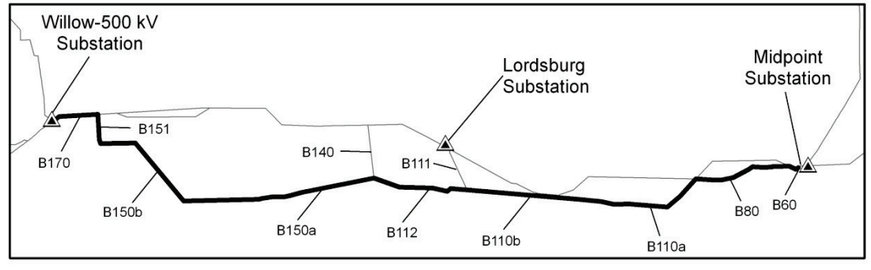
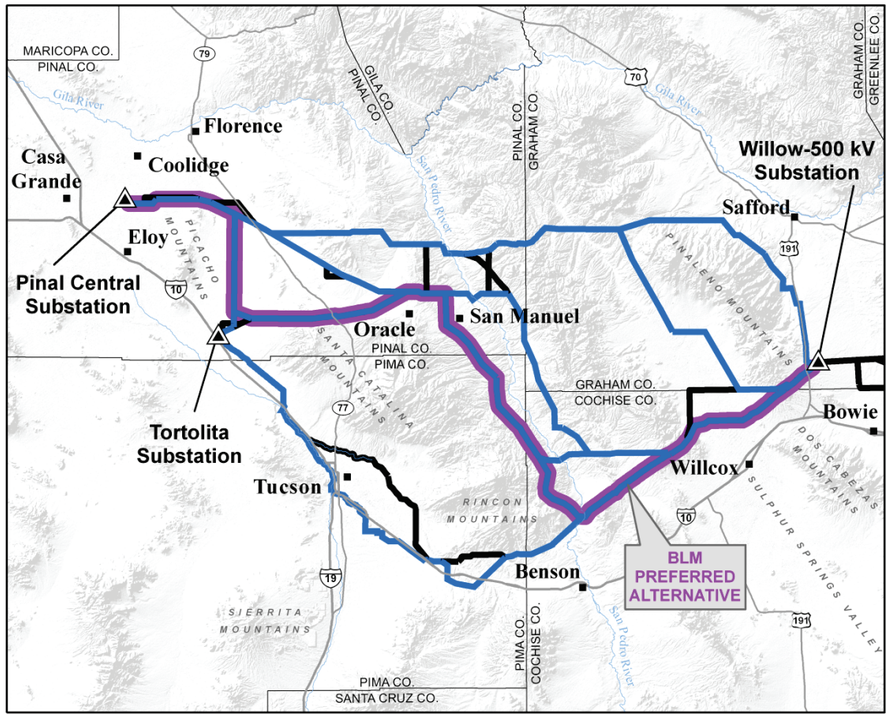


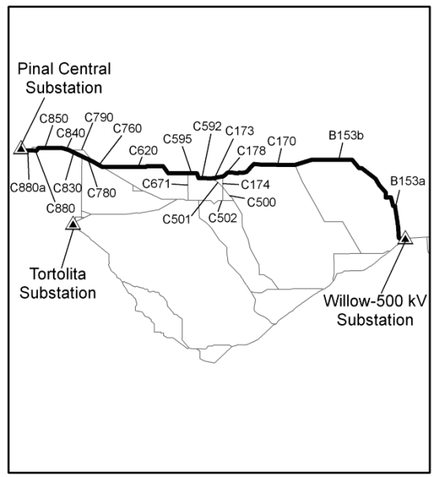
Figure 2-5. Route Group 3: Midpoint Substation to Willow-500 kV Substation

This page intentionally left blank.

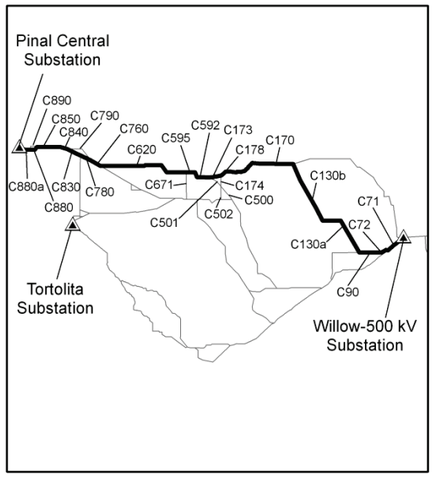
ROUTE GROUP 4: Willow-500 kV Substation to Pinal Central Substation



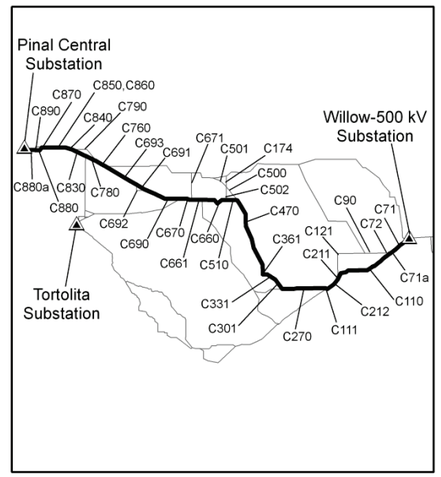
SUBROUTE 4A - NORTH OF MT. GRAHAM
(132.9 miles)



SUBROUTE 4B - SULPHUR SPRINGS VALLEY
(133.0 miles)

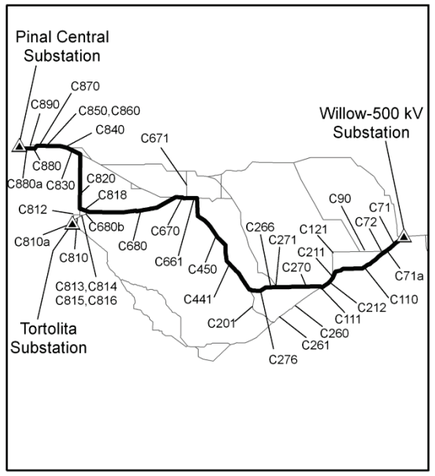


SUBROUTE 4C1 - EAST OF SAN PEDRO VALLEY
(139.0 miles)

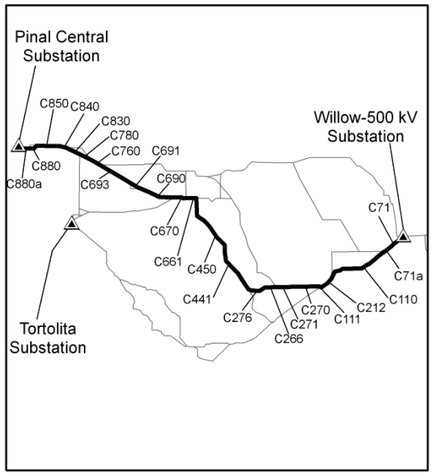


BLM PREFERRED ALTERNATIVE

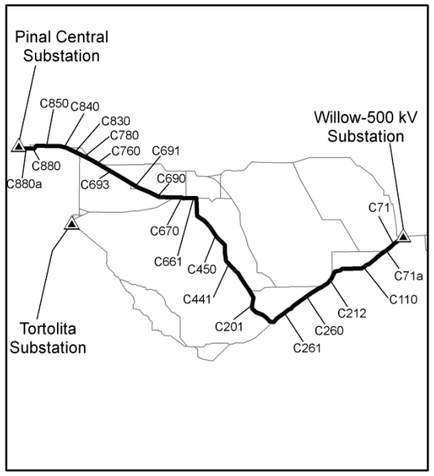
SUBROUTE 4C2 - WEST OF SAN PEDRO VALLEY
(151.8 miles)



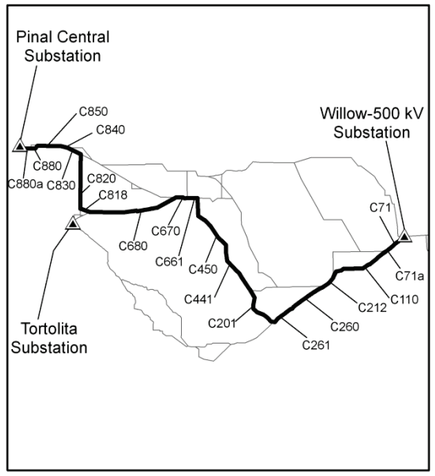
SUBROUTE 4C2a - WEST OF SAN PEDRO VALLEY
(137.8 miles)



SUBROUTE 4C2b - WEST OF SAN PEDRO VALLEY
(147.2 miles)



SUBROUTE 4C2c - WEST OF SAN PEDRO VALLEY
(161.2 miles)



SUBROUTE 4C3 - TUCSON
(172.9 miles)

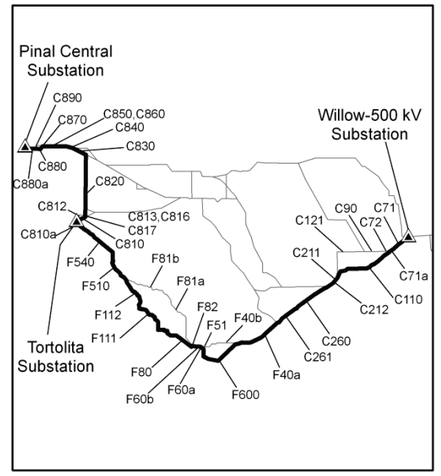


Figure 2-6. Route Group 4: Willow-500 kV Substation to Pinal Central Substation

This page intentionally left blank.

2.3.2.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A – North River Crossing

Subroute 1A (219.5 miles) proceeds west from the proposed SunZia East Substation, passes adjacent to the Sevilleta NWR, and crosses the Rio Grande 4 miles north of the community of Socorro. The subroute continues west before it turns south for 23 miles, parallel to a 345 kV transmission line. Subroute 1A turns southwest, with a portion of the subroute parallel to I-25 and a 115 kV transmission line, before it crosses over State Highway 107 to parallel State Route (SR) 1. The subroute continues in a southerly direction parallel to a 345 kV transmission line, with a portion of the subroute also parallel to SR 27 and SR 26. Subroute 1A parallels approximately 113.5 miles of existing or designated utility corridors.

Subroute 1A1 – North River Crossing

Subroute 1A1 (228.8 miles) proceeds west from the proposed SunZia East Substation, then continues north into Torrance County approximately 4 miles north of the Gran Quivira (links E82, E84, and E85), and rejoins Subroute 1A in Socorro County, east of the Sevilleta NWR. Subroute 1A1 follows the remaining alignment of Subroute 1A, except for the portion located west of the Rio Grande, crossing from Socorro County into Sierra County; that portion follows Link A260 within an existing transmission line corridor for approximately 25 miles. Subroute 1A1 parallels approximately 140.7 miles of existing or designated utility corridors.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 (230.3 miles), the BLM preferred alternative, proceeds west from the proposed SunZia East Substation, then continues north into Torrance County approximately 4 miles north of the Gran Quivira (links E82, E84a, and E86a). As Subroute 1A2 proceeds west, it parallels Subroute 1A1 between 2 and 3 miles to the north, then rejoins Subroute 1A in Socorro County, east of the Sevilleta NWR. As with Subroute 1A1, Subroute 1A2 follows the remaining alignment of Subroute 1A as described above. Subroute 1A2 parallels approximately 140.7 miles of existing or designated utility corridors. Subroute 1A1 was identified in the Draft EIS as the BLM preferred alternative. The selection of Subroute 1A2 as the BLM preferred alternative in this Final EIS was made in response to comments on the Draft EIS that requested modifications to segments E80d and E101a in order to increase the distance between the transmission lines and the military missile launch complex 94 (LC 94). Aligning the transmission lines along Subroute 1A2 places project facilities approximately 4 miles north of LC 94 and farther from the projected debris field of LC 94. Subroute 1A2 was also modified in response to comments on the Draft EIS regarding views from Gran Quivira.

Subroute 1B1, 1B2, 1B2a, and 1B3 – San Antonio Crossing

Subroute 1B1 (223.6 miles) proceeds west from the proposed SunZia East Substation, then turns south approximately 5 miles east of the Sevilleta NWR. The subroute continues south, then turns and again heads west, crosses the Rio Grande, and continues approximately 1.5 miles north of the community of San Antonio roughly parallel to US Route 380 before it again turns south, approximately 8 miles south of the city of Socorro. As Subroute 1B1 proceeds south, it passes

west of Elephant Butte Reservoir and 8 miles west of the city of Truth or Consequences, with a majority of this segment parallel to I-25. The subroute turns slightly to the southwest and proceeds to the proposed Midpoint Substation northeast of Deming. Subroute 1B1 parallels approximately 98.6 miles of existing and designated utility corridors, as well as a large portion of I-25 and US Route 380.

Subroute 1B2 (209.2 miles) proceeds west, similar to subroutes 1A and 1B1, then turns slightly southwest and continues west, parallel to US Route 380 (12 miles north of the WSMR). Subroute 1B2 then turns south and continues west again, from which point it follows the same path as Subroute 1B1. The subroute heads south again, parallel to I-25, then turns slightly southwest and proceeds to the proposed Midpoint Substation. Subroute 1B2 parallels approximately 89.6 miles of existing and designated utility corridors, as well as a large portion of I-25 and US Route 380.

Subroute 1B2a (212.8 miles) is similar to Subroute 1B2, with the exception of Link A260 in place of Link A270. Link A260 follows an existing transmission line east of I-10 in Sierra County and crosses back west of I-10, north of Truth or Consequences, to reconnect with Subroute 1B2. Subroute 1B2a parallels approximately 99.5 miles of existing and designated utility corridors, as well as a large portion of I-25 and US Route 380.

Subroute 1B3 (206.3 miles) proceeds west, similar to Subroute 1B2. It passes approximately 5 miles north of the WSMR, parallel to US Route 380. From here, Subroute 1B3 follows the same path as 1B2, continues west, and crosses the Rio Grande. Subroute 1B3 passes approximately 1.5 miles north of the community of San Antonio and continues parallel to US Route 380 before it proceeds south, parallel to I-25, then turns southwest and proceeds to the proposed Midpoint Substation. Subroute 1B3 parallels approximately 88.6 miles of existing and designated utility corridors, as well as a large portion of I-25 and US Route 380.

2.3.2.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A – North

Subroute 3A (123.4 miles) proceeds west from the proposed Midpoint Substation along the Subroute 3A2 alignment to approximately 10 miles west of the New Mexico-Arizona state line. The subroute proceeds west and crosses the southern tip of the Hot Well Dunes Recreation Area approximately 3 miles north of the San Simon Creek Basin, then proceeds west into the proposed Willow-500 kV Substation. Subroute 3A parallels approximately 42.4 miles of existing or designated utility corridors.

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 (123.9 miles), the BLM preferred alternative, is a variation of Subroute 3A. The subroute proceeds west from the proposed Midpoint Substation, and then crosses a 115 kV transmission line and US Route 180 approximately 7.5 miles north of Deming. From that point, Subroute 3A2 proceeds southwesterly, and then turns northwest to parallel a 345 kV transmission line and pipeline adjacent to the Hidalgo Substation. The subroute then heads west, to cross the New Mexico-Arizona state line from Hidalgo County into Greenlee County. The subroute then proceeds west into Graham County, and south of the Hot Well Dunes Recreation

Area, and continues through the San Simon Valley to the proposed Willow-500 kV Substation. Subroute 3A2 parallels approximately 42.4 miles of existing or designated utility corridors.

The BLM preferred alternative described in the Draft EIS was the combination of subroutes 3A and 3B, which included Crossover Link B140 (Subroute 3A1). The selection of Subroute 3A2 was made in response to comments received on the Draft EIS to include a modification of the alignment of Link B160 (a portion of Subroute 3A), to avoid the Hot Well Dunes Recreation Area.

Subroute 3B – South

Subroute 3B (128.6 miles) proceeds in a westerly direction and crosses a 115 kV transmission line and US Route 180, approximately 5 miles north of Deming. The subroute continues west, turns southwest, continues west again and crosses a 115 kV transmission line and several pipelines. Subroute 3B parallels a 345 kV transmission line for approximately half of this portion of the subroute. It then heads southwest and crosses I-10, the Union Pacific Railroad (UPRR), and two pipelines approximately 2 miles north of the community of Lordsburg before it crosses back to the north side of I-10 and proceeds northwest parallel to several pipelines. Subroute 3B then heads west and continues to parallel several pipelines, then turns north adjacent to the UPRR, then heads west again as it proceeds to the proposed Willow-500 kV Substation. Subroute 3B parallels approximately 76.2 miles of existing or designated utility corridors.

2.3.2.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A (132.9 miles) proceeds north from the proposed Willow-500 kV Substation, parallel to a 230 kV transmission line, pipeline, and US Route 191, then heads west to a point just outside the eastern boundary of the Coronado National Forest (CNF). Subroute 4A then heads northwest to a point just outside the northeast corner of the CNF (approximately 7.5 miles from the community of Safford), turns west then slightly southwest (approximately 2 miles north of the northern boundary of the CNF), to a point approximately 2 miles north of Mammoth. It crosses the San Pedro River, a 115 kV transmission line, and a pipeline along this segment. The subroute heads north parallel to the San Pedro River, then west where it crosses two pipelines, is parallel to one pipeline, and crosses SR 79 and a 115 kV transmission line adjacent to SR 79. The subroute continues west and crosses the CAP and SR 87 before it proceeds to the permitted Pinal Central Substation. Subroute 4A parallels approximately 27.6 miles existing or designated utility corridors.

Subroute 4B – Sulphur Springs Valley

Subroute 4B (133.0 miles) proceeds southwest from the proposed Willow-500 kV Substation, parallel to two 345 kV transmission lines, and crosses two pipelines and US Route 191. The subroute proceeds southwest then west, and crosses two 345 kV transmission lines before it heads northwest to follow the western portion of the CNF. The subroute turns west before it turns slightly southwest (approximately 2 miles north of the northern boundary of the CNF), to a point approximately 2 miles north of Mammoth. It crosses the San Pedro River, a 115 kV

transmission line, and a pipeline along this segment, following the same path as Subroute 4A. Subroute 4B parallels approximately 21.6 miles of existing or designated utility corridors.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 (139.0 miles) proceeds southwest from the proposed Willow-500 kV Substation, parallel to two 345 kV transmission lines, and crosses two pipelines and US Route 191. The subroute proceeds west/southwest, parallel to two 345 kV transmission lines, before it continues west and crosses over two 345 kV transmission lines. Subroute 4C1 then turns northwest, enters the Muleshoe Ecosystem CMA, turns west along the southern boundary of the CMA, and then heads northwest and crosses two pipelines west of the CMA and CNF, roughly parallel to the San Pedro River (approximately 7 miles east of the community of San Manuel). Subroute 4C1 heads west and crosses the San Pedro River (approximately 4.5 miles south of Mammoth and 4 miles north of San Manuel), where it crosses SR 77 then heads northwest parallel to a pipeline, and crosses SR 79 and a 115 kV transmission line. As the subroute then heads west, it crosses the CAP and SR 87 before it proceeds to the permitted Pinal Central Substation. Subroute 4C1 parallels approximately 63.9 miles of existing or designated utility corridors.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 (151.8 miles) proceeds southwest from the proposed Willow-500 kV Substation, parallel to two 345 kV transmission lines, and crosses two pipelines and US Route 191. The subroute heads west, parallel to two 345 kV transmission lines, then southwest. The subroute crosses the 345 kV lines approximately 0.7 mile west of the San Pedro River and turns northwest, then north (approximately 2 miles west of San Manuel). Subroute 4C2 then heads west, crosses SR 77 (approximately 2 miles north of the community of Oracle), and parallels a 115 kV transmission line to the southwest, to a point adjacent to the Oracle Junction Substation. Subroute 4C2 then proceeds parallel to a 500 kV and a 115 kV transmission line, and crosses SR 79. The subroute proceeds northwest then north, to follow the same path as Subroute 4C1 into the permitted Pinal Central Substation. Subroute 4C2 parallels approximately 73.1 miles of existing or designated utility corridors.

Subroute 4C2a (137.8 miles) is similar to 4C2, with the exception of the segment between Oracle and the Pinal Central Substation (C690, C691, C693, C760, and C780), which follows an existing pipeline corridor for approximately 30 miles in Pinal County.

Subroute 4C2b (147.2 miles) is similar to 4C2a, with the exception of the segment between a point north of Willcox and the San Pedro River, where Subroute 4C2b continues parallel to the existing 345 kV transmission lines for approximately 20 miles, and crosses the San Pedro River south of the Three Links Ranch in Cochise County (links C260, C261, and C201). The subroute continues northwesterly through the northeast corner of Pima County into the Oracle area of Pinal County, west of the San Pedro River.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c (161.2 miles), the BLM preferred alternative, is a combination of 4C2 and 4C2b. The subroute follows the existing 345 kV transmission lines from the Willow-500 kV Substation across the San Pedro River, and continues northwesterly through the northeast corner of Pima

County into Pinal County, following the Subroute 4C2b alignment. It then follows the westerly route toward the Tortolita Substation (Subroute 4C2, Link C680), and from that point follows links C818 and C820 approximately 15 miles north to rejoin the 4C2 routes. The preferred alignment along Link C820 would be parallel to and east of the proposed Pinal Central to Tortolita 500 kV transmission line within right-of-way on BLM land for approximately 10.8 miles. Subroute 4C2c parallels approximately 90.4 miles of existing or designated utility corridors.

Subroute 4C3 – Tucson

Subroute 4C3 (172.9 miles) follows the same path as Subroute 4C2 from the Willow-500 kV Substation to a point west of Cascabel Road, then continues southwest parallel to two 345 kV transmission lines, and crosses a pipeline and a 115 kV transmission line (approximately 8 miles northwest of the community of Benson) before it continues southwest to cross three pipelines and I-10. The subroute then heads west (approximately 4 miles south of Saguaro National Park) before it turns north approximately 2 miles east of the community of Vail. As Subroute 4C3 turns west again, to a point adjacent to the intersection of I-10 and Colossal Cave Road, it crosses I-10 and proceeds northwest parallel to the interstate. Subroute 4C3 again heads west before it parallels a pipeline, turns north, proceeds west, crosses Wilmot Road, and continues northwest to a point adjacent to I-10. Subroute 4C3 continues northwest and parallels Benson Highway, then heads north along Alvernon Way and into central Tucson. The subroute proceeds northwest roughly parallel to I-10, then crosses I-10 and I-19. Subroute 4C3 proceeds northwest, with portions paralleling a 138 kV transmission line, adjacent to the Santa Cruz River and I-10. The subroute turns north, primarily parallel to a 138 kV transmission line, and crosses I-10 proceeding northwest, then crosses the CAP near the Tortolita Substation. Subroute 4C3 continues north from the Tortolita Substation, parallel to two 500 kV transmission lines and one 115 kV transmission line, then heads northeast and crosses the CAP. The subroute proceeds north, and then turns northwest approximately 2 miles southwest of SR 79, and reconnects with subroutes 4C1 and 4C2. Subroute 4C3 parallels approximately 118.3 miles of existing or designated utility corridors.

2.3.3 Alternatives Considered but Eliminated

According to the BLM NEPA handbook, an alternative may be eliminated from detailed analysis if (1) it is ineffective (i.e., it would not respond to the purpose and need); (2) it is technically or economically not feasible; (3) it is inconsistent with management objectives for the area (i.e., does not conform with land use plans); (4) its implementation is remote or speculative; (5) it would be substantially similar in design (function and purpose) to another alternative already analyzed; and (6) it would have substantially similar effects to another alternative already analyzed. This section includes descriptions of the alternatives that were considered but eliminated from detailed analysis, including eliminated transmission line routes, alternative transmission line technologies, and alternatives to the construction of a new transmission line.

As described in Section 2.2, input from the public and various agencies resulted in the addition, modification, or elimination of alternative transmission line routes evaluated during the scoping process. Following is a summary of the routes considered but eliminated from detailed study in this EIS. These routes are also illustrated on Figure 2-7; and Table A-9 of Appendix A includes

detailed information describing the alternative transmission routes (and link numbers) that were eliminated or modified and the justification for those changes. In addition to the elimination of various routes, minor modifications or realignments to some route segments identified during the development of alternatives were made in response to site-specific conditions. (Modified route segments are shown on Figure 2-7 as alternatives eliminated, and described in Appendix A.)

2.3.3.1 Alternative Transmission Line Routes Considered but Eliminated

Alternatives Considered but Eliminated in Route Group 1 and Route Group 2

Alternatives North of WSMR

Following the second scoping period conducted in the fall of 2009, Department of the Army personnel representing the WSMR recommended a set of additional alternative routes that would be located within Socorro, Torrance, or Valencia counties, between 20 and 60 miles north of the WSMR boundary. The WSMR conducts military training and testing missions, including low-level flight operations in airspace surrounding the WSMR[1]. The area north of the WSMR also includes the Northern Call-up Area, comprising 1.5 million acres of BLM, state, and private lands where missile test firings are conducted. Pursuant to private agreements between the WSMR and ranchers using the lands, the WSMR requires the evacuation of the Northern Call-up Area prior to and during missile testing. In order to minimize impacts to critical test missions, the WSMR identified a series of alternative routes known as WSMR Routes[2] 1, 1a, 2, 2a, and 2b, which would avoid this area (Figure 2-7).

In response to the military's request for consideration of the northern alternative routes, the study area was extended approximately 40 miles north of the initial study area boundary, as shown on Figure 2-7. Additional study of opportunities and constraints was conducted to identify a range of alternative routes within the expanded area, including the WSMR alternatives. The alternatives identified and considered by the BLM for detailed study in the EIS included a group of route segments referred to as subroutes 1A and 1B, which included portions of the WSMR Routes 1, 2, and 2a. Other segments of the WSMR routes were subsequently eliminated because of specific constraints (described below). The resulting set of alternatives would have a substantially similar function and purpose as the WSMR routes, providing a transmission line right-of-way between the proposed SunZia East Substation and the Midpoint Substation, and would avoid potential conflicts with military activities conducted in the area north of the WSMR.

WSMR Route 1 would begin at the proposed SunZia East Substation and continue northwest for 15 miles across a portion of the Cibola National Forest into Valencia County, south of Belen. WSMR Route 1 would continue for approximately 14 miles from north to south, parallel to an existing 345 kV line through the Sevilleta NWR. WSMR Route 1A was an alternative segment of WSMR Route 1 that would parallel the northern border of the Sevilleta NWR, and continue through the Sevilleta NWR along WSMR Route 1. After further review, it was determined that a

[1] Department of the Army. WSMR. Memorandum to Ms. Linda Rundell, BLM, New Mexico State Office, signed by John S. Regan, Brigadier General, Commanding.
[2] WSMR route number designations differ from Project subroute numbers.

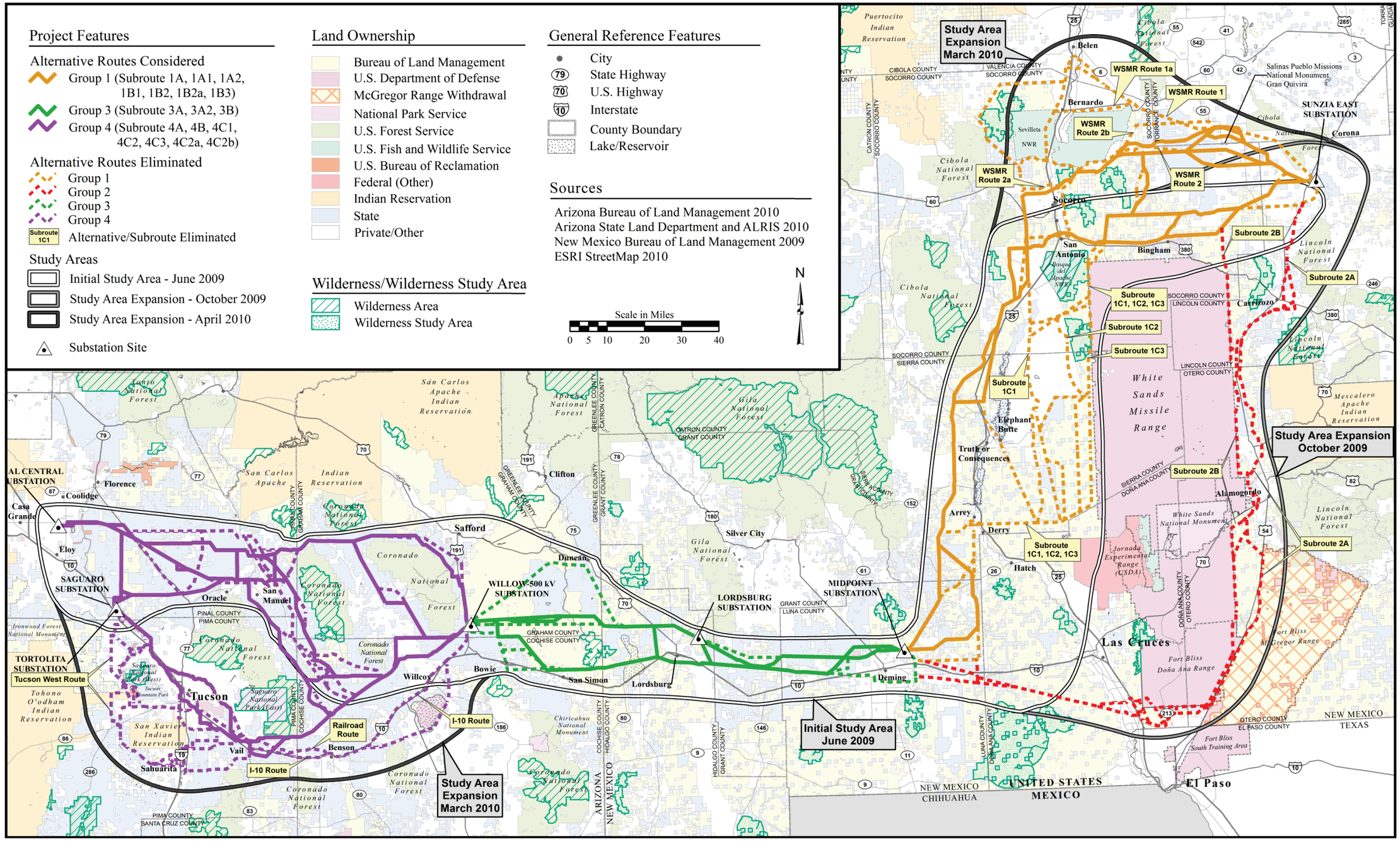


Figure 2-7. Alternatives Considered but Eliminated

This page intentionally left blank.

new transmission line right-of-way crossing the Sevilleta NWR would conflict with the refuge management policy and legal restrictions that prohibit commercial uses, as stated in the Sevilleta NWR land grant deed[1]. Therefore, WSMR Route 1 and WSMR Route 1A were eliminated from detailed study.

The WSMR also requested the evaluation of a route that would continue north of the Sevilleta NWR, heading west to avoid the Sierra Ladrones Wilderness Study Area (WSA) and the Ladron Mountain/Devil's Backbone Complex ACEC, before turning to the south and connecting with WSMR routes 1 and 2, west of the Rio Grande and south of the Sevilleta NWR. This route would not directly cross the Sevilleta NWR, but would cross a BLM right-of-way exclusion area and the Cibola National Forest. This (unnamed) route would be constrained to the east of the forest service land by the Sierra Ladrones WSA and the Sevilleta NWR, and would be located across the Cibola National Forest where there are no existing utility rights-of-way. According to the Cibola National Forest Land and Resource Management Plan, "*(where) no reasonable alternative exists, additional or new facilities should be restricted to existing rights-of-way"* (1985). This route was eliminated because it would not be compatible with Cibola National Forest land management policies, and it would cross a BLM right-of-way exclusion area. Alternative Subroute 1A would fulfill a substantially similar function and purpose, as stated above.

WSMR Route 2 would follow the alternative Subroute 1A from the SunZia East Substation to the northwest, following a portion of the southern boundary of the Sevilleta NWR across the Rio Grande before turning south, approximately 10 miles west of the Rio Grande (see Figure 2-7). Variations of WSMR Route 2 included Route 2a, which would also cross the Rio Grande near Socorro, and WSMR Route 2b, which would be located approximately 8 miles north of Subroute 1A where it would cross the Socorro-Torrance county line. WSMR Route 2b was recommended by the Department of the Army as an alternative to the Project alternative Subroute 1A in order to increase the distance between the transmission lines and LC 94, which is used to test-fire missiles onto the WSMR one to two times per year. Subroute 1A is approximately 2 miles north of LC 94, and WSMR Route 2b would be approximately 10 miles to the north. Although WSMR routes 2a and 2b would be substantially similar in purpose and function to Subroute 1A, these routes would impact a greater number of residential properties and ranch operations located north of Subroute 1A. WSMR has stated that, compared to WSMR Route 2a or 2b, transmission lines constructed along the Subroute 1A alignment would create a higher risk of potential "damage (to) the transmission lines within a 'safety zone' surrounding the launch site should a missile launched from LC 94 malfunction and need to be remotely destroyed."[2] Although the limits of the "safety zone" have not been determined, it is reasonable to assume that increasing the distance between the proposed transmission lines and LC 94 could avoid potential conflicts with launch malfunctions. However, the distance to effectively mitigate the risk of damage to

[1] The restriction in the Sevilleta NWR land grant deed in Section 3d, page 8, states; "The property shall not be sold, exchanged, transferred or abandoned. Nor shall it be leased or used for any commercial purpose other than where deemed appropriate by the Bureau and The Nature Conservancy for the purposes of sound wildlife management." Section 4, page 8, states; "If the property shall cease to be administered as a national wildlife refuge or should the Grantee breach the aforementioned use regulations, the title of the Grantee and its successors and assigns, shall cease and determine, and the title shall revert in fee simple to the Grantor" (Warranty Deed 1973).

[2] Comment to BLM from Renee Blotske, WSMR, February 22, 2012

the Project has not been determined. In addition, whether the risk of constructing transmission lines located 2 miles away, as opposed to WSMR Route 2b located 10 miles away, would require protection to minimize the risk of damage to Project facilities, relocation of LC 94, or other mitigation to avoid conflict with potential launch malfunctions. Therefore, the proposed WSMR alternative (either WSMR route 2a or 2b, 10 miles north of the Subroute 1A alignment) was not analyzed in detail in the Draft EIS because there would be no substantial advantage achieved by the using this alternative. However, based on additional information regarding WSMR operations and further analysis, the alignment for Subroute 1A1 was modified in order to reduce the risk of conflict between the proposed transmission lines and the LC 94, while limiting the potential for impacts to residential and ranch properties. The modified alignment (Subroute 1A2) is located within the area of analysis for Subroute 1A1 that was documented in the Draft EIS, and the centerline of the proposed Project right-of-way would be located approximately 3 miles north of Subroute 1A1. Additional mitigation to reduce risks associated with military operations may be developed in coordination with the Applicant and BLM.

On May 11, 2011, the DOD sent a letter to the BLM[1] in which the DOD identified several alternative route segments associated with the proposed Project and included their evaluation of potential effects of the respective routes to the DOD's missions. These included some segments that would have adverse effects on missions that "cannot be economically mitigated." The letter clarified the DOD's position on the northern alternative routes originally proposed during the scoping process. These routes would be located in the Northern Call-up Area, in proximity to Gran Quivira. The DOD's position was to provide an alternative route located north of Subroute 1A that would avoid adverse effects to critical test profiles. In response to their position, local alternatives to Subroute 1A north of the Gran Quivira were added for further study in the EIS (subroutes 1A1 and 1A2 and Local Alternative Link E83). According to the DOD, the remaining subroutes in the Northern Call-up Area (subroutes 1A, 1B1, 1B2, and 1B3) would present adverse effects that could not be economically mitigated. However, in this instance the BLM is the relevant decision-maker in determining whether to issue any rights-of-way traversing the Northern Call-up Area and consequently, the routes within the Northern Call-up Area were carried forward for further consideration and analysis. The BLM, responsible for determining the appropriate mitigation, will consider the DOD's comments and concerns.

An alternative route was identified to follow along an existing pipeline on the east side of the Rio Grande, between San Antonio and Socorro (Link E140, see Appendix A). Because this alternative would potentially result in greater cultural resource impacts along portions of the Camino Real National Historic Trail (NHT), and the function and purpose of Subroute 1A would be substantially similar to Link E140, that alternative segment was eliminated.

Alternatives East, South, and West of WSMR

As noted above, the May 11 DOD letter identified certain route segments that would "have an adverse effect on test and training at WSMR…" For purposes of clarification, the following is a brief description of two of the route groups discussed in the letter, as well as the general

[1] DOD letter sent to the BLM, and signed by Dorothy Robyn, Deputy Under Secretary of Defense (Installations and Environment); Samuel Kleinman, Deputy Under Secretary of Defense (Readiness); and David Duma, Principal Deputy Director (Operational Test and Evaluation).

treatment of each group in this EIS. One group of segments associated with the Rio Grande crossing between Arrey and Derry, New Mexico would be located between the Rio Grande and the WSMR[1] (subroutes 1C1, 1C2, and 1C3). Subroute 1C3 would also require use of the right-of-way on DOD land along Link A300, east of the Jornada del Muerto WSA. These segments would traverse at least a portion of land under the sole jurisdiction and control of the WSMR.

Another group of segments[2] located to the east and south of the WSMR would have crossed either portions of the WSMR or Fort Bliss. Route Group 2 included Subroute 2A, Subroute 2B, and local alternatives between the proposed SunZia East Substation and the proposed Midpoint Substation, east of White Sands. Although there is a BLM-designated, 1-mile-wide utility corridor parallel to US Route 54 as indicated in the BLM RMP for the McGregor Range, it could be used only with concurrence by the Secretary of the Army (BLM 2006). (PL 106-65 pursuant to the terms of the Engle Act withdrew the McGregor Range from the BLM's exclusive decision-making authority and vested the approval of rights-of-way traversing the Range with the DOD.) Therefore, the Department of the Army is the relevant decision-maker in determining whether to issue a right-of-way on these DOD lands and whether to require any mitigation measures. According to the Department of the Army, any rights-of-way crossing these DOD land segments could not be granted without significant and economically infeasible mitigation measures. Consequently, routes crossing DOD land were eliminated from further consideration, including subroutes 1C1, 1C2, 1C3, 2A, and 2B.[3]

Alternatives Considered but Eliminated in Route Group 3

Alternatives Considered but Eliminated Common to Subroute 3A

An alternative route was considered that would parallel the existing 345 kV transmission lines between Hidalgo County, New Mexico and Cochise County, Arizona; south of US Route 70 to a point south of Duncan, Arizona. The route would include a segment parallel to the Tucson Electric Power (TEP) 345 kV transmission lines heading southwest to the proposed Willow-500 kV Substation. This alternative route was eliminated because it would add an additional 14 miles of transmission line (including new access roads), would offer no environmental advantage over other more direct routes, and would be substantially similar in purpose and function to Subroute 3A.

Alternatives Considered but Eliminated Common to Subroute 3B

Alternative routes that would be located west of San Simon, crossing I-10 near Bowie, and connecting into the proposed Willow-500 kV Substation were considered but eliminated, because they would impact multiple residential properties and center-pivot irrigated farmlands. While selective structure placement could be applied to mitigate impacts to irrigated farmlands, it is not technically feasible to span the edge of center-pivot irrigated fields with two 500 kV

[1] Referenced as segments A180, A181, A183, A300, A312, and A313 in the May 11, 2011 letter, and are parts of subroutes 1C1, 1C2, and 1C3.
[2] Referenced as segments D260b, D270, D271, D272, D310, D320, and/or D800a/b in the May 11, 2011 letter, and are parts of Route Group 2.
[3] Note that Subroute 1B3 would cross an isolated 1-mile segment of DOD land, and was carried through detailed study.

transmission lines. Alternative subroutes 3A or 3B would be substantially similar to this alternative, but would avoid impacts in the Bowie area.

Alternatives Considered but Eliminated in Route Group 4

Alternatives Considered but Eliminated Common to Subroute 4B

Northwest of Willcox and in the vicinity of Bonita, Arizona, a local alternative for Subroute 4B was eliminated because it would conflict with center-pivot irrigated farmland. Alternative Subroute 4B would be substantially similar to this alternative, but would avoid impacts to center-pivot irrigated farmlands as described above.

The northernmost route located between the San Pedro River and the permitted Pinal Central Substation was eliminated, because it would conflict with The Nature Conservancy (TNC) conservation allotments in the vicinity of the San Pedro River crossing, and would be substantially similar to alternative subroutes 4A and 4B.

Alternatives Considered but Eliminated Common to Subroute 4C1

Alternative routes that would parallel the San Pedro River were eliminated because they would cross constraining features, including wildlife habitat, farmland, and residences. These alternatives, located within existing power line and pipeline corridors in the San Pedro River Valley, were identified during the regional study of opportunities and constraints. Other constraints to new rights-of-way in this area include TNC lands with deed restrictions that prohibit any new utility easements. An alternative route that would parallel an existing pipeline through the Muleshoe Ranch CMA was eliminated, because the alternative would cross a BLM-designated right-of-way exclusion area. The remaining route that was carried through for detailed study (Subroute 4C1) would cross a portion of the Muleshoe area designated as right-of-way avoidance along its southwestern boundary, and would be substantially similar to the eliminated alternatives.

Alternatives Considered but Eliminated Common to Subroute 4C2

A route was considered as an alternative to a portion of 4C2 that would parallel scenic highway SR 79, but was eliminated. This alternative would result in potential impacts to viewers along SR 79, whereas alternative subroutes 4C1 or 4C2 would be substantially similar and have less impact. Another route located west of Oracle that would include a segment parallel to an existing 500 kV transmission line was also eliminated, because it would require additional out-of-direction transmission line construction and would be substantially similar to 4C2.

Alternatives Considered but Eliminated Common to Subroute 4C3

During the second scoping period, additional routes that would be located along I-10 (I-10 Route), the UPRR corridor (Railroad Route), existing transmission line corridors through Pima County, and other local alternatives including the Tucson West Route were identified in response to public comments.

The I-10 Route alternatives proceed from the proposed Willow-500 kV Substation through Benson and Tucson, and were evaluated to identify opportunities and constraints as documented in Appendix A. Two alternatives were considered between Willcox and Benson; one that follows

I-10, and a second that follows portions of the existing 230 kV and 115 kV transmission lines, south of the Willcox Playa and ending in Vail, Arizona. The route would be located north of I-10 near the northwest end of the city of Benson and would proceed west on the north side of I-10 until reaching Vail. The route that follows I-10 was eliminated because it would impact residential areas near Willcox. Construction and operation of the proposed transmission lines using the I-10 Route alternative (following the existing transmission lines south of I-10) would potentially impact wildlife habitat near the Willcox Playa, as well as residences located south of the Willcox Playa near the Sunsites community and the Apache Power Plant, and in the city of Benson.

The I-10 Route alternative between Vail and Tucson would be located approximately 1 mile north of I-10 through the southeastern portion of Tucson, would continue to Alvernon Way, and then head north for approximately 1.5 miles. From that point, it would turn northwest, parallel to Aviation Highway and the railroad. This portion of the route would be directly west of and in line with the main runway at Davis-Monthan AFB. The right-of-way required for this I-10 Route alternative could displace approximately 415 single-family residences, 50 commercial buildings, 2 schools, and 130 industrial structures along the corridor between Vail and Speedway Boulevard in Tucson. Portions of this route would also cross historic districts in central Tucson, resulting in associated visual (aesthetic) impacts. Comments received during the scoping period included the following:

> The City of Tucson (City) is engaged in a long-term economic development and revitalization process for the Tucson Downtown. This effort is often referred to as Rio Nuevo. Siting of transmission lines could have a detrimental impact on this effort of [sic] they reduced the look and feel of the Downtown area. Rejuvenation of the Downtown is extremely important to the economic vitality of the entire region. Factors such as aesthetics play a critical role in the success of such efforts.[1]

The Railroad Route alternative was also considered in response to public concerns. It would parallel the UPRR between Benson and Tucson, and would continue through the city of Tucson parallel to the I-10 Route to Speedway Boulevard. Residential impacts along the Railroad Route northwest of Benson and Mescal, and near the town of Vail, would be similar to impacts of the I-10 Route described above.

The I-10 and Railroad routes were eliminated from further study as they would be substantially similar to Subroute 4C3, but would result in potentially greater impacts to land uses and wildlife habitat, as described above. Subroute 4C3 (C71, C110, C212, C260, C261, and F40a) would be located within the existing 345 kV transmission line corridor for approximately 30 miles, generally parallel to I-10 between Benson and the Tortolita Substation. The alternative Subroute 4C3 was carried forward for detailed analysis in the EIS because, to some extent, it would have potentially fewer land use impacts than the I-10 and Railroad routes through central Tucson.

Various alternative alignments were identified that would be located south and west of Tucson between Vail, Sahuarita, and the Tortolita Substation, including the Tucson West Route and

[1] Letter from A. Elias, Director, City of Tucson Housing and Community Development Department, June 10, 2010.

other local alternatives. During the evaluation of opportunities and constraints in the Tucson West area, constraints to acquisition of new rights-of-way in three areas were identified. First, it was determined that no new utility corridors would be permitted through the Tucson Mitigation Corridor, which is managed by Pima County, the AZGFD, and the BOR. Second, the Tohono O'odham Nation passed a resolution in opposition to the Project, thereby precluding a new right-of-way along the portion of the Tucson West Route alternative that would require crossing tribal land[1]. Third, the Tohono O'odham Nation also passed a resolution to deny any Project route that would cross the San Xavier District[2].

Other alternative routes through the city of Tucson were evaluated and found to have the following potential impacts:

- acquisition of residential, commercial, and industrial properties
- viewer impacts from Saguaro National Park and residential areas of Avra Valley
- conflicts with the Tucson redevelopment plan
- conflicts with aircraft operations at Tucson International Airport

The Tucson West Route and other local alternatives within the Tucson area were eliminated because they were substantially similar to Subroute 4C3, but would have greater environmental impacts and would conflict with city, county, and tribal government plans.

2.3.3.2 Alternative Transmission Technologies

Alternative Voltage Levels

The Project is planned as two single-circuit 500 kV transmission lines. One line would be an AC line with a transfer capability of 1,500 MW; the other line would be either an additional AC line with a 1,500 MW capacity or a DC line with a 3,000 MW capacity.

Voltage levels other than 500 kV could meet the Project transfer capability (see Section 2.3.3.3). A 765 kV transmission voltage represents the next level (greater than 500 kV) of AC voltage in current practice within the United States (but currently not within the western United States). Operation of higher voltage transmission lines will result in the overbuild of facilities for the existing transmission system. Higher voltage levels would result in excess capacity and increased costs, whereas lower voltage levels would require construction and operation of additional lines. Therefore, alternative voltage levels would not be technically feasible and have been eliminated from further evaluation.

Direct Current Transmission

The proposed action includes the option to construct and operate one line as a 500 kV AC line, with the other line as a 500 kV DC line; the main benefit of which is the greater control of power flows over long distances. The DC line would have increased transfer capability, and would transport energy directly from the region of high wind energy potential in New Mexico to central

[1] Resolution of the Schuk Toak District Council 2010
[2] Resolution of San Xavier District Council 2011

Arizona. In order to interconnect with an AC system, the DC current must be converted to AC. Converter substations require more land and are significantly more expensive than a typical 500 kV AC substation, rendering intermediate interconnections cost-prohibitive. As such, the DC line would have no intermediate substations, unlike an AC line. This means the Project would not be capable of (1) providing energy to reach local energy consumers, (2) interconnecting with the existing transmission system, or (3) accepting energy from generators along the transmission path. The lack of intermediate interconnection with the existing transmission systems would not improve reliability or relieve congestion on the existing system, and would therefore not meet the purpose and need. Although the environmental effects of constructing two DC lines would be substantially similar to the effects of one AC and one DC line, given the reasons above, at least one AC line is needed to meet the Applicant's objectives. Thus, the alternative to construct two DC lines was eliminated from further consideration.

Underground Transmission

In response to scoping comments, an alternative to construct and operate certain portions, or the entire length, of the proposed 500 kV transmission line project underground was considered but eliminated from further consideration. A technical feasibility study was prepared to evaluate the operational, economic, and environmental factors associated with underground transmission line systems (SunZia Transmission, et. al. 2011). Burial of the entire Project or portions of the Project is considered technically infeasible due to potential reliability concerns, operational risks, environmental impacts, and high construction cost. Additional contributing factors would include a limited supply of materials, and limited manufacturing capability to produce long lengths of 500 kV buried cable systems. The SunZia Project would be 20 times longer than the longest known underground 500 kV transmission line project (Williams and Gregory 2010).[1] Accordingly, potential construction and operation of portions of the Project using underground cable systems was eliminated from further consideration. Although burial of portions of the Project were not considered feasible, in response to public concerns, the effects of undergrounding a portion of the transmission lines at the Rio Grande crossing, north of the Bosque del Apache NWR, were evaluated as a potential mitigation alternative (see Section 4.16).

High-voltage underground transmission lines have markedly different technological requirements and are more difficult to place underground than lower voltage underground distribution lines, which provide electricity to individual homes and businesses. High-voltage underground lines (138 kV, 230 kV, and 345 kV) have been constructed in some parts of the United States, primarily for short distances, and usually where circumstances dictated that overhead lines were not feasible (e.g., in the vicinity of airports and urban centers). The only 500 kV underground transmission lines in the United States are at the Grand Coulee Dam. Due to concerns regarding underground transmission line failures, Bonneville Power Administration and the BOR are currently evaluating replacing the underground lines at Grand Coulee Dam with overhead transmission lines (Bonneville Power Administration 2009).

[1] The Shinkeiyo-Toyosu Project is the longest known 500 kV underground transmission line. The double-circuit 500 kV underground cable system was built in Tokyo, Japan in the year 2000. This project was a total length of 40 kilometers (20 miles) and required nine years to test, manufacture, and install.

Options for underground transmission cable systems include gas-insulated line (GIL), high-pressure fluid-filled (HPFF), self-contained fluid-filled (SCFF), and extruded dielectric. Summaries of each of the technological capabilities and their feasibility are presented as follows.

GIL systems typically require a hollow aluminum tube that is held by epoxy spacers in the center of a second, larger diameter aluminum pipe that is filled with gas. Historically, the gas pressurization system was entirely composed of sulfur hexafluoride (SF_6). As a result of the increased cost of SF_6 and of environmental concerns (i.e., releases to the air that contribute to ozone depletion), the current practice is to use a mixture of nitrogen (N_2) and SF_6. GIL technology at 500 kV levels has been implemented primarily within substations and is typically limited to distances less than 1,000 feet. Limited experience exists for 500 kV GIL systems beyond use within substations. GIL has limited applications, lacks the experience of completing underground transmission systems, has limited suppliers, and is not available for a potential DC application. For these reasons, it would not be technically feasible for use by the Project, and was eliminated from further evaluation.

HPFF is a pipe-type system where three high-quality paper insulated cables, along with a dielectric fluid, are installed within a single steel pipe. The dielectric fluid is maintained at a nominal pressure of 200 pounds per square inch to increase the insulation dielectric strength, suppress the possibility of ionization in the insulation, and prevent moisture and contamination from entering. A pressurization plant, which includes a large reserve tank to facilitate the expansion and contraction of the dielectric fluid as the system undergoes thermal cycling, would be required at one end of the line in a terminating station to retain the required pressure on the cable's insulation. The system is designed to relieve the pressure as the temperature increases and maintain the pressure as the temperature decreases. Industry-sponsored testing has proven that this technology can operate at the 500 kV level; however, there are only two known 500 kV installations, which are located in Japan. Using an HPFF system provides high reliability, but requires additional equipment, resulting in additional opportunity for component failure. Recently, application of HPFF is diminishing as are the number of manufacturers that are qualified to supply this cable, manufacture accessories, and assist with maintenance of these systems. A major concern of this transmission cable system is the potential for a leak and the release of the dielectric fluid into the environment. The EPA has expressed concern over fluid leaks from HPFF systems. Due to limited experience with HPFF at 500 kV levels, diminishing manufacturers, and environmental concerns, the HPFF cable system was eliminated from further evaluation.

SCFF cable systems consist of three cables insulated with a high-quality paper, each with a metallic shielding system and a plastic jacket. The copper or aluminum conductor has a hollow core, which provides for the installation of a dielectric fluid at a low pressure of 40 to 50 pounds per square inch. The dielectric fluid increases the insulation dielectric strength, suppresses the possibility of ionization in the insulation, and prevents moisture and contamination from entering. A plastic jacket encapsulates each completed cable. Similar to the HPFF system, the cable system would be pressurized and a fluid reservoir would be included inside one of the terminating stations. The cables would then be installed in a duct or in a tunnel. Because each cable is independently pressurized, in the event of a dielectric fluid leak, less fluid is released and can be more easily contained within the duct. This type of cable system has been used for 345 kV systems, two 525 kV AC systems, and one 500 kV DC system. Similar to the HPFF, but

to a lesser degree, this technology is diminishing in application and fluid leaks present an environmental concern. As such, SCFF was eliminated from further evaluation.

Extruded dielectric cable systems are typically composed of three copper or aluminum cables with a cross linked polyethylene (XLPE) insulation extruded on the conductor. A metallic shielding system and a plastic jacket complete the cable construction. At 500 kV, it is recommended that each cable be installed in a separate polyvinyl chloride conduit within a concrete enclosed duct bank. This cable technology has the benefits of a simplified installation method, in turn reducing operations costs as compared to other cable systems. The trend in AC underground transmission cables in recent years has been toward extruded XLPE cables, with less reliance on laminated cable systems (HPFF and SCFF). Extruded XLPE technology has been the primary cable for AC applications in the United States for the past 10 years, for voltages ranging from 69 to 230 kV. One 345 kV XLPE cable system is operational in the northeastern United States. For current underground transmission cable systems, extruded cables offer the largest number of cable manufacturers and the greatest technical support for installation and maintenance. An extruded AC cable with XLPE insulation is considered technically feasible for short distances.

To date, there are three known applications of underground 500 kV DC transmission lines; each uses SCFF technology. With the technology available for 500 kV converter stations today, high-voltage DC cables using XLPE insulation have proven unsuccessful at this voltage. If underground 500 kV DC cable installation was to be considered in the future, it would be necessary to continue to monitor research and development of this technology. Currently, 500 kV DC underground cable technology has been primarily used with submarine applications using SCFF cables for ocean or water crossings. Since 500 kV DC cables using XLPE insulation are presently not feasible, underground 500 kV DC transmission was eliminated from further consideration.

While XLPE has been proven to be technically feasible over short distances, it has not been proven technically feasible for the total distance required by the Project. Regardless of cable technology, the full length of the Project is approximately 20 times longer than the longest known 500 kV underground transmission project. As such, there are significant logistical concerns regarding the manufacture, construction, and operation of a 500 kV underground transmission project of such magnitude. For example, there may not be adequate worldwide cable manufacturing capability to produce 500 miles of 500 kV underground cable and accessories (or 1,000 miles for two transmission lines). In addition, due to technology limitations, a 500-mile 500 kV underground transmission line would likely have to be constructed as a DC transmission line. The cost to transition from underground to overhead facilities, coupled with the need to convert from DC to AC, would eliminate the possibility of intermediate interconnections and would not meet the Project objectives.

Cable System Support Bridge

Another method to construct transmission lines across the Rio Grande without placing the transmission lines (conductors or cables) on typical overhead transmission support structures, or under the river, would be a cable system support bridge. Occasionally, underground cable systems are attached to a vehicular bridge, although there are no known existing installations

where a bridge was constructed solely to support a high-voltage cable system. A conceptual design was developed to evaluate the feasibility of constructing a bridge across the Rio Grande. With this approach, a steel bridge would be built across the river and a cable system (using cables similar to those designed for underground use) would be affixed to a bridge. In order to meet structural and electrical safety design standards, the support bridge would be approximately 25 feet wide and would require a minimum of four 100-foot-tall towers to support the size and weight of four 36-inch-diameter pipes containing the cable systems for two 500 kV circuits. Additional towers would likely be necessary to support the weight of the structure if shorter towers were required.

In order to achieve the same objective as the underground concept that would include burial of a 2.3-mile segment of the transmission lines under the floodplain, farms, and densely vegetated areas, underground segments would remain between the bridge and the transition stations. The potential advantage of a cable bridge structure is that the bridge would be more visible to birds in flight than would overhead transmission lines, and could reduce the risk of potential avian collisions. However, construction of the bridge would result in a larger area of impact to riparian vegetation and habitat than either the overhead transmission lines or the underground alternative, and potentially conflict with access to the river. In addition, because of the structural requirements, the cable system support bridge would likely be more expensive than an underground cable crossing of the Rio Grande. Therefore, a cable system support bridge would not provide any advantage compared to the underground transmission line alternative.

New Transmission Technologies

New bulk-power transmission technologies are emerging. Current research and development indicate some technologies eventually may become viable alternatives to traditional overhead transmission systems. However, these technologies are experimental and not currently available for commercial use. For example, high temperature superconducting (HTS) cables—conductors made of materials that were first discovered in 1986—are now available from a number of manufacturers, primarily for niche applications. HTS cable systems at 345 kV and 500 kV are not yet available, and lower voltages are incapable of supporting the Project's transfer capability. Considerable research and development (including engineering, design, and installation of a demonstration project to determine the feasibility of the technology) is required to make HTS available at 500 kV or for this Project's transfer capability. For these reasons, a superconducting cable system is not a viable alternative and has been eliminated from further evaluation.

2.3.3.3 Alternatives to New Transmission

During the scoping process, various questions and comments were received from the public regarding potential alternatives to building new transmission lines. In response to these questions and comments, the following descriptions are provided, including the discussion of demand-side management (DSM), new generation, distributed generation, and existing transmission systems upgrades.

Demand-Side Management

DSM programs are implemented by electric utilities to encourage consumers to modify their levels and patterns of energy consumption. Also referred to as load management, DSM programs were originally intended to help defer the need for new sources of power, including generating and transmission facilities. Currently, DSM is typically implemented to manage energy consumption during peak hours. It achieves load reduction through various programs and customer agreements, including interrupting the power supply to individual appliances or equipment, requesting customers (usually large commercial and industrial customers) to reduce energy use during peak hours, and shifting loads (such as the use of certain appliances) from on-peak to off-peak hours. Utilities also promote energy efficiency to reduce overall energy consumption. Energy efficiency programs reduce consumption over many hours during the year through use of energy saving appliances and lighting, whereas DSM programs achieve an immediate reduction in peak load.

DSM and energy-efficiency programs are valuable tools that allow load-serving entities (utilities) to manage the demand for and consumption of energy on a local, temporary basis. However, the Project is needed to increase transfer capability (up to 4,500 MW) in an electrical grid that is currently insufficient to support the development, access, and transport of additional generating resources, including renewable energy. Increasing interstate transfer capability and access to renewable resources is needed to meet federal energy policy objectives and state RPS. Since DSM and energy-efficiency programs do not address these needs, they were eliminated from further consideration.

New Generation

In response to public comments stating that the need for new transmission lines could potentially be met by constructing new renewable generation facilities, new generation was considered as an alternative to construction and operation of the proposed Project. Several renewable generation facilities are proposed in New Mexico and Arizona. More than 7,000 MW of proposed generation projects (primarily from renewable sources) have provided interconnection requests to existing transmission owners (utilities) within the Project area.

As discussed in Chapter 1, the DOE studied transmission corridors to identify areas of congestion, including areas where development of new renewable generation resources was inhibited by insufficient transmission facilities or transfer capability. The DOE report characterizes the need to resolve current transmission congestion as "urgent," as demonstrated by the large number of both wind and solar projects that have applied for interconnection to the transmission grid, but cannot be built due to insufficient transfer capability. In addition, the Western Renewable Energy Zone study identified 11,300 MW of potential wind resources near the eastern terminus of the Project, and 10,500 MW of solar potential in southwest New Mexico and southeast Arizona; but notes that "lack of cost effective transmission access was, and remains, the greatest impediment to the rapid development" of these resources (WGA and DOE 2009).

The Project is needed to increase available transfer capability in an electrical grid that is currently insufficient to support the development, access, and transport of additional energy-generating resources, including renewable energy; thereby relieving existing transmission

congestion, allowing additional electricity to be generated and transported to western power markets and load centers in the Desert Southwest. The Project would be located near areas of undeveloped renewable resource potential, to provide a path for renewable energy delivery. The addition of new generation within the Project area would require new transmission, and therefore would not address the need for additional transfer capability. As such, the alternative to add new renewable generation was eliminated from consideration in this EIS.

Distributed Generation

Distributed generation resources are small-scale power generation technologies that are usually installed at or near the location where the generated power is used.

Distributed generation systems range in size from approximately 5 kilowatts to 10 MW, in contrast to centralized generation resources that range from 10 MW to more than 1,000 MW per site. Distributed generation resource technologies include photovoltaic (PV), energy storage devices, microturbines, solar, wind, and fuel cells. One common example of distributed generation is roof**top** solar panels.

Distributed generation would provide small-scale local renewable energy generation opportunities. Although distributed generation may increase local regional transfer capability, it would not increase regional transfer capability by a minimum of 3,000 MW across the Southwest; and it would not increase reliability or transfer capability on a regional transmission system scale. Therefore, the development of distributed generation resources would not meet the purpose and need and was eliminated from further consideration.

Existing Transmission Systems Upgrades

The Applicant applied for right-of-way on BLM land to accommodate two new 500 kV transmission lines with a combined transfer capability of approximately 3,000 MW (Option A) or 4,500 MW (Option B). The National Electrical Safety Code (NESC) contains the basic provisions that are considered necessary for the safety of employees and the public during transmission line construction and operation (Institute of Electrical and Electronics Engineers [IEEE] 2010). Transmission line design characteristics are interrelated, such that adjusting one variable often requires the adjustment of other characteristics to maintain compliance with the NESC. Examples of transmission line design characteristics include, but are not limited to: ground clearance (i.e., the distance between the ground and the lowest sagging point on the wire), structure height, structure width, span (i.e., the distance between structures), and voltage. Right-of-way widths directly relate to safety requirements associated with design characteristics for a given transmission line.

As stated in *The Design, Construction, and Operation of Long-Distance High-Voltage Electricity Transmission Technologies* (Argonne 2007), the function of the right-of-way is to provide "…a safety margin between the transmission facilities and surrounding structures and vegetation. The right-of-way also provides a path for ground-based inspections and access to transmission towers and other line components, if repairs are needed. Failure to maintain an adequate right-of-way can result in dangerous situations, including ground faults.…The use of a common corridor of right-of-way for multiple transmission lines is likely to be restricted if it presents a credible risk

of a multicircuit outage. Mitigation measures, principally increasing line spacing beyond that required for fault protection, may be used to reduce risk."

In addition, the Argonne report indicates that multiple lines in a single corridor are subject to the following hazards:

a) *A tower from one line falling against conductors of an adjacent line*
b) *A shield wire (grounded lightning protector connecting the tops of the towers) being dragged onto adjacent lines by an aircraft*
c) *An aircraft damaging more than one circuit*
d) *Fire or smoke on the right-of-way*
e) *Lightning strikes*
f) *Deliberate malicious damage*

"A line separation of at least one span (perhaps 700 feet) has proven effective in avoiding multicircuit outages" (*ibid*).

Table 2-3 provides the typical transfer capability and right-of-way for various sizes of transmission lines.

Table 2-3. Typical Transmission Line Transfer Capabilities and Rights-of-Way

Transmission Line Voltage	Typical Transfer Capability[1] (MW)	Typical Right-of-Way Width[2] (feet)
115 kV (AC)	150 to 200	35 to 50
138 kV (AC)	200 to 400	35 to 50
230 kV (AC)	400 to 800	50 to 75
345 kV (AC)	800 to 1,200	150 to 175
500 kV (AC)	1,500 to 2,000	200 to 250
500 kV (DC)	3,000 to 3,500	200 to 250

[1] Calculated based on electrical current capability of the wire.
[2] Typical right-of-way widths as provided by TEP (2011) and consistent with their transmission facilities.

The existing extra-high voltage (EHV) transmission system in New Mexico and southern Arizona is characterized by a 345 kV backbone, which feeds lower voltage systems (e.g., 230 kV, 138 kV, and 115 kV) to meet local load-serving needs. EHV transmission facilities, specifically 345 kV and 500 kV, are more efficient (i.e., less line or energy loss and more transfer capability for the same current level) for longer distance energy delivery, but require significantly more land for substations and for equipment costs compared to lower voltage systems. The transmission path in southwestern New Mexico is one of the most heavily used and congested transmission paths in the West (DOE 2009). Because the existing system is operating near capacity, increasing from 345 kV to 500 kV would not achieve the added regional transfer capability planned for the Project while still maintaining existing capacity reserved for the respective transmission owner. In addition, the existing transmission system in southern New Mexico and southern Arizona has limited redundancy; therefore, there are limitations to taking these lines out of service for an extended amount of time due to their importance in delivering energy to regional loads. Several of these lines are delivering energy from baseload resources (e.g., Palo Verde, Springerville, San Juan, etc.), which are critical to provide a consistent and reliable supply of electricity. The transmission owners are required by the NERC to meet

reliability standards under normal and emergency conditions. If the existing transmission lines were taken out of service to perform upgrades within these areas, consumers could be at a significant risk for exposure to power outages for the duration of the upgrade process.

For the reasons stated above, constructing the full length of the Project as an upgrade to the existing transmission system is not considered reasonable or feasible. The following discussion pertains to performing upgrades on only those portions of the existing transmission system in the area of Tucson, Arizona.

Tucson Area Upgrades

The electrical system in the Tucson area consists of 138 kV (operated by TEP), 115 kV (operated by Western Area Power Administration), and lower voltage distribution lines. Within this area, transfer capacities for 138 kV lines are typically 310 to 350 MW, and transfer capacities for 115 kV lines are typically 180 MW. The rights-of-way for these 138 kV and 115 kV lines vary in width throughout the system, although they are typically 50 feet wide. By comparison, the proposed Project would be capable of transferring approximately 3,000 MW or 4,500 MW and would require 200 feet of right-of-way per transmission line, based on Project design characteristics and to be compliant with NESC requirements (NESC defines the minimum safe electrical clearances to ground and adjacent facilities).

The two primary methods for upgrading an existing system include a tear-down and rebuild in-place, or construction of the new facilities adjacent to the existing facilities, then removing the old facilities once the new become operational. Given the limited redundancy of the existing system, a tear-down and rebuild in-place is considered unreasonable as it could expose consumers to significant power outages for the duration of the upgrade process. Alternatively, the construction of new transmission towers parallel to the existing transmission towers would minimize the risk of outages for local consumers. Upgrading an existing transmission line could consist of either replacing lower voltage facilities with higher voltage facilities, or building new double-circuit structures that could accommodate the capacity of the existing wires on one side of the structure and the new wires on the other side of the structure (Figure 2-8).

Existing electrical system structures (towers or poles), wires, and substations were built in accordance to design specifications for their given voltage levels. Replacing lower voltage wires with higher voltage wires would require building new structures and substation interconnections using the design requirements for the higher voltage transmission system. These requirements include larger substation footprints, additional substation equipment, taller structures with larger wires, and wider rights-of-way to accommodate the larger structures and to meet applicable NESC safety requirements.

Replacing the existing 138 kV or 115 kV with 500 kV facilities would require that the transfer of transfer capability for the existing system and that of the Project be consolidated into one set of wires. This approach would reduce the Project's ability to meet the intended minimum transfer capability of approximately 3,000 MW, because a portion of the capacity of one of the two proposed transmission lines for the Project would be reserved for service to local transmission owners, and would require a more robust system to achieve the total transfer capability. Using DC technology with this approach would likely not be feasible due to the cost of the DC

conversion stations and the inability to have multiple DC taps to the underlying system, as described in *DC Option* (below).

The existing 138 kV and 115 kV lines are integrated to support power flows to lower voltage systems; as such, upgrading the existing transmission lines would require upgrading all substations along the existing path to include equipment that could support the existing interconnections. Transformers (a substation component) are used within substations to change from one voltage level to another. Because 500 kV transmission lines are not intended to connect directly to voltage levels that serve local loads, manufacturers do not make transformers that accommodate these types of voltage changes. As a result, several transformers would be required to change the voltage from 500 kV to lower voltage levels that serve local loads. For example, a substation may require a transformer to change from 500 kV to 138 kV or 115 kV, and another transformer to change from 138 kV or 115 kV to a lower distribution voltage level. Typical substations for 138 kV and 115 kV systems encompass approximately 2 to 3 acres; whereas 500 kV substation footprints are typically a minimum of 20 acres to accommodate the additional larger equipment required for a 500 kV transmission system. The cost to upgrade equipment and maintain the existing substation interconnections would be approximately $30 million to $50 million per substation. Additional costs associated with land acquisition for substation expansions would vary depending on the existing uses, and would be higher for substations surrounded by houses or businesses.

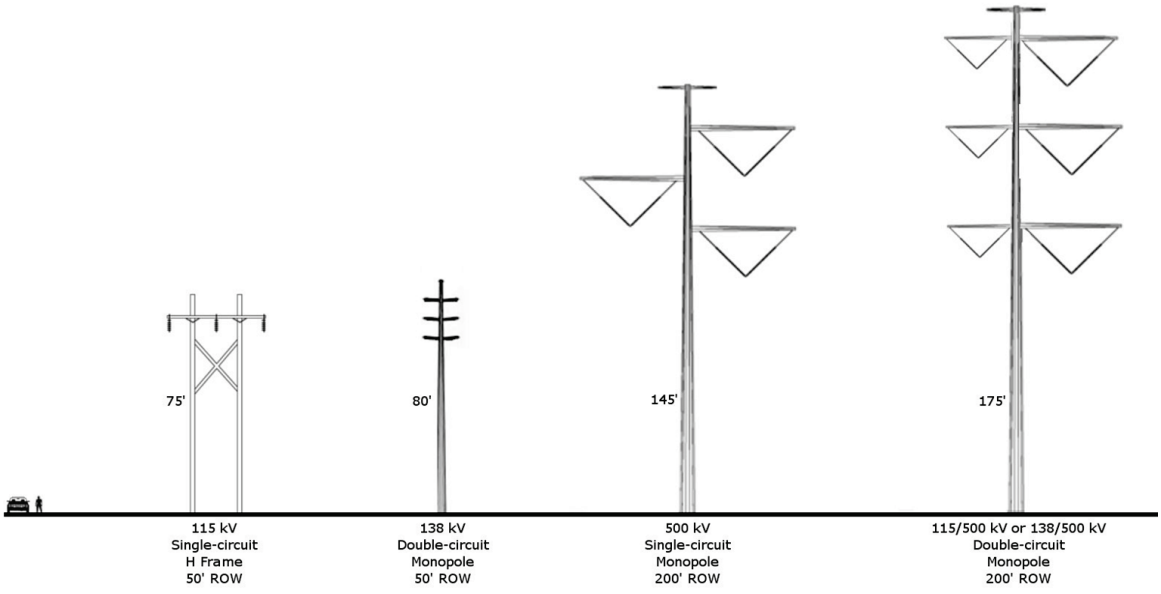


Figure 2-8. Comparison of Typical Structures Replacing Lower Voltage Facilities with Higher Voltage Facilities

If existing electrical system upgrades were implemented and the 1,500 MW transfer capability of one of the two proposed transmission lines was achieved, a new, second transmission line would still be needed to achieve the Project's planned transfer capability. As previously stated, rights-of-way for 138 kV and 115 kV are typically 50 feet wide; whereas the Project would require 400 feet of right-of-way based on Project design characteristics and to be compliant with NESC

requirements anticipated for the Project. In narrow areas, due to special conditions such as built environments that do not contain a corridor that would accommodate 400 feet of new right-of-way width, the total right-of-way width for both transmission lines may be made as narrow as 330 feet by adjusting the design characteristics (e.g., structure height, structure width, span length, sharing of conductor blowout, etc.) for the Project. Existing transmission system upgrades could not be accomplished without substantial expansion of the existing right-of-way.

Double-circuit Structures

Another option for upgrading the existing system consists of constructing new double-circuit structures that could accommodate the size of the existing wires on one side of the structure and the new wires for the Project on the other side of the structure. Considerations for performing existing system upgrades using a double-circuit structure would be similar to the discussion above, with the following exceptions: (1) this approach would not require substation modifications, as the lower voltage wires would be used to maintain the existing interconnections; and (2) this approach would not subtract capacity from the 500 kV wires, because the capacity required to serve the existing commitment of the local transmission owner would be met through the lower voltage wires on one side of the structure, while the 500 kV wires on the other side of the structure would be dedicated for use by the Project. This approach would require a minimum of 200 feet per circuit, and would require an expansion of the existing right-of-way by as much as 150 feet for each circuit (assuming the existing line has 50 feet of existing right-of-way). In most areas within and around Tucson, this expansion of right-of-way would result in significant land use impacts.

DC Option

In order to maintain the integrity of the existing transmission system, upgrades would have to maintain the connectivity of the transmission and distribution systems. DC transmission lines are designed to accommodate greater power flows for long distances with less power loss over the distance of the line, and typically do not allow for intermediate substations. By using voltage source converter technology, a DC transmission line could maintain some substation interconnections; however, the Project has not evaluated the use of voltage source converters and there is currently only one supplier of this technology. Due to limitations on maintaining substation connections with the existing electrical system, replacing the existing, lower voltage facilities with higher voltage DC facilities was determined not feasible for the Project.

Colocating one AC circuit and one DC circuit on the same structure is considered unreasonable and not technically feasible for this Project. Colocation of the circuits for the entire length of the Project would create reliability concerns by placing the method of transport for 4500 MW of transfer capability on a single structure. Because upgrading the existing electrical system to include a DC transmission line is not feasible, a separate new transmission line would have to be constructed using DC technology in order to achieve 4,500 MW of transfer capability. Existing transmission system upgrades could not be accomplished without substantial expansion of the existing right-of-way. In most cases, the total right-of-way requirements should be assumed to be 200 feet per circuit, for a total of 400 feet, to accommodate a separate circuit to be operated at 500 kV DC.

Environmental Impacts

Various environmental impacts would result if it were feasible to implement the proposed Project by upgrading and consolidating existing transmission lines within existing rights-of-way in or near the I-10 corridor. Dense land uses, including residences, businesses, and industrial operations, have been built up to the edge of the existing rights-of-way within the city of Tucson. As such, larger transmission line structures would result in major visual impacts to residences, including those within historic districts in south and central Tucson, and to parks and trails and other areas.

Public concerns have also been expressed regarding potential health effects associated with exposure to electric and magnetic fields (EMF). Although specific health effects have not been determined, upgrading existing transmission lines within existing rights-of-way adjacent to residential areas or schools could result in increased human exposure to EMF. In addition, construction within or adjacent to residential areas could result in disproportionately high and adverse impacts to minority and low-income populations subject to EO 12898, which addresses environmental justice.

The TEP 138 kV transmission lines through the Tucson area have been constructed within the major drainage corridors of the Pantano Wash, Rillito River, and Santa Cruz River. Major portions of these watercourses have been dedicated to Pima County for flood control and recreation uses, and for wetlands replacement mitigation in compliance with Section 404 of the Clean Water Act (CWA). Pima County has indicated that construction or replacement of transmission lines through these drainage corridors would conflict with these uses and mitigation lands[1].

In summary, upgrading existing transmission facilities would add substantial cost to the Project due to the construction of substation upgrades, acquisition of additional right-of-way width, and associated condemnation. This alternative would result in substantial environmental impacts, and would likely not achieve the transfer capability required to meet the Applicant's objectives. Therefore, the alternative to upgrade existing transmission facilities was eliminated from further consideration.

2.4 DESCRIPTION OF PROPOSED ACTION AND PLAN OF DEVELOPMENT

The proposed action is for the BLM to issue a right-of-way grant to SunZia for the construction and operation of two 500 kV transmission lines from the proposed SunZia East Substation in New Mexico to the permitted Pinal Central Substation in Arizona. Project facilities, design characteristics, construction activities, and mitigation measures generally would be consistent regardless of the route alternative selected. Features that are common to all action alternatives are described in this section. This Project description is the basis for the analysis of impacts in Chapter 4.

[1] A local alternative route was analyzed and considered in this EIS that would include new construction of two 500 kV transmission lines within these drainage corridors (see Section 2.3.2, Pantano/Rillito Local Alternative). Construction of the proposed transmission lines using this route would require replacement of the existing transmission structures in some locations, and requires additional right-of-way to provide for adequate separation between the transmission lines.

A Final POD would be required to be approved by the BLM prior to any construction or surface disturbing activities occurring on the right-of-way. A BLM Notice to Proceed authorization would not be issued until the Final POD has been approved by the BLM. In the interim, a Preliminary POD has been prepared in conjunction with this Final EIS and is available for review at the BLM New Mexico State Office or online[1]. The Final POD would include detailed engineering, mitigation, and environmental mapping upon approval of the final and approved route alignment. The POD would detail the methods and procedures that would be used in construction of the Project and serves as a reference for contractors, construction crews, agency personnel, resource inspectors, and environmental compliance monitors. In addition to a detailed Project description, the POD would contain BMPs and mitigation measures; specify environmental compliance field activities; and include a number of plans developed to achieve regulatory compliance and resources protection, including:

- Construction Plan and Program
- Flagging, Fencing, and Signage Plan
- Transportation Management Plan
- Fire Protection Plan
- Blasting Plan Methodology
- Erosion, Dust Control, and Air Quality Plan
- Hazardous Materials Management Plan
- Emergency Preparedness and Response Plan Guidelines
- Environmental Compliance Management Plan
- Biological Resources Protection Plan
- Avian Protection Plan
- Noxious Weed Management Plan
- Cultural Resources Historic Properties Treatment Plan (HPTP)/Monitoring and Discovery Plan/NAGPRA Plan of Action/PA
- Paleontological Resources Treatment Plan (PRTP)
- Stormwater Pollution Prevention Plan Methodology
- Right-of-Way Preparation, Reclamation, and Monitoring Framework Plan

An Avian Protection Plan and migratory bird conservation strategy would be approved by the USFWS prior to the BLM's Notice to Proceed. The vegetation management plan will be included in the Final POD as part of the Biological Resources Protection Plan.

[1] http://www.blm.gov/nm/st/en/prog/more/lands_realty/sunzia_southwest_transmission.html

2.4.1 Overhead Transmission Lines

Two 500 kV overhead transmission lines would be constructed for the proposed Project. Both AC and DC configurations are being considered as design options, as follows:

> **Option A**: Two transmission lines would be constructed and operated, each as a 500 kV single-circuit, AC facility.
>
> **Option B**: One transmission line would be constructed and operated as a 500 kV single-circuit AC facility, and one transmission line would be constructed and operated as a 500 kV single-circuit DC facility.

Each transmission line would extend between the proposed SunZia East Substation and the permitted Pinal Central Substation for approximately 500 miles, depending on the alternative route selected. The transmission line components include structures, foundations, conductors, insulators and associated hardware, overhead groundwire (OHGW), and fiber optic facilities. Table 2-4 summarizes typical design characteristics for each of the two options, and Figure 2-9 is a diagram of the typical transmission line and right-of-way configuration.

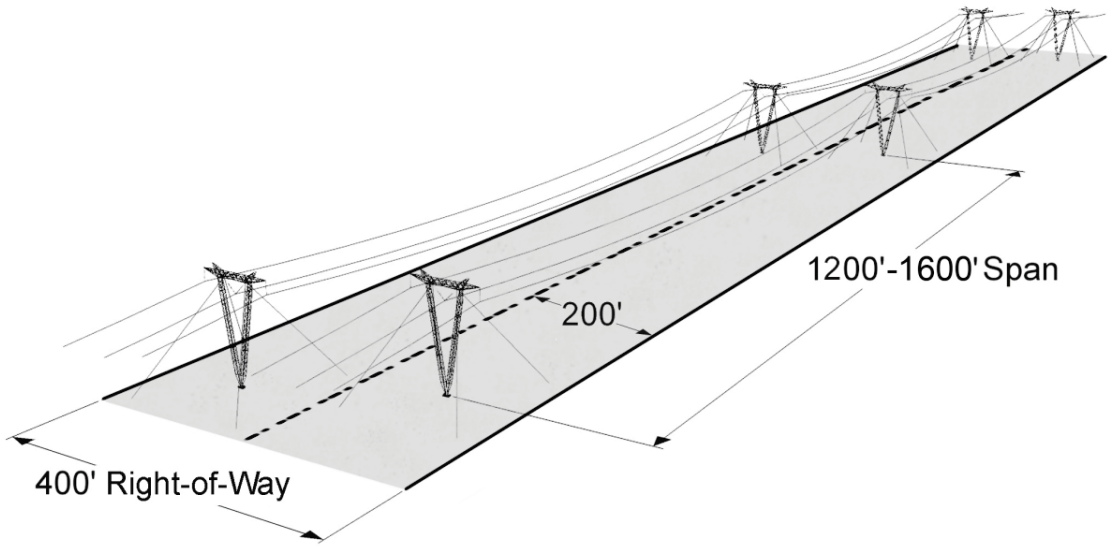


Figure 2-9. Typical 500 kV Transmission Line and Right-of-Way Configuration

Table 2-4. Typical Design Characteristics of the Proposed 500 kV Transmission Line Project		
General Description		
Structure type	Guyed and self-supporting steel tubular and lattice structures	
Structure height	Typical 135 feet; range of height varies with span and terrain	
Span length	1,200 to 1,600 feet (3 to 4 structures per mile)	
Right-of-way width, Typical Narrow, due to special conditions	200 feet per transmission line (circuit) – 400 feet total for two transmission lines 165 feet per transmission line (circuit) – 330 feet total for two transmission lines	
Electrical Properties		
Structure Base Areas	**Option A**	**Option B**
Nominal voltage in kilovolts	500 kV AC	500 kV AC and 500 kV DC
Capacity in megawatts	3,000 MW	4,500 MW
Circuit configuration (preliminary determination)	Horizontal, vertical, or delta	AC: Horizontal, vertical, or delta DC: Horizontal
Conductors 1590 ACSR 'Lapwing,' 1.5-inch diameter conductor (3 conductors/bundle)	3 conductor bundles per phase	AC: 3 conductor bundles per phase DC: 2 conductor bundles per phase
Minimum conductor clearance above ground (per NESC requirements)	30 to 35 feet	AC: 30 to 35 feet DC: 30 to 38 feet
Land Permanently Disturbed		
Permanent Structure Base Area Required[1]		
Guyed (lattice or tubular) 4-foot diameter base plus 4 anchors (1 approximate 45-foot x 45-foot base area per line)	4,050 sq. feet (2,025 sq. feet per structure)	
Self-supporting Lattice 3-foot diameter x 4 legs (1 approximate 60-foot x 60-foot base area per line)	7,200 sq. feet (3,600 sq. feet per structure)	
Self-supporting Tubular 8-foot diameter (1 approximate 53-foot x 53-foot base area per line)	5,650 sq. feet (2,825 sq. feet per structure)	
Dead-end Lattice 6-foot diameter x 4 legs (1 approximate 55-foot x 55-foot base area per line)	6,050 sq. feet (3,025 sq. feet per structure)	
Dead-end Tubular [2]	**Option A**	**Option B**
AC: 10-foot diameter (3 approximate 33-foot x 33-foot base areas for Option A; 1 approximate 45-foot x 45-foot for Option B) DC: 12-foot diameter (1 approximate 45-foot x 45-foot base area)	6,550 sq. feet (3,225 sq. feet per structure)	4,050 sq. feet (2,025 sq. feet per structure)
Ancillary Facilities		
Fiber Optic Communication Regeneration Station	100 feet x 100 feet (0.23 acre); located at 75-mile intervals	
Ground electrode facility	One facility near each terminus (DC only)	
Access Roads[3]		
New roads or existing road improvement	24 feet total width (20-foot-wide travelway and 2-foot-wide berms/drainage on each side)	

Table 2-4. Typical Design Characteristics of the Proposed 500 kV Transmission Line Project	
Land Temporarily Disturbed	
Structure work area[4]	Each structure site will be 200 feet x 200 feet (0.9 acre)
Construction yard	One yard every 40 miles; approximately 15 to 20 acres per site
Concrete batch plant	One plant every 30 miles; approximately 3 to 5 acres per site
Wire pulling/tensioning/splicing site (full)	Approximately 200 feet x 600 feet (2.8 acres); one every 18,000 feet, alternating every 9,000 feet with reduced site
Wire pulling/tensioning/splicing site (reduced)	Approximately 200 feet x 400 feet (1.8 acres); one every 18,000 feet alternating every 9,000 feet with full site
Vegetation Management	
Conductor clearance to meet safety standards[5]	Trimming trees and woody vegetation within the wire zone. Trimming may be required within the border zone in riparian and woodland areas.

NOTES:
[1]Permanent structure base areas include the area surrounding each structure foundation necessary for Project maintenance, rounded up to the nearest 50 sq. feet.
[2]Diameter indicated for each single pole; the dead-end structure for the AC line could have a single pole or three pole configuration.
[3]Typical main access road or spur road width indicated; maximum road widths will be specified in the POD and are dependent on terrain and construction specifications for selected transmission line route.
[4]Temporary structure work area is inclusive of permanent structure base area.
[5]NESC standards require minimum ground clearance of 30 feet (AC) to 38 feet (DC) for 500 kV transmission lines at the maximum allowable conductor sag. NERC standards require minimum clearance of approximately 6 feet (AC) to 9 feet (DC) between vegetation and conductors based on the system voltage and elevation. Typical wire zone is 90 feet wide for each circuit, which includes 10 feet on either side of the outside conductor location for blowout. The border zone is the remaining portion of the right-of-way.
ACSR = Aluminum conductor, steel reinforced

2.4.2 Structures

Seven typical 500 kV structure types, as described below, could be used for the proposed Project. Additional structure types may be identified during future engineering and design, but are anticipated to result in similar impacts to those identified in this EIS. The locations for each structure type would be determined during final design, and selected based on site-specific conditions (i.e., topography, terrain, land use, constrained right-of-way, etc.) or to mitigate impacts resulting from the Project. Proposed structures vary in height, with none anticipated to exceed 200 feet, in order to remain below the threshold at which the structure may affect navigable airspace based on Federal Aviation Administration (FAA) regulations. Structure components are illustrated on Figure 2-10.

Similar structure types would be used for either the AC or DC transmission lines, except that each DC structure would contain only two sets of bundled conductors, versus three sets for an AC structure. In addition, the guyed structures would be vertical for the DC transmission line, compared to V-shaped towers for the AC transmission line.

Guyed "V" Lattice – The single-circuit, guyed, V-shaped lattice (GVL) structure would be galvanized steel (Figure 2-11). The typical structure height would be 135 feet, ranging between 130 and 160 feet, with a typical span between structures of 1,400 feet. This tangent structure would be used where the AC transmission line proceeds in a straight line or directly parallel to

the adjacent transmission line, and up to an angle of 15 degrees. Due to the simplicity of the design and assembly, the GVL is cost efficient and results in less ground disturbance during construction than other structure design options. The DC line would require use of the guyed lattice tangent structure.

Guyed "V" Tubular – The single-circuit, guyed, V-shaped tubular (GVT) structure would be made of self-weathering or galvanized steel (Figure 2-12), and would be a tangent structure used for AC lines as an alternate to the GVL. The DC line would require use of the guyed tubular tangent structure (Figure 2-19). The typical structure height would be 135 feet, and would range between 130 and 160 feet with a typical span of 1,400 feet between structures.

Self-Supporting Lattice – The single-circuit, self-supporting lattice (SSL) structure would be made of galvanized steel (Figure 2-13). The typical structure height would be 135 feet, ranging between 130 and 160 feet, with a typical structure span of 1,500 feet. The SSL structure could be used as a tangent structure, but also can accommodate angles (0 to 30 degrees) and longer spans than the GVL or GVT structures. However, the SSL structure is heavier and requires larger foundations than the GVL or GVT structures. Maintenance activities are faster on the SSL structure than on other structure design options, due to the configuration of the circuits and climbing legs.

Self-Supporting Tubular – The single-circuit, self-supporting tubular (SST) structure would be made of self-weathering or galvanized steel (Figure 2-14). The typical structure height would be 145 feet, ranging between 145 and 170 feet, with a typical structure span of 1,000 feet. The SST structure has a smaller footprint and typically would be used in areas of narrow or constrained right-of-way; however, these structures would be taller and closer together (requiring more structures per mile) than other tangent structures proposed for the Project.

Dead-end Lattice – A single-circuit, self-supporting, dead-end lattice (DEL) structure made of galvanized steel (Figure 2-15) would primarily be used for large angles or terminations. The DEL structure would have a larger footprint than the SSL, due to a larger base and a wider horizontal configuration. The typical structure height would be 135 feet, ranging between 130 and 160 feet.

Dead-end Tubular – A single-circuit, self-supporting, dead-end tubular (DET) structure made of self-weathering or galvanized steel (Figure 2-16) would primarily be used for larger angles in those areas where right-of-way may be too constrained to accommodate a DEL structure. The typical structure height would be 145 feet, ranging between 130 and 160 feet.

Dead-end Tubular, 3-Pole – The dead-end tubular, 3-pole (DET3) alternative to the DET is a self-supporting tubular steel structure also used for larger angles; however, the DET3 includes three poles, each with a single conductor bundle (Figure 2-17). The typical structure height would be 100 feet. The DET3 structure would be used for the AC structure in areas where a lower height is desired, although the three adjacent structures would require additional right-of-way and would have a larger footprint.

Figures 2-18 through 2-23 show the six structures configured for a DC transmission line (except for the DET3).

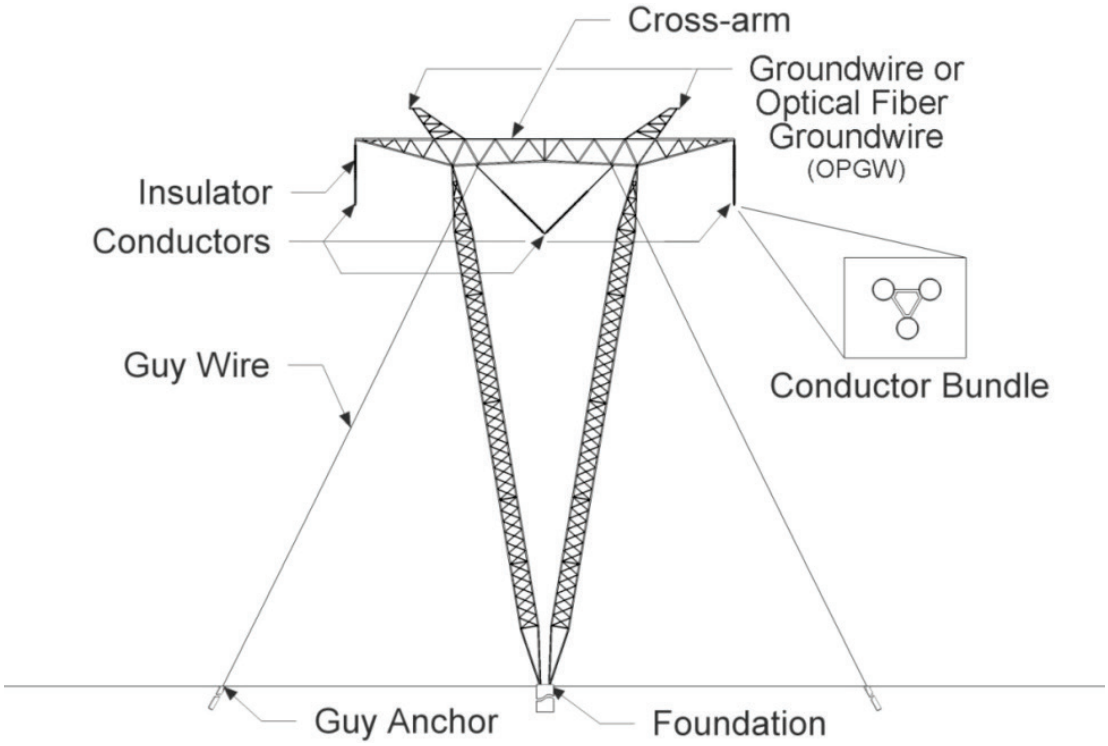


Figure 2-10. Typical 500 kV Structure Diagram

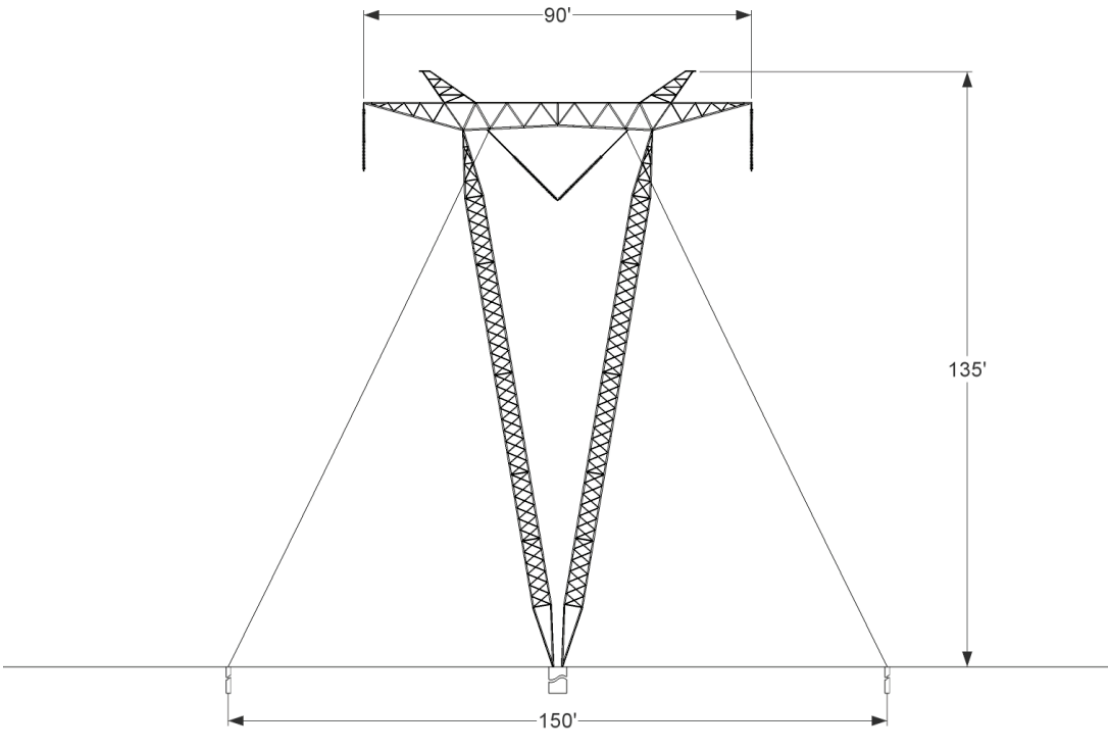


Figure 2-11. Typical AC Guyed "V" Lattice Tangent Structure

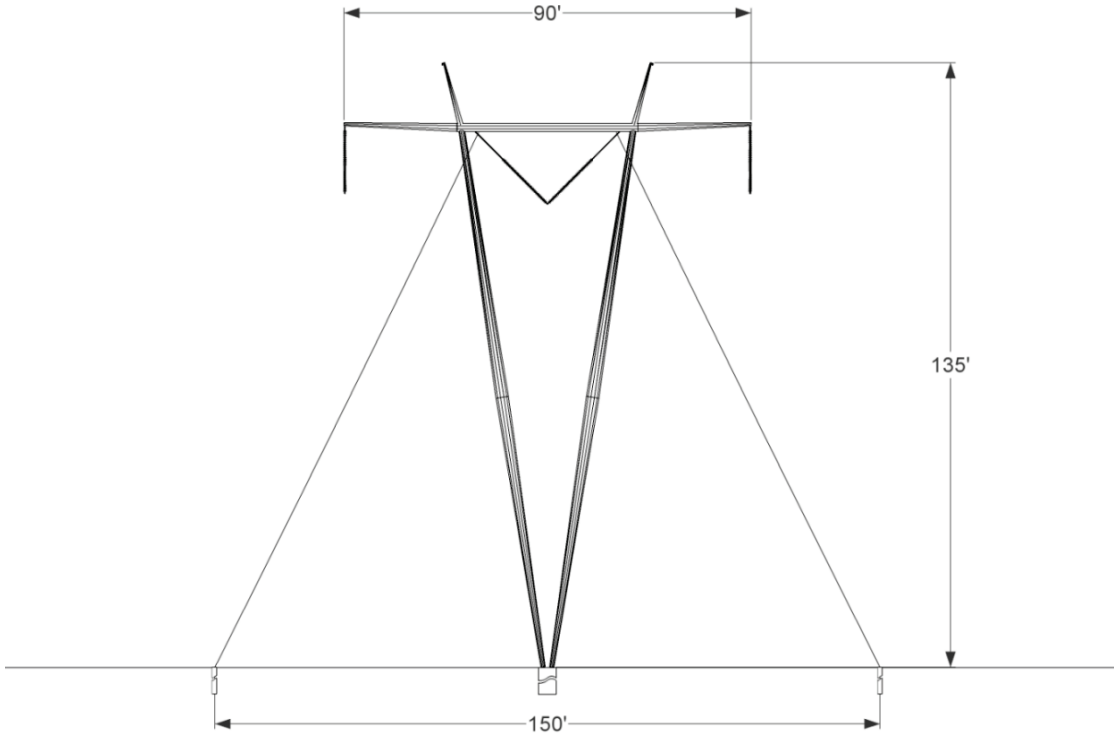


Figure 2-12. Typical AC Guyed "V" Tubular Tangent Structure

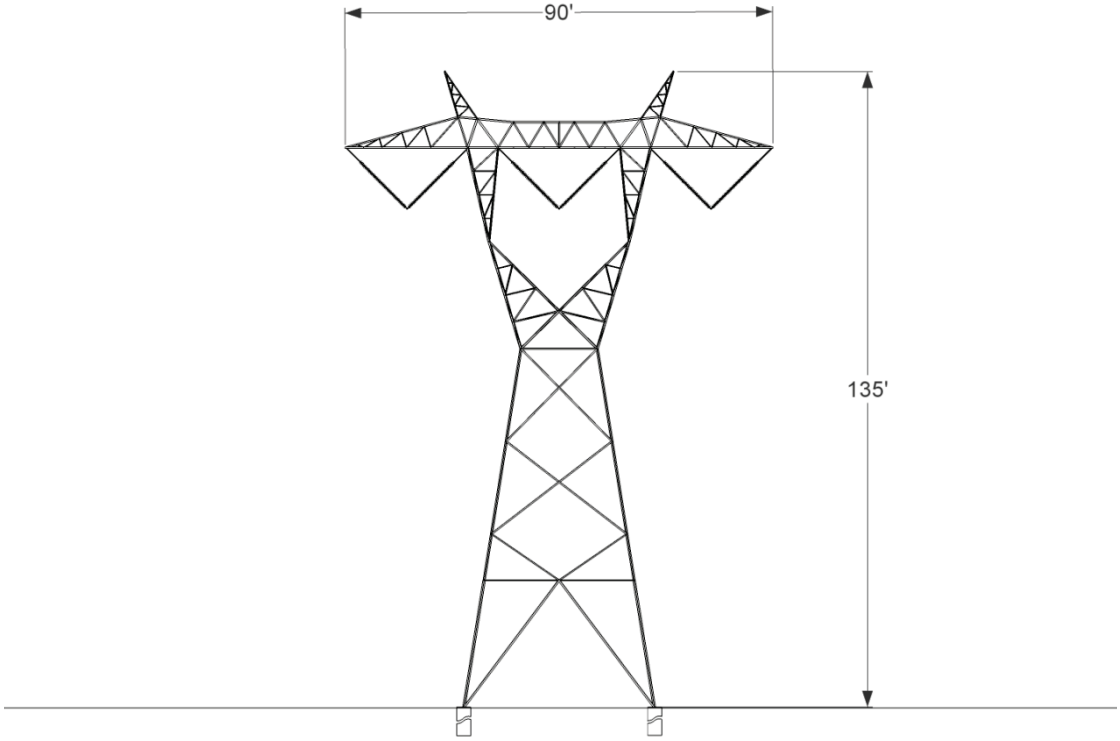


Figure 2-13. Typical AC Self-Supporting Lattice Tangent Structure

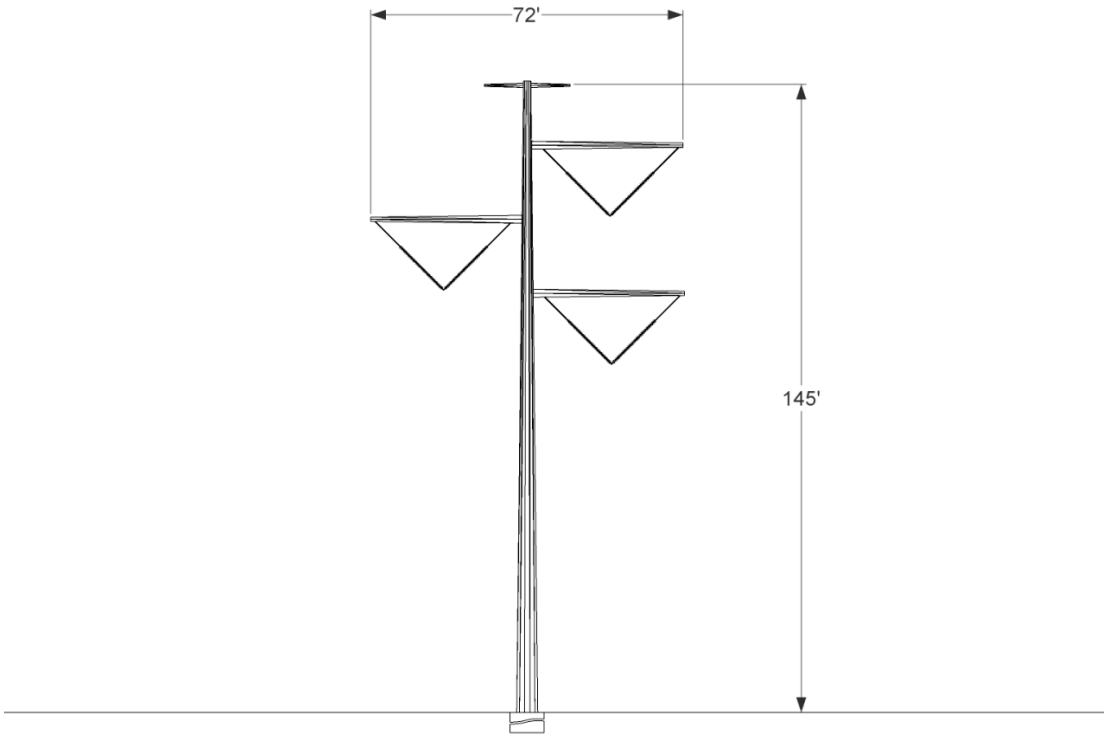


Figure 2-14. Typical AC Self-Supporting Tubular Tangent Structure

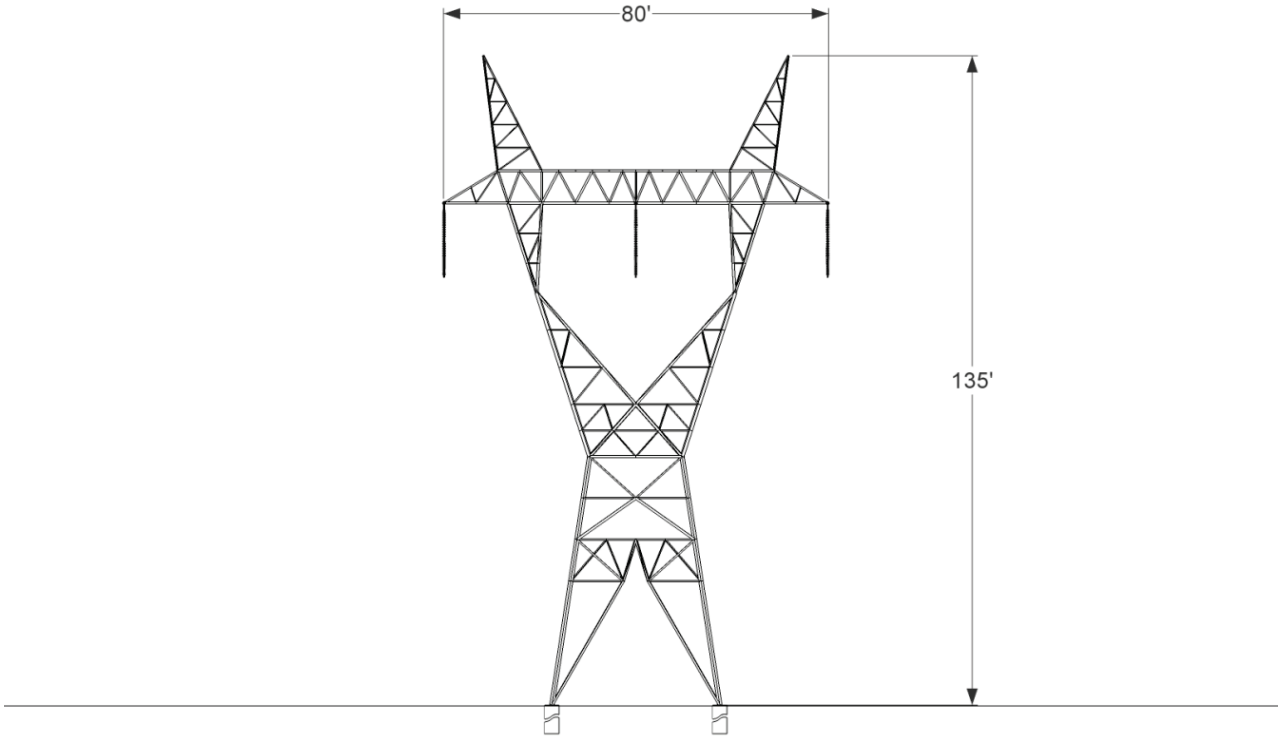


Figure 2-15. Typical AC Self-Supporting Dead-End Lattice Structure

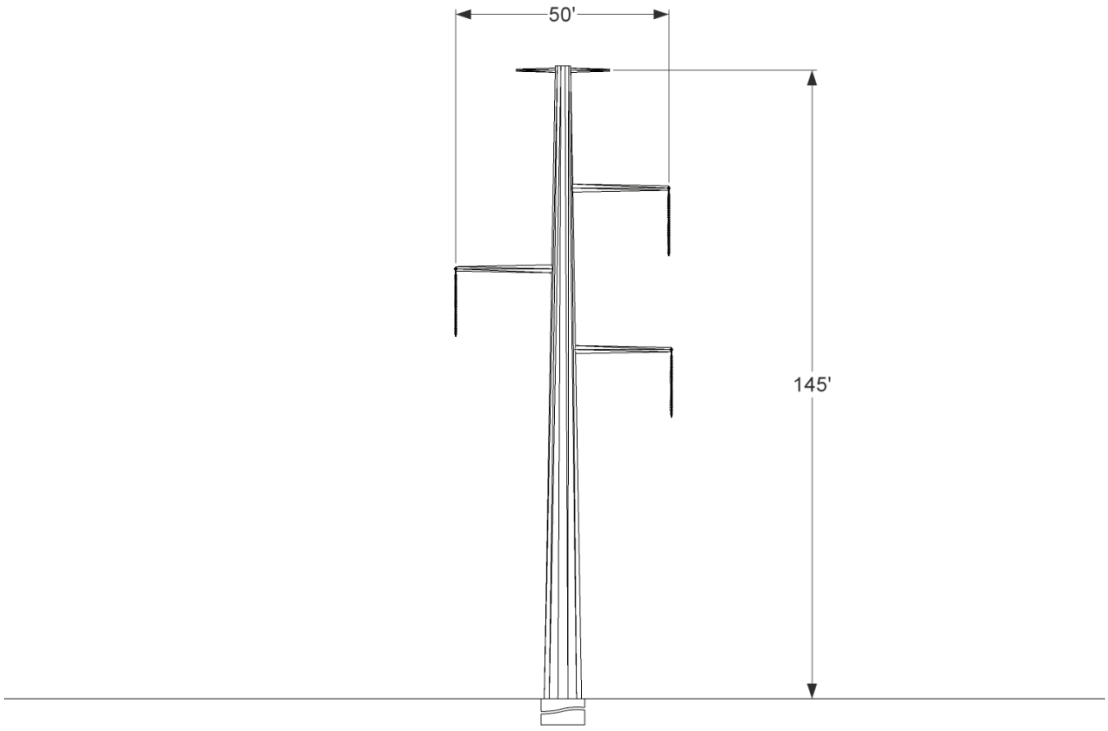


Figure 2-16. Typical AC Self-Supporting Dead-End Tubular Structure

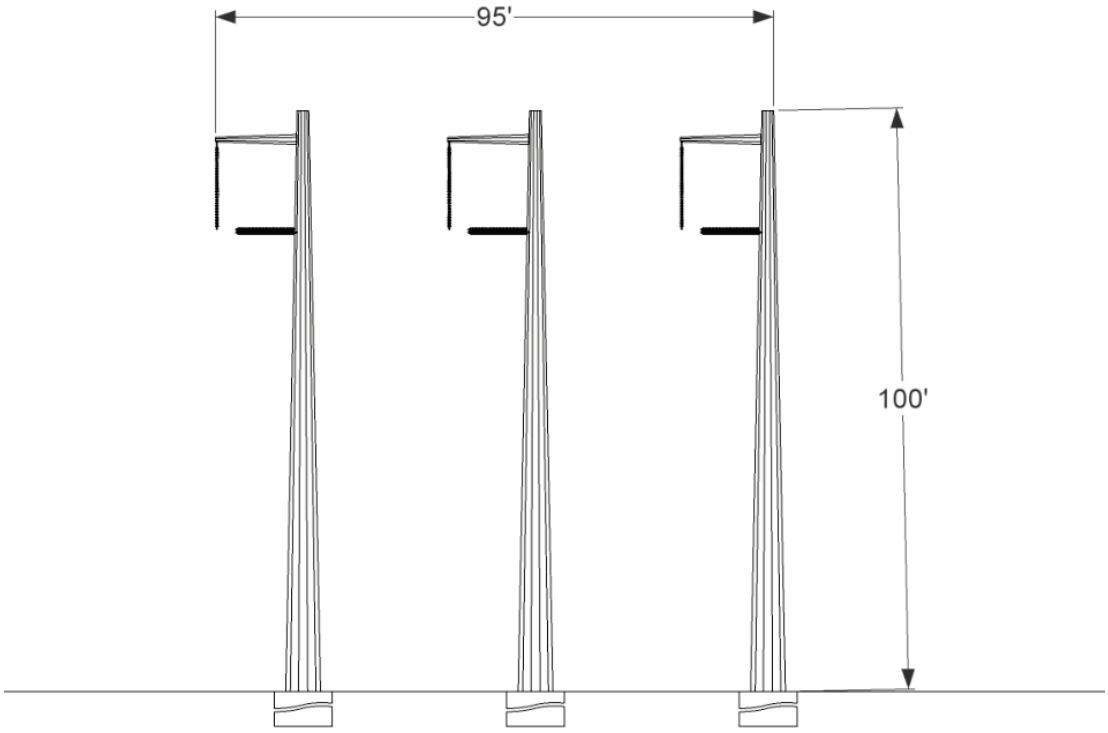


Figure 2-17. Typical AC Self-Supporting Dead-End Tubular, 3-Pole Structure

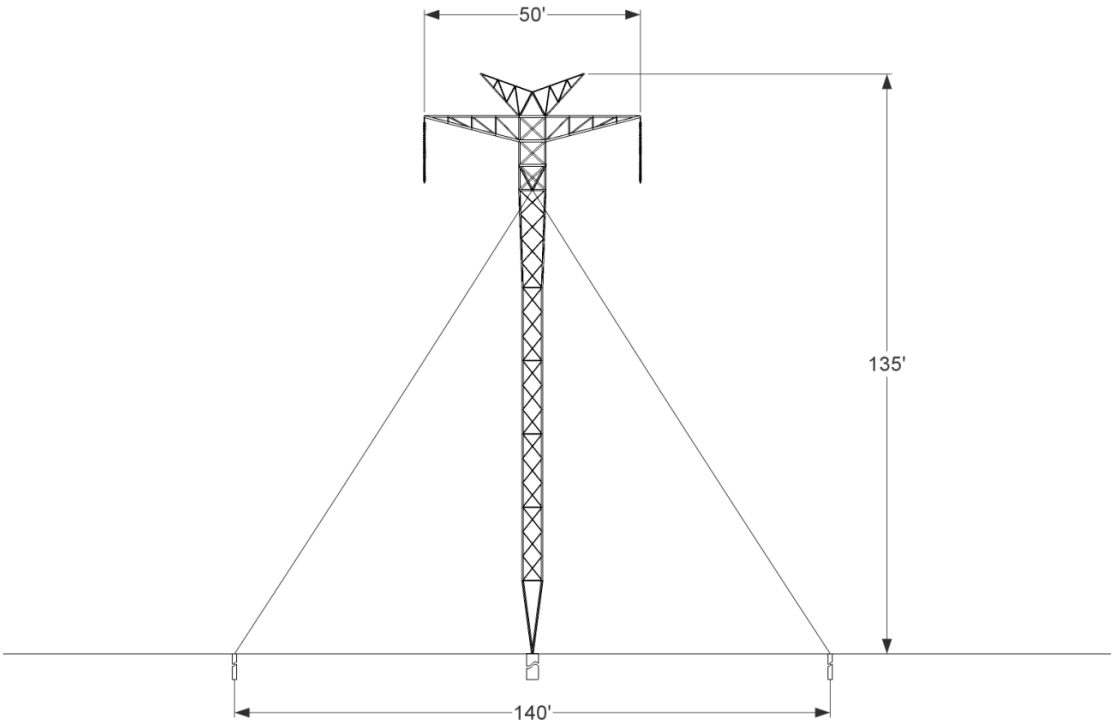


Figure 2-18. Typical DC Guyed Lattice Tangent Structure

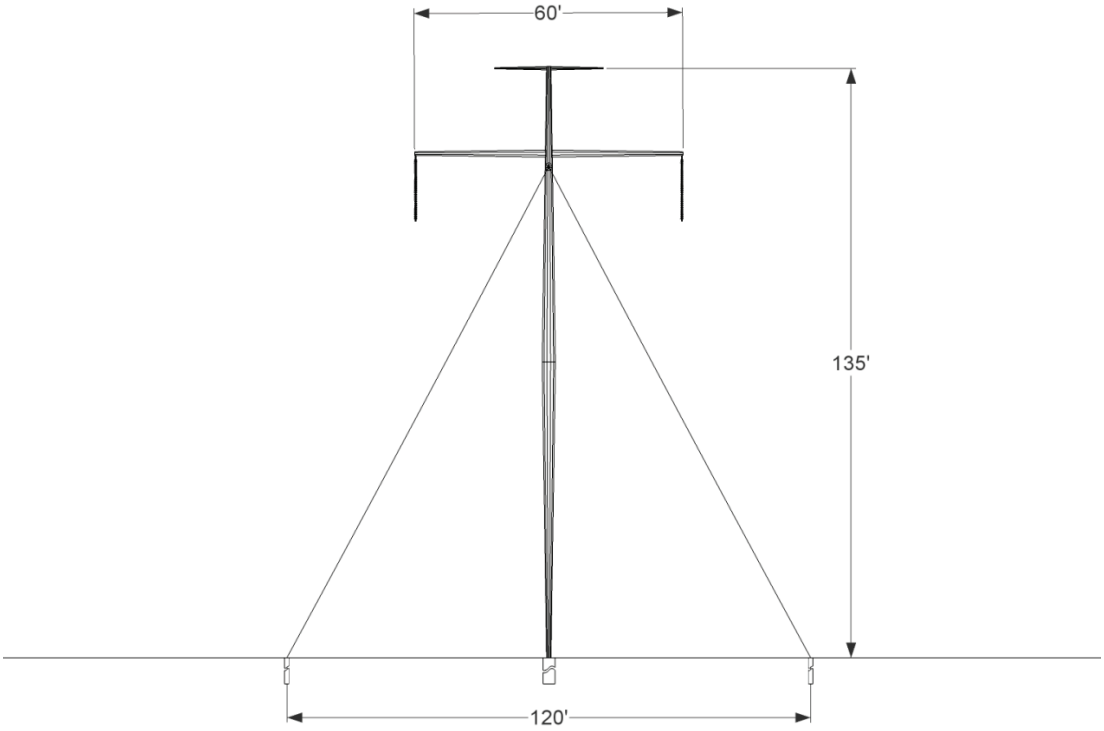


Figure 2-19. Typical DC Guyed Tubular Tangent Structure

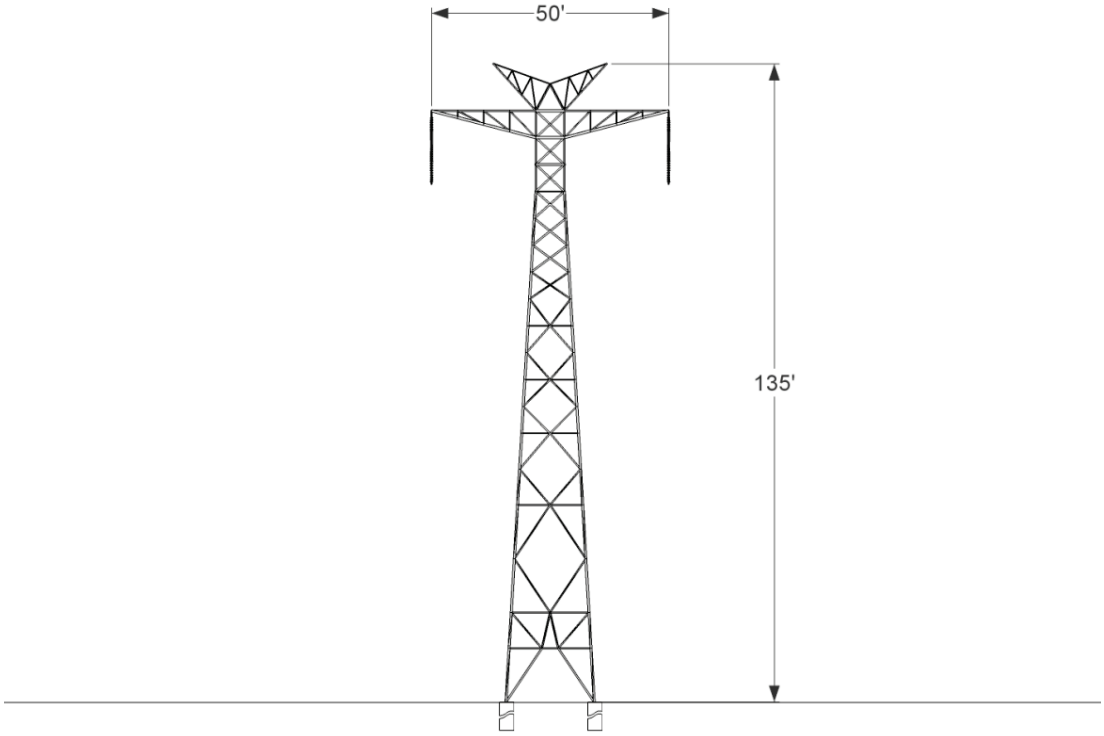


Figure 2-20. Typical DC Self-Supporting Lattice Tangent Structure

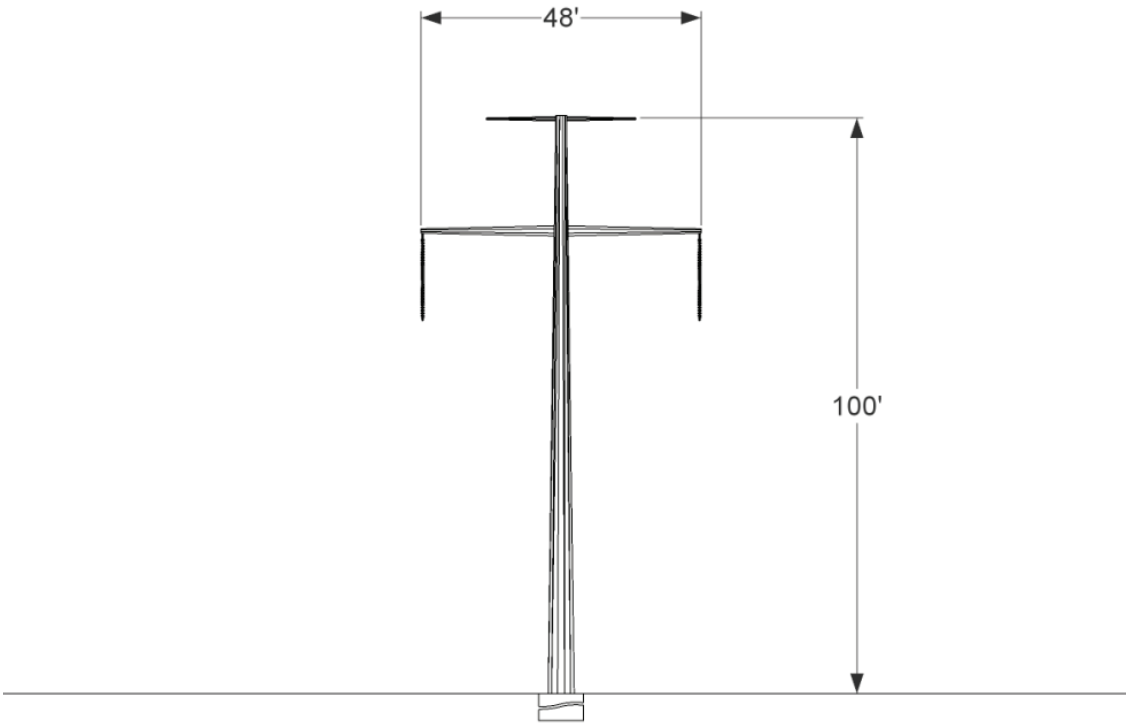


Figure 2-21. Typical DC Self-Supporting Tubular Tangent Structure

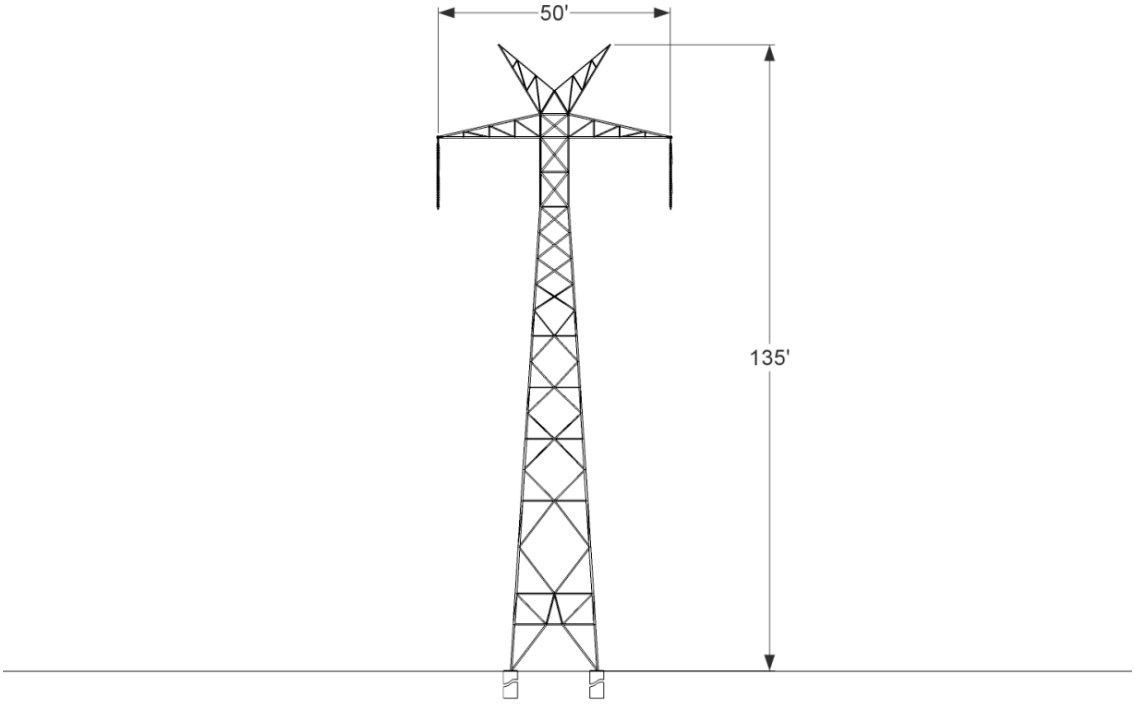


Figure 2-22. Typical DC Self-Supporting Dead-End Lattice Structure

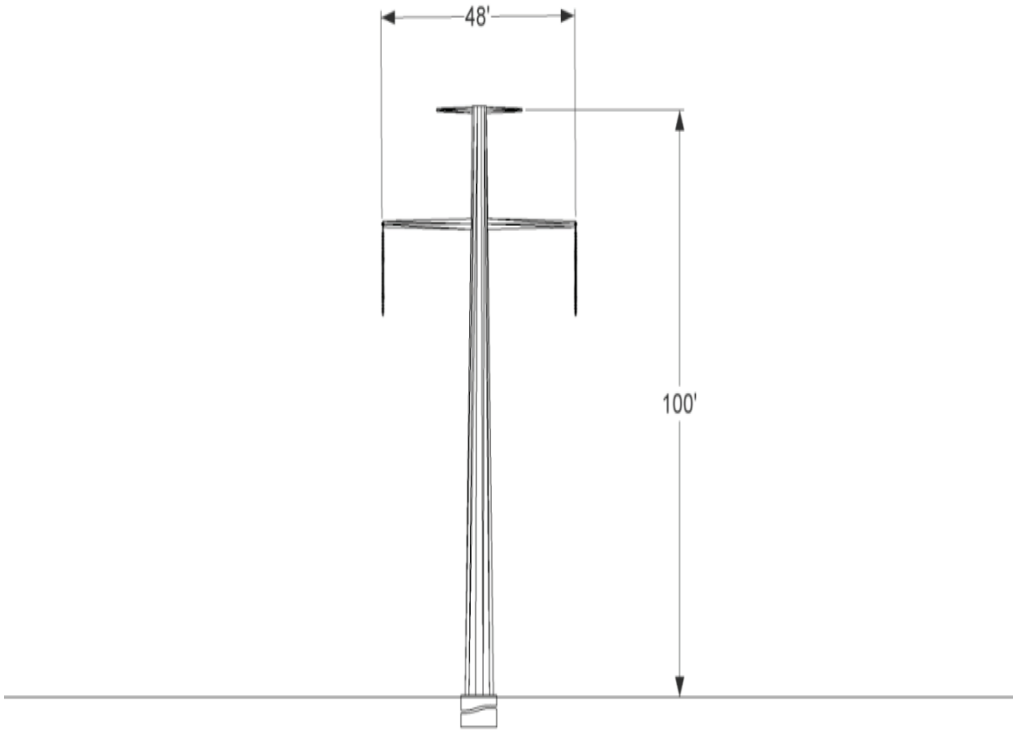


Figure 2-23. Typical DC Self-Supporting Dead-End Tubular Structure

2.4.3 Foundations

Each structure type requires specific foundations, although foundation design would be similar for either AC or DC structures. The guyed (GVL or GVT) structures would require a center pier and four anchors for the guy wires. The center pier would be cast-in-place concrete, a precast concrete foundation, or grillage foundation (a grillage consists of buried galvanized steel members designed to resist foundation loads). Drilled grouted soil, drilled grouted rock, disk, or log anchors would be used. For drilled anchors, each anchor hole would be 6 to 12 inches in diameter and range in depth from 10 to 40 feet. For disk or log anchors, typical excavations are 6 feet by 3 feet wide, and 10 feet to 15 feet deep.

Each SSL structure would require four cast-in-place drilled pier footings, each ranging from 3 to 6 feet in diameter (based on soil conditions) and 15 to 40 feet in depth. The footings would be installed by placing reinforcing steel and a structure stub into the foundation hole, positioning the stub and encasing it in concrete.

The SST structures would be installed on a single drilled pier foundation, which would typically be 6 feet in diameter; but may range from 4 to 8 feet in diameter based on soil conditions, and would be 20 to 50 feet deep.

The DEL structures require four footings installed on drilled pier foundations, which would typically be 6 feet in diameter; but may range from 4 to 8 feet in diameter based on soil conditions, and would be 20 to 50 feet deep.

The dead-end tubular structures would be installed using either one (DET) or up to three (DET3), single drilled pier foundations, which typically would be 6 feet in diameter; but may range from 8 to 12 feet in diameter based on soil conditions, and would be 20 to 50 feet deep.

2.4.4 Conductors

The conductors are the wire cables strung between transmission line structures over which the electric current flows. Conductors for the Project would be aluminum with a steel reinforced core. The aluminum carries most of the electric current, and the steel provides tensile strength to support the aluminum strands. The AC transmission line would consist of three phases for each circuit, including a bundle containing three conductors per phase.

The minimum conductor height above ground for the AC transmission line would be 30 to 35 feet, at 176 degrees Fahrenheit conductor operating temperature, based on NESC and Applicant design standards. The exact height of each structure would be governed by topography and safety requirements for conductor clearance.

The DC transmission line would use the same conductor as the AC transmission line, except that each DC structure would contain only two sets of bundled conductors. Minimum conductor height above ground for the DC transmission line would be 38 feet, based on NESC standards.

2.4.5 Insulators and Associated Hardware

Insulators, which are made of an extremely low conducting material such as porcelain, glass, or polymer, are used to suspend the conductors from each structure. They inhibit the flow of electrical current from the conductor to the ground, the structure, or another conductor. Insulator material would be selected based on electrical properties and maintenance practices, according to final Project engineering. Assemblies of insulators are designed to maintain electrical clearance between the conductors, structure, and ground. A permanent assembly of insulators, ranging from 20 to 28 feet long, would be used to position and support each of the three-conductor bundles to the structures. Insulator assemblies may be either "V" shaped or "I" shaped (vertical) for the tangent structures, and "I" shaped (horizontal) for the dead-end structures. See figures 2-11 through 2-23 for illustrations of the conductors for the proposed AC and DC structure types.

2.4.6 Overhead Groundwire and Electrodes

To protect conductors from lightning strikes, two OHGWs would be installed on the top of the structures. Current from lightning strikes would be transferred through the groundwires and structures into the ground. The groundwires would be composed of extra-high strength steel wire of approximately 0.5-inch diameter. One or both of the OHGWs would be an approximately 1-inch diameter fiber optic groundwire (OPGW), which would facilitate data transfer—required for system control and monitoring between the transmission facilities—along the fiber path.

The DC structures (Option B) may require two overhead conductors in the OHGW position for a portion of the line emanating from each of the SunZia East and Pinal Central substation terminations. These specific overhead conductors are a component of the ground return facilities required for DC operation. With this configuration, an OPGW will also be required to provide continuity of the fiber optic cable system for the entire line. The ground return conductors would then be connected to two independent ground electrode facilities, one near each end of the AC/DC converter station locations to maintain electrical current continuity during emergency conditions[1]. Each ground electrode facility would consist of a network of drilled deep earth wells (electrodes), grouted to a depth of 100 feet or more, depending upon the geological structure and electrical parameters of the area. Each site may be up to 600 acres in size (although other uses may be allowed within the site). Each well would be electrically interconnected to a small control building via buried low voltage underground cables, and each well and the electrode line would be continuously monitored via a telecommunications link that would use fiber optic or fixed radio communications equipment. Ground current would be effectively shared through the buried electrode network interconnecting the wells, to create a very low resistance earth connection by distributing the ground current over a large area. Surface access to the wells would be via utility access vault type arrangements to prevent any public access to the well connections or the electrode components.

[1] The ground electrodes provide an earth return path for the electrical current when one set of the DC current carrying circuits, also known as a monopole circuit, of the DC line is out of service. These conditions are most often the result of an unexpected outage of one monopole circuit, which would result in the electrical current flowing through the earth for a short period of time (typically 10 minutes to less than an hour).

2.4.7 Fiber Optic Regeneration Station

As the data signal passes through the optical fibers in the groundwire, the signal degrades with distance. Fiber optic regeneration stations are required to amplify the system control and monitoring signals carried over the OPGW attached to the transmission structures. Sites for fiber optic regeneration stations would be located within the proposed substations at approximately 75-mile intervals, and at other remote sites located along the transmission line route approximately halfway between each substation. Locations of regeneration sites would be identified in the final POD. The remote regeneration sites would be adjacent to the proposed transmission lines and within the right-of-way, at locations near existing low-voltage electric distribution lines, and easily accessible by vehicle. Typically, a separate permanent access spur road, up to 12 feet wide, would be located within the transmission line right-of-way as required for maintenance purposes for each site. Permanent access roads built for the transmission lines would be used to the extent practical. An extension of a distribution line would be needed to service each facility.

The remote regeneration sites would typically be in a fenced area of up to 100 feet by 100 feet, with building dimensions 12 feet wide by 32 feet long by 9 feet tall. The OPGW cable supported on the transmission structures would be routed in and out of the regeneration site building from the nearest transmission structure, either underground or overhead, along two separate paths. Electronic equipment that is required to support the fiber optic cable installation would be located inside the building. At each remote site, an emergency diesel and/or propane generator would be installed to provide backup power should an outage of the local electric distribution supply system occur.

2.4.8 Substations

Several substations would be associated with the proposed Project, constructed on private or state lands, and therefore not included in the BLM right-of-way grant. The size of each substation is dependent on whether an AC only or an AC/DC facility is installed at the site. The parcel would include the secure, fenced area containing the electrical equipment, plus sufficient area surrounding the substation components for placement of transmission structures entering and exiting the substation, and to provide setbacks to buffer neighboring lands. The maximum height of structures in the substation would be approximately 170 feet. The substation yards would be open air and include equipment such as transformers, circuit breakers, disconnect switches, lightning/surge arrestors, reactors, capacitors, bus (conductor) structures, and a microwave antenna. Typically, substation components would be surrounded by an 8-foot-high chain-link fence topped with barbed wire. Typical design characteristics for the substations are listed in Table 2-5 and may vary subject to local regulations. Estimated areas of ground disturbance for each substation are listed in Table 2-6.

Table 2-5. Typical Design Characteristics of a 500 kV Substation	
Equipment	• Transmission line take-off structures • Power circuit breakers • Power transformers • Switching equipment • Bus work or bus conductor • Control house • Microwave antenna • Current limiting reactors • Capacitor banks
Access road • Width • Road surface • Grading	• Minimum 24 feet wide, based on site-specific conditions (a maximum of 28 feet, including drainage/berms on each side) • Gravel • Heavy road base to support larger equipment
Fire protection facilities	• Fire-wall barriers for protection from transformers
Substation/Reactive compensation grounding	• Copper wire will be used to facilitate personnel ground protection
Land permanently disturbed[1]	• Each substation site: 35 to 85 acres
Land temporarily disturbed	• Each substation site: 5 to 20 acres (in addition to permanent disturbance)
Voltage	• Multiple voltages; can change voltage from 500 kV to lower voltages
[1] May include areas for transmission structures outside fenced areas shown in figures 2-24 through 2-27 and 2-30.	

As proposed, AC transmission lines would interconnect the proposed SunZia East Substation at the eastern terminus with the Pinal Central Substation at the western terminus. The SunZia East Substation would be located in Lincoln County, New Mexico, near US Route 54 and County Road A035. The Pinal Central Substation has been permitted and will be constructed by SRP at a location in Pinal County, Arizona, near US Route 287 and US Route 87. The Project may include one or more of the following three intermediate substations:

- Midpoint Substation would be located in Luna County, New Mexico, near Deming
- Lordsburg Substation would be located in Hidalgo County, New Mexico, near the existing Hidalgo Substation
- Willow-500 kV Substation would be located in Graham County, Arizona, near US Route 191 and the existing TEP 345 kV transmission lines[1]

The sequence and timing for construction of intermediate substations would be subject to future requests for interconnection to the Project facilities. The DC transmission line would not include interconnections with these intermediate substations, but would require AC/DC converter stations in the substation at each terminus. Figures 2-24 through 2-28 illustrate the substation layouts for the proposed substations. An elevation view of a typical 500 kV substation is provided on Figure 2-29, and a typical 500 kV DC converter station is shown on Figure 2-30.

Table 2-6. Substations: Estimated Temporary and Permanent Ground Disturbance (in acres)

Substations	Option A – Temp	Option A – Perm	Option B – Temp	Option B – Perm
SunZia East	15	45	20	85
Willow-500 kV	5	40	5	35

[1] The Willow 345 kV Substation has been permitted, and the site is located west of the proposed SunZia Willow-500 kV Substation.

Table 2-6. Substations: Estimated Temporary and Permanent Ground Disturbance (in acres)				
Substations	**Option A – Temp**	**Option A – Perm**	**Option B – Temp**	**Option B – Perm**
Midpoint	5	60	5	60
Lordsburg	5	40	5	35
Pinal Central[1]	5	0	10	45
Subtotal	**35**	**185**	**45**	**260**
Total Disturbance	**220**		**305**	
[1]Disturbance areas indicated are the portion within the Pinal Central Substation for SunZia the transmission line facilities (see Figure 2-28)				

2.4.9 Preconstruction Activities

Following are descriptions of preconstruction activities for the Project: right-of-way land acquisition, geotechnical investigations, and centerline survey.

2.4.9.1 Right-of-Way and Land Acquisition

New permanent and temporary land rights (e.g., right-of-way grant, easements, license agreement, and fee simple) are required for Project facilities, such as the transmission line corridor, access roads, and temporary work sites. Where the proposed transmission lines would parallel an existing transmission line, the right-of-way would be adjacent to the existing right-of-way to the extent feasible. The right-of-way width must be sufficient to accommodate "conductor blowout" (the swinging of the conductor midway between structures) due to wind, as well as maintenance clearances at the structure sites.

The Applicant filed a preliminary right-of-way application with the BLM in September 2008, for a major right-of-way for the transmission lines. The duration of the right-of-way would be 50 years, and a width of up to 1,000 feet. The terrain, separation criteria, and final design will determine the corridor centerline and total width of the right-of-way. Typically, each line will require 200 feet within a 400-foot-wide right-of-way for the two proposed transmission lines. Once the BLM has issued a ROD, the right-of-way application would be finalized with Project design details and right-of-way width (see Figure 2-9 for a typical right-of-way configuration).

Additional right-of-way may be required in areas where the proposed transmission lines would turn at a sharp angle. In some areas, a narrower right-of-way may be required due to certain site conditions or constraints. In these locations, the right-of-way could be as narrow as 330 feet for limited distances. Access roads may be located outside of the transmission line right-of-way where required, due to steep terrain or other restrictive site conditions. Access roads would be identified in the POD and approved by the BLM before construction. Additional permits would be required for access roads located outside of the Project right-of-way according to state and local regulations. Access roads located outside of the right-of-way on federal lands may require site-specific NEPA analysis or other permits. Areas that are used temporarily (e.g., roads, staging areas, batch plants) may require short-term rights-of-way.

Sites for substations will be purchased in fee, leased with a long-term land lease, or secured with a right of way, depending on whether the site is on state or private land.

2.4.9.2 Geotechnical Investigation

The purpose of the geotechnical investigation is to collect information regarding subsurface stability, used in the final design of each transmission structure and foundation. This activity helps to ensure the system is designed and constructed to be safe, reliable, and cost efficient, and can reduce the overall environmental disturbance during initial build and over the life of the Project. The geotechnical investigation would consist of the drilling and sampling of soils to a typical depth of 30 to 40 feet below the existing ground; however, borehole depth may exceed 50 feet, depending on soil conditions. The boreholes would have a diameter of approximately 8 inches and would be backfilled with auger cuttings and on-site soils. No new road construction or blading would be required for the investigation. Surface disturbance would be limited to the actual tracks left by the drill rig and support vehicles within the work areas, and along overland access routes.

Helicopter-transported drill rigs may be used for geotechnical exploration in areas where existing roads do not provide adequate access or where overland travel is expressly prohibited. Geophysical exploration techniques may be employed in areas where drilling is not practical, to assist in subsurface characterization, and may use instrumentation combined with surficial actuation to identify subsurface soil and rock stratification.

2.4.9.3 Centerline Survey

If an action alternative is approved in the ROD, an engineering survey would then be completed, which would involve verifying and staking the centerline of the transmission line route, structure center hubs, access roads (where needed), spur roads to structure sites, and temporary work areas. The centerline may be adjusted to accommodate engineering requirements. Some engineering survey activities may begin as early as 2 years prior to the start of construction. Required cultural, paleontological, and biological resource surveys may begin once certain survey information is available.

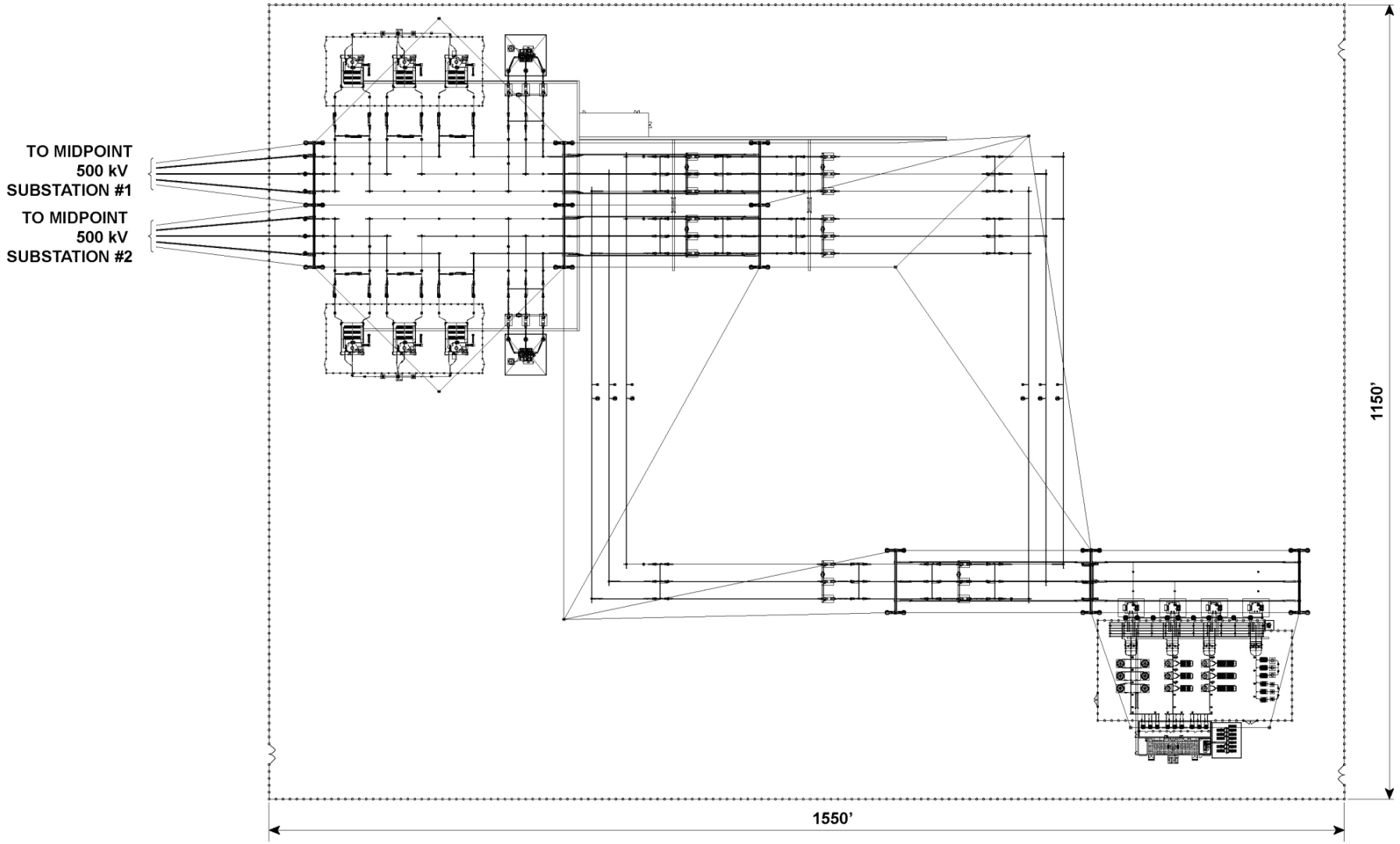


Figure 2-24. Proposed Substation Layout: SunZia East

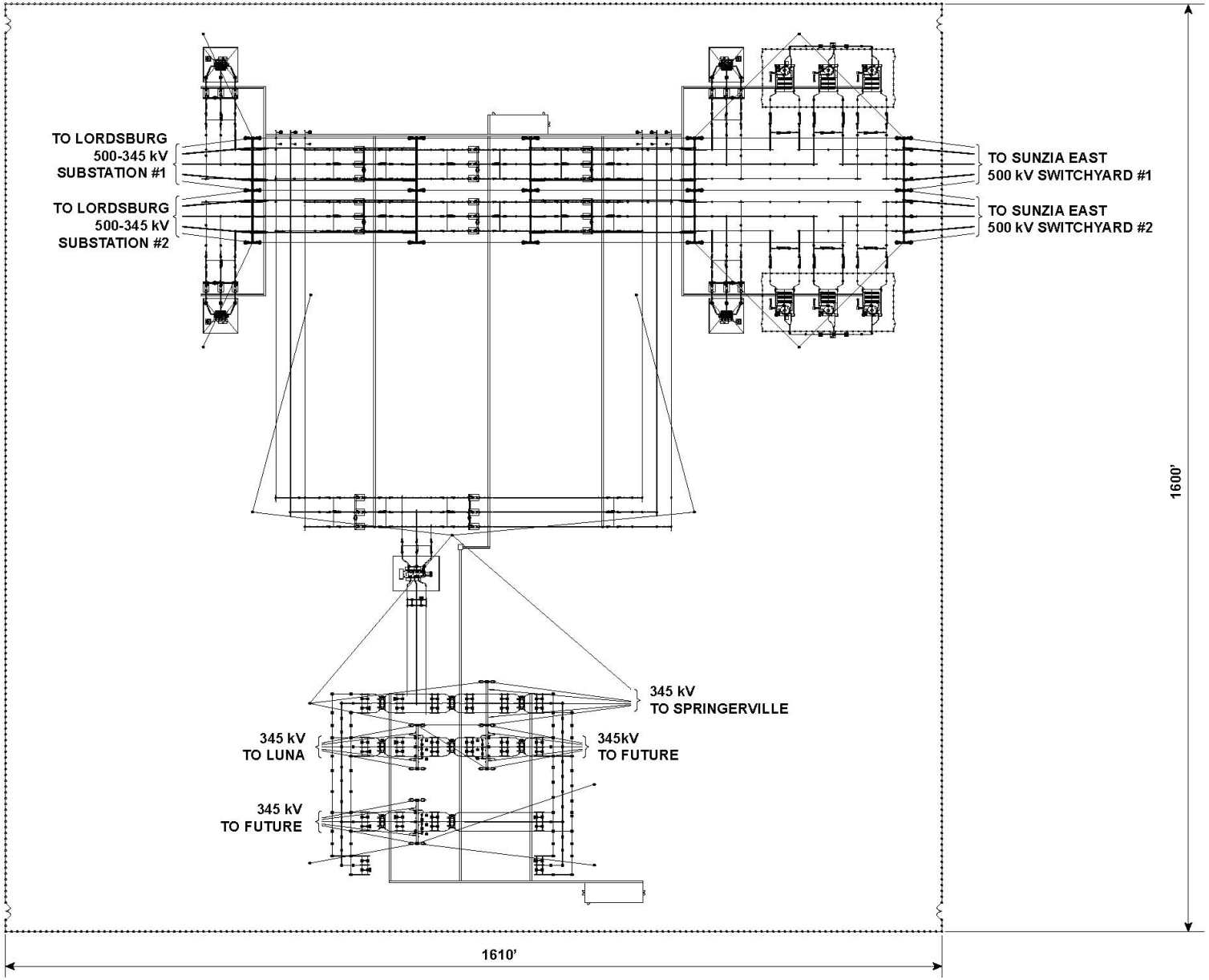


Figure 2-25. Proposed Substation Layout: Midpoint

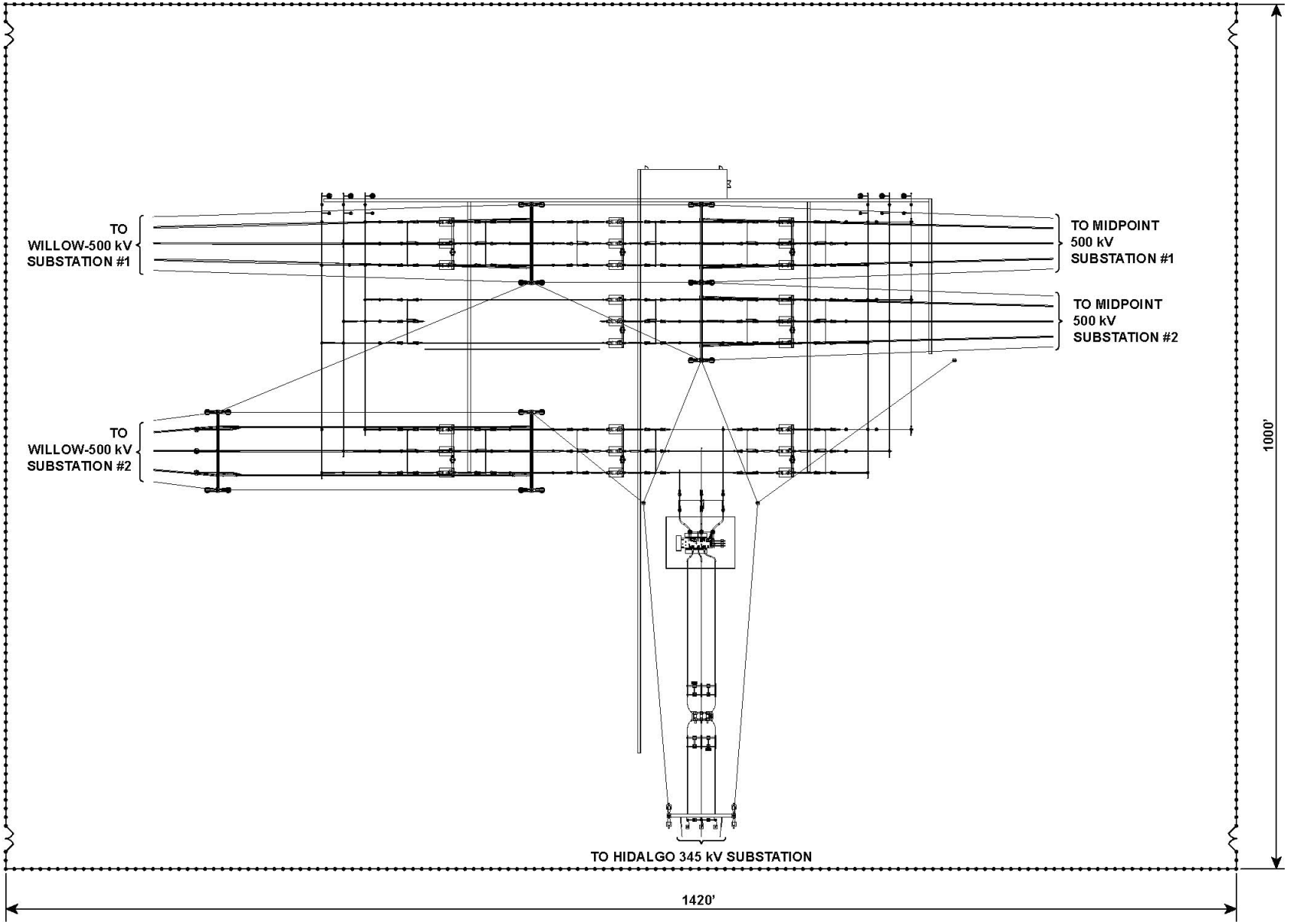


Figure 2-26. Proposed Substation Layout: Lordsburg

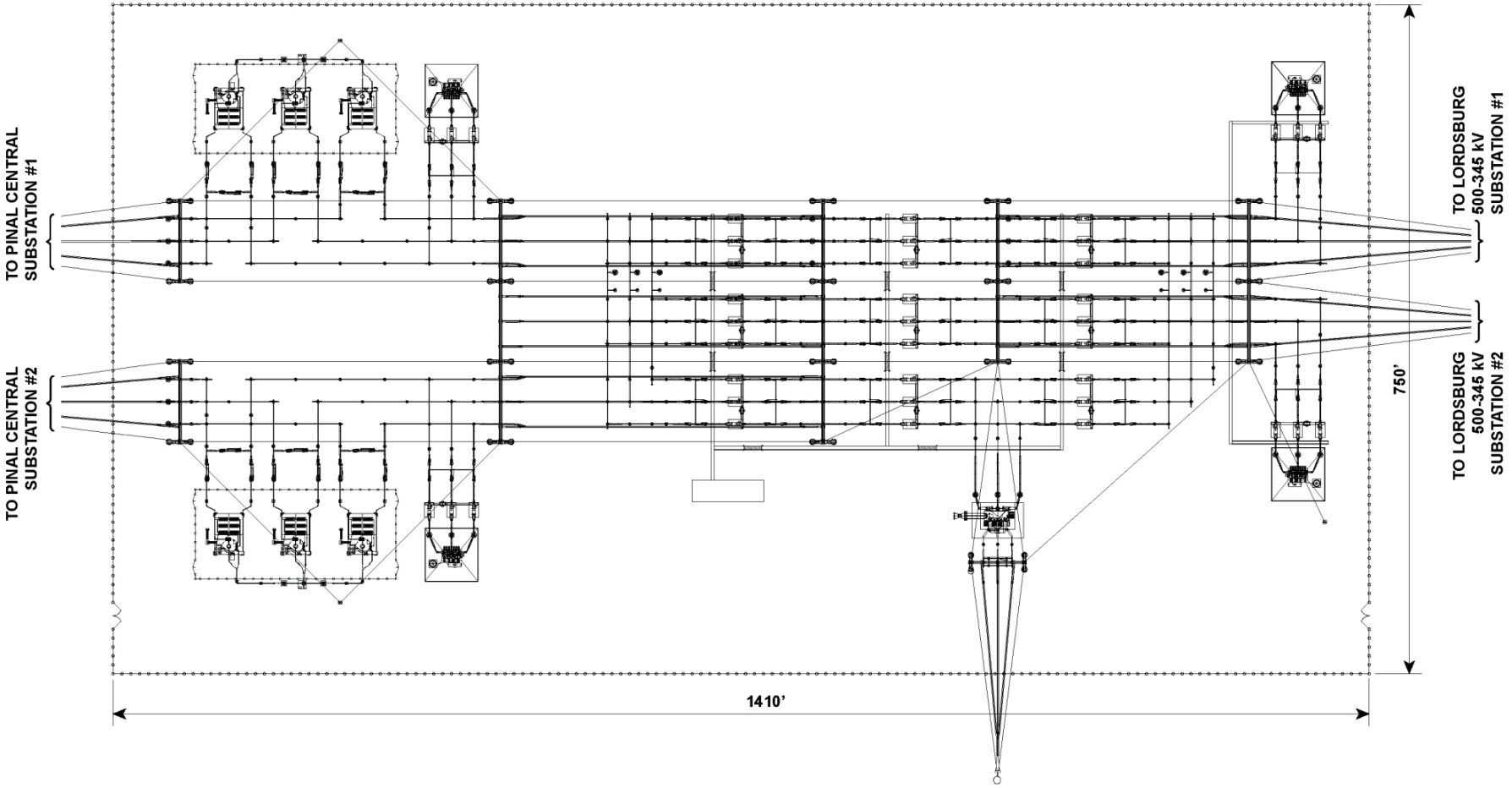


Figure 2-27. Proposed Substation Layout: Willow-500 kV

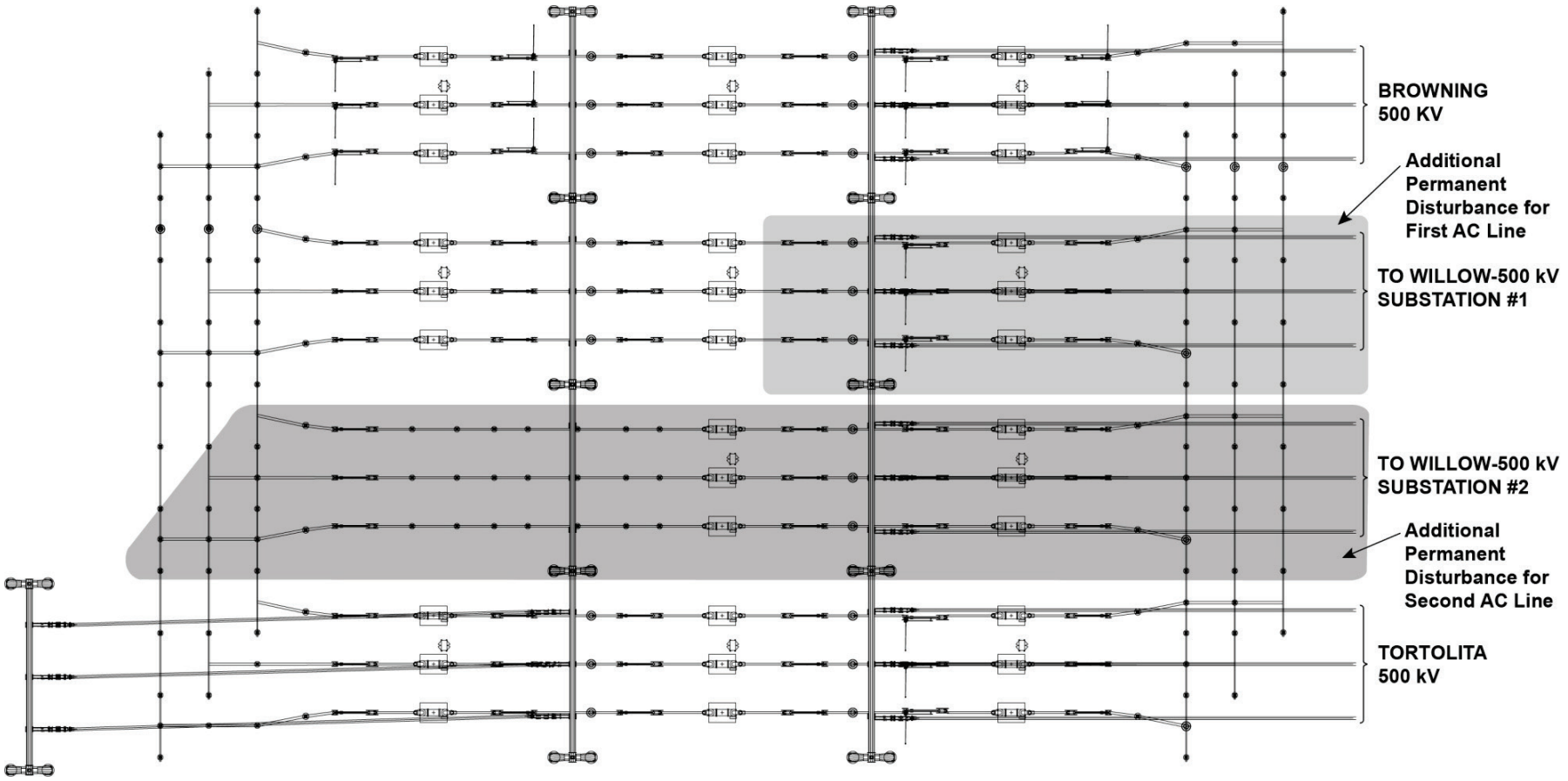


Figure 2-28. Proposed Expansion: Pinal Central Substation

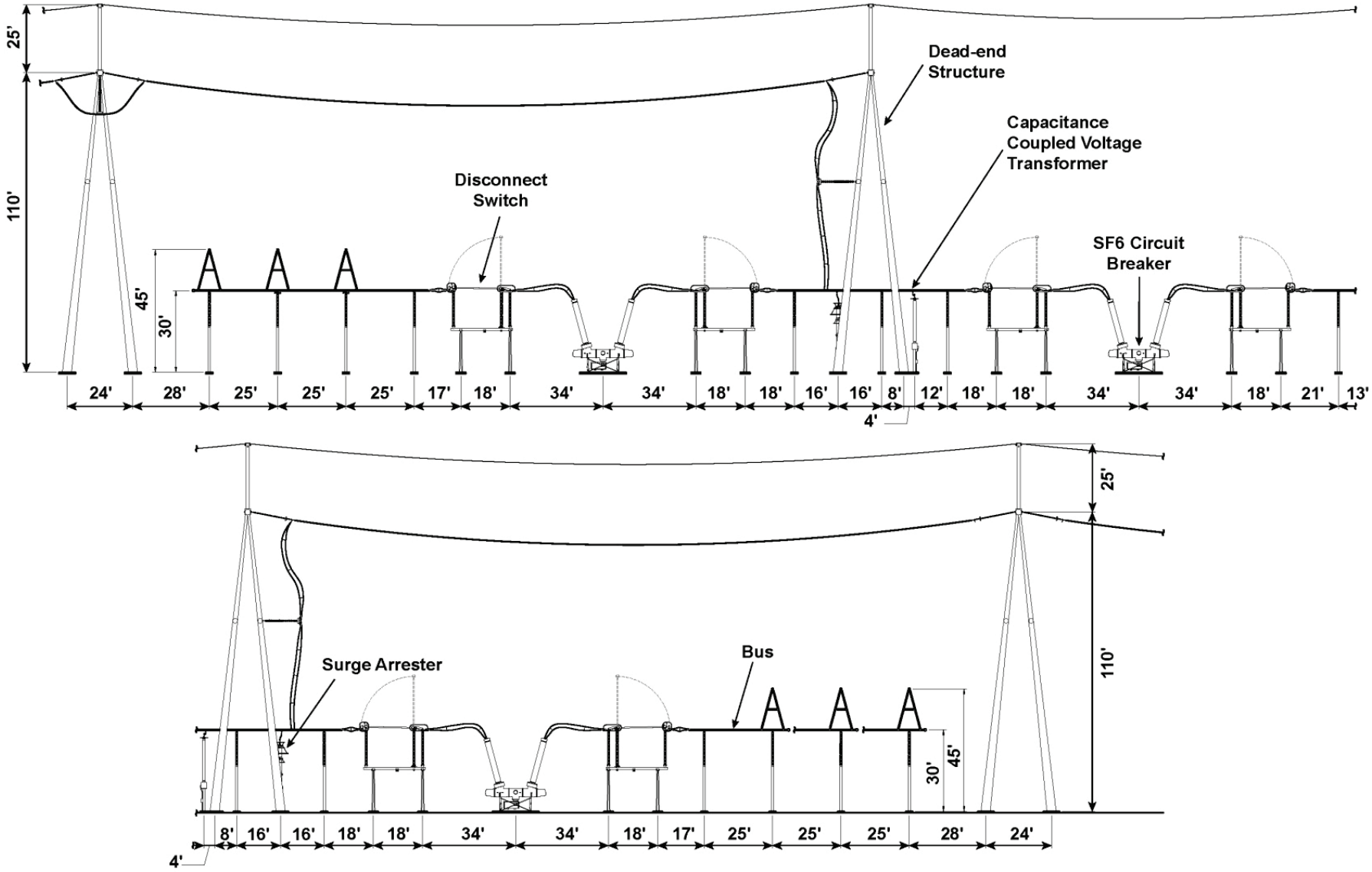


Figure 2-29. Typical 500 kV Substation Schematic – Elevation View

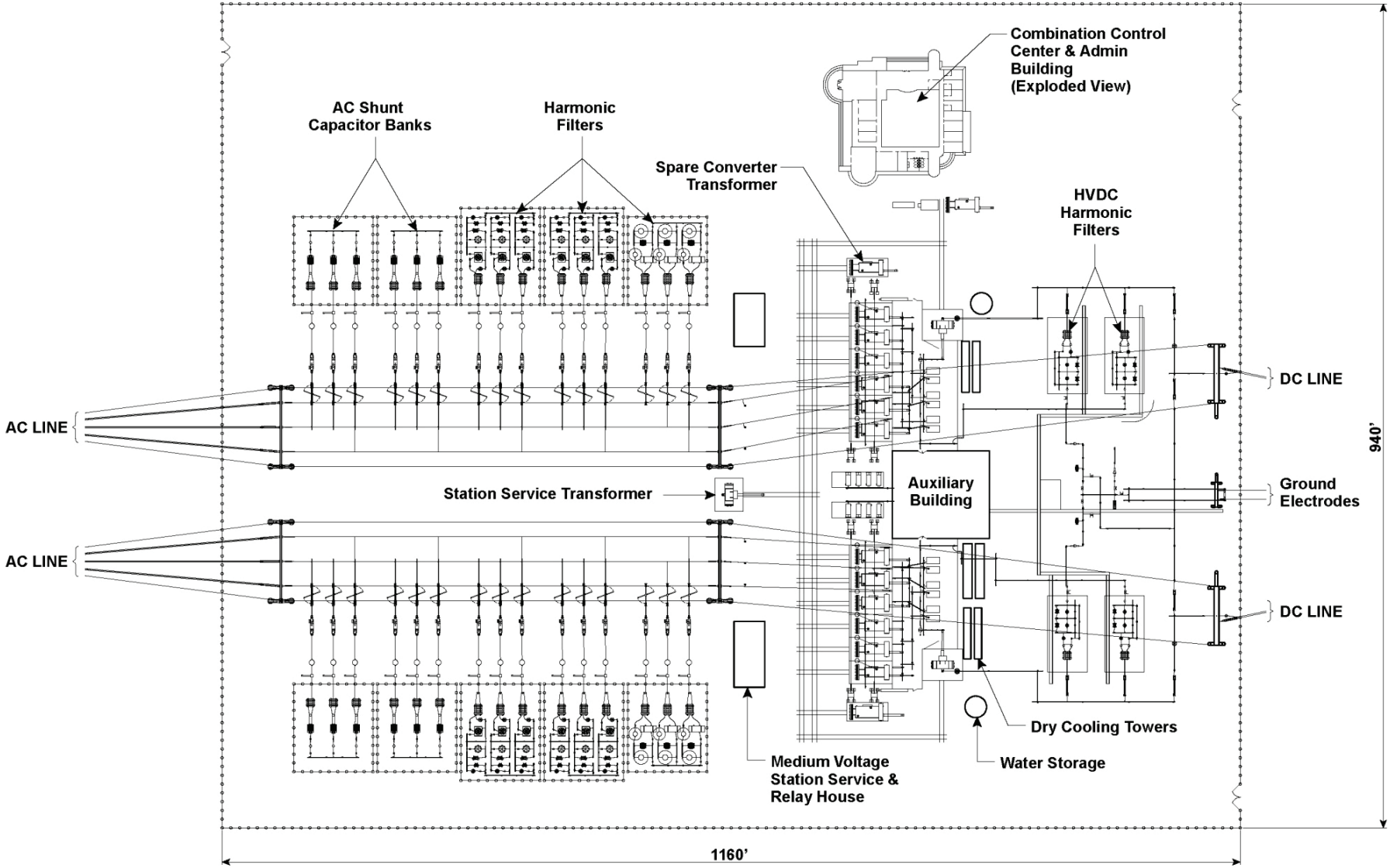


Figure 2-30. Typical 500 kV DC Converter Station.

2.4.10 Construction Activities

Construction activities would be similar regardless of design option (AC or DC). Construction specifications could be refined during detailed engineering; however, these refinements would be within the limits of the detailed analysis addressed by this EIS. Any changes to Project design or construction would be reflected in the final POD, as necessary. The POD will also include a list of those mitigation measures to which the Applicant has committed to protect the environment during Project construction and operation (see Section 2.4.12). The design, construction, and operation of the Project would meet or exceed the requirements of the NESC, U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Standards, and the Applicant's requirements for safety and protection of landowners and their property.

2.4.10.1 Access Roads

Roads enable access to the right-of-way and structure sites for both construction and long-term maintenance of the transmission lines. To limit the amount of new road construction for the Project, existing paved and unpaved access roads would be used, to the extent practicable, for the transportation of materials and equipment from the storage yards to the areas where they would be needed along the transmission line right-of-way. Because access roads must be sufficient to bear the weight and endure heavy construction vehicle use, existing access roads may need to be upgraded to meet construction requirements. Affected private landowners and agencies would be consulted before road upgrades or construction begins. Relevant road construction criteria of the affected agencies and landowners, including BLM requirements, will be outlined in the POD. The POD will also document specific plans for the construction, rehabilitation, and/or maintenance of the roads, including general locations of access roads and construction methods (i.e., overland drive and crush, cut and clear, etc.), based on site-specific conditions.

The typical transmission tower span would be 1,200 to 1,600 feet; based on the use of either a guyed-V structure or the SSL structure. In order to limit the amount of new road construction for the Project, existing roads within 700 feet of the Project representative centerline are proposed to be used for access to the Project right-of-way and Project facilities, where practicable. Where existing roads could be used for construction and operation purposes, only spur roads to Project or structure work areas may be needed. Beyond 700 feet from the Project representative centerline, constructing a new road from structure-to-structure would typically result in less ground disturbance than building spur roads from existing roads to each Project or structure work area. The number of new spur roads would be held to a minimum, consistent with their intended use (e.g., structure construction or conductor stringing and tensioning). Some existing roads could require upgrading to meet BLM standards for road construction. All existing roads would be left in a condition equal to or better than their condition prior to construction, in accordance with BLM, state, and/or local road standards or private landowner agreements.

Where new roads are required to meet the access needs of the Project, it is anticipated that a single new road would be constructed to serve both 500 kV facilities (Figure 2-31). In locations of steep or rugged terrain, two separate access roads may be required to accommodate construction of the two parallel transmission lines. New roads may be built as either temporary

or permanent access. Where new roads are required for construction purposes only, or to access temporary work areas (e.g., wire pulling and tensioning sites, concrete batch plants, etc.), access roads may be built for temporary use. Temporary roads serve the needs for Project access during the construction phase, but are not anticipated to be necessary for operations or decommissioning purposes. Upon completion of construction activities, temporary access roads would be reclaimed according to the procedures specified in the Final POD. Where new roads are required for construction and operation purposes, or where landowners or land-management agencies require, access roads would be constructed for permanent use.

All access roads (new, improved, or spur), temporary or permanent, would typically be constructed with a travel-surface width of 20 feet, and 2-foot berms and/or drainage ditches on both sides of the travel surface, for a total roadway width of 24 feet. In steep terrain, total disturbance would likely exceed 24 feet (e.g., up to 50 feet for a 2:1 slope), due to cut and fill conditions according to design standards (Figure 2-32). In addition, roads may be routed around specific areas due to topographical constraints or to avoid sensitive resources. Helicopters may be used for wire stringing, and in some locations structure placement, in areas where there are environmental constraints, terrain restrictions, or where it is economically practical.

To reduce the severity of Project disturbance where operations access will be required, overland road construction methods (i.e., overland drive and crush; overland cut and clear) may be implemented where feasible. Overland drive and crush is defined as vehicular travel to the Project right-of-way and/or facilities without significantly modifying the landscape; vegetation is crushed but not cropped, thereby minimizing disturbance to root mass and organics in the soil, and soil may be compacted but no surface soil is removed. It is anticipated that overland drive and crush could be implemented where new access is required in flat terrain (0 to 3 percent slope) and within the vegetation communities listed below.

- Semidesert grassland
- Lower Colorado River subdivision of the Sonoran Desert
- Chihuahuan Desertscrub
- Plains and Great Basin grassland
- Sand dunes
- Plains-mesa grassland
- Plains-mesa sand scrub
- Desert grassland

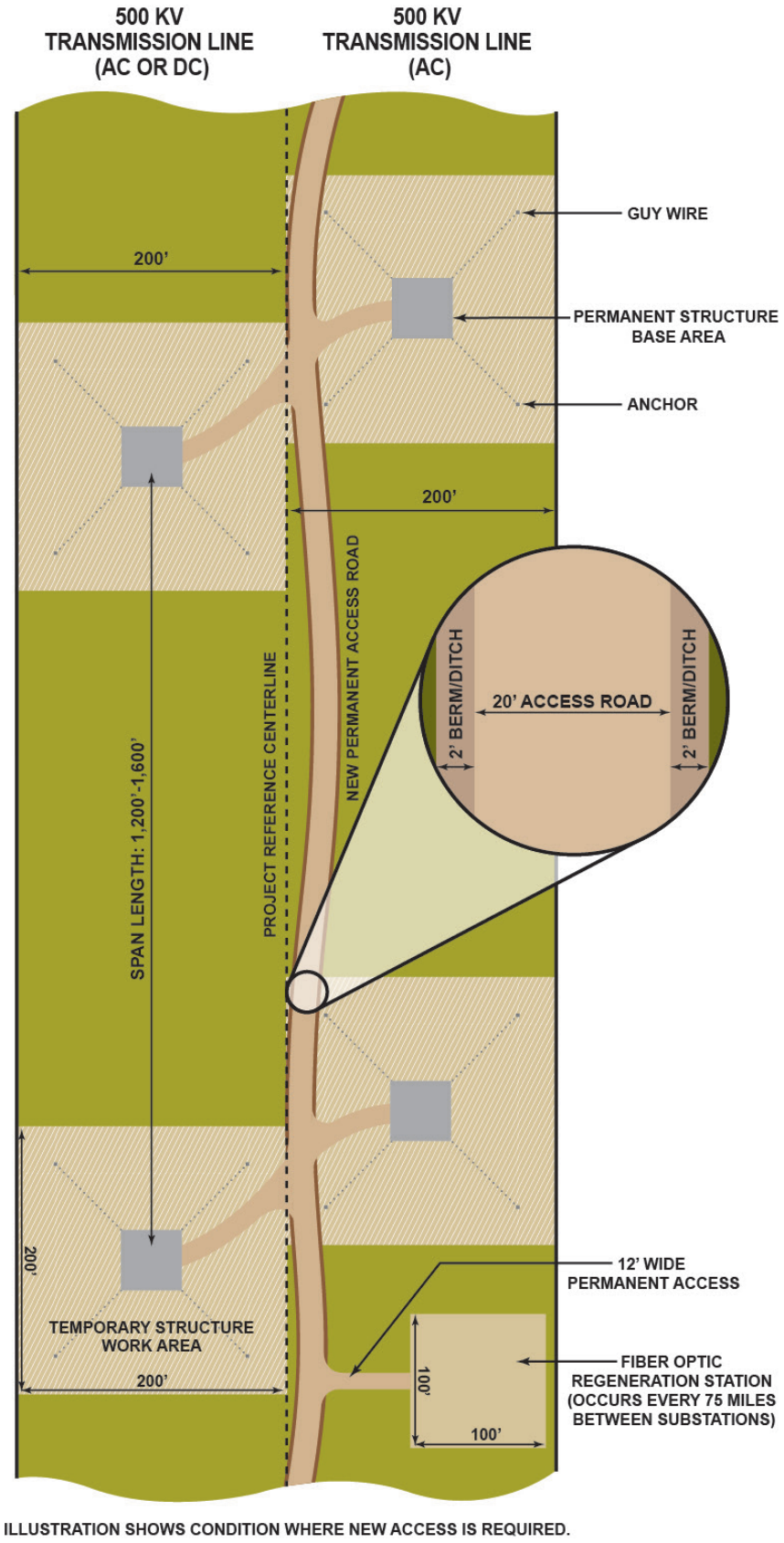


Figure 2-31. Typical Right-of-Way Configuration

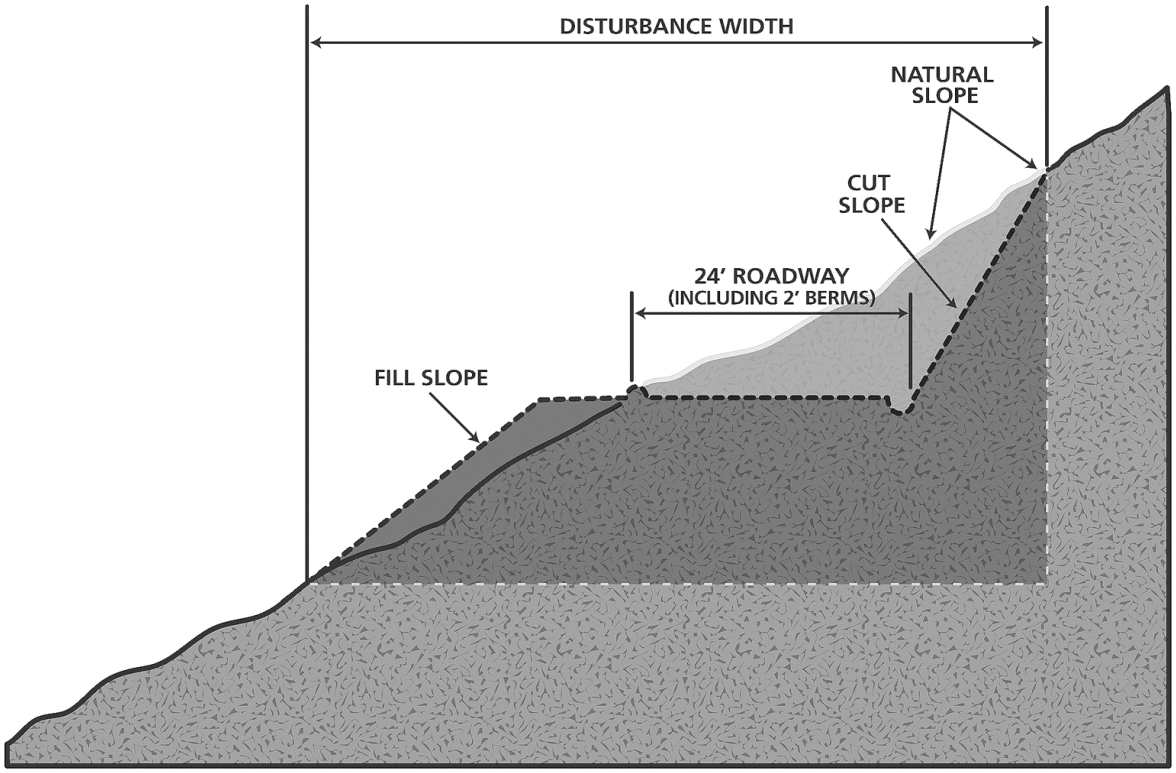


Figure 2-32. Typical Roadway Cut and Fill Conditions

Where new roads are required outside of the vegetation communities identified above, and where no grading is necessary (i.e., areas of 0 to 3 percent slope), overland cut and clear would be used to the greatest extent possible. Overland cut and clear is the removal of all vegetation to improve or provide suitable access for equipment. All vegetation is removed using above-ground cutting methods that leave the root mass intact. Soil is compacted but no surface soil is removed.

In certain areas, it could be necessary to block roads after construction to restrict future access for general and undesired use. Such areas would be identified through negotiations with the landowner or land-management agency, and identified in the final POD. Methods for road closure or management may include installing locking gates or obstructing the path with earthen berms or boulders. Blocked access routes would have the ability to be reopened, when necessary, where access is impeded for maintenance and emergency repairs.

Access Levels

For the EIS analysis, three levels of access were identified and the associated amount of ground disturbance from upgrading or constructing access was estimated (Table 2-7). A description of the methods used to estimate the levels of disturbance associated with access are included in Appendix I – Analysis of Access Conditions and Potential Ground Disturbance. Existing roads suitable for access and the general condition for each have been mapped. This information was combined with slope and vegetation classifications, to provide an estimate of the potential ground disturbance that could result from using existing access roads, upgrading existing roads, or constructing new roads. Estimates of ground disturbance were applied to analyze impacts to environmental resources.

Table 2-7. Access Levels and Associated Potential Ground Disturbance					
		Area of Potential Ground Disturbance			
Access Level	Access Road Condition	Slope (percent)	Access Road Miles per Mile of Transmission Line	Spur Road Length (feet)	Ground Disturbance Ratio (acres per mile)
1	No road improvements required, 24-foot spur road used for width of disturbance	0 – 8	1.1	770	1.6
		8 – 15	1.5	1,050	2.2
		15 – 35	1.8	1,260	2.6
		35+	2.3	1,610	3.4
2	Improvement to existing road required, ground disturbance includes 10-foot width plus 24-foot-wide spur road	0 – 8	1.1	770	2.8
		8 – 15	1.5	1,050	3.4
		15 – 35	1.8	1,260	3.8
		35+	2.3	1,610	4.6
3	Construct new access road with 24-foot width total disturbance	0 – 8	1.1	–[1]	3.2
		8 – 15	1.5	–[1]	4.4
		15 – 35	1.8	–[1]	5.2
		35+	2.3	–[1]	6.7
[1] Spur roads are included within temporary structure work areas, up to 700 feet within right-of-way (see Figure 2-31)					

Access levels have been organized numerically, beginning with the access level of least disturbance. Existing roads suitable for Project construction access were mapped, and segments of the Project alternatives were designated as Level 1 based on two criteria associated with these roads: (1) alternatives are within 700 feet of an existing road suitable for construction, and alternatives parallel that existing road for a minimum of 700 feet, or (2) where an existing road suitable for construction crosses the proposed Project right-of-way, or another existing road suitable for construction crosses the proposed Project right-of-way within 0.5 mile along the Project representative centerline.

Existing roads requiring improvements were also mapped and segments of the Project alternatives were designated as Level 2, based on the same criteria as described for Access Level 1.

Areas of Project alternatives greater than 700 feet from existing roads, or where existing roads crossed the proposed Project right-of-way but did not have another road cross the proposed Project right-of-way within 0.5 mile, would require new access roads to be constructed and were designated as Access Level 3. In addition, access levels were combined with vegetation data to identify areas of potential temporary disturbance, thus minimizing impacts to environmental resources as a result of Project construction.

2.4.10.2 Equipment Staging and Construction Yards

Staging of equipment would be located at pulling and tensioning sites or other temporary work areas. These areas would be used to temporarily lay out equipment to be used for work on specific Project activities at nearby locations. Construction yards would be located approximately every 40 miles, and concrete batch plants would be located on temporary work sites of approximately 3 to 5 acres, located every 30 miles along the right-of-way.

2.4.10.3 Structure Pad Clearing/Grading

Clearing of natural vegetation would be required for construction purposes (access, spur roads, structure sites), land surveying activities, clearances for electrical safety, long-term maintenance, and reliability of the transmission lines. Within or adjacent to the right-of-way, mature vegetation would be removed under or near the conductors to provide adequate electrical clearance, as required by the NESC. Typically, only large trees or fast growing vegetation approximately 12 feet or higher would be topped or removed. In sensitive areas, as determined by the BLM or other agencies, clearing of natural vegetation would occur by hand.

Typical Structure Site and Work Area

At each structure site, work areas are required to facilitate the safe operation of equipment and construction. Typical work areas in flat terrain would require an area of 200 feet by 200 feet of temporary disturbance for equipment and construction tasks. The work area would be cleared of vegetation to the extent necessary. Access within the work area would be overland travel with grading, as required in the work site. After construction, all temporary work areas would be restored in accordance with the Reclamation Plan. Permanent disturbance associated with the structures and structure footings would include an area of up to 60 feet by 60 feet (all dimensions are approximate for tangent structures).

Specific structure sites and work areas would be identified in the POD, once a final route has been determined.

Structure Site and Work Area in Steep/Rough Terrain

Work areas may be expanded to 200 feet by 300 feet in areas of steep or rough terrain, though the size of the work area may vary depending on site conditions. Approximately two-thirds of this area would be permanently disturbed, to accommodate structures and crane pads used for both construction and operations crews. The remaining one-third of the area would be restored in compliance with the Reclamation Plan, following temporary construction use.

At structure sites in areas of rough and steep terrain, where economically practicable or a result of sensitive resource issues, helicopters may be used for construction purposes. This would involve ferrying work crews, supplies, and structure materials to the structure sites.

2.4.10.4 Foundation Installation

Power equipment would be used to excavate foundations. Where the soil permits, a vehicle-mounted power auger or backhoe would be used. In rocky areas, the foundation holes may be excavated by drilling and blasting or installing special rock anchors. Soil stabilization by water or a gelling agent may be required for excavation in extremely sandy areas. The BLM would be notified in advance of any required blasting so that the area can be cleared and sensitive resources protected. After excavations are completed, cast-in-place, precast, or drilled pier footings would be installed, depending on the structure type.

The excavation and installation of the foundation would require access to the site by a power auger or drill, a crane, material trucks, and concrete trucks using the access roads. In environmentally sensitive areas or areas of steep terrain, excavation and installation of the foundation may use a power auger or drill brought in by helicopter or all-terrain vehicle (ATV).

Foundation holes left open or unguarded would be covered to protect the public and wildlife. If practical, fencing may be used. Soil removed from foundation holes would be stockpiled on the work area and used to backfill the foundation holes, as necessary. Any remaining soil would be spread on the access road. The first 6 inches of topsoil would be stockpiled separately, to ensure that the best possible topsoil for reseeding is not covered by auger cuttings during site rehabilitation. Some large rocks may be left onsite to help blend the area with the surrounding landscape.

2.4.10.5 Structure Assembly and Erection

Structures would be assembled and erected onsite using appropriately sized cranes; except where helicopter construction is employed due to access or environmental constraints, such as in areas with rough or steep terrain. The construction specification would be written to allow the contractor the flexibility to use ground-based or helicopter construction methods, or a combination of both.

When helicopter construction methods are employed, construction activities would be based at a fly yard. Fly yards would be used for material storage and partial assembly of each structure in multiple sections or components. The structure sections or components would be assembled by weight, based on the lifting capacity of the helicopter, and transported to the final structure location for installation. Heavy lift helicopters capable of lifting 15,000 to 20,000 pounds per flight (depending on elevation) would be used.

When ground-based construction methods are employed, tubular pole sections or bundles of steel for lattice towers and associated hardware for each structure would be delivered to the site by trucks and flatbed trailers. Tubular pole sections would be assembled on the ground at the site; the assembled structure would then be lifted onto foundations using a crane. The contractor would also have the option to assemble the tubular pole sections in place, assisted by helicopter. Lattice tower subsections, or tower components, would be pre-assembled on the ground using a truck-mounted crane. The pre-assembled bottom portion of towers (leg extensions) would be lifted onto foundations using a crane. Once the leg extensions are bolted to the foundation stub angles, the remaining tower components (tower body, body extension, cross arms, groundwire peaks) would be lifted in sequence and bolted to each other and to the leg extensions, completing the lattice tower erection. The crane would move along the right-of-way from one location to another, erecting structures.

2.4.10.6 Ground Rod Installation

As part of standard construction practices, prior to wire installation, structure footing resistance along the route would be measured. Grounding of structures would be accomplished by installation of driven ground rods, typically ¾-inch by 16 feet deep, or counterpoise (grounds), which consist of a bare copper-clad or galvanized steel cable buried a minimum of 12 inches

deep (minimum of 18 inches in cultivated areas), extending from one or more structure legs for approximately 200 feet within the right-of-way.

2.4.10.7 Stringing Conductors and Groundwire

Conductors and groundwires would be placed on the transmission line support structures by a process called stringing. The first step to wire stringing would be to install insulators (if not already installed on the structures during ground assembly) and stringing sheaves. Stringing sheaves are rollers that are temporarily attached to the lower portion of the insulators at each structure to allow conductors and OHGWs to be pulled along the line. In addition, temporary clearance structures (guard structures) would be erected where required for safety and protection during wire stringing operations. Guard structures consist of H-frame poles and nets placed on either side of an obstacle. These structures prevent groundwire, conductors, or equipment from falling on an obstacle.

Equipment for erecting guard structures includes augers, line trucks, pole trailers, and cranes. Guard structures may not be required for small roads or may be accommodated by line trucks or other methods. On such occasions, other safety measures such as barriers, flagmen, or other traffic control would be used.

Once the stringing sheaves and temporary guard structures are in place, a pilot line would be pulled (strung) from tower to tower (or pole to pole) by helicopter, truck, or ATV, and threaded through the stringing sheaves at each structure. A larger diameter, stronger line (pulling line or hard line) would then be attached to the pilot line and strung. This process is repeated until the groundwires and conductors are pulled through all sheaves. Groundwires and conductors would be strung using powered pulling equipment at one end, and powered braking or tensioning equipment at the other.

The 500 kV lines use a three-conductor bundle for each phase (three bundles for AC, two bundles for DC). The conductor would be delivered on steel reels containing approximately 9,000 feet of conductor per reel; therefore, conductor joints would occur approximately every 9,000 feet. These joints, also called splices or compression sleeves, would provide electrical continuity and mechanical strength between adjacent reels of conductors. Following the initial stringing operation, pulling and tensioning the wires/conductors would be required to achieve the correct sagging of transmission lines between structure supports. Typically, sites for tensioning and pulling equipment are approximately 200 feet by 600 feet, and would be required approximately every 18,000 feet. However, to accommodate directional changes within the Project alignment and site-specific design requirements, smaller 200 feet by 400 feet pulling, tensioning, and/or splicing sites would be located at 9,000-foot intervals between the larger 200 feet by 600 feet tensioning and pulling sites. Also, when construction occurs in steep and rough terrain, larger, less symmetrical pulling and tensioning areas at more frequent locations may be required. Once a final route has been determined, pulling, tensioning, and splicing sites would be identified in the POD.

2.4.10.8 Substation and AC/DC Converter Stations

Preparation and construction at the substation sites would require the following:

- Cut-and-fill grading (terrain dependent)
- Placement and compaction of structural fill to serve as a sub-base under the foundations for equipment
- Subsurface grounding grids
- Subsurface control conduits
- Grading to maintain drainage patterns
- Oil spill containment facilities
- Gravel-surfaced yard
- Gravel-surfaced parking areas approximately 100 by 100 feet
- Gravel-based roads (a minimum of 24 feet wide, based on site-specific conditions)
- Fencing and gate
- Facility construction
- Revegetation with native plants, where practicable

2.4.10.9 Waste Removal

Construction sites, material storage yards, and access roads would be kept orderly. Refuse and trash would be removed from the sites and disposed of in an approved landfill. In remote areas, trash and refuse would be removed to a construction staging area until proper disposal can be facilitated. No open burning of construction trash would occur without appropriate approval.

2.4.10.10 Reclamation

The right-of-way would be reclaimed to its original condition as is practicable, through methods described in the Reclamation Plan as described in the POD. In areas of temporary disturbance, all practical means would be made to reclaim the land to its original contour, natural drainage patterns, and vegetation (i.e., use of native plants or seed mix) along the right-of-way, as required by the BLM and outlined in the POD.

2.4.10.11 Labor Force and Equipment

The estimated workforce and equipment required to construct the proposed transmission lines and substations are listed in tables 2-8 and 2-9. The proposed Project would consist of several phases of construction at various locations, allowing some shared personnel between work sites according to the task schedule. An estimated total of 206 workers would be required for construction of each transmission line, and approximately 55 workers would be needed to construct each new substation. For Option A, up to four new AC substations would be constructed with the first AC transmission line, followed by the expansion of each of those substations for the second AC transmission line. For Option B, up to four new AC substations would be constructed with the AC transmission line, and AC/DC converter substations would be constructed at the Pinal Central Substation and the proposed SunZia East Substation, for a total workforce of 110. In total, the maximum substation construction workforce would be 424 for

Option A, or 330 for Option B. (Actual construction workforce at any one time would be less than the maximum.)

2.4.11 Operation, Maintenance, and Decommissioning

The transmission lines would be protected with power circuit breakers and line relay protection equipment. If a conductor fails, power would be automatically removed from the line. Lightning protection would be provided through OHGW.

All buildings, fences, and other structures with metal surfaces located within 200 feet of the centerline of the right-of-way would be grounded, as needed. Typically, residential buildings located 200 feet or more from the centerline would not require grounding; the need to ground other structures beyond 200 feet would be determined by the NESC. All metal irrigation systems that parallel transmission lines for a distance of 1,000 feet or more and within 100 feet of the centerline would be grounded. If grounding were required outside the right-of-way, a temporary use permit would be obtained, as needed.

2.4.11.1 Maintenance

The transmission lines would be patrolled bi-annually for maintenance, either by helicopter or by driving patrol. Over-flight line maintenance during the spring and fall of each year is based on weather conditions, helicopter availability, and statutory requirements of the states served by the Applicant. Spring and fall over-flight maintenance activities are conducted prior to peak demand of summer and winter months, to identify and resolve conditions that pose an immediate hazard to the public or employees, or that risk immediate loss of supply or damage to the electrical system. Maintenance crews would be trained and adhere to Bird Management and Avian Protection Plans for all maintenance activities. Avian monitors would routinely identify nest locations and check structures for activity. Over-flight maintenance activities are conducted at a distance and speed that would not result in disturbance to avian species or nests.

Monitoring and maintenance would be done from approved or existing access roads. When access into the structure locations needs improvement, a tracked bulldozer or other heavy equipment would be used after notifying the BLM Authorized Officer. As necessary, maintenance crews would be required to re-scarify and reclaim newly disturbed areas to pre-existing conditions. Any berms or boulders that were in place to limit access would also be restored after completion of the maintenance work.

Table 2-8. Estimated Personnel and Equipment for Transmission Line Construction					
		500 kV AC Line		500 kV AC or DC Line	
Activity	Equipment Type	Quantity of Equipment	Personnel (per line)	Quantity of Equipment	Personnel (per line)
Material Yard/ Receiving/Distribution	¾-ton Pickup	4	14	4	14
	10,000 lb. Forklift	2		2	
	50-ton Crane	2		2	
	Tractor Trailer (flatbed)	6		6	
	20-ton Boom Truck	3		3	
	100-ton Crane	0		0	
Survey (Construction Staking)	½-ton Pickup	2	4	2	4
	ATVs	4		4	
Soil Borings	¾-ton Pickup	2	6	2	6
	Drill Rig	2		2	
Right-of-Way Clearing	¾-ton Pickup	3	4	3	4
	Chainsaw	2		2	
	Hydro Axe	1		1	
Roads and Access	1-ton Pickup	2	6	2	6
	Cat D-6	1		1	
	Grader	1		1	
	Semi w/Dump Trailer	1		1	
	Water Truck	3		3	
Foundations (3 crews)	½-ton Pickup	3	36	3	36
	1-ton Pickup	6		6	
	Drill Rig	3		3	
	Loader/Backhoe	3		3	
	Boom Truck	3		3	
	Concrete Truck	6		6	
	Generator	3		3	
	Cat D-6	3		3	
Structure Assembly Lattice (3 crews)	½-ton Pickup	3	30	3	30
	1-ton Line Truck	3		3	
	20-ton Boom Truck	3		3	
	Air Compressor	3		3	
	30-ton R/T Crane	3		3	
Structure Assembly Tubular (1 crew)	½-ton Pickup	1	10	1	10
	1-ton Flatbed Truck	1		1	
	Air Compressor	1		1	
	30-ton R/T Crane	1		1	

Table 2-8. Estimated Personnel and Equipment for Transmission Line Construction

Activity	Equipment Type	500 kV AC Line		500 kV AC or DC Line	
		Quantity of Equipment	Personnel (per line)	Quantity of Equipment	Personnel (per line)
Structure Erection (Lattice – 1 crew)	½-ton Pickup	1	10	1	10
	1-ton Flatbed Truck	1		1	
	200-ton Crane	2		2	
	20-ton Boom Truck	2		2	
	Air Compressor	1		1	
Structure Erection (Tubular – 1 crew)	½-ton Pickup	1	10	1	10
	1-ton Flatbed Truck	1		1	
	200-ton Crane	1		1	
	20-ton Boom Truck	1		1	
	Air Compressor	2		2	
Wire Pulling (Conductor, OHGW, OPGW)	1-ton Line Truck	2	20	2	20
	200-ton Crane	2		2	
	20-ton Boom Truck	2		2	
	Air Compressor	0		0	
	Cat D-8	3		3	
	Puller	2		2	
	Tensioner	2		2	
Conductor Clipping and Dead-ending (3 clip, 1 dead-end)	½-ton Pickup	4	32	4	32
	1-ton Line Truck	6		6	
	Bucket Truck/ Boom w/Basket	4		4	
Restoration	½-ton Pickup	2	4	2	4
	Tractor with Disc	1		1	
	Cat D-4	1		1	
	Hydro Seed Truck	1		1	
Contractor Management/ Compliance Monitors	½-ton Pickup	20	20	20	20
	ATV (Inspection)	2		2	
Total Personnel[1]			**206**		**206**

[1] Maximum total personnel required during the construction period, considering all tasks (actual personnel at any one time would be up to 824 if two contractors are working simultaneously).

Table 2-9. Estimated Personnel and Equipment for Substation Construction							
		500 kV Transmission Line (AC) (per substation)		500 kV Transmission Line (DC) (per substation)		Second 500 kV Transmission Line (AC) (per substation)	
Activity	Equipment Type	Quantity of Equipment	Quantity of Equipment	Personnel	Personnel	Quantity of Equipment	Personnel
Material Yard/ Receiving/ Distribution	¾-ton Pickup	2	2	3	3	2	3
	5-ton R/T Forklift	2	2			2	
	50-ton Crane	1	1			1	
	Tractor Trailer	1	1			1	
	30-ton Boom Truck	1	1			1	
Construction Staking	½-ton Pickup	1	1	2	2	1	2
Soil Borings	¾-ton Pickup	1	1	2	2	1	2
	Drill Rig	1	1			1	
Site Clearing and Grading	¾-ton Pickup	2	2	8	8	2	4
	F-350 Pickup	2	2			2	
	Cat D-6	2	2			2	
	Grader	2	2			2	
	Semi with Dump Trailer	4	4			4	
	Water Truck	1	1			1	
	Scrapers	1	1			1	
	Roller Compactors	2	2			2	
Foundations/ Raceway/Grounding	½-ton Pickup	3	2	10	10	2	10
	¾-ton Pickup	4	2			2	
	Drill Rig	1	1			1	
	Loader/ Backhoe	2	2			2	
	Boom Truck	1	1			1	
	Concrete Truck	1	1			1	
	Excavator	1	1			1	
	Dump Truck	2	2			2	
	5-ton R/T Forklift	1	1			1	
	Mini Excavator	2	2			2	

Table 2-9. Estimated Personnel and Equipment for Substation Construction							
		500 kV Transmission Line (AC) (per substation)		500 kV Transmission Line (DC) (per substation)		Second 500 kV Transmission Line (AC) (per substation)	
Activity	**Equipment Type**	**Quantity of Equipment**	**Quantity of Equipment**	**Personnel**	**Personnel**	**Quantity of Equipment**	**Personnel**
	Air Compressor	2	2			2	
	Trencher	2	2			2	
	Roller Compactor	2	2			2	
	Hand Compactor	3	3			3	
Structure and Equipment Installation	½-ton Pickup	4	4	10	10	4	10
	1-ton Line Truck	2	2			2	
	200-ton Crane	1	1			1	
	30-ton Boom Truck	4	4			4	
	Air Compressor	3	3			3	
	Man Lifts	4	4			4	
	50-ton Crane	2	2			2	
	Generator	2	2			2	
	5-ton R/T Forklift	4	4			4	
Wiring	½-ton Pickup	1	1	12	12	1	12
	1-ton Line Truck	1	1			1	
	Generator	2	2			2	
	5-ton R/T Forklift	1	1			1	
Testing and Cleanup	½-ton Pickup	2	2	5	5	2	5
	Bucket Truck/Boom w/Basket	2	2			2	
Contractor Management	½-ton Pickup	3	3	3	3	3	3
Total per substation			55		55		51
Total for Option A[1]			**220**				**204**
Total for Option B[1]			**220**		**110**		

[1] Maximum total personnel required during the construction period (actual personnel at any one time would be less), considering all tasks for construction of 4 AC substations (Option A) or 4 AC and 2 DC substations (Option B). Multiple crews may be required depending on schedule requirements.

Procedures for vegetation management and noxious weed treatment would be outlined in the Final POD. The need for vegetation management would be determined by regular inspection patrols according to NERC standards to prevent accidental grounding contact with conductors. Where necessary, maintenance crews would trim trees and other woody vegetation, and remove brush from the right-of-way. Vegetation management would occur periodically (every 2 to 5 years), generally in the summer and fall seasons. The Project right-of-way would not be chemically treated with pesticides or herbicides unless needed, and only upon prior approval of the land manager or owner. Chemical treatment generally would be limited only to areas with noxious weeds. The Applicant would comply with requirements of the land-managing agencies regarding management of noxious weeds (e.g., cleaning equipment to prevent spread of noxious weeds) along access roads, within the right-of-way, and at temporary use areas.

Inspection and maintenance of the communication regeneration site, including the building, communication facilities, and other physical equipment, would occur as needed. Maintenance of the communication facilities would consist of testing, repairing, and replacing electronic equipment located within the building at the regeneration site.

The substation yards would be maintained and inspected according to BMPs and the Applicant's standards.

2.4.11.2 Fire Protection and Emergency Response

Emergencies are any events requiring immediate response to a condition and may include fires, car-to-pole contacts, downed poles, transformer outages, and/or outages due to downed wire as a result of extreme weather. All applicable fire laws and regulations, including BLM fire safety standards, would be observed during construction and operation. A Fire Protection Plan would be provided in the Final POD. If extreme fire conditions were to occur, the BLM and other land management agency representatives would be contacted and access would be restricted. Maintenance personnel would coordinate with the agency representatives and implement practical measures to report, prevent, and suppress fires such as brush clearing, stationing a water truck at the job site to keep the ground vegetation moist in extreme fire conditions, enforcing red flag warnings, and providing "fire behavior" training to all pertinent personnel.

Responding crews would vary in number and equipment needs, depending on the size and severity of the emergency. Typically, a four-person crew with a line truck, aerial lift truck, and an assist truck would respond to the emergency to make repairs. Crews may be required to respond to an emergency in a remote area without roads. In areas without vehicle access, helicopters may be used to respond quickly to emergencies. Refueling of equipment and helicopter staging areas would be at nearby airports or staging areas on private property.

2.4.11.3 Decommissioning

The term of the BLM right-of-way grant to allow use of federal land would be limited to 50 years, although the useful life of the Project facilities is projected to be at least 50 years and up to 75 years. The transmission lines and associated facilities would be decommissioned at the end of the useful life of the Project if the facilities were no longer required (after 50 years, or longer with a new right-of-way grant or renewal). Subsequently, conductors, insulators, concrete pads,

and hardware would be dismantled and removed from the right-of-way. Tower and pole structures would be removed and foundations broken off at least 2 feet below ground surface. All areas of permanent disturbance would be restored in accordance with a Termination and Reclamation Plan approved by the BLM Authorized Officer.

2.4.12 Mitigation

Mitigation includes specific means, measures, or practices that would reduce or eliminate effects of the proposed action or alternatives. Mitigation may be used to reduce or avoid adverse impacts to environmental resources, whether or not they are significant in nature. Standard mitigation (ST) measures are those that apply to the Project as a whole. These measures typically address specific environmental policies, BMPs, planning guidelines, or regulatory requirements. Standard mitigation measures are listed in Table 2-10.

Selective mitigation (SE) measures (Table 2-11) were developed in collaboration with the BLM and cooperating agencies and include measures or techniques recommended or required by the agencies or landowners. As such, selective mitigation measures provide a planning tool for minimizing potential adverse impacts. Where warranted, selective mitigation measures are recommended to reduce potential impacts in specific locations. These measures would be modified as appropriate, to reduce impacts associated with specific resource concerns (e.g., cultural, biological, visual) associated with the selected route, and included prior to Project construction in the Final POD. Additional site-specific NEPA analysis would be completed as required (e.g., where construction of new access routes would be located outside of the proposed right-of-way). The construction contractor(s) would adhere to the measures identified during the engineering/design phase, as well as those measures that address construction and reclamation activities. The Compliance Inspection Contractor (CIC) would be responsible for the oversight of the implementation of these measures, to ensure that the Applicant and the construction contractor(s) meet the intent of the mitigation measures.

In addition to standard and selective mitigation measures, an alternative to constructing overhead transmission lines to cross the Rio Grande floodplain is evaluated in Chapter 4, Section 4.16 – Effects of the Underground Mitigation Alternative. The results of the evaluation indicated that burial of the transmission line across the Rio Grande would not be a feasible alternative. An underground transmission line would pose greater operational risks and maintenance concerns, as well as permanent impacts to riparian and aquatic habitats.

In compliance with Section 7 of the ESA, mitigation to address the loss of critical habitat would be implemented. Such mitigation measures may include on-site or off-site compensation or habitat replacement, to be specified by the USFWS in the Biological Opinion. The USACE would also participate in this mitigation plan as required under Section 404 of the CWA, to address the potential loss of wetlands or riparian resources.

To address potential impacts to migratory birds, and in compliance with the Migratory Bird Treaty Act (MBTA), EO 13186, and the Bald and Golden Eagle Protection Act (BGEPA), mitigation measures have been prescribed in this EIS. Among others, standard mitigation measures include preconstruction surveys (ST 25, Table 2-10), and selective measures include installing bird diverters to increase visibility of wires (SE 15, Table 2-11).

As discussed in Section 2.3.3.2, Alternative Transmission Technologies, undergrounding the entire length or portions of the Project is considered to be technically infeasible; however, the BLM, DOD, and the Applicant continue to review the feasibility of underground transmission systems and other possible measures to address potential impacts related to the construction and operation of the SunZia Project. Additional discussions relate to indemnification and operational procedures to respond to concerns identified by the WSMR. In the event that further discussions between the BLM, DOD, and the Applicant lead to additional information pertinent to the Project analysis, these issues would be addressed consistent with NEPA's requirements before the BLM issues a final decision.

Additional mitigation measures to reduce the potential for avian collisions would be specified in detail in the Final POD, and associated Avian Protection Plan and conservation strategy as approved by the USFWS, to be implemented during construction and operation of the Project. The USFWS would participate in the mitigation planning process to facilitate the eventual approval of the Avian Protection Plan, which would identify certain measures that may include, but would not be limited to, the following:

- Applying special structural design to decrease the heights of groundwires and conductors
- Marking wires (bird diverters) and/or using special structure design to increase visibility to birds
- Monitoring to ensure that mitigation measures are implemented
- Conducting additional avian studies, surveys, and/or monitoring to record the presence of birds and incidence of avian collisions, and provide data that could be useful to minimize the potential for collisions with the Project, as well as with existing and future power lines in other locations
- Conducting habitat equivalency, or resource equivalency, analyses for calculating in-kind replacement of lost ecological functions and values (services), as determined applicable, in order to improve the breeding productivity of migratory birds

Table 2-10. Standard Mitigation Measures

Standard mitigation measures are part of the Project description; they are applied to all alternatives considered in the impact assessment.

	Mitigation Measure	Mitigation Application Phase		
		Engineering, Design, and Location	Construction	Operations
1	Prior to construction, a detailed POD will be developed to further describe Project features, selective mitigation, and procedures. At a minimum, the POD will address Project design, construction and operation considerations, biological considerations (including noxious weed management), cultural resources, paleontological considerations, hazardous materials management, and reclamation considerations.	●	●	●
2	All vehicle movement outside the right-of-way would typically be restricted to designated access, contractor acquired access,	●	●	●

Table 2-10. Standard Mitigation Measures				
Standard mitigation measures are part of the Project description; they are applied to all alternatives considered in the impact assessment.				
		Mitigation Application Phase		
	Mitigation Measure	**Engineering, Design, and Location**	**Construction**	**Operations**
	or public roads.			
3	The boundary of construction activities would typically be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits.		●	
4	The alignment of any new access roads or overland route would follow the designated area's landform contours where possible, provided that such alignment does not additionally impact resource values. This would minimize ground disturbance and/or reduce scarring (visual contrast).	●	●	
5	In construction areas where grading is not required, vegetation would be left in place wherever possible, and original contour would be maintained to avoid excessive root damage and allow for regrowth. All existing roads would be left in a condition equal to or better than their condition prior to the construction of the transmission lines, as determined by the appropriate land-managing agency.	●	●	
6	To limit new disturbance, existing access roads in the Project area would be used to the extent practicable, provided that doing so does not additionally impact resource values.	●	●	●
7	Construction holes left open overnight would be appropriately fenced or covered to prevent damage to wildlife or livestock.		●	
8	In construction areas (e.g., marshalling yards, structure sites, spur roads from existing access roads) where grading is required, surface restoration would be implemented as required by the landowner or BLM Authorized Officer. The method of restoration would normally consist of returning disturbed areas back to their natural contour, reseeding (where required), cross drains installed for erosion control, placing water bars in the road, and filling ditches.		●	
9	Watering facilities (e.g., tanks, developed springs, water lines, wells, etc.) would be repaired or replaced if they are damaged or destroyed by construction activities to their predisturbed condition, as required by the landowner or land management agency. Temporary watering facilities would be provided for wildlife and livestock until permanent repair or replacement is complete.		●	

Table 2-10. Standard Mitigation Measures

Standard mitigation measures are part of the Project description; they are applied to all alternatives considered in the impact assessment.

	Mitigation Measure	Mitigation Application Phase		
		Engineering, Design, and Location	Construction	Operations
10	Nonspecular conductors would be used, where specified by the BLM Authorized Officer, to reduce visual impacts.	●	●	
11	"Dulled" metal or self-weathering finish structures would be used to reduce visual impacts, if specified by the BLM Authorized Officer.	●	●	
12	Structures and/or groundwire would be marked with high-visibility devices where required by government agencies (e.g., FAA).	●	●	●
13	On agricultural land, right-of-way would be aligned, in so far as practicable, to reduce the impact to farm operations and agricultural production.	●		
14	Prior to construction, all supervisory construction personnel would be instructed on the protection of cultural and ecological resources. The training program outlined in the HPTP would be implemented. To assist in this effort, the construction CIC or a resource specialist would address: (a) federal and state laws regarding antiquities and plants and wildlife, including collection and removal; (b) the importance of these resources and the purpose and necessity of protecting them.	●	●	
15	Cultural resources would continue to be considered during post-EIS phases of Project implementation, in accordance with a PA executed for the Project. This would involve efforts such as intensive surveys, documentary and archival research, and/or visual modeling to inventory and evaluate potential impacts to historic properties within the areas of potential effect, as identified in the PA (direct and indirect). This would also require preparation and approval of a cultural resource inventory report, and the preparation and implementation of an approved HPTP to avoid, minimize, or mitigate adverse effects, as appropriate to each historic property.	●	●	●
16	Project Owners would respond to complaints of line-generated radio or television interference by investigating the complaints and implementing appropriate mitigation measures. The transmission line would be evaluated on a regular basis so that damaged insulators or other line materials that could cause interference are repaired or replaced.			●
17	Project Owners would apply necessary mitigation to eliminate problems of induced currents and voltages onto conductive objects sharing right-of-way, to the mutual satisfaction of the parties involved.	●	●	●

Table 2-10. Standard Mitigation Measures

Standard mitigation measures are part of the Project description; they are applied to all alternatives considered in the impact assessment.

	Mitigation Measure	Mitigation Application Phase		
		Engineering, Design, and Location	Construction	Operations
18	Roads would be built as near as possible at right angles to the streams and washes. Culverts or temporary bridges would be installed where necessary. All construction and operations activities shall be conducted in a manner that would minimize disturbance to vegetation, drainage channels, and intermittent or perennial stream banks.	●	●	●
19	To the extent practicable, structures would be sited with a minimum distance of 200 feet from stream banks.	●		
20	All requirements of those entities having jurisdiction over air quality matters would be adhered to, any necessary dust control plans would be developed, and permits for construction activities would be obtained. Open burning of construction trash would not be allowed unless permitted by appropriate authorities.		●	
21	Fences and gates would be repaired or replaced to their original, predisturbed condition, as required by the landowner or the BLM Authorized Officer if they are damaged or destroyed by construction activities. New temporary and/or permanent gates would be installed only with the permission of the landowner or the BLM. Temporary gates not required for postconstruction access control (see SE 6) would be removed following construction completion, and the area restored in accordance with the POD (see ST 1).		●	●
22	Transmission line materials would be designed and tested to minimize corona. Bundle configuration and larger diameter conductors would be used to limit the audible noise, radio interference, and television interference due to corona. Tension would be maintained on all insulator assemblies to ensure positive contact between insulators, avoiding sparking. Caution would be exercised during construction and operations to avoid scratching or nicking the conductor surface, which may provide points for corona to occur.	●	●	●
23	During operation of the transmission lines, the right-of-way would be maintained free of nonbiodegradable debris. Slash would be left in place or disposed of in accordance with requirements of the land owner or management agency.		●	●
24	In consultation with appropriate land-management agencies, specific mitigation measures for paleontological resources would be developed and implemented to mitigate any identified adverse impacts. These measures would include: preparation of a PRMP; paleontological surveys; personnel education; monitoring ground disturbance for fossils; curation of fossils; and deposition of fossils in a paleontological repository.	●	●	

Table 2-10. Standard Mitigation Measures

Standard mitigation measures are part of the Project description; they are applied to all alternatives considered in the impact assessment.

	Mitigation Measure	Mitigation Application Phase		
		Engineering, Design, and Location	Construction	Operations
25	Preconstruction surveys for species listed under the ESA or specified by the appropriate land management agency as sensitive or of concern would be conducted in areas of known occurrence or suitable habitat. Timing of the surveys would be determined by species, coordinated with agency wildlife biologists, and completed prior to construction. Monitoring of construction activities would be required in some areas to ensure that effects to these species are avoided during construction. If Bald Eagle or Golden Eagle nests are identified during preconstruction surveys, seasonal restrictions on construction within a specified buffer would be implemented in coordination with the USFWS and/or species survey protocols, as appropriate, and comply with the BGEPA. Preconstruction nesting-season surveys for migratory birds, and surveys for Burrowing Owls in suitable habitat, would be conducted as needed to comply with the MBTA.	●	●	●
26	Preconstruction native plant inventories and surveys for noxious weed species as stipulated by the appropriate land-administering agency would also be conducted once transmission line centerline, access roads, and tower sites have been located.	●	●	
27	Surveys for bat roosts would be conducted within ¼ mile of the Project right-of-way in areas that potentially contain caves, karst features, or mines. Occupied bat roosts would be avoided.	●	●	
28	Paniculate agave plants (*Agave palmeri, A. parryi,* and *A. chrysantha*) and saguaro cacti (*Carnegiea gigantea*) within the known range of the Lesser Long-nosed Bat or Cactus Ferruginous Pygmy-owl would be avoided or salvaged for replanting within the right-of-way or suitable adjacent habitat. Only agaves not possessing flower stalks would be salvaged, and only saguaros of transplantable size (15 feet or less in height) would be salvaged.	●	●	
29	Electrical facility design would be in accordance with "Suggested Practices for Raptor Protection on Power Lines" (Avian Power Line Interaction Committee 2012).	●		

HPTP – Historic Properties Treatment Plan
PRMP – Paleontological Resources Monitoring Plan

This page intentionally left blank.

Table 2-11. SunZia Selective Mitigation Measures

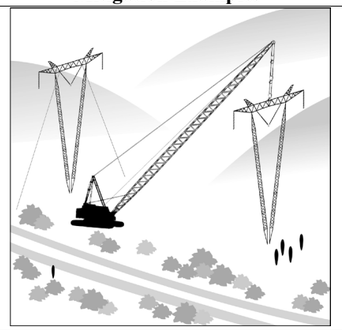
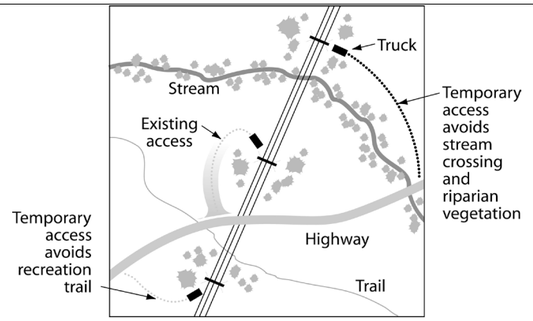
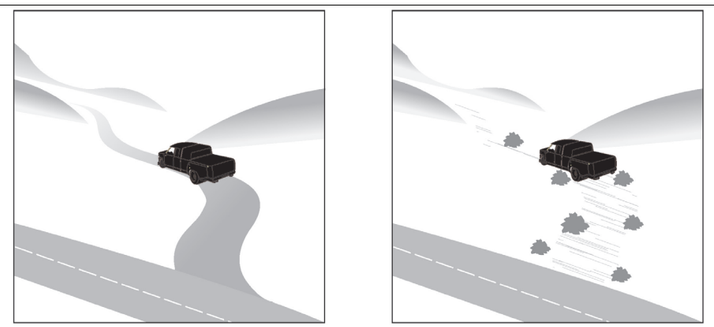
Mitigation Measure	Mitigation Examples	Mitigation Application Phase			Mitigation Effectiveness								
		Engineering, Design, and Location	Construction	Operations	Water Resources: Streams/ Washes	Water Resources: Wetlands/ Springs	Earth Resources: Geology/ Soils	Earth Resources: Paleontology	Biological Resources: Sensitive Wildlife Species	Biological Resources: Sensitive Plant Species	Land Use	Visual Resources	Cultural Resources
1. No widening or upgrading of existing access roads would be undertaken in the area of construction and operations, except for repairs necessary to make roads passable, where soils and vegetation are very sensitive to disturbance, or where existing archaeological sites are present.		●	●	●	●	●	●			●	●	●	●
		Avoiding unnecessary access road upgrades would limit the amount of habitat disturbed or removed. In addition, the avoidance of road upgrades would minimize increases to vehicular traffic, thereby reducing the potential for indirect effects such as damage or loss of vegetation, spread of noxious weeds, harassment of wildlife, vandalism of cultural resources, and disturbance to sensitive land uses (e.g., parks, preservation, and recreation areas).											
2. There would be no blading of new access roads in select areas of construction and operations. Existing crossings would be utilized at perennial streams, designated recreational trails, and irrigation channels. Off-road or cross-country access routes would be used for construction and maintenance in select areas. This would minimize ground disturbance impacts. These access routes must be flagged with an easily seen marker, and the route must be approved in advance of use by the BLM Authorized Officer or landowner.		●	●		●	●	●		●	●	●	●	●
		Selective Mitigation Measure 2 is effective for the same reasons as Selective Mitigation Measure 1. Minimizing ground-disturbing construction activities in the same vicinity as streams would limit disturbance to riparian areas and/or streambeds, thereby avoiding turbidity and sedimentation. In addition, it would limit land use conflicts with trails and/or disruption of sensitive views.											
3. Overland access (i.e., drive-and-crush or cut-and-clear) would be used to the greatest extent possible in areas where no grading would be needed to access work areas. Drive-and-crush is vehicular travel to access a site without significantly modifying the landscape. Vegetation is crushed, but not cropped. Soil is compacted, but no surface soil is removed. Cut-and-clear is considered as brushing off (removal) of all vegetation to improve or provide suitable access for equipment. All vegetation is removed using above-ground cutting methods that leave the root crown intact.		●	●	●	●	●	●		●	●	●	●	
		Overland access would avoid or minimize the removal of surface soil and vegetation, reducing the potential for erosion and loss of habitat. In addition, avoiding the construction of a new road would reduce the potential for increased traffic and the associated indirect effects.											

Table 2-11. SunZia Selective Mitigation Measures

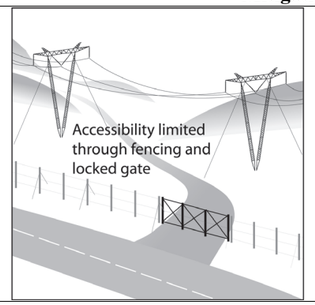
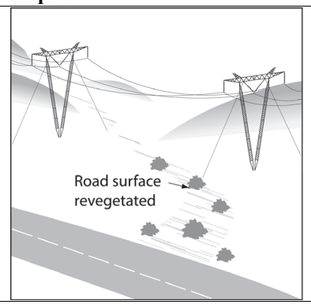
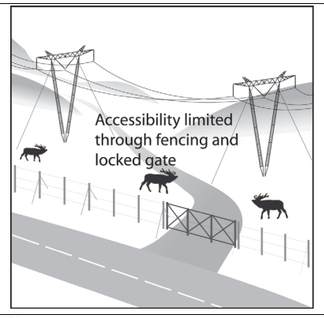
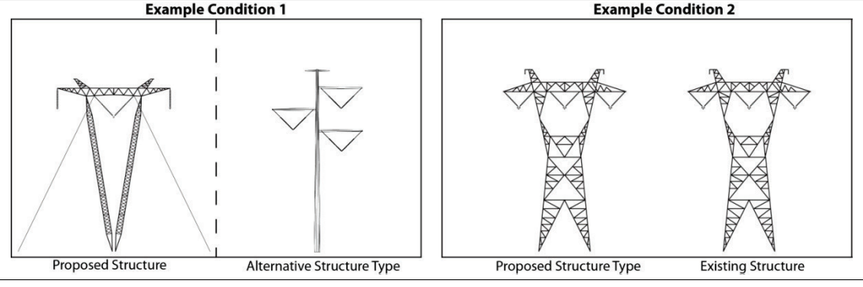
Mitigation Measure	Mitigation Examples	Mitigation Application Phase			Mitigation Effectiveness								
		Engineering, Design, and Location	Construction	Operations	Water Resources: Streams/ Washes	Water Resources: Wetlands/ Springs	Earth Resources: Geology/ Soils	Earth Resources: Paleontology	Biological Resources: Sensitive Wildlife Species	Biological Resources: Sensitive Plant Species	Land Use	Visual Resources	Cultural Resources
4. All new access roads not required for maintenance would be permanently closed using the most effective and least environmentally damaging methods appropriate to that area (e.g., stock piling and replacing topsoil, or rock replacement), with concurrence of the landowner or appropriate land management agency. This would limit new or improved accessibility into the area.	 		●	●	●	●	●		●	●	●	●	●
					Closing access roads where they are not needed after construction protects the resources in that area from further disturbance for reasons described in SE 1.								
5. In addition to standard reseeding and recontouring practices (see ST 8), a detailed Project reclamation plan would be developed to mitigate site-specific resource impacts.			●	●	●	●	●		●	●	●	●	
6. To minimize disturbance to sensitive habitats or resources, access roads required for operations purposes would be gated or otherwise blocked from public access. Fences would meet BLM or other applicable agency/owner specifications.			●	●					●	●	●		●
					Limiting access to sensitive areas would reduce the potential for indirect effects associated with increased traffic.								
7. Modified tower design or alternate tower type would be used to minimize ground disturbance, operational conflicts, visual contrast, and/or avian conflicts.		●	●	●					●		●	●	
					Flexibility in designing the tower or use of different tower types would allow tower structures to be adapted to specific site situations (i.e., Condition 1 – New Route, Condition 2 – Existing Corridor). For example, in areas where there are sensitive views and an existing transmission line, structures used for the Project would match the existing structures, minimizing visual contrast. Structures with perching opportunities for aerial predators where sensitive grassland species occur may be used.								

Table 2-11. SunZia Selective Mitigation Measures

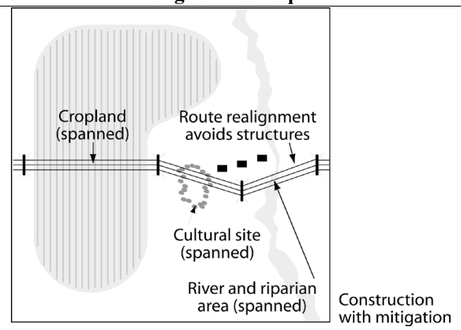
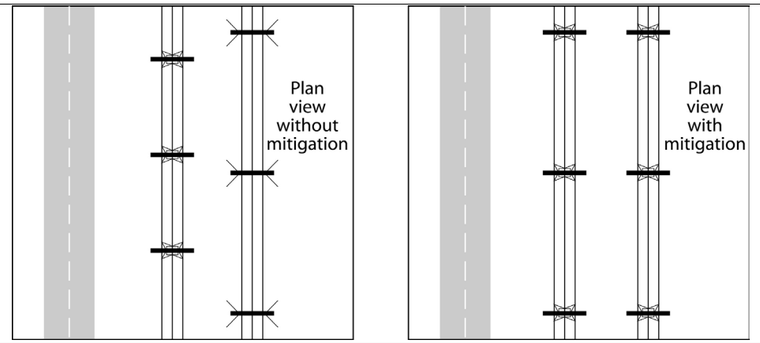
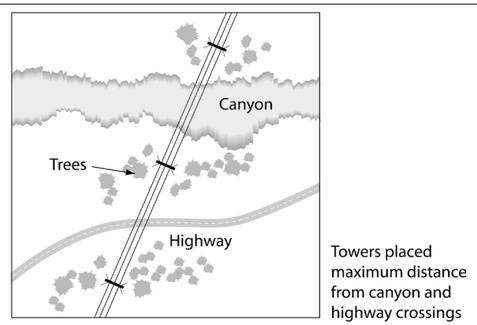
Mitigation Measure	Mitigation Examples	Mitigation Application Phase			Mitigation Effectiveness								
		Engineering, Design, and Location	Construction	Operations	Water Resources: Streams/ Washes	Water Resources: Wetlands/ Springs	Earth Resources: Geology/ Soils	Earth Resources: Paleontology	Biological Resources: Sensitive Wildlife Species	Biological Resources: Sensitive Plant Species	Land Use	Visual Resources	Cultural Resources
8. In designated areas, structures would be placed so as to avoid, and/or to allow conductors to span sensitive features such as riparian areas, water courses, roads, trails, bat roosts, and cultural sites within limits of standard tower design. This would minimize the amount of sensitive features disturbed and/or reduce visual contrast.		●			●	●	●		●	●	●	●	●
					Flexibility in the placement of structures allows for sensitive features to be avoided. Realigning the structures along a route or realigning the route can result in avoiding or minimizing direct impacts on resources, such as cultural and biological, as well as land uses such as agriculture, parks, preservation, hazardous substance remediation, and recreation areas.								
9. Standard tower design would be modified to correspond with spacing of existing transmission line structures where feasible, and within limits of standard tower design. The typical span would be modified to correspond with existing structures, but not necessarily at every location. This would reduce visual contrast and/or potential operational conflicts.		●							●		●	●	●
					Matching tower spacing with existing parallel lines reduces the visual space occupied by the structures and minimizes the amount of contrast between the man-made structures and the landscape.								
10. At highway, canyon, and trail crossings, structures are to be placed at the maximum distance practicable from the crossing to reduce visual impacts.		●									●	●	●
					Placing structures at a maximum distance from major or sensitive crossings (i.e., roads and trails) would reduce visual impacts and potential safety hazards (i.e., vehicle collision with tower).								

Table 2-11. SunZia Selective Mitigation Measures

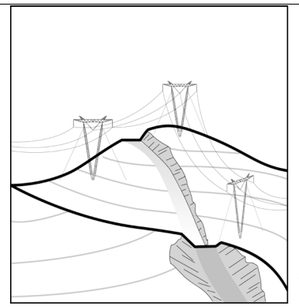
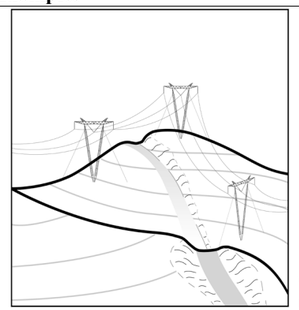
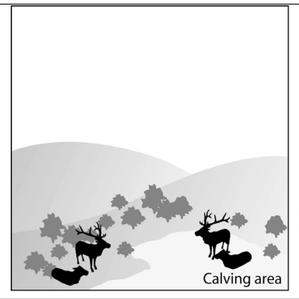
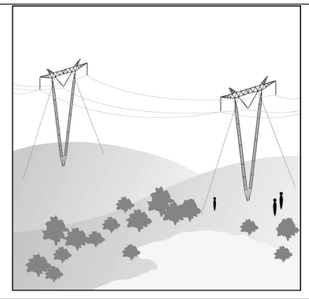
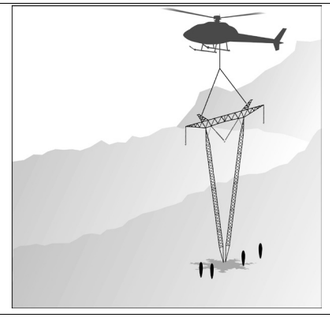
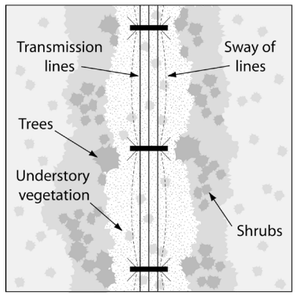
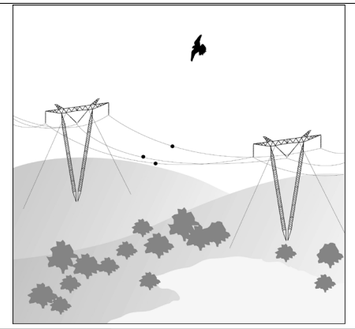
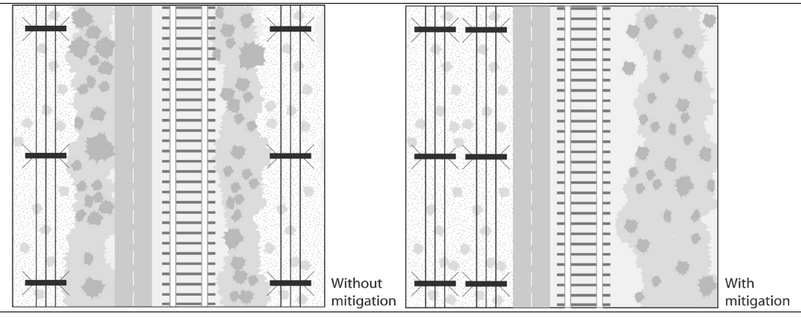
Mitigation Measure	Mitigation Examples	Mitigation Application Phase: Engineering, Design, and Location	Mitigation Application Phase: Construction	Mitigation Application Phase: Operations	Mitigation Effectiveness: Water Resources: Streams/Washes	Water Resources: Wetlands/Springs	Earth Resources: Geology/Soils	Earth Resources: Paleontology	Biological Resources: Sensitive Wildlife Species	Biological Resources: Sensitive Plant Species	Land Use	Visual Resources	Cultural Resources
11. To reduce visual contrast, mineral or asphalt emulsions (e.g., Permeon™ or approved equivalent) would be applied in rocky areas where newly exposed rock color would create strong landscape contrasts.	 Without mitigation  With mitigation	●	●									●	●
The implementation of mineral or asphalt emulsions (e.g., Permeon™ or approved equivalent) would reduce the visual contrast between exposed ground and the surrounding environment. The application of this mitigation would be determined in the field, during or after construction, by the CIC and Authorized Officers.													
12. With the exception of emergency repair situations, right-of-way construction, restoration, maintenance, and termination activities in designated areas would be modified or discontinued during sensitive periods (e.g., nesting and breeding periods) for candidate, proposed threatened and endangered, or other sensitive animal species. Sensitive periods, species affected, and areas of concern would be approved in advance of construction or operations by the BLM Authorized Officer.	 Calving area Construction activities suspended during sensitive breeding periods  Construction activities resumed following calving period		●	●				●				
Restricting construction activities or maintenance during breeding or nesting periods eliminates potential disturbance of wildlife during these critical periods of their life cycles.													
13. Helicopter placement of structures may be used to reduce ground disturbance (e.g., to minimize soil erosion, vegetation loss, and visual impacts) caused by permanent access road construction.			●				●	●	●	●	●	●	●
Using helicopters to place structures in steep terrain or otherwise sensitive areas reduces land use and natural resource impacts that would otherwise result from ground-disturbing activities. The decrease of ground disturbance would reduce the loss of vegetation, soil erosion, potential damage to cultural resources, and visual impacts.													

Table 2-11. SunZia Selective Mitigation Measures

Mitigation Measure	Mitigation Examples	Mitigation Application Phase: Engineering, Design, and Location	Mitigation Application Phase: Construction	Mitigation Application Phase: Operations	Mitigation Effectiveness: Water Resources: Streams/ Washes	Water Resources: Wetlands/ Springs	Earth Resources: Geology/ Soils	Earth Resources: Paleontology	Biological Resources: Sensitive Wildlife Species	Biological Resources: Sensitive Plant Species	Land Use	Visual Resources	Cultural Resources
14. To minimize disturbance to riparian vegetation and woodlands, and to reduce visual contrast, clearing of trees in and adjacent to the right-of-way would be minimized to the extent practicable to satisfy conductor-clearance requirements (NESC and up to 10 years of timber growth). Trees and other vegetation would be removed selectively (e.g., edge feathering) to blend the edge of the right-of-way into adjacent vegetation patterns, as practicable and appropriate.	 Clearing of trees minimized		●						●		●	●	
					Selectively removing vegetation (i.e., trees) within and along the edges of the right-of-way reduces disruption of habitat, minimizes removal of timber resources, and reduces the visual contrast between the right-of-way and the surrounding environment. Furthermore, "feathering" the edges of the right-of-way instead of cutting trees and vegetation in a straight line results in a more gradual modification to the environment.									
15. To minimize bird collisions, bird diverters would be installed and maintained on groundwires, transmission lines, and/or guywires in areas of heavy bird use (i.e., Rio Grande and other riparian corridors). Groundwires would be replaced with one-inch diameter OPGWs to increase visibility where practicable and appropriate.			●	●					●				
					Conductor, groundwire or guywire markings on segments of the transmission lines that cross through, or are adjacent to, heavy bird migration corridors and/or habitat would minimize the risk of avian collision.									
16. To reduce ground disturbance and visual contrast, the separation between the transmission lines and existing utilities, roads, or railroads would be minimized to the extent practicable.		●							●		●	●	
					Consolidating the transmission lines with existing facilities such as roads, railroads, or other utilities (e.g., transmission lines, distribution lines, pipelines, etc.) would typically minimize ground disturbance, habitat fragmentation, and visual contrast. Furthermore, locating the transmission lines within designated utility corridors (where established) minimizes potential land use conflicts and other resource impacts.									

This page intentionally left blank.

2.5 COMPARISON OF ALTERNATIVES

This section of the document provides a detailed comparative analysis of each alternative. The Project alternatives have been divided into three route groups:

- Route Group 1: SunZia East Substation to Midpoint Substation (New Mexico)
  BLM Preferred Alternative: Subroute 1A2
- Route Group 3: Midpoint Substation to Willow-500 kV Substation (New Mexico and Arizona)
  BLM Preferred Alternative: Subroute 3A2
- Route Group 4: Willow-500 kV Substation to Pinal Central Substation (Arizona)
  BLM Preferred Alternative: Subroute 4C2c

Each route group is composed of individual alternative subroutes (Route Group 2 was eliminated from detailed analysis, as described in Section 2.3.3.1). Table 2-12 includes a comparison of land ownership, existing utility corridors, and potential temporary and permanent ground disturbance associated with each of the subroutes; Table 2-13, Table 2-14, and Table 2-15 include the comparison of resource impacts for alternative subroutes; and Figure 2-33, Figure 2-34, and Figure 2-35 illustrate the locations of key issue areas and alternatives.

The alternative subroutes within each route group are compared with respect to resource issues and impacts; the detailed analysis is described in Chapter 4 of this EIS. BLM VRM compliance and land use conformance, in addition to agency comments, have been considered in the comparison of alternatives. As stated in Section 2.6, the BLM preferred alternative would include amendments to RMPs for conformance with VRM and right-of-way management objectives. Land use plan amendments that may be required for the grant of right-of-way in order to conform to RMP management objectives have been identified.

2.5.1 Route Group 1: SunZia East Substation to Midpoint Substation

Each of the alternatives within Route Group 1 heads west or southwest from the proposed SunZia East Substation in Lincoln County, and crosses the Rio Grande before heading south to the Midpoint Substation near Deming, in Luna County. Subroutes 1A, 1A1, and 1A2 cross the Rio Grande at the north river crossing near Socorro, and the 1B subroutes (1B1, 1B2, 1B2a, and 1B3) cross the Rio Grande approximately 5 miles north of the Bosque del Apache NWR in the vicinity of San Antonio, New Mexico. Subroute 1A2 is the longest of Route Group 1 at 230.3 miles, and Subroute 1B3 the shortest at 206.3 miles.

Subroute 1A crosses approximately 104.9 miles of BLM land, with the remainder crossing state and private or other lands. The proposed Project right-of-way along Subroute 1A would be located adjacent to 93.7 miles of existing transmission lines; including portions of the DOE West-wide Energy Corridor following existing 345 kV and 115 kV lines in Socorro and Sierra counties. Subroute 1A is also adjacent to 10.0 miles of existing pipelines.

Subroutes 1A1 and 1A2 were identified as alternatives to Subroute 1A in order to avoid potential impacts to the viewshed south of Gran Quivira. A modification of the Subroute 1A1 alignment, identified as Subroute 1A2, was developed after the Draft EIS was published based on input from cooperating agencies (including the NPS and WSMR) to mitigate impacts to visual resources and military operations. Segments of subroutes 1A1 and 1A2, northwest of the proposed SunZia East Substation, are located approximately 4 miles north of Gran Quivira (links E84a, E84b, and E86a, in Torrance County); compared to Subroute 1A, which would include a segment located approximately 6 miles south (Link E80c, in Socorro County). Gran Quivira is an important cultural resource site associated with surrounding views of the landscape (see sections 3.8.4 and 4.9.3.1). The location of Subroute 1A1 to the north would be effective in reducing potential impacts to the Gran Quivira viewshed, as well as reducing potential conflicts with the military test profiles. Subroute 1A2 was added because it would further reduce impacts to the Gran Quivira viewshed and military testing, compared to Subroute 1A1. Two local alternative segments were also considered at intermediate locations between the northern (1A1 and 1A2) and southern (1A) alternatives, which would have greater levels of visual impact than Subroute 1A2 in this area. Subroute 1A2 falls within the existing study corridor that was developed for Subroute 1A1 in the Draft EIS, and the effects of the modified proposed action that have been documented in this Final EIS are within the range of effects analyzed in the Draft EIS. Therefore, the modification of the alternative route (from Subroute 1A1 to Subroute 1A2) is not a substantial change.

Subroute 1B1 heads west before turning south near the Sevilleta NWR and crossing the Rio Grande north of San Antonio. Subroute 1B2 takes a more southerly route before using the same San Antonio crossing as 1B1. Subroute 1B3 uses a route farther south than 1B2 (links A40, A41, and A80), before crossing the Rio Grande north of San Antonio and proceeding south to the Midpoint Substation.

Biological resource impacts in Route Group 1 would be associated with proposed transmission lines crossing the Rio Grande, as this area is an important migratory corridor for Sandhill Cranes, geese and other waterfowl, and numerous passerines. The Rio Grande corridor also contains critical habitat for the endangered Southwestern Willow Flycatcher and Rio Grande Silvery Minnow. A concern voiced by the USFWS Bosque del Apache NWR management, members of conservation groups, and bird watching enthusiasts, was that transmission lines may increase the risk of bird–power line collisions and avian mortality. Field studies were conducted to estimate the potential for avian collisions, which concluded that the potential for avian collisions with overhead transmission lines could be mitigated by increasing the visibility of the lines using diverters and OPGW. The potential for avian collisions would be comparable at either of the Rio Grande crossing alternatives, because the conditions at the north river crossing would be similar to the conditions at the San Antonio crossing. Removal of riparian vegetation may affect the critical habitat for Southwestern Willow Flycatcher, although the impacts would be greater at the San Antonio alternative crossing (1B subroutes) where there is a somewhat larger area of better quality habitat than at the northern Rio Grande crossing for Subroute 1A, 1A1, or 1A2.

Residential uses are concentrated near the Rio Grande and would not be directly affected by any of the alternatives; however, high visual impacts are expected for residences in the Socorro area for Subroute 1A, 1A1, or 1A2, and high visual impacts for residences in the San Antonio area would result for the 1B subroutes. All of the subroutes within Route Group 1 cross similar

amounts of Class A and B scenery, particularly at river crossing areas (see Section 3.9.1.2 for a definition of scenery classifications, and Section 4.9.2.1 for impacts and assessment techniques). Visual impacts to recreation and travel viewers would be lower for the 1B subroutes, compared to Subroute 1A, 1A1, or 1A2.

Portions of each of the alternatives in Route Group 1 do not conform to the Socorro, White Sands, or Mimbres RMP where the RMP objectives indicate right-of-way avoidance or VRM Class II or Class III areas. Subroute 1A2 crosses 21.3 miles of BLM right-of-way avoidance areas in three locations. The same areas would be indicated for Subroute 1A. The 1B subroutes cross between 10.9 miles and 13.9 miles of avoidance areas. Up to 14.1 miles of Subroute 1A2 do not conform to VRM objectives, somewhat more than the nonconforming portions of any of the 1B subroutes (up to 5.3 miles). The proposed RMP amendments would include a 400-foot-wide corridor to conform to the RMPs, subject to the BLM field office or district office decisions.

Overall, Subroute 1A, 1A1, or 1A2 would have potentially lower levels of impact to known cultural resources than the 1B subroutes. All subroutes in Route Group 1 are expected to have minimal impacts on population and housing, and would provide equivalent levels of employment and tax revenues. Subroutes 1A, 1A1, and 1A2 would have a low to moderate potential for affecting environmental justice populations (Socorro and Escondida communities), while the 1B subroutes could have slightly greater impacts (San Antonio community). All routes are expected to have low impacts with respect to climate and air quality, noise, public safety, hazardous materials, and cumulative effects.

Subroutes 1A1 and 1A2 also include a segment that crosses the I-25 from Socorro County into Sierra County, from the northwest to the southeast (Link A260). In comparison, subroutes 1A, 1B1, 1B2, and 1B3 include a segment located west of I-25 (Link A270) in that area. Although this particular segment of subroutes 1A1 and 1A2 would require two separate crossings over I-25, the visual impact would be lower for the segment because it would follow a 115 kV transmission line, compared to the segment west of I-25 that would require new access and be visible from the highway.

New access roads for the transmission lines would account for the majority of the ground-disturbing activities. The amount of ground disturbance is directly related to the length of any of the transmission line routes; permanent disturbance is estimated to be up to 5.5 acres per mile. The construction of new access roads and other areas could result in potential soil erosion/sedimentation to the Rio Grande and associated habitat, or to other drainage crossings. Such impacts would not be significant with regard to any of the alternatives, with the application of standard mitigation (e.g., BMPs and design to minimize vegetation loss). Because subroutes 1A, 1A1 and 1A2 would each be approximately 10 percent longer than the shortest of the alternatives in this group (Subroute 1B3), it is expected that the temporary and permanent ground disturbance would also be 10 percent greater.

2.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Route Group 3 consists of subroutes 3A, 3A2, and 3B. While Subroute 3B takes a southern route near the communities of Deming, Lordsburg, and San Simon, Subroute 3A diverges north and

avoids potential impacts to those communities. Subroute 3A2 includes the majority of Subroute 3A, with a slight deviation to avoid the Hot Well Dunes Recreation Area, and terminates at the Willow-500 kV Substation.

Subroute 3A2 is approximately 123.9 miles in length and extends across 61.6 miles of BLM land and 50.8 miles of state land. At 128.6 miles, Subroute 3B is approximately 5 miles longer than Subroute 3A and extends along portions of an existing pipeline corridor between Deming, Lordsburg, and San Simon. Subroute 3B contains 56 miles of BLM land, while Subroute 3A has 58.1 miles of BLM land. The remaining lands are held by the state of New Mexico, the state of Arizona, or private landowners, with the DOD holding 0.3 mile of the Subroute 3B alignment.

Subroutes 3A and 3A2 cross 0.3 mile of a BLM right-of-way avoidance area, and Subroute 3B crosses 1.9 miles of avoidance areas in five locations. None of the subroutes in Route Group 3 would cause any direct residential conflicts. Regarding visual resources, Subroute 3B crosses more Class B scenery than Subroute 3A. Subroute 3A avoids visual impacts to residences near Deming, Lordsburg, and San Simon, whereas Subroute 3B has high to moderate-high visual impacts to these residential viewers. Subroute 3A2 would have similar visual impacts as Subroute 3A.

Subroute 3B parallels 24.1 miles of existing transmission lines and 74.2 miles of existing pipelines; Subroute 3A parallels 42.4 miles of transmission lines and 27.0 miles pipelines; and Subroute 3A2 parallels approximately 27 miles of existing pipelines and 42.4 miles of existing transmission lines. Due to the limited use of existing access, the amount of ground disturbance on subroutes 3A and 3A2 (5.4 acres per mile, 665 to 669 total acres respectively) would be greater than the amount on Subroute 3B (5.0 acres per mile total of 638 acres). However, Subroute 3B crosses the Lordsburg Playa where there is a high potential for soil erosion.

Subroute 3B would impact sensitive plants and invertebrates at the Lordsburg Playa. Arizona portions of Subroute 3B would have less impact than 3A or 3A2 to potential Chihuahua scurfpea habitat. Subroute 3B would have potentially lower impacts to cultural resources. In terms of socioeconomics, all of the subroutes are expected to have minimal impacts on population and housing. Subroute 3B could have potential environmental justice impacts in the vicinity of Deming and Lordsburg, New Mexico. No environmental justice effects are anticipated for subroutes 3A and 3A2.

Another important issue associated with this group of alternatives is the Hot Well Dunes Recreation Area, used primarily for off-highway vehicle (OHV) recreation and camping. Subroute 3A2 was added as a modification of Subroute 3A as it would avoid potential impacts to the Hotwell Dunes Recreation Area. In addition, all of the Route Group 3 subroutes cross the Continental Divide National Scenic Trail (CDNST), which is important for recreational and visual resource site. Notable historic sites within the Route Group 3 corridors include the Gila, Butterfield, and Janos Copper trails and the Shakespeare ghost town, south of Lordsburg.

Although subroutes 3A and 3A2 would require a greater amount of new access, Subroute 3B would have higher levels of visual impact where it crosses the Lordsburg Playa, as well as higher levels of impacts to residential viewers and VRM Class II areas southwest of Lordsburg.

Subroute 3B would also have higher visual resource impacts in the vicinity of San Simon, as well as impacts to wilderness characteristics of the Peloncillo Wilderness.

2.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Route Group 4 consists of subroutes 4A, 4B, 4C1, 4C2, 4C2a, 4C2b, 4C2c, and 4C3. Subroute 4A is located north of Mount Graham, while Subroute 4B is located in the Sulphur Springs Valley south and west of Mount Graham; the remaining subroutes are located in or near the San Pedro River Valley. Subroute 4C1 is east of the San Pedro River; subroutes 4C2, 4C2a, 4C2b, and 4C2c are located west of the San Pedro River; and Subroute 4C3 crosses the San Pedro River before following it through south and west Tucson. All subroutes end at the Pinal Central Substation site near Eloy, Arizona.

Subroutes 4A and 4B are similar in length, at 132.9 miles and 133.0 miles respectively. Subroute 4C1 is 139.0 miles long, 4C2 is 151.8 miles long, 4C2a is 137.8 miles long, 4C2b is 147.2 miles long, and 4C2c is 161.2 miles long. At 172.9 miles, Subroute 4C3 is the longest. None of the subroutes in this group contains a substantial amount of BLM land. Subroute 4C2c has the most BLM land, at 14.8 miles; Subroute 4C2a has the least, at 1.9 miles. The majority of land ownership for all subroutes in Route Group 4 is held by the ASLD (ranging from 110.9 miles [4A] to 128.8 miles [4C2c]), with smaller amounts owned by private landowners or by the BOR.

New access roads needed for construction and maintenance of the Project would account for the majority of the ground disturbing activities. The amount of estimated ground disturbance for seven of the eight subroutes is relatively similar and would vary from 5.7 to 6.0 acres per mile. However, ground disturbance for Subroute 4C3 would be lower (5.2 acres per mile), because much of it is already developed and would have existing access roads available.

Subroute 4C2c, the BLM preferred alternative, crosses ASLD lands located west of the San Pedro River that are leased for grazing and managed by Pima County. Alternative subroutes 4C2, 4C2a, and 4C2b cross the same ASLD lands. Within this group, only Subroute 4C1 would be subject to a BLM RMP amendment, as it crosses 1.4 miles of a right-of-way avoidance area (ACECs).

Subroute 4C3 would have high impacts to residential, commercial, and industrial properties in the Tucson area. Subroute 4C3 could result in the displacement of approximately 260 properties, including 216 residences (with local alternative F81a-F81b, 170 properties would be displaced). The highest levels of visual impacts would be associated with Subroute 4C3, where it passes through Tucson.

Subroutes 4C1, 4C2, 4C2a, 4C2b, and 4C2c would impact Class A and Class B scenery, as well as residential views along the San Pedro River. Likewise, subroutes 4A and 4B would impact views of scenery and residential viewers, especially residences near Safford. Subroutes 4C2b and 4C2c would have lower impacts to residential viewers in the vicinity of Cascabel than would 4C1, 4C2, or 4C2a.

All alternatives would cross Southwestern Willow Flycatcher designated critical habitat. The southernmost crossing of the San Pedro (Subroute 4C2b, 4C2c, or 4C3) would result in the least

impact to riparian habitat. Similar to Route Group 1, wintering Sandhill Cranes use a daily migration corridor between Willcox Playa and the Sulphur Springs Valley that would take them across the proposed transmission line (all subroutes except 4A). Subroutes 4A and 4B cross a roadless area north of the Galiuro Mountains and south of Aravaipa Creek, potentially allowing new vehicle access to recreationists. Although it would impact Cienega Creek, which provides habitat for several ESA-listed species, and riparian areas in the Santa Cruz River, Subroute 4C3 would have relatively fewer biological impacts because it passes through a large area of existing disturbance and development (Tucson and I-10 northwest of Tucson). Subroutes 4C1, 4C2, 4C2a, 4C2b, and 4C2c would affect Sonoran Desert Tortoise habitat in the San Pedro River Valley. Subroutes 4A, 4B, and 4C3 would affect considerably less Sonoran Desert Tortoise habitat.

Subroute 4A would have potential impacts to known archaeological districts in the Safford area, and Subroute 4B would have the least potential impact to known cultural resources. Subroute 4C1 (east of the San Pedro River) would potentially impact a higher number of known archaeological sites than subroutes 4C2, 4C2a, 4C2b, and 4C2c (west of the San Pedro River). Subroute 4C3 would have the highest level of cultural resource impacts, both known historic and prehistoric sites. There are several known historic and prehistoric cultural resources in the Tucson area (Subroute 4C3), including: historic districts, the Silverbell National Register of Historic Places (NRHP)-nominated site, the McClellan Wash Archaeological District, and the Southern Pacific, Juan Bautista de Anza, Gila, General Cooke's Wagon Road/Mormon Battalion, Butterfield, and Zuniga trails.

In terms of socioeconomics, all subroutes are expected to have minimal impacts on population and housing. The economic impacts would be similar for all of the alternatives and include employment gains and long-term tax revenues. Subroute 4C3 would likely have disproportionately high impacts on environmental justice populations in Tucson, due to numerous residential displacements. The other alternative subroutes within Route Group 4 would have low to moderate impacts on environmental justice populations in portions of Pinal County and the Willcox, Oracle, and San Manuel communities.

All routes are expected to have low impacts related to air quality, noise, public safety, and hazardous materials.

The alternative subroutes parallel to the existing TEP 345 kV lines (4C1, 4C2, 4C2a, 4C2b, 4C2c, and 4C3) cross portions of the Electronic Proving Ground, a DOD testing program area. The testing program maintains a background noise baseline measurement that could be potentially affected by the operation of new transmission lines; however, the effects have not been described or quantified.

2.5.4 Selection of the BLM Preferred Alternative

The BLM preferred alternative consists of the combination of three subroutes—**1A2, 3A2, and 4C2c—**one from each of the route groups 1, 3, and 4, for a total length of 515.4 miles.

The BLM preferred alternative route starts at the proposed SunZia East Substation in Lincoln County, New Mexico (Route Group 1), heads in a westerly direction into Torrance and Socorro

counties, and crosses the Rio Grande approximately 4 miles to the north of the town of Socorro. The route turns south, 9 miles west of the Rio Grande, along a 345 kV transmission line corridor into Sierra County, generally parallel to I-25 and the Rio Grande. The route continues south into Luna County along a 345/115 kV transmission line corridor, then turns west approximately 8 miles northeast of Deming at the proposed Midpoint Substation site. Continuing in a westerly direction (Route Group 3), the route crosses Grant and Hidalgo counties north of Lordsburg. The route continues west to the Arizona border. Crossing into Greenlee and Graham counties, the route continues west into the San Simon Valley, then proceeds west to the proposed Willow-500 kV Substation site located in Graham County. From the Willow-500 kV Substation (Route Group 4), the route heads southwest and crosses the Sulphur Springs Valley 7 miles north of Willcox, and continues along a 345 kV transmission line corridor, generally parallel to and north of the I-10. The route crosses the San Pedro River approximately 11 miles north of Benson, turns northwest, and continues at a distance ranging from 2 to 6 miles west of the San Pedro River through portions of Cochise and Pima counties. The route continues northwest along a pipeline corridor into Pinal County, turns west at a point 5 miles northwest of San Manuel, then proceeds westerly, north of Oracle and the Santa Catalina Mountains, and along portions of 115 and 500 kV transmission line corridors, north of the Tortolita Mountains. The route turns north from a point near the Tortolita Substation toward SR 79, and then west, north of the Picacho Mountains, to its termination at the Pinal Central Substation located 8 miles north of Eloy, in Pinal County.

This route was selected as the BLM preferred alternative because it would:

- maximize use of existing utility corridors and infrastructure
- minimize impacts to sensitive resources
- minimize impacts at river crossings
- minimize impacts to residential and commercial uses, and
- minimize impacts to military operations within the restricted airspace north of the WSMR

A major portion of the BLM preferred alternative would be constructed along established utility corridors where existing access is available. Approximately 53 percent (273.5 miles) of the route would be parallel to existing or designated utility corridors, including 228.7 miles parallel to existing transmission lines.

2.5.4.1 New Mexico

Although the preferred alternative **Subroute 1A2** is the longest route (230.3 miles) among the alternatives within Route Group 1, it has a greater proportionate length parallel to existing utility corridors (140.7 miles or 61 percent).

Subroute 1A2 was developed as a modification of the Subroute 1A1 alignment, after the Draft EIS was published based on input from the NPS and WSMR, to provide additional mitigation. The portion of the preferred route that extends northwest from the proposed SunZia East Substation through Lincoln, Torrance, and Socorro counties would have less potential visual and cultural resource impacts to Gran Quivira than the alternatives located to the south. The preferred route would also affect less of the restricted airspace north of the WSMR, and avoid potential impacts in proximity to the LC 94 missile launch facility.

At the Rio Grande, the level of impact resulting from construction and operation of the proposed transmission lines at the north river crossing near Socorro (Subroute 1A1, 1A2, or 1A), compared to the crossing near San Antonio (1B subroute group), would be lower with respect to visual and biological resources. Within the area along the river designated as Critical Habitat for Southwestern Willow Flycatcher and Rio Grande Silvery Minnow, the potential to impact suitable riparian habitat is lower at the north river crossing; the habitat quality is higher at the southern (San Antonio) crossing. Based on the information from the class I and II inventories conducted for this Project, cultural resource impacts would also be lower at the crossing near Socorro.

The preferred route through Sierra and Luna counties, south to the Midpoint Substation, in Luna County is primarily parallel to existing 345 and 115 kV transmission lines. Construction through these corridors would be achieved with a lower amount of new access road, resulting in less ground disturbance, lower potential vegetation loss and soil erosion, and lower levels of visual impact compared to the other alternatives. No significant impacts to other resources would be likely to occur.

The portion of preferred alternative **Subroute 3A2** that extends west from the proposed Midpoint Substation (also Subroute 3A) follows existing 345 kV transmission lines in Grant and Hidalgo counties, near the proposed Lordsburg Substation. Land use and visual resource impacts would be lower along this route than the alternative located south of the Lordsburg community (Subroute 3B). Based on the information from the class I and II inventories conducted for this Project, cultural resource impacts would also be lower.

2.5.4.2 Arizona

Preferred alternative **Subroute 3A2** crosses into Greenlee County and continues west, 5 miles north of the Peloncillo Mountains Wilderness area. The subroute continues west into Graham County, south of the BLM Hot Well Dunes Recreation Area, and into the proposed Willow-500 kV Substation. No significant impacts would be likely to occur along this portion of the preferred route.

Preferred alternative **Subroute 4C2c** follows a corridor containing two existing 345 kV transmission lines from the Willow-500 kV Substation, southwest into Cochise County and north of Willcox to the San Pedro River crossing. The proposed transmission lines would cross the San Pedro River within designated critical habitat for Southwestern Willow Flycatcher (Subroute 4C2c, also Subroute 4C2b and 4C3). The potential to impact suitable riparian habitat, land uses, and visual resources is lower at this river crossing, compared to the alternative river crossings to the north. Based on the information from the class I and II inventories conducted for this Project, cultural resource impacts would also be lower.

From the river crossing, the preferred route continues to the northwest, located between 2 and 6 miles west of the San Pedro River, crossing hilly, grazing lands. The route follows an existing pipeline through a portion of Pima and Pinal counties, then turns west at a point west of San Manuel, north of Oracle, and then follows existing 115 kV and 500 kV transmission lines toward the Tortolita Substation near I-10. The route continues north, and turns west to the north of the Picacho Mountains to the Pinal Central Substation.

With the exception of Subroute 4C3 (173 miles), the BLM preferred alternative is longer (161 miles) than the other alternatives within Route Group 4 (133 to 152 miles); it also has the greatest proportionate length parallel to existing transmission lines (72 miles, or 45 percent). Subroutes 4A and 4B are approximately 20 percent shorter than the BLM preferred alternative, generally resulting in 17 to 20 percent less ground disturbance. However, alternative subroutes 4A and 4B would require construction through areas where there is less existing access or other development. The construction of new transmission lines through relatively undeveloped areas could also cause cumulative impacts, such as the potential for habitat fragmentation and ground disturbance resulting from future access. Although these impacts could be reduced with effective mitigation measures, such as closing roads and restoring disturbed lands after construction, using corridors containing existing utilities and access for construction of new transmission lines would more likely reduce the potential for such impacts to occur.

This page intentionally left blank.

Table 2-12. Alternative Route Comparison

Group/Subroute	Length of Subroute (miles)	Land Ownership (miles crossed)					Utility Corridors Parallel[1] (miles)			Ground Disturbance			
										Temporary Disturbance		Permanent Disturbance	
		BLM	BOR	DOD	State	Private/ Other	Existing Transmission Lines	Existing Pipelines	Designated Utility Corridors	acres	acres/mile	acres	acres/mile
Route Group 1. SunZia East Substation to Midpoint Substation													
Subroute 1A. North River Crossing													
1A	219.5	104.9	—	—	44.6	70.0	93.7	10.0	19.9	1,739	7.9	1,196	5.4
1A1	228.8	110.1	—	—	39.7	79.0	114.1	18.5	36.4	1,813	7.9	1,238	5.4
1A2 – **BLM Preferred Alternative**	230.3	108.1	—	—	40.3	81.9	114.1	18.5	36.4	1,819	7.9	1,270	5.5
Subroute 1B. San Antonio Crossing													
1B1	223.6	114.0	—	—	45.2	64.4	79.6	10.0	9.0	1,772	7.9	1,189	5.3
1B2	209.2	120.2	—	—	37.7	51.3	79.6	—	9.0	1,657	7.9	1,121	5.4
1B2a	212.8	124.3	—	—	38.3	50.2	100	—	25.8	1,686	7.9	1,130	5.3
1B3	206.3	122.4	—	1.0	34.5	48.4	79.6	—	9.0	1,635	7.9	1,106	5.4
Route Group 3. Midpoint Substation to Willow-500 kV Substation													
Subroute 3A. North													
3A	123.4	58.1	—	—	53.8	11.5	42.4	27.0	—	978	7.9	665	5.4
3A2 – **BLM Preferred Alternative**	123.9	61.6	—	—	50.8	11.5	42.4	27.0	—	979	7.9	673	5.4
Subroute 3B. South													
3B	128.6	56.0	—	0.3	43.8	28.5	24.1	74.2	7.4	1,019	7.9	638	5.0
Route Group 4. Willow-500 kV Substation to Pinal Central Substation													
Subroute 4A. North of Mt. Graham													
4A	132.9	11.0	0.4	—	110.9	10.6	12.2	25.0	—	1,053	7.9	778	5.9
Subroute 4B. Sulphur Springs Valley													
4B	133.0	5.0	0.4	—	117.0	10.6	8.6	13.0	—	1,054	7.9	793	6.0
Subroute 4C. San Pedro Valley and Tucson													
4C1	139.0	5.3	0.4	—	112.1	21.2	31.0	34.9	—	1,101	7.9	802	5.8
4C2	151.8	14.8	0.4	—	118.8	17.8	54.9	20.2	—	1,203	7.9	870	5.7
4C2a	137.8	1.9	0.4	—	117.1	18.4	31	40.7	—	1,092	7.9	781	5.7
4C2b	147.2	1.8	0.4	—	127.1	17.8	48.3	40.7	—	1,166	7.9	839	5.7
4C2c – **BLM Preferred Alternative**	161.2	14.8	0.4	—	128.8	17.2	72.2	20.2	—	1,277	7.9	928	5.8
4C3	172.9	13.2	1.2	—	110.7	47.8	109.6	34.9	—	1,370	7.9	892	5.2
BLM Preferred Alternative Route. SunZia East Substation to Pinal Central Substation													
1A2, 3A2, 4C2c (combined)	**515.4**	**184.5**	**0.4**	**—**	**219.9**	**110.6**	**228.7**	**65.7**	**36.4**	**4,077**	**7.9**	**2,859**	**5.5**

Note: Totals may not sum, due to rounding.
[1] Total may include overlap of facilities.

Table 2-13. Resource Comparison Summary for Route Group 1: SunZia East Substation to Midpoint Substation

Subroute			Subroute 1A. North River Crossing			Subroute 1B. San Antonio Crossing			
			1A	1A1	1A2 (BLM Preferred Alternative)	1B1	1B2	1B2a	1B3
Length of Subroute (miles)			219.5	228.8	230.3	223.6	209.2	212.8	206.3
Land Ownership (miles)		**BLM**	104.9	110.1	108.1	114.0	120.2	124.3	122.4
		BOR	—	—	—	—	—	—	—
		DOD	—	—	—	—	—	—	1.0
		State – NM	44.6	39.7	40.3	45.2	37.7	38.3	34.5
		State – AZ	—	—	—	—	—	—	—
		Private/ Other	70.0	79	81.9	64.4	51.3	50.2	48.4
Total distance parallel to existing utilities and designated utility corridors (in miles)			113.5	140.7	140.7	98.6	89.6	99.5	88.6
Ground Disturbance	**Temporary Disturbance**	**acres**	1,739	1,813	1,819	1,772	1,657	1686	1,635
	Permanent Disturbance	**acres**	1,196	1,238	1270	1,189	1,121	1130	1,106
		acres per mile	5.4	5.4	5.5	5.3	5.4	5.3	5.4
BLM Resource Management Plan Conformance	**VRM Compliance**		• VRM plan nonconformance: - E101a: Class III (0.1 mile) – Socorro RMP, 2009 - E101b: Class II (5.5 miles) and Class III (3.9 miles) – Socorro RMP, 2009 - E133: Class II (2.4 miles) and Class III (2.2 miles) – Socorro RMP, 2009			• VRM BLM plan nonconformance: - A90: Class III (0.8 mile) – Socorro RMP, 2009			
						• VRM BLM plan nonconformance: - A111: Class II (2.2 miles) and Class III (0.3 mile) – Socorro RMP, 2009 - A112: Class II (1.6 miles) – Socorro RMP, 2009 - A140: Class II (0.4 mile) – Socorro RMP, 2009			
	BLM Plan ROW Avoidance Areas		• BLM plan nonconformance: - An avoidance area managed by Mimbres RMP for VRM Class II with links A440 and A530 for 0.9 mile and 1.9 miles						
			• BLM plan nonconformance: - An avoidance area managed by the Socorro RMP for VRM Class II is crossed by 5.8 miles of Link E101b, and 5.3 miles of Link E133; Link E211 crosses an avoidance area for 10.1 miles, and Link A161 crosses an avoidance area for 0.1 miles - An avoidance area managed by the Mimbres RMP for the Butterfield Trail is crossed by Link A440 for 0.9 mile.			• BLM plan nonconformance: - An avoidance area in the Socorro RMP managed for VRM Class II and the San Pedro SMA is crossed by Link A111 for 2.1 miles; links A112 and A140 cross the same avoidance area for 2.3 miles and 0.4 mile - An avoidance area in the Socorro RMP crossed by links A160 and A161 for 6.0 miles and 0.1 mile - An avoidance area managed by the Mimbres RMP for the Butterfield Trails is crossed by Link A440 for 0.9 mile		• Includes BLM plan nonconformance areas in Subroutes 1B1, 1B2, 1B2a, as well as: - An avoidance area in Socorro RMP crossed by Link A80 for 3.0 miles
			• Total BLM plan ROW avoidance nonconformance: 22.2 miles			• Total BLM plan ROW avoidance nonconformance: 11.8 miles			• Total BLM plan ROW avoidance nonconformance: 17.6 miles

Table 2-13. Resource Comparison Summary for Route Group 1: SunZia East Substation to Midpoint Substation

Subroute	Subroute 1A. North River Crossing			Subroute 1B. San Antonio Crossing			
	1A	1A1	1A2 (BLM Preferred Alternative)	1B1	1B2	1B2a	1B3
Agency Comments	• The DOD recommends that any route parallel or north of E80c (links E-81, E-82-E83-E85, and E82-E84-E85, portions of subroutes 1A, 1A1, and 1A2) is acceptable			• The DOD states that these alternatives would have an adverse effect on testing and training at WSMR			
	• NMDFG: impacts to migrating Sandhill Cranes, Snow Geese, and ducks • USFWS: negative effects on breeding, migratory, and wintering bird populations and compromise the establishment purpose of the Bosque del Apache National Wildlife Refuge.						
Land Use, Recreation, and Special Designations	• Crosses four BLM ROW avoidance areas – two south of the Sevilleta National Wildlife Refuge, one west of Socorro, and one north of Deming: links E101b, E133, E211, A161, A440 and A530	• Crosses four BLM ROW avoidance areas – two south of the Sevilleta National Wildlife Refuge, one west of Socorro, and one north of Deming: links E101b, E133, E211, A161, A440 and A530	• Crosses four BLM ROW avoidance areas – two south of the Sevilleta National Wildlife Refuge, one west of Socorro, and one north of Deming: links E101b, E133, E211, A161, A440 and A530	• Crosses four BLM ROW avoidance areas – three east and west of San Antonio (links A111, A112, A140, A160, and A161); and one north of Deming (links A440 and A530)			• Crosses four BLM ROW avoidance areas (links A80, A111, A112, A140, A160,and A161) east of San Antonio • Link A80 passes through a 1-mile-wide corridor through a BLM ROW exclusion area east of San Antonio along US Route 380
	- Crosses the Johnson (Gordy's) Hill SRMA (E133, E180), managed for OHV recreation uses						
Visual Resources	• *Scenery*: Crosses mostly Class B scenery along northern portion - E180: Crosses limited portion of Class A scenery associated with the Rio Grande • *Viewers*: High impacts are anticipated for Socorro residences (3.2 miles) - Greatest amount of high to moderate-high impacts for recreation and travel route viewers associated with Stallion WSA, Veranito WSA, Johnson (Gordy's) Hill SRMA, Rio Grande, and Quebradas Back Country Byway - This subroute would cross and parallel the El Camino Real National Scenic Byway, and El Camino Real de Tierra Adentro National Historic Trail resulting in high impacts; portions of the subroute crossing this scenic byway would be skylined - Low impacts are anticipated for Gran Quivira viewers, and this route would be viewed in context with other regional modifications (windfarm, pipeline, etc.)			• *Scenery*: This subroute crosses primarily Class B and C scenery - A140: Crosses limited portion of Class A scenery associated with the Rio Grande. - Contrast would be reduced at this crossing because riparian vegetation is less dense and not as tall as Subroute Group A crossing • *Viewers*: All subroutes in 1B would have high impacts for San Antonio residences (1.7 miles)			
				• *Scenery*: This subroute has fewer existing access roads than subroutes 1A and 1B1 for the northern portion • *Viewers*: Low to low-moderate impacts anticipated for Quebradas Backcountry Byway viewers - This subroute would generally parallel US Route 380 for 2 miles			• *Scenery*: This subroute has existing access and modifications along links A40, A41, and A80. - High impacts are anticipated where the subroute would cross and/or parallel portions of the El Camino Real National Scenic Byway - This subroute would generally parallel US Route 380 for 5 miles
				• *Viewers*: High impacts are anticipated where the subroute would cross and/or parallel portions of the El Camino Real National Scenic Byway		• *Viewers*: This subroute would avoid paralleling the El Camino Real National Scenic Byway; however, it would cross the scenic byway three times	
Biological Resources	• Bird collision risk is expected to be similar for all subroutes; mitigation would include bird diverters for increased visibility • All subroutes cross Southwestern Willow Flycatcher designated critical habitat at the Rio Grande • All subroutes cross the Chupadera Mesa BHCA						
	• Avoids ACEC for Desert Bighorn Sheep but crosses designated movement corridor • Crosses a 2010-foot wide strip of critical habitat for the Southwestern Willow Flycatcher			• Habitat for Fugate's blue star may be impacted • Riparian habitat at San Antonio Crossing is more suitable for Southwestern Willow Flycatcher, Yellow-billed Cuckoo than the habitat at the North River Crossing. This alternative would cross an area of critical habitat 5570 feet wide.			
	• Crosses extensive undeveloped area with dense junipers on Chupadera Mesa BHCA	• Uses much existing access through low-density juniper woodland on Chupadera Mesa BHCA	• Crosses extensive undeveloped area through low-density juniper woodland on Chupadera Mesa BHCA	• Uses the same links across Chupadera Mesa BHCA as Subroute 1A	• Crosses the narrowest portion of Chupadera Mesa BHCA	• Link A260 crosses areas with lower slopes than Link A270 (Subroute 1B2), also parallel to existing transmission lines	• Crosses low-density juniper woodland on Chupadera Mesa BHCA

Table 2-13. Resource Comparison Summary for Route Group 1: SunZia East Substation to Midpoint Substation							
	Subroute 1A. North River Crossing			**Subroute 1B. San Antonio Crossing**			
	1A	**1A1**	**1A2**	**1B1**	**1B2**	**1B2a**	**1B3**
Subroute			**(BLM Preferred Alternative)**				
Earth and Water Resources	• Minerals: No key issues						
	• Soils: Fewer potential impacts to soils than the 1B subroutes			• Soils: wind erosive soils (A60, A90); issues with soils along Rio Grande (A112, A140)			• Soils: Least amount of mileage needing mitigation; issues with soils along Rio
	• Paleontology: 18 fossil localities within 1 mile of the centerline	• Paleontology: nine fossil localities within 1 mile of centerline along links A111 and A112	• Paleontology: nine fossil localities within 1 mile of centerline along links A111 and A112	• No key issues for paleontological resources			
	• Water: These subroutes would have similar impacts to stream crossings					• Link A260 is closer to Rio Grande then A270 of 1B2, and crosses several more intermittent streams as a result	• Water: Impacts slightly less due to fewer tributaries crossed
	• No key issues for geological hazards						
Cultural Resources	• Potential for visual/cultural impact: El Camino Real Tierra Adentro, Butterfield, Gila, and General Cooke's Wagon Road/Mormon Battalion trails • Potential impact to two known habitation sites						• Potential impacts to Mockingbird Gap Archaeological District
	• Potential visual impacts to the Gran Quivira				• Potential for visual/cultural impact: Less than 1 mile from Playas Pueblo Archaeological District		
Socioeconomics/ Environmental Justice	• Population: Minimal impacts expected during construction and operations • Housing: vacant, affordable units in proximity • Economics: Project would create approximately 1,400 jobs during construction and equivalent levels of tax resources benefitting affected counties.						
	• Lower potential impacts to EJ populations			• Potential low and moderate Environmental Justice impacts in proximity to the San Antonio community			
Air Quality	• All alternatives have potential to impact air quality during construction due to fugitive dust and equipment emissions relative to length of route • Does not traverse any nonattainment or maintenance areas						
Public Health, Noise, and Hazardous Materials	• All alternative subroutes carry the same risk of leaks during refueling or handling of chemicals, noise, or injury during construction • All alternative subroutes would have similar low levels of EMF exposure during operations						

Table 2-14. Resource Comparison Summary for Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute			Subroute 3A. North	Subroute 3A2. North (BLM Preferred Alternative)	Subroute 3B. South
Length of Subroute (miles)			123.4	123.9	128.6
Land Ownership (miles)		**BLM**	58.1	61.6	56.0
		BOR	—	—	—
		DOD	—	—	0.3
		State-NM	48.7	48.7	41.7
		State-AZ	5.1	2.1	2.1
		Private/ Other	11.5	11.5	28.5
Total distance parallel to existing utilities and designated utility corridors (in miles)			42.4	42.4	76.2
Ground Disturbance	**Temporary Disturbance**	**acres**	978	979	1019
	Permanent Disturbance	**acres**	665	673	638
		acres per mile	5.4	5.4	5.0
BLM Resource Management Plan Conformance	**VRM Compliance**		• Compliant with VRMs	• Compliant with VRMs	• BLM plan nonconformance: B112: Class II (0.8 mile) – Also associated with avoidance area, Mimbres RMP
	BLM ROW Avoidance Areas		• BLM plan nonconformance: - Avoidance areas in the Mimbres RMP crossed by Link B120b for 0.3 mile	• BLM plan nonconformance: - Avoidance areas in the Mimbres RMP crossed by Link B120b for 0.3 mile	• BLM plan nonconformance: - Avoidance areas in the Mimbres RMP, with Link B110a crossing an avoidance area for 0.3 mile - For 1.6 miles, Link B112 crosses an avoidance area
			• BLM plan nonconformance 0.3 mile	• BLM plan nonconformance 0.3 miles	• BLM plan nonconformance 1.9 miles
Agency Comments			• No applicable agency comments		
Land Use, Recreation Resources, and Special Designations			• Crosses one BLM ROW avoidance area (Link B120b) • Parallels approximately 42.4 miles of existing 345 kV transmission line • Potential access road restriction needed to Hot Well Dunes OHV Recreation Area	• Crosses one BLM ROW avoidance area (Link B120b) • Parallels approximately 42.4 miles of existing 345 kV transmission line	• Crosses three BLM ROW avoidance areas (links B110a and B112) • Parallels several pipelines which would allow for better construction access and follows portions of a BLM utility corridor (West-wide) • Crosses multiple residential areas
Visual Resources			• *Scenery*: Majority of route crosses Class C scenery with some areas of Class B scenery - Parallels more additional existing transmission lines than 3B • *Viewers*: This subroute avoids residences associated with San Simon, Lordsburg, and Deming - The northern portion of the Continental Divide Trail, a National Scenic Trail would be crossed by this subroute, but existing transmission lines and a substation are within close proximity	• *Scenery*: Majority of route crosses Class C scenery with some areas of Class B scenery - Parallels more additional existing transmission lines than 3B • *Viewers*: This subroute avoids the majority of residences associated with Deming - The northern portion of the Continental Divide Trail, a National Scenic Trail would be crossed by this subroute, but existing transmission lines and a substation are within close proximity	• *Scenery*: Majority of route crosses Class C scenery; however, this subroute crosses slightly more Class B scenery than Subroute 3A • *Viewers*: High to moderate-high impacts anticipated for residences near Lordsburg, San Simon, and Deming - This subroute would cross southern portion of Continental Divide Trail, but existing modifications and development are evident

Table 2-14. Resource Comparison Summary for Route Group 3: Midpoint Substation to Willow-500 kV Substation			
Subroute	**Subroute 3A. North**	**Subroute 3A2. North (BLM Preferred Alternative)**	**Subroute 3B. South**
Biological Resources	• Avoids sensitive plant and invertebrate species at the Lordsburg Playa • May impact the Chihuahua Scurfpea, Sprague's Pipit, and the Arizona Striped Whiptail • Subroute would affect undisturbed habitat in the Peloncillo Mountains		• Crosses sensitive plant and invertebrate habitat at the Lordsburg Playa • May impact the Chihuahua Scurfpea, Sprague's Pipit, and the Arizona Striped Whiptail • Crosses Peloncillo Mountains parallel to an existing gas pipeline • Subroute would impact more previously disturbed habitat than Subroute 3A
Earth and Water Resources	• No key issues for soils, minerals, geologic hazards, or water resources		
	• Paleontology: Fossiliferous 111 Ranch Beds along Link B160		• Paleontology: Slightly fewer potential impacts with this route
Cultural Resources	• Crosses Gila, Butterfield, General Cooke's Wagon Road/Mormon Battalion, Janos Copper trails • Potential impacts to one known habitation site	• Crosses General Cooke's Wagon Road/Mormon Battalion, Janos Copper, and Gila trails; and crosses the Butterfield trail twice • Potential impacts to three known habitation sites	• Crosses Gila Trail twice, as well as General Cooke's Wagon Road/Mormon Battalion, Janos Copper, and Butterfield trails
Socioeconomic/ Environmental Justice	• Population: Minimal impacts expected for all routes within Route Group 3 • Housing: Minimal impacts expected, adequate vacant, affordable units available • Economics: Approximately 500 jobs in New Mexico could be created during construction of lines - Luna, Hidalgo, and Grant counties would benefit from tax revenues and job creation - Due to proximity to Arizona, some economic benefits could also result in this state • Approximately 270 jobs in Arizona could be created during the construction of the lines - Graham and Greenlee counties would benefit from tax revenues and job creation		
Air Quality	• All alternatives have potential to impact air quality during construction due to fugitive dust and equipment emissions relative to length of route • Does not traverse any nonattainment or maintenance areas		
Public Health, Noise, and Hazardous Material	• Each alternative subroute carries the same risk of leaks during refueling or handling of chemicals, noise, or injury during construction • Each alternative subroute would have similar low levels of EMF exposure during operations		

Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson

Subroute			Subroute 4A. North of Mt. Graham	Subroute 4B. Sulphur Springs Valley	Subroute 4C. San Pedro Valley and Tucson					
					4C1 East of San Pedro River	4C2 West of San Pedro River	4C2a West of San Pedro River	4C2b West of San Pedro River	4C2c West of San Pedro River (BLM Preferred Alternative)	4C3 Tucson
Length of Subroute (miles)			132.9	133.0	139.0	151.8	137.8	147.2	161.2	172.9
Land Ownership		**BLM**	11.0	5.0	5.3	14.8	1.9	1.8	14.8	13.2
		BOR	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.2
		DOD	—	—	—	—	—	—	—	—
		State – NM	—	—	—	—	—	—	—	—
		State – AZ	110.9	117.0	112.1	118.8	117.1	127.1	128.8	110.7
		Private/ Other	10.6	10.6	21.2	17.8	18.4	17.8	17.2	47.8
Total distance parallel to existing utilities and designated utility corridors (in miles)			27.6	21.6	63.9	73.1	69.7	87.0	90.4	118.3
Ground Disturbance	**Temporary Disturbance**	**acres**	1053	1054	1101	1203	1092	1166	1277	1370
	Permanent Disturbance	**acres**	778	793	802	870	781	839	928	892
		acres per mile	5.9	6.0	5.8	5.7	5.7	5.7	5.8	5.2
BLM Resource Management Plan Conformance	**VRM Compliance**		• Compliant with VRMs							• VRM plan nonconformance: Link C817-Class III (0.5 mile), Phoenix RMP 1988
	BLM ROW Avoidance Areas		• Conforms to RMPs		• BLM plan nonconformance: - Safford RMP crossing an avoidance area with links C331 and C361 for 0.4 mile and 1.0 mile • Total BLM plan nonconformance: 1.4 miles		• Conforms to RMPs			

Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson

Subroute	Subroute 4A. North of Mt. Graham	Subroute 4B. Sulphur Springs Valley	Subroute 4C. San Pedro Valley and Tucson					
			4C1 East of San Pedro River	4C2 West of San Pedro River	4C2a West of San Pedro River	4C2b West of San Pedro River	4C2c West of San Pedro River (BLM Preferred Alternative)	4C3 Tucson
Agency Comments	• USFWS: Conservation lands along the San Pedro River, riparian birds, and multiple threatened and endangered species • AZGFD: May decrease wildlife and recreation values at Cluff Ranch	• AZGFD: Impact to Pronghorn, Ornate Box Turtles, and a Sandhill Crane migration corridor	• U.S. Army Fort Huachuca: Buffalo Soldier Electronic Proving Ground's baseline measurements would be potentially affected; however, effects have not been described or quantified • Pima County requested that the County's preserved lands and grazing leases be avoided					• City of Tucson: Transmission lines could have detrimental impact on Tucson downtown area economic development process. Transmission lines conflict with recreation use and conservation at the (Santa Cruz) river corridor.
Land Use, Recreation Resources and Special Designations	• No direct impacts to residences, commercial, or industrial properties • Subroute 4A would cross platted residential subdivisions in the Safford area	• No direct impacts to residences, commercial, or industrial properties	• Crosses Muleshoe Ranch CMA ACEC for approximately 5.5 miles (links 301, C331, C361) • Crosses the Muleshoe EMA-ROW avoidance (links C331 and C361) • Crosses Swamp Springs-Hot Springs Watershed ACEC for approximately 1.4 miles (links C331 and C361) • Mitigation needed for agriculture and multiple residences along the San Pedro River.	• Crosses State Land – Pima County managed grazing leases (Six Bar Ranch, Link C450; and A7 Ranch, links C276, C441) • No direct impacts to residences, commercial, or industrial properties				• This route would displace over 200 residences, and additional commercial, and industrial properties • The local alternative (links 81a and 81b) impacts over 100 additional properties • Impacts recreation use in the Santa Cruz River corridor.

Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson

Subroute	Subroute 4A. North of Mt. Graham	Subroute 4B. Sulphur Springs Valley	Subroute 4C. San Pedro Valley and Tucson					
			4C1 East of San Pedro River	4C2 West of San Pedro River	4C2a West of San Pedro River	4C2b West of San Pedro River	4C2c West of San Pedro River (BLM Preferred Alternative)	4C3 Tucson
Visual Resources	• *Scenery*: Crosses mostly high quality Class B scenery (i.e., San Pedro River Valley) with isolated areas of Class A scenery at the river - Modifications are limited to SR 77 and residences near Mammoth		• *Scenery*: Crosses mostly high quality Class B scenery on the east side of the San Pedro River Valley area - This subroute crosses Class A scenery associated with Desert Canyons and the San Pedro River - Crossing of San Pedro River is more compatible than other subroutes because it would be adjacent to the San Manuel Copper Mine • *Viewers:* Generally few dispersed residential viewers on this subroute - Would cross the Muleshoe Ranch CMA ACEC, Arizona Trail, and Pinal Pioneer Parkway - Dispersed recreation viewers in Redfield Canyon Wilderness may have views of the Project - Future residential development (Link C691) would have views of the subroute, which would parallel an existing pipeline	• *Scenery*: Crosses mostly high quality Class B scenery on the west side of the San Pedro River Valley area • *Viewers*: High impacts to residences near Cascabel with views of the San Pedro River crossing, - Few dispersed residences within 2 miles of San Manuel would have views of subroute - Subroute would cross the Arizona Trail, Pinal Pioneer Parkway, and Redington Road scenic routes - Residences near the Tortolita Substation would have views of this subroute where it parallels an existing transmission line		• *Scenery*: similar to Subroute 4C2 with the exception of the San Pedro River crossing		• *Scenery*: This subroute primarily traverses developed land associated with the Tucson Metropolitan Area - Generally, there are multiple existing transmission lines and other modifications associated with Class A scenery (San Pedro River/Riparian and the Cienega Creek Preserve) and Class B scenery • *Viewers*: Several existing residences have views of this subroute within immediate foreground distance zone - Subroute would traverse designated recreation areas and occur adjacent to the Juan Bautista de Anza National Historic Trail. It would also cross the Arizona National Scenic Trail
	• *Viewers:* High impacts are anticipated for residences within 0.5 mile to 1 mile - High to moderate-high impacts for residences near Artesia - High impacts to the following scenic travel routes: the Pinal Pioneer Parkway, Swift Trail Parkway, and Stockton Pass Road - High impacts to recreation viewers of the Arizona Trail and Rug Road	• *Viewers* – High to moderate-high impacts to are anticipated for residences within 0.5 mile to 1 mile - Moderate to low-moderate impacts anticipated for Sulphur Springs Valley dispersed residences - High impacts to these scenic travel routes the Pinal Pioneer Parkway and Stockton Pass Road - Similar to 4A, the Arizona Trail and Rug Road would also be impacted		• This subroute crosses Class A scenery (San Pedro River and a small portion of Desert Canyon) • Generally more existing access along the west side of the valley, and this subroute would parallel existing pipeline (Link C450)	• Similar to Subroute 4C1, existing residences (near Pinal Central Substation) and future residential development (Link C691) would have views of the subroute within 0.5 mile; however, it would parallel an existing pipeline	• *Viewers*: Few residences near the San Pedro River crossing would have views of the subroute; and the route would be viewed in context with two existing 345 kV transmission lines - High impacts to recreation viewers of the Arizona Trail which would be crossed - With the exception of the river crossing, viewers associated with this subroute are similar to 4C2a - This subroute would cross the San Pedro River near two existing 345 kV transmission lines		

Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson

Subroute	Subroute 4A. North of Mt. Graham	Subroute 4B. Sulphur Springs Valley	Subroute 4C. San Pedro Valley and Tucson					
			4C1 East of San Pedro River	4C2 West of San Pedro River	4C2a West of San Pedro River	4C2b West of San Pedro River	4C2c West of San Pedro River (BLM Preferred Alternative)	4C3 Tucson
Biological Resources	• Portion of subroute north of Pinaleño Mountains has few unique biological impacts	• Northern Sulphur Springs Valley is Pronghorn habitat in large, intact grassland • Arizona Striped Whiptail habitat north of Willcox • Potential bird collision risk north of Willcox	• Designated critical habitat for three ESA-listed fish in Hot Springs and Redfield canyons upstream from crossing locations • 1139 acres of total ground disturbance and 42.0 miles of new access within Desert Tortoise habitat. • Avoids Pima County preserves • San Pedro River crossing is adjacent to planned transmission line; increased visibility may help reduce bird collisions • Impacts to riparian vegetation at the San Pedro River crossing • Crosses a 2380-foot wide strip of critical habitat for the Southwestern Willow Flycatcher on the San Pedro River	• 1210 acres of total ground disturbance and 33.7 miles of new access within Desert Tortoise habitat. • Tucson Shovel-nosed Snake may be present near Tortolita Substation	• 1109 acres of total ground disturbance and 34.4 miles of new access within Desert Tortoise habitat.	• 1227 acres of total ground disturbance and 41.0 miles of new access within Desert Tortoise habitat.	• 1329 acres of total ground disturbance and 40.3 miles of new access within Desert Tortoise habitat. • Tucson Shovel-nosed Snake may be present near Tortolita Substation • Crosses designated critical habitat for the Southwestern Willow Flycatcher	• Generally fewer impacts, as area has extensive modification and urban areas • Several special-status species are present in the Cienega Creek Preserve • Pima pineapple cactus may be present near Tucson • Low amount of Desert Tortoise habitat affected - 789 acres of total ground disturbance and 20.6 miles of new access. • Tucson Shovel-nosed Snake may be present near Tortolita Substation • Impacts to riparian vegetation at San Pedro River crossing and Cienega Creek • Designated critical habitat for Gila Chub at Cienega Creek
	• Crossings of dry reaches of Aravaipa Creek and San Pedro River • Crossing of Galiuro Mountains would affect large area with steep terrain, no existing access • Crosses a 4380-foot-wide strip of critical habitat for the Southwestern Willow Flycatcher on the San Pedro River • Lowest amount of Desert Tortoise habitat affected - 661 acres of total ground disturbance and 21.6 miles of new access • May affect Acuña cactus			• Riparian habitat at San Pedro River crossing is similar to Subroute 4C1, but Subroute 4C2 lacks disturbance associated with mine and planned transmission line				
				• Crosses a 2930-foot-wide strip of critical habitat for the Southwestern Willow Flycatcher on the San Pedro River		• River crossing is lowest sensitivity on San Pedro River, but this subroute is longer than Subroute 4C2 and would require much additional ground disturbance		

Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson

Subroute	Subroute 4A. North of Mt. Graham	Subroute 4B. Sulphur Springs Valley	Subroute 4C. San Pedro Valley and Tucson					
			4C1 East of San Pedro River	4C2 West of San Pedro River	4C2a West of San Pedro River	4C2b West of San Pedro River	4C2c West of San Pedro River (BLM Preferred Alternative)	4C3 Tucson
Earth and Water Resources	• Minerals: Active mines and claims (C170, C173, and C592) • Soils: Less erosion and less farmland (only along B153a) • Hazards: Fewer geological hazards; fissures are located near Pinal Central Substation • Paleontology: Fewer impacts to paleontology	• Segment between Aravaipa Canyon and Safford has greater geological hazards; fissures are located near Pinal Central Substation • Minerals: Active mines and claims (C170, C173, and C592) • Soils: Erosive soils in Sulphur Springs Valley (C130b)	• Minerals: Active mines and claims (C510) • Soils: Erosive soils in San Pedro River Valley (C660) • Water: Subroute 4C1 has fewer washes and tributaries than Subroute 4C2; parallels San Pedro River • Fissures are located near Pinal Central Substation	• Minerals: No key issues • Has slightly more geological hazards; fissures are located near Pinal Central Substation • Links C441 and C450 may cross fossiliferous Quiburis Formation • Parallels San Pedro River				• Minerals: Mining claims along C820 • Soil: farmable soils (F510 and F540); less ground disturbance to erosive soils (F40a, F112, and F510); • Hazards: Santa Cruz River floods • Paleontology: Young sediment, less chance of fossils • Water: Numerous wells, Tucson Sole Source Aquifer - Parallels Santa Cruz River
		• No key issues for paleontological resources		• Soils: Erosive soils in San Pedro River Valley (C266, C276, and C441)	• Erosive soils in San Pedro River Valley (C450 and C661)	• Erosive soils in San Pedro River Valley (C450 and C661) • Crosses different perennial and intermittent streams than 4C2, but impacts are similar		
Cultural Resources	• Crosses Southern Pacific Mail Line, Butterfield Trail, and Zuniga Trail							• High density of resources, less than 0.5 miles from known historic districts • Potential impacts to eight known habitation sites • Crosses Gila, General Cooke's Wagon Road/Mormon Battalion, Butterfield, and Zuniga trails • Potential cultural-visual impacts to the McClellan Wash Archaeological District • Potential cultural-visual impacts to the Colossal Cave Mountain Park Natural Landmark, Juan Bautista de Anza
	• Potential impacts to five known habitation sites • Potential visual impacts to Oak Draw Archaeological District and Marijilda Canyon Archaeological District		• Potential impacts to four known habitation sites	• Potential impacts to one known habitation sites • Potential cultural-visual impacts to the McClellan Wash Archaeological District			• Potential impacts to two known habitation sites • Potential cultural-visual impacts to the McClellan Wash Archaeological District	
	• Concerns identified by San Carlos Apache Nation and other Apache Tribes for Mt. Graham and other culturally-sensitive areas							

Table 2-15. Resource Comparison Summary for Route Group 4: San Pedro River and Tucson

Subroute	Subroute 4A. North of Mt. Graham	Subroute 4B. Sulphur Springs Valley	Subroute 4C. San Pedro Valley and Tucson					
			4C1 East of San Pedro River	4C2 West of San Pedro River	4C2a West of San Pedro River	4C2b West of San Pedro River	4C2c West of San Pedro River (BLM Preferred Alternative)	4C3 Tucson
Socioeconomic/ Environmental Justice	• Population: Minimal impacts expected during construction and operations • Housing: vacant, affordable units in proximity • Economics: Construction of each alternative subroute would create approximately 1,000 jobs							
	• Low to moderate impacts expected to result to environmental justice populations in Pinal County near the Pinal Central Substation and in Cochise County north of Willcox			• Low to moderate impacts to environmental justice populations in Oracle and San Manuel				• High, disproportionate impacts to environmental justice populations - Approximately 216 residences could be taken as part of the right-of-way acquisition
Air Quality	• All alternatives have potential to impact air quality during construction due to fugitive dust and equipment emissions relative to length of route.							
	• Traverses San Manuel SO2 maintenance area							• Traverses Tucson/Pima County CO maintenance area • Traverses Rillito PM10 nonattainment area
Public Health, Noise, and Hazardous Material	• All alternative subroutes carry the same risk of leaks during refueling or handling of chemicals, noise, or injury during construction • All alternative subroutes would have similar low levels of EMF exposure during operations							

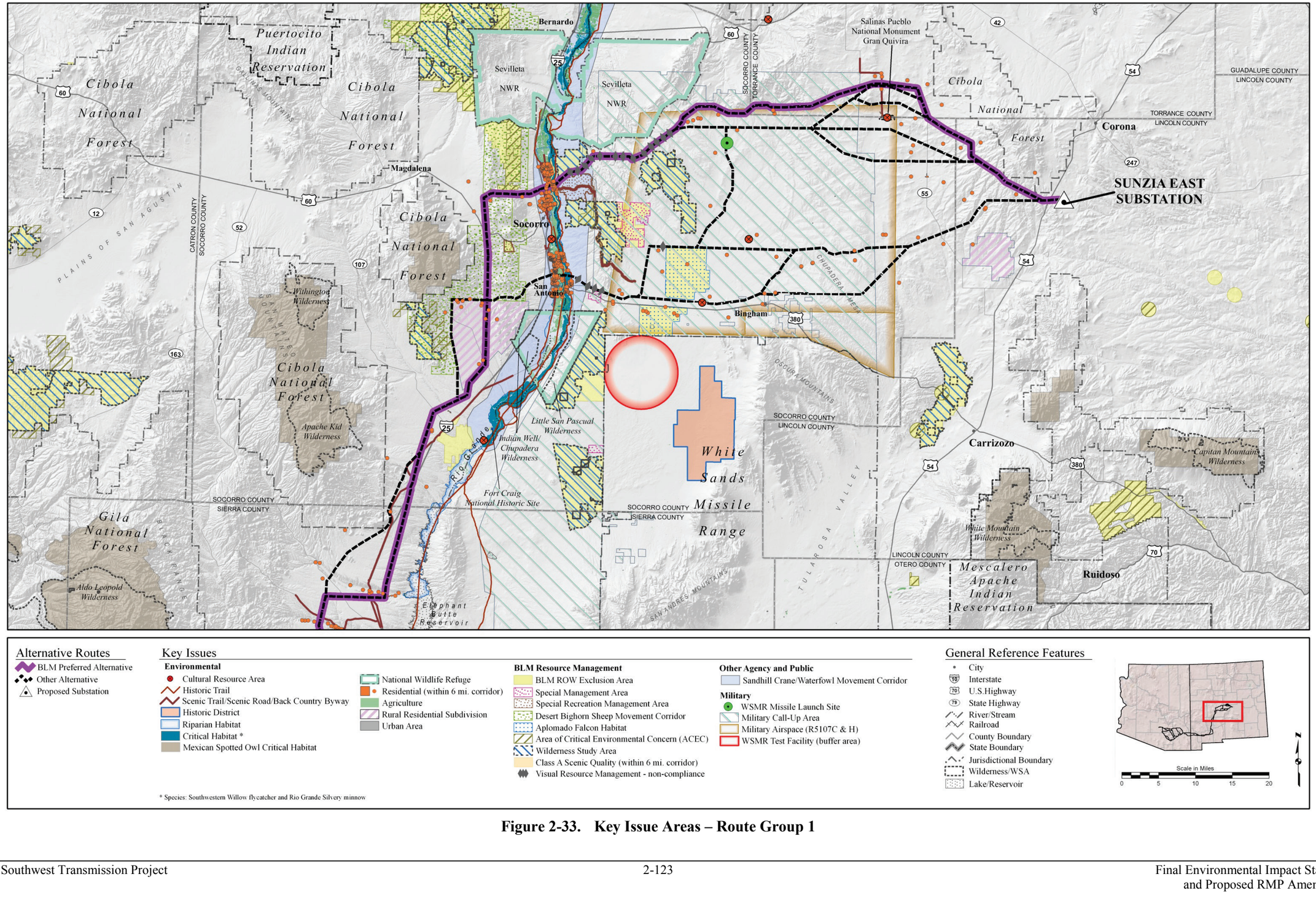


Figure 2-33. Key Issue Areas – Route Group 1

This page intentionally left blank.

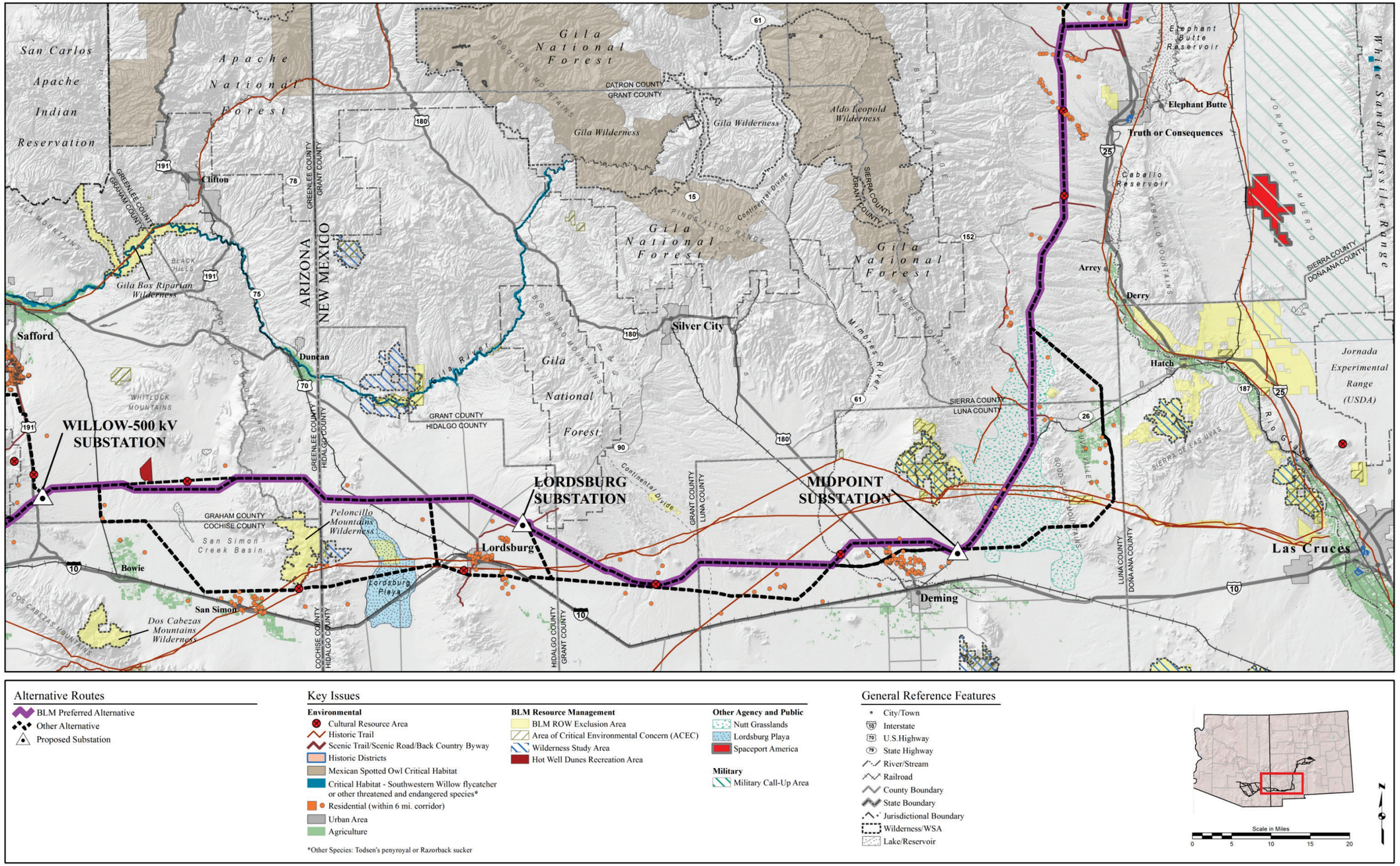


Figure 2-34. Key Issue Areas – Route Group 3

This page intentionally left blank.

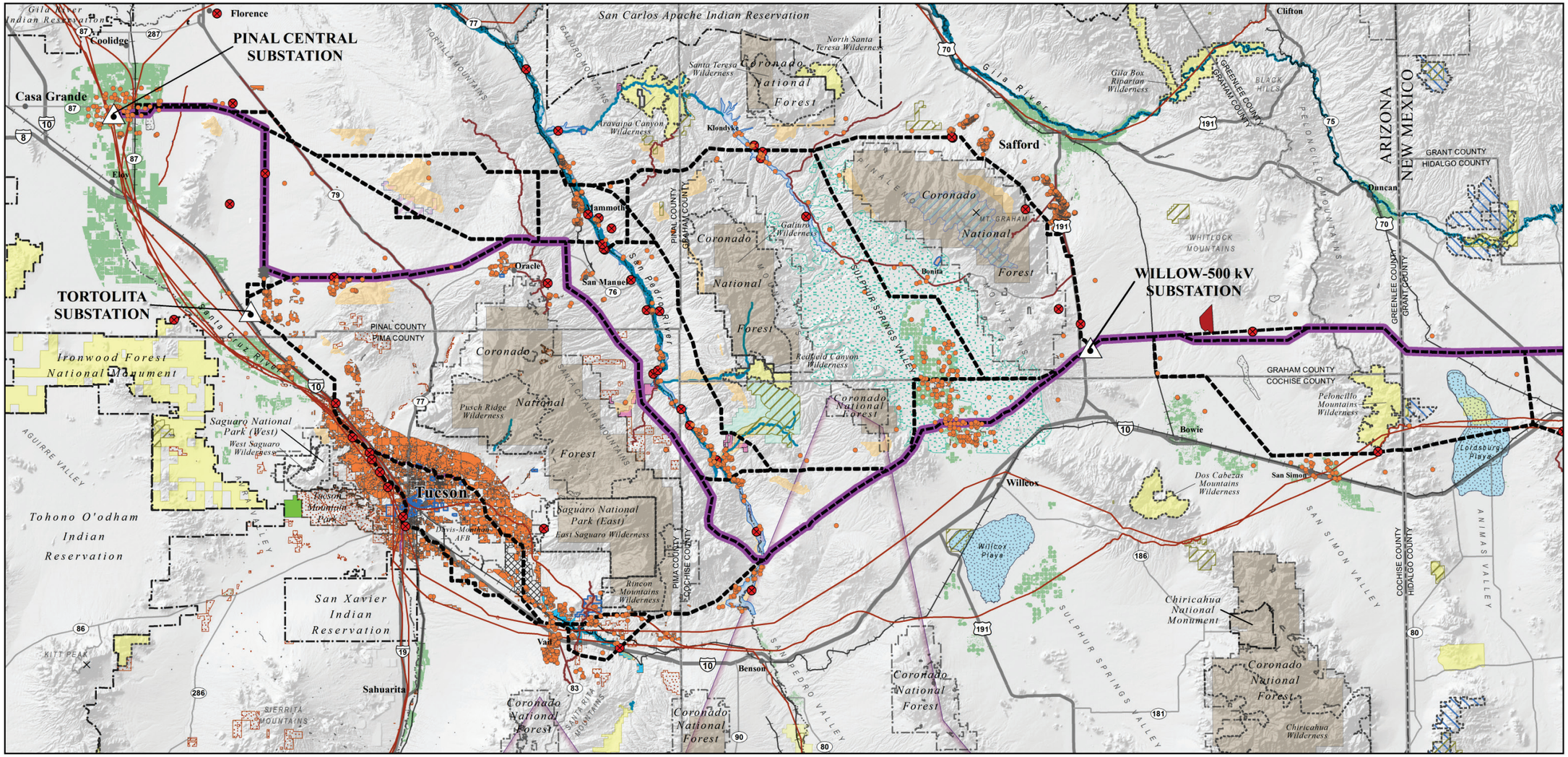


Figure 2-35. Key Issue Areas – Route Group 4

This page intentionally left blank.

2.6 PROPOSED PLAN AMENDMENTS

As described in Chapter 1, Section 1.11, alternatives have been evaluated for conformance with existing BLM RMPs.

In each of the plan amendment locations, the construction and operation of the proposed SunZia transmission line alternatives would not conform to the RMP due to either one of the following conditions: the right-of-way would cross an area designated in the RMP as right-of-way avoidance, or the proposed Project would not comply with VRM objectives. Plan amendments would be required for alternatives where no conforming alternatives could be developed that would meet the purpose and need of the Project.

In addition to the alternative transmission line routes, three plan amendment alternatives have been identified for each of the affected RMPs, as follows:

No Action: If no action is taken, then the right-of-way for the Project would not be granted and no amendment to the affected RMP would be necessary.

Corridor[1] – 400 feet (BLM preferred plan amendment alternative): The affected RMP would be amended to designate a 400-foot-wide corridor that would include the proposed SunZia transmission line right-of-way, and other future rights-of-way, through the BLM right-of-way avoidance areas. The VRM objective would be modified to Class IV within the corridor.

Corridor[1] – 2,500 feet: The affected RMP would be amended to designate a 2,500-foot-wide corridor that would include the proposed SunZia transmission line right-of-way and other future rights-of-way, through the BLM right-of-way avoidance areas. The VRM objective would be modified to Class IV within the corridor.

The corridor alternatives were identified in order to evaluate the environmental effects that would result from a reasonable range of plan amendment alternatives. It is assumed for purposes of this analysis that additional transmission lines or pipelines could be built within a common corridor with sufficient separation between facilities. The nominal 400-foot width would allow a nonexclusive right-of-way for the Project and potentially other additional rights-of-way within the corridor. The width of 2,500 feet represents a typical corridor designation on BLM land and would accommodate multiple rights-of-way for facilities. Minor deviations from the limits of the corridor may be required to accommodate site-specific considerations, and any new rights-of-way would be subject to case-by-case evaluations according to future project applications.

Impacts associated with the plan amendment alternatives are described in Chapter 4. Direct and indirect effects of the Project have been described in the resource sections (4.2 through 4.15). Impacts resulting from corridor plan amendments, including impacts of additional rights-of-way and facilities, are documented in Section 4.18.

The BLM preferred alternative includes proposed plan amendments to the Socorro and Mimbres RMPs for specific corridor locations along the BLM preferred route. The BLM preferred plan

[1] A corridor is defined in BLM Manual 2800 as "a tract of land forming a passageway for linear utilities or transportation uses." Note: The "study corridors" as defined in this EIS are resource-specific and vary between 1,200 feet and 6 miles wide.

amendment alternative is the 400-foot-wide corridor that may be included as an amendment to RMPs for conformance with VRM and right-of-way management objectives. For the proposed action, including alternatives, the following RMPs in New Mexico and Arizona would be subject to amendment:

- Socorro RMP, Socorro Field Office (2010) – BLM preferred alternative
- Mimbres RMP, Las Cruces District Office (1993)) – BLM preferred alternative
- Final Safford District RMP and EIS, Safford District Office (1991)

No amendments to the RMPs in Arizona would be required for the BLM preferred alternative route. Right-of-way avoidance area locations are described in Section 3.10.3.7, VRM classifications are shown in Section 3.9.3, and the analysis of plan amendment alternatives can be found in Section 4.18. The locations of the proposed plan amendments for the BLM preferred alternative are described as follows and are presented on Figure 2-36 through Figure 2-38.

2.6.1 Socorro RMP: Proposed Plan Amendment

For the Socorro RMP, the BLM preferred alternative would affect 384 acres of VRM Class II lands and 295 acres of VRM Class III lands, resulting in nonconformance due to project contrast that would range from strong to moderate/strong along links E101b and E133. The proposed plan amendment would result in a reduction of VRM Class II lands by 0.07 percent and a reduction of VRM Class III lands by 0.06 percent, while VRM Class IV lands would increase by 0.13 percent. Table 2-16 provides a summary of the effects of the proposed plan amendments for VRM conformance within the Socorro Field Office area for the BLM preferred alternative.

Table 2-16. Proposed Plan Amendments – VRM Classifications

Links with VRM Nonconformance (Socorro Field Office, Subroute 1A2)	VRM Classifications within Proposed Plan Amendment Areas for Socorro RMP				VRM Classification Total Change
	Proposed Plan Amendment Area within 400-foot-wide Corridor (acres)	VRM Classifications		Resource Change by Link	
		Socorro RMP Existing VRM Class	Proposed Plan Amendment VRM Class		
E101b	267	Class II	Class IV	Class II: Reduced by 0.05% Class IV: Increased by 0.05%	Class I: Existing 28,718 acres No Change Class II: Existing 510,945 acres Reduced by 383 acres (0.07%) Class III: Existing 448,612 acres Reduced by 294 acres (0.06%) Class IV: Existing 517,330 acres Increased by 681 acres (0.13%)
	189	Class III	Class IV	Class III: Reduced by 0.04% Class IV: Increased by 0.04%	
E133	116	Class II	Class IV	Class II: Reduced by 0.02% Class IV: Increased by 0.02%	
	107	Class III	Class IV	Class III: Reduced by 0.02% Class IV: Increased by 0.02%	

Right-of-way plan amendments would also be required for the Socorro RMP for locations along links A161, E101b, E133, and E211 where the BLM preferred alternative would cross right-of-way avoidance areas. A total of 1,022 acres of avoidance areas would be removed from these lands in the Socorro Field Office for the BLM preferred alternative; a reduction of 1.9 percent. Table 2-17 provides a summary of the effects of the proposed plan amendments for right-of-way avoidance within the Socorro Field Office area for the BLM preferred alternative.

Table 2-17. Proposed Plan Amendments – Right-of-Way Avoidance

BLM Resource Management Plan	BLM Preferred Alternative: Links within Right-of-Way Avoidance Areas	Plan Amendment Change for 400-foot-wide Corridor (acres)	Right-of-Way Avoidance Total Change
Socorro RMP (Subroute 1A2)	A161/E211	495	Existing Right-of-Way Avoidance Area 52,583 acres Reduced by 1,033 (1.9%)
	E101b/E133	538	

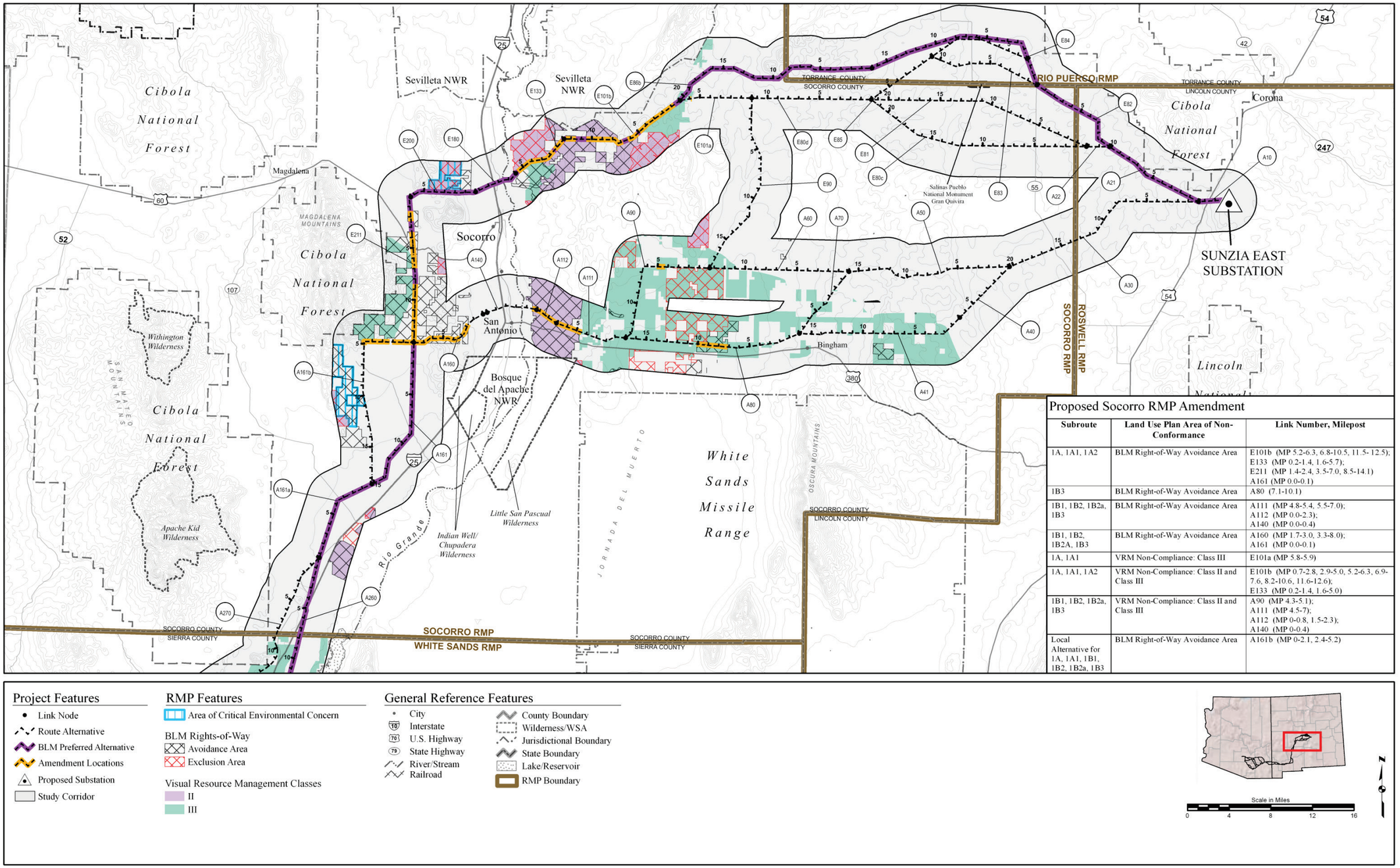
2.6.2 Las Cruces District Office, Mimbres RMP: Proposed Plan Amendment

For the Mimbres RMP, right-of-way plan amendments would be required for links A440, A530, and B120b where the BLM preferred alternative would cross designated avoidance areas. A total of 188 acres would be removed from lands within the Las Cruces District Office area for the BLM preferred alternative; a reduction of 1.9 percent. Table 2-18 provides a summary of the effects of the proposed plan amendments for right-of-way avoidance within the Las Cruces District Office area for the BLM preferred alternative.

Table 2-18. Proposed Plan Amendments – Right-of-Way Avoidance Mimbres RMP

BLM Resource Management Plan	BLM Preferred Alternative: Links within Right-of-Way Avoidance Areas	Plan Amendment Change for 400-foot-wide Corridor (acres)	Right-of-Way Avoidance Total Change
Mimbres RMP, Las Cruces District (Subroute 1A2 and 3A2)	A440	87	Existing Right-of-Way Avoidance Area 9,899 acres Reduced by 194 acres (2.0%)
	A530	92	
	B120b	15	

This page intentionally left blank.



Proposed Socorro RMP Amendment

Subroute	Land Use Plan Area of Non-Conformance	Link Number, Milepost
1A, 1A1, 1A2	BLM Right-of-Way Avoidance Area	E101b (MP 5.2-6.3, 6.8-10.5, 11.5- 12.5); E133 (MP 0.2-1.4, 1.6-5.7); E211 (MP 1.4-2.4, 3.5-7.0, 8.5-14.1) A161 (MP 0.0-0.1)
1B3	BLM Right-of-Way Avoidance Area	A80 (7.1-10.1)
1B1, 1B2, 1B2a, 1B3	BLM Right-of-Way Avoidance Area	A111 (MP 4.8-5.4, 5.5-7.0); A112 (MP 0.0-2.3); A140 (MP 0.0-0.4)
1B1, 1B2, 1B2A, 1B3	BLM Right-of-Way Avoidance Area	A160 (MP 1.7-3.0, 3.3-8.0); A161 (MP 0.0-0.1)
1A, 1A1	VRM Non-Compliance: Class III	E101a (MP 5.8-5.9)
1A, 1A1, 1A2	VRM Non-Compliance: Class II and Class III	E101b (MP 0.7-2.8, 2.9-5.0, 5.2-6.3, 6.9-7.6, 8.2-10.6, 11.6-12.6); E133 (MP 0.2-1.4, 1.6-5.0)
1B1, 1B2, 1B2a, 1B3	VRM Non-Compliance: Class II and Class III	A90 (MP 4.3-5.1); A111 (MP 4.5-7); A112 (MP 0-0.8, 1.5-2.3); A140 (MP 0-0.4)
Local Alternative for 1A, 1A1, 1B1, 1B2, 1B2a, 1B3	BLM Right-of-Way Avoidance Area	A161b (MP 0-2.1, 2.4-5.2)

Project Features
- Link Node
- Route Alternative
- BLM Preferred Alternative
- Amendment Locations
- Proposed Substation
- Study Corridor

RMP Features
- Area of Critical Environmental Concern

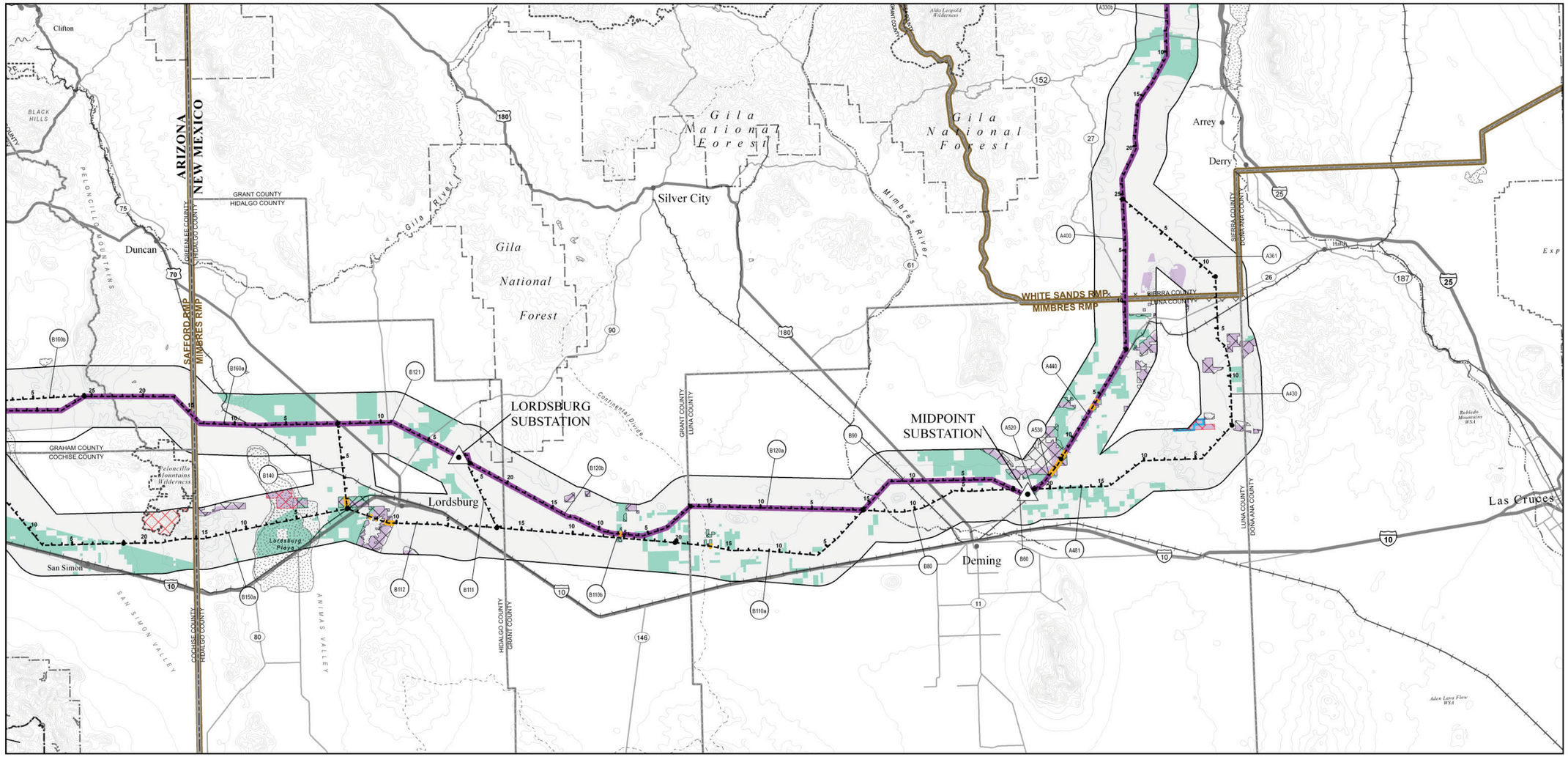
BLM Rights-of-Way
- Avoidance Area
- Exclusion Area

Visual Resource Management Classes
- II
- III

General Reference Features
- City
- Interstate
- U.S. Highway
- State Highway
- River/Stream
- Railroad
- County Boundary
- Wilderness/WSA
- Jurisdictional Boundary
- State Boundary
- Lake/Reservoir
- RMP Boundary

Figure 2-36. Proposed Socorro RMP Amendments

This page intentionally left blank.



Proposed Mimbres RMP Amendment

Subroute	Land Use Plan Area of Non-Conformance	Link Number, Milepost
1A, 1A1, 1A2, 1B1, 1B2, 1B2a, 1B3	BLM Right-of-Way Avoidance Area	A440 (MP 5.6-5.9, 6.2-6.8, 11.5-12.4), A530 (MP 0.0-1.9)
3A, 3A2	BLM Right-of-Way Avoidance Area	B120b (MP 7.6 – 7.9)
3B	BLM Right-of-Way Avoidance Area	B110a (MP 16.6-16.9) B112 (MP 10.2-11.2, 11.5-11.6, 11.9-12.1, 12.5-12.8)
3B	VRM Non-Compliance: Class II	B112 (MP 10.4-11.2)
Crossover Link for 3B, 3A, 3A2	BLM Right-of-Way Avoidance Area	B140 (MP 0.2-1.2)

Figure 2-37. Proposed Mimbres (Las Cruces) RMP Amendments

This page intentionally left blank.

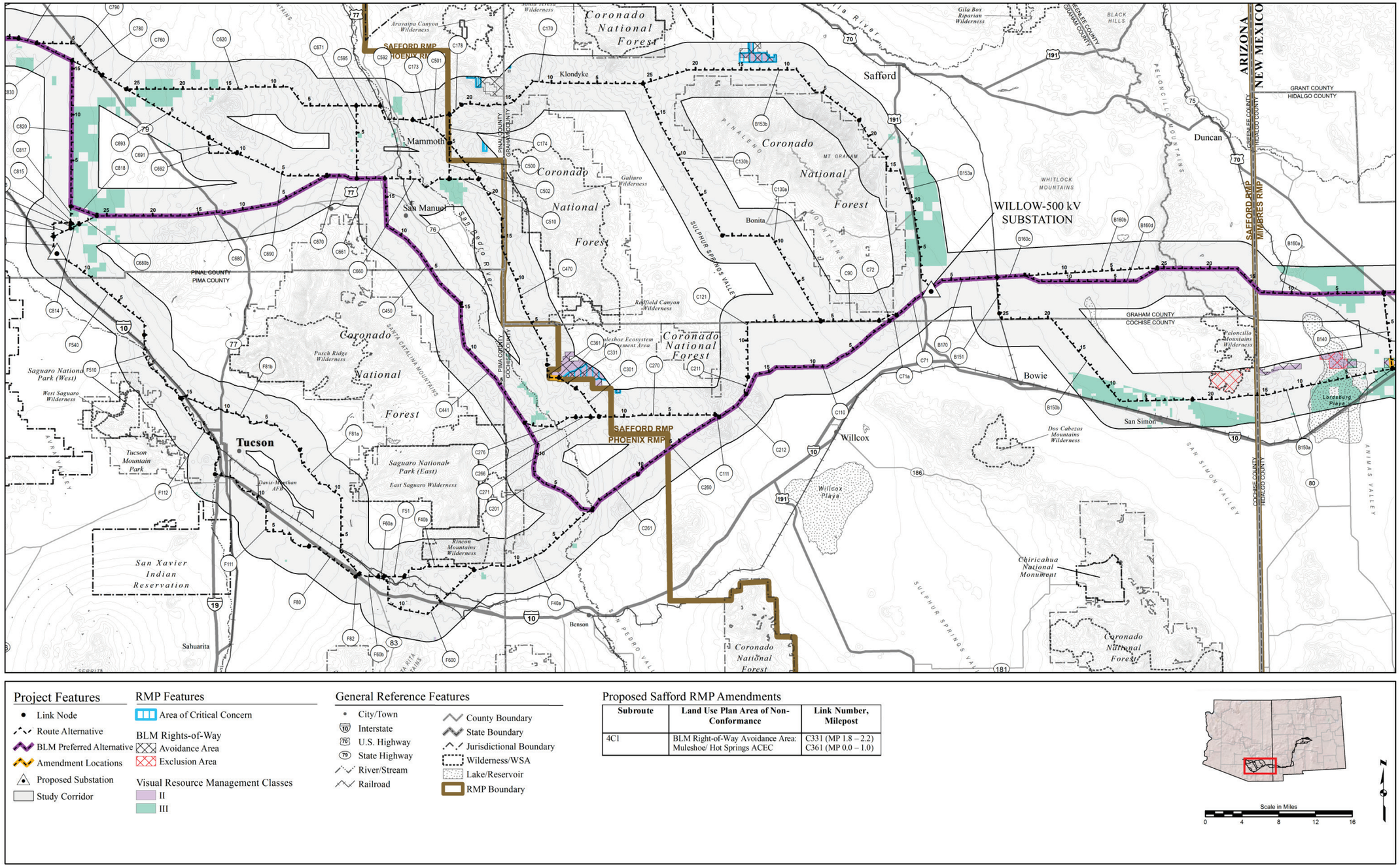


Figure 2-38. Proposed Safford RMP Amendments

This page intentionally left blank.

CHAPTER 3 – AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Chapter 3 includes a description of the environment and resources that have the potential to be affected by the alternatives described in Chapter 2, as well as the current condition of each resource and the relevant characteristics that may be subject to impacts from the Project. Environmental resource baseline information is presented to allow the comparison of potential impacts that could result from the action alternatives and the No Action alternative.

Resources that may be affected by the Project have been carried forward for analysis in this EIS and are discussed in chapters 3 and 4. These resources and land management programs were selected based on federal regulatory requirements and policies, concerns of lead and cooperating agencies, and/or issues identified during scoping, and include:

- Climate and Air Quality
- Earth Resources
  - Geology
  - Minerals
  - Soils
- Paleontological Resources
- Water Resources
- Biological Resources
  - Vegetation
  - Noxious and Invasive Weeds
  - Wildlife
  - Special-status Species
- Wildland Fire Ecology and Management
- Cultural Resources
- Visual Resources
- Land Use and Recreation Resources
- Special Designations
- Wilderness
- Social and Economic Conditions
- Environmental Justice
- Health and Safety/Hazardous Materials (EMF, noise)

Information on the existing condition of each of the resources was compiled from the most recent data available—published and unpublished reports, land use plans, maps, and agency databases. Resource inventories were developed in sufficient detail for the areas within the study corridors to assess the potential impacts that could result from the proposed Project. (A study corridor is the area surrounding the Project alternative centerlines in which a detailed inventory of existing conditions was completed.) While the focused impact analyses specifically address impacts to the affected environment within study corridors, resource data have also been collected outside of the study corridors to indicate regional context. Field reconnaissance was conducted to review baseline resource conditions where needed, and to verify land use and visual resources data. Following the initial inventory effort, federal, state, and land and resource management agencies were contacted to refine and verify or supplement information, and to solicit information regarding issues, concerns, policies, and regulations. The width of the study corridors along the alternative routes differs for each of the resource disciplines, depending on the area that potentially could be affected (Table 3-1).

Table 3-1. Study Corridors by Resource	
Resource[1]	**Study Corridor Width (miles)[2]**
Earth Resources	2
Paleontological Resources	2
Water Resources	—
• Streams, springs, wells, bodies of water	1,200 (feet)
• Unique or impaired waters	0.5
Biological Resources	8
Wildland Fire Ecology and Management	2
Cultural Resources	—
• Class I Archaeological Survey	0.25
• National Registered Historic Properties and other areas[3]	6
Visual Resources	6
Land Use, Recreation, Special Designations	6
Health and Safety/Hazardous Materials	0.2

[1] Analysis of air quality, wilderness, lands with wilderness characteristics, and wilderness study areas is based on regional study area data. Social and economic data in the Project area is based on county and statewide data.
[2] Study corridor width includes specific area of resource analysis. For display purposes, a 6- or 8-mile-wide corridor is shown on the resource maps in the Map Volume.
[3] Includes national parks and monuments, and state register properties

To facilitate the analysis of alternative routes, study corridors are centered on a line referred to as the "reference centerline," which approximates the right-of-way location. The precise location of the right-of-way centerline would be determined through engineering surveys of the selected route prior to transmission line construction. Study corridors include the areas surrounding the eastern and western termini of the Project. Ancillary facilities would be located within the study corridor associated with each alternative route or subroute, which are included as components of the impact assessment. The precise locations of access roads and ancillary facilities, including substations, regeneration stations, and temporary construction areas within the study corridors would be determined prior to construction.

Resource data were assessed along route segments called links. Where appropriate, the resource discussions in this chapter refer to the links shown on the resource maps to provide a geographic reference to the resource data. Resource data are shown on the maps in the Map Volume (figures M1-1 through M10-4).

3.2 CLIMATE AND AIR QUALITY

3.2.1 Introduction, Methods, and Regulatory Framework

3.2.1.1 Introduction

This section describes the climate and baseline air quality conditions existing in the portions of New Mexico and Arizona traversed by the proposed Project, including the types of pollutants and regulations that would apply to construction and operations.

Climate refers to the long-term average and range of weather conditions that prevail at any given place. Climatological "normal" conditions are defined as a 30-year average of weather, most often described in terms of temperature and precipitation.

The Southwest climate is arid to semiarid and warm, with temperatures ranging widely on both daily and seasonal scales. In winter, when easterly storm tracks originating over the Pacific Ocean shift over the region, the Southwest can receive widespread precipitation. The North American monsoon brings summer moisture from a combination of oceanic sources into the Southwest by July, resulting in thunderstorms when local conditions cause air masses to rise (Sheppard et al. 1999).

Precipitation in the Southwest has varied sharply in the past, at timescales ranging from annual to multi-decadal. Past temperature of the Southwest has also varied annually and on decadal scales. There has been a recent upward trend of temperatures, to a point outside the range of variation of past temperature, as reconstructed from tree rings (*ibid*).

Air quality monitoring networks operate in urban and rural areas throughout New Mexico and Arizona, to inform the public about local air quality conditions and to help the regulatory agencies identify sources of air pollution. Various agencies (state, federal, and local), companies, individuals, and organizations collect ambient air quality monitoring data at carefully chosen, representative physical locations. Monitors are sited to determine ambient concentrations of both criteria and hazardous air pollutants. Networks also monitor the nature and causes of visibility impairment in Class I areas (areas where only a small amount of air quality deterioration is allowed) in both states.

3.2.1.2 Methods

Instrumental measurement of temperature and precipitation in the Southwest dates back to the middle to late 1800s. Today, more than 200 cooperative stations in New Mexico and 240 in Arizona gather and report temperature and precipitation data in the Project study area; in addition, the National Weather Service operates one station in Arizona in the area traversed by the subroutes. Automated stations, many at high elevation, monitor levels of precipitation (Sheppard et al. 1999).

One method used in reporting climate data relies on dividing states into climate divisions. A climate division is defined as "a region within a state that is reasonably homogenous with respect to climatic and hydrologic characteristics." Climate divisions of the Southwest generally follow patterns of mean annual precipitation (*ibid*).

Information on current climate in the Project study area was obtained from monitoring station summaries accessed through the Western Regional Climate Center (WRCC) website. Information regarding air quality monitoring in New Mexico and air quality monitoring sites in Arizona was obtained online (New Mexico Environment Department [NMED] 2011a and Arizona Department of Environmental Quality [ADEQ] 2011a, respectively). Current and historical ambient air quality data are available through both sites. Arizona also publishes an annual air quality monitoring summary that includes the stations operated by the ADEQ (2011b) and the data from county and federal sites that operate in the state.

3.2.1.3 Regulatory Framework

Federal

Responsibility for administering and enforcing rules and regulations pertaining to air quality in the Project study area is shared between federal, state, tribal, and county jurisdictions. Regulations and standards to implement the requirements of the federal Clean Air Act are set by the EPA. While the EPA retains authority for certain air quality rules, including most pertaining to emission standards for mobile sources, many requirements are delegated to states and, in some cases, to tribal governments that are treated in the same manner as states.

The EPA has set National Ambient Air Quality Standards (NAAQS) (Table 3-2) for air pollutants considered harmful to public health and the environment. Ambient standards regulate the amount of contaminants in the air due to all sources. Standards have been set for six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), lead, and particulate matter (PM). There are two types of standards: primary standards set to protect public health, and secondary standards set to protect public welfare, including damage to buildings, animals, and vegetation.

Table 3-2. Ambient Air Quality Standards

Pollutant/ Averaging Period	National		Arizona		New Mexico
	Primary Standards	Secondary Standards	Primary Standards	Secondary Standards	Primary Standards
CO: 8 hour	9 ppm (10 mg/m^3)[1]	—	9 ppm (10 mg/m^3)[1] [2]	—	8.7 ppm
CO: 1 hour	35 ppm (40 mg/m^3)[1]	—	35 ppm (40 mg/m^3)[1][2]	—	13.1 ppm
NO_2: Annual arithmetic mean	0.053 ppm (100 µg/m^3)	Same as Primary	0.053 ppm (100 µg/m^3) [2]	Same as Primary	0.05 ppm
NO_2: 24 hour	—	—	—	—	0.10 ppm
NO_2: 1 hour	100 ppb (188.7 µg/m^3)[3]	—	—	—	—
SO_2: Annual arithmetic mean	0.03 ppm (80 µg/m^3)	—	0.03 ppm (80 µg/m^3)[2]	—	0.02 ppm
SO_2: 24 hour	0.14 ppm (365 µg/m^3)[1]	—	0.14 ppm (365 µg/m^3)[1][2]	—	0.10 ppm
SO_2: 3 hour	—	0.5 ppm (1,300 µg/m^3)[1]	—	0.5 ppm (1,300 µg/m^3)[1][2]	—
SO_2: 1 hour	75 ppb (196.4 µg/m^3) [4]	—	—	—	—
O_3: 8 hour[5] (2008 standard)	0.075 ppm	Same as Primary	0.08 ppm[2]	Same as Primary	—
O_3: 8 hour[6] (1997 standard)	0.08 ppm	Same as Primary			
O_3: 1 hour[7]	0.12 µg/m^3	Same as Primary	0.12 µg/m^3	Same as Primary	—
Lead: Rolling 3-month average[8] (2008 standard)	0.15 µg/m^3	Same as Primary	—	—	—
Lead: Quarterly	1.5 µg/m^3	Same as Primary	1.5 µg/m^3[2]	Same as Primary	—

Table 3-2. Ambient Air Quality Standards

Pollutant/ Averaging Period	National		Arizona		New Mexico
	Primary Standards	Secondary Standards	Primary Standards	Secondary Standards	Primary Standards
average[8] (1978 standard)					
PM_{10}: Annual arithmetic mean	—	—	50 $\mu g/m^3$[2]	Same as Primary	—
PM_{10}: 24 hour[9]	150 $\mu g/m^3$	Same as Primary	150 $\mu g/m^3$[2]	Same as Primary	—
$PM_{2.5}$: Annual arithmetic mean[10]	12.0 $\mu g/m^3$	Same as Primary	15.0 $\mu g/m^3$[2]	Same as Primary	—
$PM_{2.5}$: 24 hour[11]	35 $\mu g/m^3$	Same as Primary	65 $\mu g/m^3$[2]	Same as Primary	—
TSP: Annual geometric mean	—	—	—	—	60 $\mu g/m^3$
TSP: 30 day	—	—	—	—	90 $\mu g/m^3$
TSP 7 day	—	—	—	—	110 $\mu g/m^3$
TSP: 24 hour	—	—	—	—	150 $\mu g/m^3$
H_2S: 1 hour	—	—	—	—	0.010 ppm[1]
Total reduced sulfur: 0.5 hour	—	—	—	—	0.003 ppm

Notes:
[1] Not to be exceeded more than once per year.
[2] Pinal County and Pima County ambient standards are the same as the AAAQS.
[3] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
[4] Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
[5] To attain this standard, the 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
[6] [a] To attain this standard, the 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations measured at each monitor, within an area over each year, must not exceed 0.08 ppm. (b) The 1997 standard, and the implementation rules for that standard, will remain in place for implementation purposes as the EPA undertakes rulemaking to address the transition from the 1997 O_3 standard to the 2008 O_3 standard.
[7] [a] The EPA revoked the 1-hour O_3 standard in 1997 in all areas, although some areas have continuing obligations under that standard (anti-backsliding). (b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to one.
[8] Final rule signed October 15, 2008. The 1978 lead standard remains in effect until one year after an area is designated for the 2008 standard (designations were finalized in November 2011), except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
[9] Not to be exceeded more than once per year, on average over 3 years.
[10] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 12.0 $\mu g/m^3$.
[11] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (effective December 17, 2006).
H_2S = Hydrogen sulfide
mg/m^3 = Milligrams per cubic meter
$PM_{2.5}$ = Particulate matter less than 2.5 micrometers
PM_{10} = Particulate matter less than 10 micrometers
ppm = Parts per million
ppb = Parts per billion
TSP = Total suspended particulates
$\mu g/m^3$ = micrograms per cubic meter
Source: EPA 2011a
www.nmcpr.state.nm.us/nmac/parts/title20/20.002.0003.htm. Accessed 1/31/2011.
www.azsos.gov/public_services/Title_18/18-02.htm#Article_2. Accessed 1/31/2011.

Areas that do not meet the NAAQS are designated as nonattainment. Previously designated nonattainment areas that have since reached attainment are referred to as attainment areas with a maintenance plan (attainment/maintenance), or simply as maintenance areas. More stringent air quality regulations apply in these areas. Portions of the route groups that would traverse any nonattainment or maintenance area require a general conformity analysis (see Section 3.2.4).

Ambient air quality standards have not been established for hazardous air pollutants, which are instead regulated on an emission basis by National Emission Standards for Hazardous Air Pollutants (NESHAP). NESHAP regulate emissions from specified emission units and source types. The Project is not expected to use equipment subject to these requirements.

Sensitive areas, such as certain national parks and wilderness, have been designated under the federal Clean Air Act as Class I areas. Class I areas are areas of special national or regional natural, scenic, recreational, or historic value for which federal regulations provide special protection with respect to air quality degradation. There are a total of 21 Class I areas in New Mexico and Arizona.

Regional haze reduces long-range visibility over a wide region. Haze is caused by fine particles and their precursors in the air that are so small they settle out only very slowly. In 1999, the EPA announced the Regional Haze Rule, which calls for state and federal agencies to work together to improve visibility in designated Class I areas, including several in the general area traversed by the Project route groups. States are required to demonstrate reasonable progress towards the national visibility goal established in 1977 by the Clean Air Act, which is "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution." The national goal is to restore natural visibility conditions in Class I areas by the year 2064.

The Western Regional Air Partnership (WRAP) is a voluntary partnership of states, tribes, federal land managers, local air agencies, and EPA that was originally chartered to develop the technical and policy tools needed by western states, including Arizona and New Mexico, and tribes to comply with EPA's regional haze regulations. The organization was re-chartered in 2009. The new charter shifts the emphasis from policy work to technical work. It also shifts the focus from regional haze to a broader one-atmosphere, multi-pollutant approach to western air quality issues.

State

The New Mexico Air Quality Control Act is codified in the New Mexico Statutes Annotated (NMSA), Chapter 74, Article 2. Rules pertaining to air quality in New Mexico are found in Title 20, Chapter 2 of the New Mexico Administrative Code (NMAC), which is administered by the NMED – Air Quality Bureau, in all areas of the state except Bernalillo County and tribal lands. Bernalillo County is a separate jurisdiction for air quality and, in working with the EPA, has the same status as a state.

In Arizona, air quality statutes are codified in Arizona Revised Statutes (ARS), Title 49, Chapter 3. Air quality regulations in Arizona are codified in the Arizona Administrative Code (AAC), Title 18, Chapter 2. Three Arizona counties (Maricopa, Pima, and Pinal) have their own

air pollution control programs and operate pursuant to agreements with the ADEQ, whose Air Quality Division is responsible for regulating air quality in most of the remainder of the state. In general, federal air quality requirements on tribal lands are administered directly by the EPA. However, the GRIC, located just to the northwest of the proposed western terminus of the Project, has recently received approval from the EPA to implement its own air quality program.

In addition to the NAAQS established by the EPA, both New Mexico and Arizona have additional ambient air quality standards that apply within their jurisdictions: the New Mexico Ambient Air Quality Standards and Arizona Ambient Air Quality Standards, respectively (see Table 3-2).

3.2.2 Regional Overview

3.2.2.1 New Mexico

Climate

New Mexico has a mild, arid, or semiarid continental climate characterized by light precipitation totals, abundant sunshine, low relative humidity, and a relatively large annual and diurnal temperature range. Its climate is varied due to the state's diverse topographic features, including high plateaus, mountain ranges, canyons, valleys, and normally dry arroyos. The principal sources of moisture for the scant rains and snows that fall on the state are the Pacific Ocean, 500 miles to the west, and the Gulf of Mexico, 500 miles to the southeast. The highest mountains have climate characteristics common to the Rocky Mountains (WRCC 2011a).

New Mexico is divided into eight climate divisions based on topographic features. The Project route groups are generally confined to three of the eight climate divisions: the Central Highlands, Central Valley, and Southern Desert (Sheppard et al. 1999).

Air Quality

Most areas of New Mexico have been designated as attainment or unclassifiable with respect to the NAAQS. Unclassifiable means that the area lacks sufficient air quality monitoring data to determine whether the ambient standards have been attained. From a regulatory standpoint, unclassifiable areas are treated as attainment areas.

New Mexico has several small, localized areas that are either designated nonattainment, or were formerly nonattainment and now have a maintenance plan (see Section 3.2.4.1). In addition, Luna County, which the proposed Project may cross, and Doña Ana County, which is included in the study area, have fugitive dust problems that are subject to Natural Events Action Plans (NEAP) (see Section 3.2.4.1).

There are nine Class I areas in New Mexico. However, because emissions from Project activities would be temporary and localized to the immediate vicinity of the Project, only those Class I areas located closest to such activities are of concern. These areas include the White Mountain Wilderness in southern Lincoln County, located approximately 30.4 miles from the closest Project alternative, and the Bosque del Apache NWR in south-central Socorro County, located

between 1.8 and 3.2 miles from the closest Project alternate routes (NMED 2011b). (See Existing Land Use and Special Designation Map M 10-1E and M 10-1W for locations of Class I areas.)

3.2.2.2 Arizona

Climate

Arizona has three main topographical areas: (1) a high plateau averaging between 5,000 and 7,000 feet in elevation in the northeast; (2) a mountainous region oriented southeast to northwest, with maximum elevations between 9,000 and 12,000 feet about mean sea level; and (3) low mountain ranges and desert valleys in the southwestern portion of the state. The higher elevations of the state average between 25 and 30 inches of precipitation (rain plus melted snow) annually, while the desert valleys may average as low as 3 to 4 inches per year (WRCC 2011b).

The state is divided into seven climate divisions, of which the Project route groups would traverse only two: the South Central division (including Pinal County) and the Southeast division (including Cochise, Graham, Greenlee, and Pima counties) (Sheppard et al. 1999).

Air Quality

Arizona has a number of nonattainment and maintenance areas in the counties that the Project route groups would traverse (see Section 3.2.4.2).

There are 12 Class I areas in Arizona, 4 of which are located near any Project route alternatives or substations. The proposed transmission line routing lies to the north of both the Chiricahua National Monument (located between 16.7 and 31 miles from the nearest Project route alternatives) and the Chiricahua Wilderness (located approximately 24 to 28 miles from the nearest Project route alternatives) in Cochise County. The Galiuro Wilderness Area (located 2.4 to 15 miles from the nearest Project route alternatives) in Graham County, and both the East and West Units of Saguaro National Park in Pima County are situated in the general vicinity of proposed route group locations (EPA 2011b). The Saguaro National Park East Unit is 4.3 to 35 miles from the nearest Project route alternatives, while the West Unit is located between 1 and 31 miles from various Project route alternatives. (See Existing Land Use and Special Designation Map M 10-1E and M 10-1W for locations of Class I areas.)

3.2.3 Climate

3.2.3.1 New Mexico

During the summer, daytime temperatures often exceed 100 degrees Fahrenheit at elevations below 5,000 feet; while the average monthly maximum temperatures during July (the warmest month) range from slightly above 90 degrees Fahrenheit at the lower elevations to the upper 70s at higher elevations. The warmest days often occur in June, before the thunderstorm season sets in. During July and August, afternoon convective storms tend to decrease solar insolation, lowering temperatures before they reach their potential daily high. A preponderance of clear skies and low relative humidity permits rapid cooling after sundown (WRCC 2011a).

January is the coldest month, with average daytime temperatures that range from the mid-50s in the southern and central valleys to the mid-30s at higher elevations. Temperatures below freezing are common in all sections of the state during the winter. The freeze-free season ranges from more than 200 days in the southern valleys to less than 80 days in the northern mountains (*ibid*).

Average annual precipitation ranges from less than 10 inches over much of the southern desert and the Rio Grande and San Juan valleys, to more than 20 inches at higher elevations; and varies widely from year to year. Summer rains fall almost entirely during brief, often intense thunderstorms.

New Mexico (as well as Arizona) is at the northern fringe of the area affected by the Southwest Monsoon, also known as the North American Monsoon. The monsoon season, characterized by a shift in winds from a southwesterly to a more southeasterly direction, brings a rapid increase in rain in June to southern Mexico, migrating to the southwestern United States in early July. The monsoon season typically ends around mid-September in New Mexico. New Mexico receives 30 to 50 percent of its yearly precipitation between July and September. Winter is the driest season, except for areas west of the Continental Divide. Much of the winter precipitation falls as snow in the mountain areas, but may occur as either rain or snow in the valleys[1] (*ibid*).

Annually, New Mexico receives 75 to 80 percent of possible sunshine. Relative humidity ranges from an average of 65 percent at sunrise to near 30 percent in mid-afternoon; however, afternoon humidity in warmer months is often less than 20 percent and occasionally as low as 4 percent (*ibid*).

Relatively strong winds may accompany frontal activity during late winter and spring months, exceeding 30 miles per hour (mph) for several hours. High winds may also occur in advance of thunderstorms. Spring is considered the windy season. Dust storms can occur during windy periods in dry or drought-affected areas (*ibid*).

Potential evaporation in New Mexico is much greater than average annual precipitation. Periods of recent extreme meteorological drought in the Project study area have been noted in the mid-1930s and in 1947 in the Central Highlands, as well as statewide in the 1950s (*ibid*). Another period of severe drought has affected the region more recently, beginning in 2000. This most recent drought was characterized by warmer temperatures than the 1950s drought, which resulted in widespread mortality to certain types of vegetation (such as piñons) and numerous wildfires (Owen 2008; Guido 2010).

As of July 2012, over 75 percent of the contiguous United States was suffering from some degree of drought or abnormally dry conditions. In New Mexico, much of the southeast quarter of the state was experiencing extreme drought conditions, with most of the project area in severe to moderate drought (WGA 2012). Monsoon rains eased the drought situation somewhat during the latter part of the summer and the National Weather Service's projected outlook expected

[1] www.climas.arizona.edu/sw-climate/monsoon. Accessed September 27, 2012.

drought conditions to continue through the fall, with above normal precipitation for the winter 2012-2013 season[1].

The influence of climate on agriculture is of major importance. Less than 4 percent of the state is under cultivation, with approximately one-third of this area being irrigated, primarily in the southern valleys. Short-season dry land summer crops are grown in some small areas in the Central Highlands. Winter grains require favorable moisture conditions from early fall throughout winter and spring, and short-season row and feed crops depend on summer showers to produce a yield. Stored surface water for irrigation, used principally for cotton, truck and feed crops, and fruit and nuts, depends on adequate winter snows in the mountains of both the northern part of the state and southern Colorado for its initial source (*ibid*).

Livestock raising is the most extensive agricultural pursuit; more than one-half of the state is pastureland. Sufficient moisture usually falls, providing for the growth of good range forage. Because of the mild climate, livestock can live on the open range throughout the year (*ibid*).

3.2.3.2 Arizona

High temperatures are common throughout the summer months at the lower elevations, with temperatures well above 100 degrees Fahrenheit in the desert areas. Extremes occur between day and night temperatures; at times with a 50 to 60 degree Fahrenheit difference between minimum and maximum daily temperatures during the drier months. Lower desert valleys sometimes have several years in succession without freezes (WRCC 2011b).

Precipitation throughout Arizona is governed to a great extent by elevation and season. From November through March, storm systems from the Pacific Ocean cross the state, at times bringing heavy snows to the central and northern parts. Gradual melting of this snow during the spring serves to maintain a supply of water in the state's principal rivers (*ibid*).

Summer rainfall begins early in July, usually lasting until mid-September, and occurs in the form of thunderstorms. Arizona is at the northern fringe of the area affected by the Southwest Monsoon. The monsoon season typically ends around mid-September in Arizona, and the state receives 30 to 50 percent of its yearly precipitation between July and September. The heaviest monsoon thunderstorms are usually found in mountainous regions of the central and southeastern portions of the state[2] (*ibid*).

A large portion of Arizona is classed as arid to semiarid; long periods may occur with little or no precipitation. The air is generally dry and clear, with low relative humidity and a high percentage of sunshine (humidity is low when compared to most other states). Due to high temperatures, dryness of the air, and a high percentage of possible sunshine (86 to 92 percent average), evaporation rates in Arizona are high (*ibid*).

Arizona has experienced significant recent drought conditions. As of July 2012, extreme drought affected the northeast and southwest corners of the state, while the area traversed by Project

[1] www.srh.noaa.gov/productview.php?pil=DGTEPZ. Accessed September 27, 2012.
[2] http://www.climas.arizona.edu/sw-climate/monsoon. Accessed September 27, 2012.

route groups was in severe drought. Monsoon rains eased conditions somewhat during the latter portions of the summer (WGA 2012), with 2012 monsoon rainfall totals generally above normal. The National Weather Service outlook projects a greater chance of above normal precipitation from September through November 2012[1].

Heavy thunderstorms during July and August at times cause flooding, resulting in considerable local damage. The heaviest rains are associated with hurricanes that dissipate as they reach land and occur on average once every 10 years. High winds accompanying heavy thunderstorms during July and August sometimes reach peak gusts of approximately 100 mph in local areas (*ibid*). Such winds can cause blinding dust storms in dry or drought-stricken areas.

3.2.4 Air Quality

3.2.4.1 New Mexico

Grant County is located in southwestern New Mexico. In 1978, the area around the Phelps Dodge Corporation's Hurley smelter/concentrator facility (located in Hurley, New Mexico) was designated nonattainment for SO_2. However, Grant County has not experienced an exceedance of the SO_2 NAAQS since the mid-1970s. The Hurley smelter was closed in 2002 and demolition began in 2005. In September 2003, the EPA approved a redesignation request and maintenance plan for the Grant County nonattainment area. The Grant County maintenance area is located well to the north of any of the Project route group locations (approximately 30 to 40 miles).

Luna County is located in southwestern New Mexico, and has an arid continental climate. Moderate to strong winds of late winter and spring can bring blowing dust. In 2003, violations of the federal standard for PM occurred, requiring the creation of a Luna County NEAP to avoid designation as a nonattainment area. The NEAP for Luna County focuses on the control of man-made sources of dust. Portions of Route Groups 1 and 3 will traverse Luna County.

Doña Ana County (located in the south-central section of the state) borders El Paso, Texas and Ciudad Juarez, Mexico. None of the Route Groups would traverse the county, but certain alternatives would be located less than 10 miles west of the county boundary. The county has historically had air quality problems, including PM and O_3 pollution. There is presently one nonattainment area within Doña Ana County. Anthony, New Mexico, which lies on the border of Texas and New Mexico, is a PM_{10} nonattainment area (so designated by the EPA in 1991).

In recent years, Doña Ana County has not met federal ambient air quality standards for PM_{10}. High levels of PM_{10} are largely due to dust storms throughout the area; however, man-made dust sources are on the rise as Doña Ana becomes more populated. In December 2000, a NEAP for the county was submitted to the EPA, with a focus on controlling man-made sources of wind-blown dust.

In 1995, the EPA declared a 42-square-mile region in the southeast corner of Doña Ana County (including Sunland Park and adjacent areas) as a marginal nonattainment area for the 1-hour ozone standard. The 1-hour ozone standard was revoked by the EPA in 2004, with the adoption

[1] www.srh.noaa.gov/productview.php?pil=DGTTWC. Accessed September 27, 2012.

of a new 8-hour ozone standard; Sunland Park was redesignated to maintenance for this new standard. In March 2008, the federal government lowered the NAAQS for ozone from 0.08 parts per million (ppm) to 0.075 ppm.

For more information regarding New Mexico nonattainment and maintenance areas, see the NMED website.

3.2.4.2 Arizona

An SO_2 nonattainment area in Morenci in Greenlee County was redesignated to attainment/maintenance in 2004, after the copper smelter responsible for the nonattainment designation was dismantled in 1995. This area lies well north of any of the Project route group locations (approximately 25 to 30 miles).

The Douglas area, in southern Cochise County, has both a moderate PM_{10} nonattainment area and a former SO_2 nonattainment area that was redesignated as attainment/maintenance in 2006. Project route groups are located well to the north of both of these areas (approximately 30 to 40 miles).

Ajo (Pima County) has both a PM_{10} nonattainment area and an SO_2 attainment/maintenance area. The Ajo area lies well to the west of any Project route groups (approximately 80 to 100 miles).

The Phoenix metropolitan area, including portions of Maricopa and Pinal counties, is designated nonattainment for the 1997 8-hour O_3 and the PM_{10} NAAQS; and portions of Maricopa County are designated attainment/maintenance for CO. In addition, the EPA has recently concurred with the state of Arizona regarding designation of the Phoenix metropolitan area as nonattainment with the 2008 8-hour O_3 NAAQS (EPA 2011c). None of the proposed Project route groups will traverse these nonattainment or maintenance areas (approximately 25 to 30 miles from Pinal Central Substation).

The Rillito area (Pima County) is designated nonattainment for PM_{10}. The major stationary source in the area is the Arizona Portland Cement Company. Other sources include construction, unstabilized river banks, agriculture, unpaved roads, and unstabilized road shoulders. In 2006, the EPA determined the Rillito nonattainment area had met the PM_{10} standard and qualified for redesignation to attainment; in 2008, a maintenance plan and request for redesignation was submitted to the EPA. Portions of Route Group 4 would traverse the Rillito PM_{10} nonattainment area.

The San Manuel area (Pinal County) is a designated attainment/maintenance area for SO_2. The San Manuel smelter permits were cancelled in March 2005, and the area was redesignated from nonattainment to maintenance in 2008. Portions of Route Group 4 would traverse this attainment/maintenance area.

Tucson (Pima County) was redesignated from nonattainment to attainment/maintenance for CO in 2000. The original nonattainment designation was primarily due to vehicular emissions, which have decreased over time as federal tailpipe emissions standards have been strengthened. Portions of Route Group 4 would traverse the Tucson CO attainment/maintenance area.

The Hayden area (Gila and Pinal counties) includes both PM_{10} and SO_2 nonattainment areas. In the late 1980s, contributors to exceedances of PM_{10} in the area were the copper ore unloading, crushing, and conveying activities at the Ray Unit crushing plant, and road dust. Ambient monitoring data reveal that the Hayden area has met the 24-hour and annual PM_{10} standards for the last several years. The SO_2 nonattainment designation was due to a copper smelting stack and fugitive emissions. The ADEQ has requested redesignation to attainment/maintenance, for which EPA action is pending. Portions of Route Group 4 would be located just south of the Hayden PM_{10} nonattainment and SO_2 nonattainment areas (approximately 5 to 10 miles).

In 2009, the EPA designated the western portion of Pinal County as a nonattainment area for $PM_{2.5}$. Pinal County and the ADEQ subsequently submitted recommendations regarding the boundaries for the nonattainment area, and the EPA finalized designation of a portion of western Pinal County as nonattainment for $PM_{2.5}$ in February 2011 (ADEQ 2011a). Both the Pinal Central Substation and Route Group 4 would be located approximately 19 miles or more to the east of the western Pinal County $PM_{2.5}$ nonattainment area. In May 2012, the EPA designated much of the western half of Pinal County to nonattainment for the 1987 24-hour PM_{10} NAAQS (EPA 2012). Ambient monitors located within this area routinely record concentrations two to three times the level of the standard. A small portion of Route Group 4 and the Pinal Central Substation are located within the new nonattainment area.

For more information regarding Arizona's nonattainment and maintenance areas, see the ADEQ website.

3.2.5 Climate Variability

According to David S. Gutzler (2004), climate variability and change exert profound influences on agriculture, natural ecosystems, wildfires, tourism, and water resources. Climate is determined by fixed or slowly varying factors that modulate weather. The primary factor is the intensity of sunlight, Earth's orbital geometry, and latitude. In addition to the sun's radiation, Earth's surface receives infrared radiation from the atmosphere above. The intensity of infrared radiation is determined by cloud cover, humidity, and the atmospheric concentrations of infrared-absorbing trace gases (greenhouse gases [GHG] such as CO_2 [carbon dioxide]).

Other climatic conditions vary depending on longitude, including the distribution of oceans and continents, continental topography, and land surface cover.

The Project area lies within a latitude zone that encompasses many of the world's deserts. This zone owes its arid character to a global circulation system called the Hadley Cell, which generates a belt of subsiding air that tends to suppress clouds and precipitation. In addition, New Mexico and Arizona's remoteness from oceanic moisture sources acts to keep the climate dry.

Average weather can vary systematically from year to year. Such variability in climate is associated with changes in ocean temperatures that modulate storm tracks and moisture transport for entire seasons or years. Slow variations in ocean temperature and currents, especially in the Pacific Ocean, are a major cause of wintertime climate variability across North America.

The El Niño cycle is the best known and best understood example of annual variability. El Niño is characterized by a tongue of anomalously warm Pacific Ocean surface water that extends

along the equator westward from the South American coast. It pulls the North Pacific atmospheric jet stream, and the storm track associated with it, southward and eastward, with increased precipitation over the southwestern United States. The mirror-image cold phase, La Niña, has the opposite effect; pushing the jet stream northward and leaving Arizona and New Mexico drier than normal. Extreme warm and cold phases tend to occur several years per decade, reaching maximum amplitude in the Northern Hemisphere's winter season.

Recent research suggests that longer, multi-decadal fluctuations in the northern Pacific Ocean also affect precipitation across southwestern North America. Northern Pacific Ocean temperatures seem to vary more slowly than tropical El Niño-related anomalies. This Pacific Decadal Oscillation tends to regulate the effects of El Niño; a negative Pacific Decadal Oscillation brings greater drought to the Southwest, while a positive phase brings wet decades.

Evidence of decade-scale climate variability during the past 1,000 years has recently come to light through examination of annual growth rings in ancient trees. One of the major results of recent tree ring analysis is the discovery of southwestern drought cycles, with intermittent severe droughts recurring every 50 to 100 years.

Forming a backdrop to the Southwest's climate variability are constant climatic shifts that occur over longer time scales. For example, over the past several decades the statewide average temperature in New Mexico has been on a fairly steady rise, with every year since 1992 being warmer than the 1971-2000 climatological average value. On the other hand, the early years of the twentieth century, as well as the 1960s and early 1970s, were generally somewhat cooler than average. The current warming trend is observed across much of the world, consistent with the prevailing hypothesis that such warming can be attributed at least partly to worldwide increases in GHGs in the atmosphere.

3.2.6 Summary of Inventory Results

The following sections present the most representative climate and existing air quality data for each route group.

3.2.6.1 Route Group 1: SunZia East Substation to Midpoint Substation

Table 3-3 summarizes climate statistics for representative locations along each of the subroutes, proceeding in a northeast to southwest direction.

Air quality data are often sparse in nonurban areas or in areas with good air quality. As a result, it is difficult to obtain representative data for many of the route group areas. Of the counties in New Mexico traversed by the various route groups, only Grant and Luna have air quality data available. Several of the monitors are sited in areas of known poor air quality that are not adjacent to the proposed transmission line routes.

Table 3-3. Climate Statistics for Route Group 1: SunZia East Substation to Midpoint Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit. Precipitation and snowfall shown in inches.													
Subroute 1A/1A1/1A2 – North River Crossing													
Socorro, New Mexico (Lat: 34.08, Lon: -106.88, Elev: 1,398 m)													
Average Maximum Temperature	52.3	58.9	66.9	74.9	83.3	90.8	91.7	89.1	83.6	73.3	61.1	50.9	73.1
Average Minimum Temperature	21.9	26.1	31.7	38.7	47.4	54.6	60.7	59.4	51.2	39.7	28.9	22.0	40.3
Average Total Precipitation	0.49	0.30	0.50	0.41	0.58	0.60	1.62	2.03	1.55	1.09	0.54	0.55	10.26
Average Total Snowfall	0.3	0.8	0.4	0	0	0	0	0	0	0.3	0.4	3.5	5.7
Truth or Consequences, New Mexico (Lat: 33.14, Lon: -107.23, Elev: 1,336 m)													
Average Maximum Temperature	56.7	62.5	69.0	77.5	86.6	95.4	95.4	92.3	87.4	77.1	65.3	55.5	76.8
Average Minimum Temperature	27.4	31.6	37.3	44.5	54.1	63.5	67.0	65.1	58.4	46.8	34.6	27.3	46.5
Average Total Precipitation	0.46	0.37	0.33	0.23	0.36	0.84	2.04	2.10	1.62	1.13	0.60	0.85	10.93
Average Total Snowfall	1.2	0.1	0.1	0	0	0	0	0	0	0	0.3	1.9	3.6
Deming, New Mexico (Lat: 32.25, Lon: -107.75, Elev: 1,311 m)													
Average Maximum Temperature	58.1	63.2	70.4	78.6	87.3	95.3	94.6	91.9	87.8	78.3	66.5	57.2	77.5
Average Minimum Temperature	27.1	30.4	35.2	41.6	50.2	59.0	64.3	63.1	56.4	45.0	33.2	27.3	44.5
Average Total Precipitation	0.53	0.60	0.32	0.34	0.25	0.53	1.99	2.00	1.17	0.94	0.67	0.90	10.24
Average Total Snowfall	0.8	0.5	0.1	0.1	0	0	0	0	0	0	0.1	0.5	2.1
Subroute 1B1/1B2/1B3 – San Antonio Crossing													
Bingham 2 NE, New Mexico (Lat: 33.91, Lon: -106.35, Elev: 1,692 m)													
Average Maximum Temperature	50.6	56.0	63.4	71.5	80.8	89.5	90.1	87.2	82.0	71.8	59.4	50.2	71.1

Table 3-3. Climate Statistics for Route Group 1: SunZia East Substation to Midpoint Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit. Precipitation and snowfall shown in inches.													
Average Minimum Temperature	22.5	26.1	30.9	37.2	46.5	55.2	60.3	59.5	52.6	41.4	30.2	22.4	40.5
Average Total Precipitation	0.52	0.66	0.57	0.46	0.60	0.94	2.48	2.40	1.46	1.39	0.69	0.74	12.91
Average Total Snowfall	1.4	1.7	1.2	0.1	0	0	0	0	0	05	0.2	2.4	8.5
Truth or Consequences, New Mexico: See Subroute 1A – North River Crossing													
Deming, New Mexico: See Subroute 1A – North River Crossing													
Source: National Climatic Data Center 2011 (period of record: 1981-2010)													

Table 3-4 summarizes the most recent available air quality data in southern New Mexico that may be applicable to the transmission line route groups. It presents the highest and second highest measured values at the designated monitor, as well as the annual average measured concentrations for pollutants with an annual averaging period. Note that no CO or lead data are available in these counties. The EPA finalized designations with respect to the 2008 revised lead standard in November 2011; no areas within New Mexico are considered nonattainment with those standards. Similarly, there are no CO nonattainment areas in the Project study area.

Table 3-4. New Mexico Air Quality Data						
Location	**Year**	**Pollutant**	**Averaging Period**	**First Maximum**	**Second Maximum**	**Annual Average**
Deming (Luna County)	2010	O_3	8-hour	0.064 ppm	0.060 ppm	—
Hurley (Grant County)	2010	O_3	8-hour	0.078 ppm	0.071 ppm	—
Las Cruces/Doña Ana County	2010	Ozone	8-hour	0.068 ppm	0.067 ppm	—
Santa Teresa/Doña Ana County	2010	Ozone	8-hour	0.067 ppm	0.065 ppm	—
Deming (Luna County)	2010	NO_2	1-hour	27 ppb	25 ppb	—
			Annual	—	—	0.011 ppm
Santa Teresa/Doña Ana County	2010	NO_2	1-hour	43 ppb	43 ppb	—
			Annual	—	—	0.014 ppm
Hurley(Grant County)	2010	SO_2	1-hour	3 ppb	2 ppb	—
			3-hour	0.001 ppm	0.001 ppm	—
			24-hour	0.001 ppm	0.001 ppm	—
			Annual	—	—	0.0002 ppm
Deming (Luna County)	2010	PM_{10}	24-hour	43 $\mu g/m^3$	33 $\mu g/m^3$	—
			Annual	—	—	17.0 $\mu g/m^3$
Silver City (Grant County)	2010	PM_{10}	24-hour	30 $\mu g/m^3$	26 $\mu g/m^3$	—
			Annual	—	—	15.4 $\mu g/m^3$

Table 3-4. New Mexico Air Quality Data						
Location	**Year**	**Pollutant**	**Averaging Period**	**First Maximum**	**Second Maximum**	**Annual Average**
Hurley (Grant County)	2010	PM_{10}	24-hour	26 μg/m^3	20 μg/m^3	—
			Annual	—	—	11.7 μg/m^3
Anthony/Doña Ana County	2010	PM_{10}	24-hour	45 μg/m^3	40 μg/m^3	—
			Annual	—	—	24.2 μg/m^3
Sunland Park/Doña Ana County	2010	PM_{10}	24-hour	62 μg/m^3	48 μg/m^3	—
			Annual	—	—	24.4 μg/m^3
Silver City (Grant County)	2010	$PM_{2.5}$	24-hour	11.8 μg/m^3	11.2 μg/m^3	—
			Annual	—	—	4.3 μg/m^3
Sunland Park/Doña Ana County	2010	$PM_{2.5}$	24-hour	50.2 μg/m^3	47.8 μg/m^3	—
			Annual	—	—	8.8 μg/m^3
Las Cruces/Doña Ana County	2010	$PM_{2.5}$	24-hour	14.5 μg/m^3	8.3 μg/m^3	—
			Annual	—	—	4.5 μg/m^3
Source: EPA 2011d						

3.2.6.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Climate statistics are summarized for representative locations along subroutes 3A and 3B, proceeding in a northeast to southwest direction. Air quality data in southwest New Mexico applicable to Route Group 3 are presented in Table 3-5. Air quality data in Arizona are scarce outside urban areas and areas with known poor air quality.

Table 3-5. Climate Statistics for Route Group 3: Midpoint Substation to Willow-500 kV Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit. Precipitation and snowfall shown in inches.													
Subroute 3A/3A2 – North													
Deming, New Mexico. See Subroute 1A – North River Crossing													
Lordsburg 4 SE, New Mexico (Lat: 32.31, Lon: -108.65, Elev: 1,294 m)													
Average Maximum Temperature	59.7	64.5	71.5	80.1	89.6	97.6	97.2	94.2	90.2	80.3	68.5	58.7	79.4
Average Minimum Temperature	24.5	27.2	31.4	37.5	47.3	56.9	63.4	62.1	54.5	42.2	30.1	24.4	41.9
Average Total Precipitation	0.91	0.83	0.74	0.34	0.34	0.51	2.08	2.19	1.15	1.14	0.87	1.23	12.33
Average Total Snowfall	0.6	0.7	0.1	0	0	0	0	0	0	0	0.1	1.5	3.0
Bowie, Arizona (Lat: 32.31, Lon: -109.52, Elev: 1,157 m)													
Average Maximum Temperature	61.0	65.6	72.1	80.3	89.1	97.5	97.2	94.1	90.6	80.9	69.5	60.5	79.9
Average Minimum Temperature	30.8	34.3	38.9	44.8	52.9	61.7	66.7	65.5	59.3	48.0	36.5	30.3	47.6
Average Total Precipitation	1.07	0.86	0.59	0.29	0.40	0.40	2.24	2.13	1.02	1.14	0.79	1.17	12.10
Average Total Snowfall	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0.6	0.9
Subroute 3B – South													
Same as Subroute 3A/3A2 – North													
Source: National Climatic Data Center 2011 (period of record: 1981-2010)													

Table 3-6 presents the highest and second highest measured values at the designated monitor, as well as the annual average measured concentrations for pollutants with an annual averaging period. No lead data are available in these counties. The EPA finalized designations with respect to the 2008 revised lead standard in November 2011; no areas within Arizona are considered nonattainment with those standards. However, monitoring requirements associated with the 2008 lead standards prompted the state of Arizona to install lead monitoring networks in late 2011 that will provide data in future years. Lead monitors were located in the Miami area (Gila County) and the Hayden area (near the border of Gila and Pinal counties), to monitor specific sources of lead. A third monitor was located in Maricopa County, to monitor lead in the Phoenix metropolitan area.

Table 3-6. Arizona Air Quality Data

Location	Year	Pollutant	Averaging Period	First Maximum	Second Maximum	Average
Chiricahua National Monument (Cochise County)	2010	O_3	8-hour	0.074 ppm	0.072 ppm	—
22nd and Craycroft (Tucson, Pima County)	2010	O_3	8-hour	0.068 ppm	0.067 ppm	—
Tucson Fairgrounds (Pima County)	2010	O_3	8-hour	0.074 ppm	0.072 ppm	—
Casa Grande Airport (Pinal County)	2010	O_3	8-hour	0.071 ppm	0.070 ppm	—
22nd and Craycroft (Tucson, Pima County)	2010	Nitrogen oxides	1-hour	63.7 ppb	58.3 ppb	—
			Annual	—	—	.027 ppm
22nd and Craycroft (Tucson, Pima County)	2010	SO_2	1-hour	14 ppb	11 ppb	—
			3-hour	0.006 ppm	0.005 ppm	—
			24-hour	0.002 ppm	0.001 ppm	—
			Annual	—	—	0.002 ppm
Douglas Red Cross (Cochise County)	2010	PM_{10}	24-hour	83 $\mu g/m^3$	81 $\mu g/m^3$	—
			Annual	—	—	32.5 $\mu g/m^3$
Corona de Tucson (Pima County)	2010	PM_{10}	24-hour	31 $\mu g/m^3$	29 $\mu g/m^3$	—
			Annual	—	—	13.2 $\mu g/m^3$
Ajo (Tucson, Pima County)	2009	PM_{10}	24-hour	42 $\mu g/m^3$	34 $\mu g/m^3$	—
			Annual	—	—	20 $\mu g/m^3$
Mammoth (Pinal County)	2010	PM_{10}	24-hour	46 $\mu g/m^3$	38 $\mu g/m^3$	—
			Annual	—	—	14.7 $\mu g/m^3$
Casa Grande Downtown (Pinal County)	2010	PM_{10}	24-hour	136 $\mu g/m^3$	101 $\mu g/m^3$	--
			Annual	—	—	39.4 $\mu g/m^3$

Table 3-6. Arizona Air Quality Data						
Location	**Year**	**Pollutant**	**Averaging Period**	**First Maximum**	**Second Maximum**	**Average**
Pinal County Housing Complex (Pinal County)	2010	PM_{10}	24-hour	128/130/1761 $\mu g/m^3$ [a]	102/111/182 $\mu g/m^3$ [a]	—
			Annual	—	—	42.7/43.7/57.7 $\mu g/m^3$ [a]
Cowtown Road (Pinal County)	2010	$PM_{2.5}$	24-hour	39.5 $\mu g/m^3$	27.1 $\mu g/m^3$	—
			Annual	—	—	12.3 $\mu g/m^3$
Douglas Red Cross (Cochise County)	2010	$PM_{2.5}$	24-hour	13.0 $\mu g/m^3$	9.6 $\mu g/m^3$	—
			Annual	—	—	6.3 $\mu g/m^3$
22nd and Craycroft (Tucson, Pima County)	2010	CO	1-hour	2.0 ppm	—	—
			8-hour	1.1 ppm	0.9 ppm	—
[a] Three monitors at this location Source: EPA 2011d						

3.2.6.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Table 3-7 summarizes climate statistics for representative locations along the subroutes of Route Group 4, proceeding in a northeast to southwest direction. (Air quality data for the area traversed by Route Group 4 is shown in Table 3-6.)

Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit; precipitation and snowfall shown in inches.													
Subroute 4A – North of Mt. Graham													
Bowie, Arizona: See Subroute 3A1/3A – North													
Safford, Arizona (Lat: 32.82, Lon: -109.68, Elev: 900 m)													
Average Maximum Temperature	60.7	65.2	71.7	80.4	90.1	98.5	98.2	95.7	92.3	82.6	70.1	60.0	80.5
Average Minimum Temperature	29.5	32.8	38.3	44.7	53.3	61.9	68.4	67.2	60.0	48.1	36.2	29.1	47.5
Average Total Precipitation	0.76	0.75	0.62	0.29	0.25	0.29	1.50	1.91	1.02	0.87	0.54	0.87	9.67
Average Total Snowfall	0.2	0.3	0	0	0	0	0	0	0	0	0	0.2	0.7
San Manuel, Arizona (Lat: 32.60, Lon: -110.63, Elev: 1,055 m)													
Average Maximum Temperature[1]	60.2	64.3	70	77.9	87.5	96.8	97	94.1	90.6	81.2	69.1	61.1	79.1

Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit; precipitation and snowfall shown in inches.													
Average Minimum Temperature[1]	34.5	37	41.2	46.5	55	65	69.7	67.3	63.3	53.2	41.6	35.6	50.8
Average Total Precipitation	1.19	1.26	0.99	0.40	0.39	0.25	2.55	3.04	1.26	0.90	0.69	1.11	14.03
Average Total Snowfall	0.5	0.3	0	0.1	0	0	0	0	0	0	0	0.3	1.2
Casa Grande, Arizona (Lat: 32.89, Lon: -111.71, Elev: 428 m)													
Average Maximum Temperature	69.2	73.0	79.2	88.0	97.2	105.9	107.1	105.1	101.0	90.3	78.0	67.9	878.5
Average Minimum Temperature	38.0	40.8	45.4	51.2	59.6	68.0	76.1	75.3	68.3	55.7	43.8	37.0	55.0
Average Total Precipitation	0.86	0.93	1.03	0.27	0.20	0.18	0.90	1.72	0.73	0.52	0.56	1.14	9.04
Average Total Snowfall	0	0	0	0	0	0	0	0	0	0	0	0	0
Subroute 4B – Sulphur Springs Valley													
Bowie, Arizona: See Subroute 3A – North													
Fort Grant, Arizona (Lat: 32.62, Lon: -109.94, Elev: 1,478 m)													
Average Maximum Temperature	56.3	59.5	66.9	75.0	84.4	93.3	91.4	90.0	87.3	78.3	67.2	56.4	75.6
Average Minimum Temperature	31.7	33.2	40.3	44.7	53.4	61.7	63.8	63.0	60.6	47.9	40.7	32.1	47.8
Average Total Precipitation	1.40	1.24	1.19	0.35	0.49	0.37	2.43	2.71	1.62	1.02	0.75	1.03	14.60
Average Total Snowfall[1]	0.6	0.6	0.6	0.5	0	0	0	0	0	0	0.3	0.9	3.5
San Manuel, Arizona: See Subroute 4A – North of Mt. Graham													
Casa Grande, Arizona: See Subroute 4A – North of Mt. Graham													
Subroute 4C1/4C2/4C2c – San Pedro Valley													
Subroute 4C1 – East of San Pedro River to Pinal Central Substation Subroute 4C2 – West of San Pedro River to Pinal Central Substation													
Bowie, Arizona: See Subroute 3A – North													
Willcox, Arizona (Lat: 32.26, Lon: -109.85, Elev: 1,272 m)													
Average Maximum Temperature	61.2	65.1	71.4	79.0	87.6	95.6	95.7	92.8	89.9	80.3	69.6	60.2	79.1

Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit; precipitation and snowfall shown in inches.													
Average Minimum Temperature	28.4	31.2	35.0	40.2	48.5	57.0	64.7	63.7	56.5	44.4	33.4	27.5	44.3
Average Total Precipitation	1.09	0.93	0.68	0.33	0.39	0.46	2.61	2.53	1.18	1.16	0.71	1.25	13.32
Average Total Snowfall	0.8	1.0	0.1	0	0	0	0	0	0	0	0.1	0.7	2.7
San Manuel, Arizona: See Subroute 4A – North of Mt. Graham													
Casa Grande, Arizona: See Subroute 4A – North of Mt. Graham													
Subroute 4C3 – Tucson													
Bowie, Arizona: See Subroute 3A – North													
Benson 6 SE, Arizona (Lat: 31.88, Lon: -110.24, Elev: 1,125 m)													
Average Maximum Temperature	63.2	66.4	71.7	79.2	88.3	97.0	95.9	92.7	90.5	81.5	71.5	63.0	80.1
Average Minimum Temperature	27.5	30.0	34.3	40.6	48.5	56.9	64.9	64.1	57.6	44.4	33.0	27.3	44.2
Average Total Precipitation	0.72	0.68	0.64	0.35	0.22	0.47	2.81	3.04	1.28	0.96	0.49	1.04	12.70
Average Total Snowfall[1]	0.1	0	0	0	0	0	0	0	0	0	0	0	0.1
Tucson WFO, Arizona (Lat: 32.23, Lon: -110.95, Elev: 742 m)													
Average Maximum Temperature	64.9	68.2	73.9	81.5	90.8	99.1	98.9	96.9	94.1	84.2	73.0	64.4	82.6
Average Minimum Temperature	41.6	44.2	48.4	54.7	63.5	71.7	75.7	74.6	70.5	59.2	48.0	40.8	57.8
Average Total Precipitation	0.97	0.93	0.77	0.36	0.17	0.21	2.34	2.24	1.18	0.86	0.62	0.97	11.62
Average Total Snowfall	0.2	0	0	0	0	0	0	0	0	0	0	0.1	0.3
Casa Grande, Arizona: See Subroute 4A – North of Mt. Graham													
Source: Unless otherwise noted, National Climatic Data Center 2011 [1] San Manual, AZ temperature data and Fort Grant, AZ snowfall data: WRCC 2011c. Period of record 1981-2010 except San Manual temperature (6/1/1954-9/30/2011) and Fort Grant, AZ snowfall (1/1/1900-10/31/2011)													

3.3 EARTH RESOURCES

3.3.1 Introduction, Methods, and Regulatory Framework

This section presents an overview of the geology, geological hazards, mineral resources, and soil resources that occur within the Project study area. The earth resources maps (see Map Volume) display all earth resources within a 6-mile-wide study corridor; however, the extent of the data used for the analysis inventory and impact assessment is described for each of the resources in the following sections.

Based on the results of preliminary research, the public scoping process, and consultation with the BLM, the following earth resources and other areas of concern were identified:

- Wind and water erosive soils in the Rio Grande, Sulphur Springs, and San Pedro river valleys
- Active mines and mining claims
- Fissures located near the Pinal Central Substation
- Geological hazards between Aravaipa Canyon and Safford
- Designated Prime or Unique Farmland soils

3.3.1.1 Methods

Information for geological hazards was obtained from scientific literature, including publications, maps, GIS data, and discussions with agency specialists at the BLM, U.S. Geological Survey (USGS), New Mexico Bureau of Geology and Mineral Resources (NMBGMR), and Arizona Geological Survey (AZGS). Geological formations, earthquake epicenters, Quaternary faults, fissures, and percent slope were recorded and mapped using GIS. These data sets were analyzed within study corridors that are 2 miles wide.

The purpose of the mineral resource inventory was to identify areas with active mining claims, mining material sites, oil and gas leases, and geothermal resources. Information for the inventory was obtained from scientific literature, including publications, maps, and discussions with agency specialists at the BLM, USGS, NMBGMR, AZGS, and state land departments of New Mexico and Arizona. Additional information was obtained from other federal and state sources, including the Arizona Department of Mines and Minerals, and the New Mexico Resource GIS program. The mineral resources inventory was conducted using the BLM and USGS' Geocommunicator service and LR2000 database. The Geocommunicator provides geospatial data based on the LR2000 database in the form of GIS-ready, downloadable data files. These publicly available information storehouses provide maps and detailed descriptions of mineral resource extraction efforts in operation on federally owned or controlled land. Searches for a wide number of mineral resources were conducted using these databases, including active mining claims; mineral resource localities; and leases for oil, gas, coal, and geothermal resources. The results of these searches were compiled into a GIS that included the Project study area, to determine which mineral resource localities might be impacted by Project routes. Results were analyzed within 2-mile-wide study corridors.

Soil survey data were derived from the Soil Data Mart[1] of the Natural Resources Conservation Service (NRCS), a division of the U.S. Department of Agriculture (USDA). Data include the spatial and tabular GIS data necessary to create maps of the soil resources within the Project study area. Soil survey data are available from two different databases: the State Soil Geographic database (STATSGO) and the Soil Survey Geographic database (SSURGO). STATSGO surveys are mapped at a smaller scale than SSURGO surveys, and cover an entire state; SSURGO surveys typically cover county-sized areas. The soil surveys used in this EIS were compiled as part of the SSURGO database, which maximizes the detail and accuracy of the soil resource inventory. Twenty-one completed, individual SSURGO soil surveys (7 in New Mexico and 10 in Arizona) provide large-scale coverage of the Project study area, ranging in scale from 1:20,000 to 1:63,630 (Table 3-8). The STATSGO surveys for New Mexico and Arizona provide smaller-scale coverage (1:250,000) of areas that are not covered by SSURGO surveys. SSURGO data gaps within the Project study area are largely restricted to land administered by the USFS in New Mexico and Arizona; however, none of the current routes crosses USFS land. Another data gap is present in southwestern Graham County, Arizona. As currently mapped, approximately 70 miles of alternative routes cross lands that are not covered by the SSURGO database. This area is currently being mapped by the Tucson office of the NRCS, which is providing provisional data as it becomes available, as part of soil survey AZ673. In these areas, data from the STATSGO databases will be used in place of the missing SSURGO data. Data sets were analyzed within 2-mile-wide study corridors.

The Redington and Winkelman NRCDs and the Cascabel Working Group (Cascabel Working Group 2010a, b) provided additional data that describes environmental conditions within the San Pedro River and Aravaipa Creek watersheds. The information was reviewed and found to be generally consistent with data from the NRCS.

Table 3-8. SSURGO Soil Surveys in the Project Study Area

Survey Number	Year	Survey Area
New Mexico		
NM023	2009	Hidalgo County
NM029	2006	Luna County
NM612	2008	Valencia County – Eastern Part
NM660	2008	Sierra County
NM662	2008	Grant County
NM664	2008	Socorro County
NM674	2009	Torrance County
NM690	2009	Doña Ana County
Arizona		
AZ659	2008	Pinal County – western part
AZ661	2009	Eastern Pinal and Southern Gila counties
AZ662	2008	Safford area; parts of Graham County
AZ663	2009	Gila-Duncan area; parts of Graham and Greenlee counties

[1] http://soildatamart.nrcs.usda.gov/

Table 3-8. SSURGO Soil Surveys in the Project Study Area		
Survey Number	**Year**	**Survey Area**
AZ664	2008	San Simon area; parts of Cochise, Graham, and Greenlee counties
AZ665	2008	Willcox area; parts of Cochise and Graham counties
AZ666	2009	Cochise County – northwest part
AZ668	2008	Tucson-Avra Valley; parts of Pima County
AZ669	2008	Pima County – eastern part
AZ703	2008	Tohono O'odham Nation; parts of Maricopa, Pima, and Pinal counties
AZ673	In Progress	Southwestern Graham County

3.3.1.2 Regulatory Framework

Federal

The NEPA, FLPMA, and Farmland Protection Policy Act of 1981 (FPPA) serve as the primary federal legislation requiring the assessment and mitigation of potential impacts to geological resources, including mineral and soil, on federally administered land. The NEPA (42 USC 4321-4347) directs federal agencies, including the BLM, to assess impacts, adverse and otherwise, to the environment. The FLPMA incorporated the Mining Law of 1872 with several provisions to aid in managing resources on public land, and provides for management and mitigation of adverse impacts on federal land by protecting "the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values" (PL 94-579). The FPPA (PL 97-98, Subtitle I of Title XV, Sec. 1539-1549) requires the assessment of impacts to farmland, namely the conversion of farmland to nonagricultural purposes.

Additional federal legislation that requires assessment and mitigation includes:

- Mineral Leasing Act of 1920 (30 USC 181) – changed the development of deposits, such as coal, petroleum, and natural gas, from claim staking to leasing
- Mineral Materials Act of 1947 (30 USC 601) and the Multiple Surface Use Mining Act of 1955 (30 USC 611-615) – provided provisions for the mining, disposal, and sale of materials, such as sand and gravel (BLM 2010d)
- Multiple Mineral Development Act of 1954 (30 USC Chapter 12, 521) – permits the use of public land for both mining operations and leasing operations
- Geothermal Steam Act of 1970 (30 USC Chapter 23) – allows for the leasing of geothermal resources on public land

State

New Mexico

The Minerals Group of the NMSLO is responsible for leases on state land for commodities such as sand and gravel, limestone, coal, and geothermal resources. NMSA Title 19, Chapter 2, includes applicable laws for governing minerals, mines, and leases on New Mexico state land.

Arizona

The ASLD is responsible for mining activities and mineral resources on state land. ARS Titles 12, 27, and 37 are the applicable state laws for governing minerals, mines, leases, and geothermal resources on Arizona state land.

3.3.2 Regional Overview

3.3.2.1 New Mexico

In New Mexico, the Project study corridors are within the Chihuahuan Desert ecoregion, which includes a large range of subregions such as basins and playas, lava malpais or badlands, grasslands, and the floodplain of the Rio Grande (Griffith et al. 2006).

In the Project study area, the Rio Grande Valley runs from the Socorro area south through El Paso, Texas. The Rio Grande lies within the Rio Grande Rift, a zone of faults that stretches from Mexico to the Colorado-New Mexico state line. The rift began approximately 24 million years ago as a series of topographically closed basins that filled with aeolian, alluvial, and volcanic deposits between the Miocene and Pleistocene epochs (Bartolino and Cole 2002).

Southwestern New Mexico is typical of the Basin and Range Province (Fenneman 1931), consisting of several basins separated by mountains. The basins are filled with Pliocene-Pleistocene alluvium, and several have old playas.

- The Animas Basin – near Lordsburg, is a remnant of the Pleistocene Lake Animas (Hawley et al. 2000). It is bounded by the Peloncillo Mountains to the west and the Animas and Pyramid Mountains to the east. The Animas Basin extends from Mexico northward to an area northwest of Lordsburg (Reeder 1957).
- The Mimbres Basin – is bounded by the Black Range to the north, the Goodsight Mountains and West Potrillo Mountains to the east, and the Cedar Mountain Range to the west; the southern boundary extends into Mexico (Hanson et al. 1994). It consists of rocks ranging in age from Precambrian to Quaternary.
- The Gila River Valley – near Duncan, is part of the Mexican Highland physiographic subdivision. The Mexican Highland runs from southeastern Arizona to north-central New Mexico and includes Pliocene-Pleistocene alluvial and lacustrine deposits in the basins, and Proterozoic through Cenozoic rocks in the mountains (Connell et al. 2005).

3.3.2.2 Arizona

Southeastern Arizona is also typical of the Basin and Range Province physiographic range, having wide basins separated by mountain ranges (Fenneman 1931). The San Simon Valley is one of these basins, which began forming approximately 17 million years ago and is filled with more than 10,000 feet of fluvial, playa, and lacustrine deposits ranging in age from Miocene to Pleistocene (Houser et al. 2004). The Peloncillo Mountains, northeast of the San Simon Valley, consist mostly of Tertiary volcanic rocks. The Pinaleño Mountains to the west consist predominantly of granitic rocks of Precambrian age (*ibid*). West of the Pinaleño Mountains is the

Sulphur Springs Valley. As in southwestern New Mexico, old playas representing ancient lake beds are found in this area, such as the Willcox Playa.

The San Pedro River/Santa Cruz River area consists of several valleys separated by mountain ranges. The San Pedro River enters Arizona from Mexico just west of Naco, and travels northward to Benson and Mammoth, eventually joining the Gila River near Hayden. The San Pedro River Valley was formed during the late Miocene between 14 and 6 million years ago (Lindsay 1984) and contains basin-filling sediment ranging in age from late Miocene to Pleistocene. The Galiuro Mountains, east of the San Pedro River, consist mostly of Miocene volcanic rocks, although Upper Jurassic through Paleocene sedimentary rocks are present as well. The Santa Cruz River valley was formed approximately 17 million years ago and also consists of basin-fill deposits of Miocene to Pleistocene age (Gettings and Houser 1997). The Santa Rita Mountains lie east of the Santa Cruz River in Santa Cruz and Pima counties. They have a complex geological history dating back to the Precambrian, with sedimentary, volcanic, and intrusive rocks found there. West of the Santa Cruz River are the Tumacacori and Sierrita mountains, which consist of Mesozoic rocks that overlie Paleozoic bedrock (AZGS 2000).

Southern Pinal County is also part of the Basin and Range Province, containing alternating mountain ranges and basins, including the Picacho Mountains, east of Eloy; the Santa Cruz River, south of the Picacho Mountains and Eloy; a broad valley that ends with the Tortolita and Suizo mountains and Durham Hills, to the east; followed by Falcon Valley and another series of small mountains and peaks. The valleys contain sediment that has accumulated between the late Miocene and Pleistocene.

3.3.3 Geology and Geological Hazards

3.3.3.1 Geology

The Paleozoic geological units crossed by the Project subroutes include the Abo, Hueco, Colina, Sly Gap, Lake Valley, Caballero, McKelligan, San Andreas, Yesa, and Ranchero formations; Madera and Peccha groups; Glorieta Sandstone; and Aleman and Cutter dolomite (Table 3-9). These geological units represent marine rocks associated with the ancient west coast of the North American continent (AZGS 2000; Scholle 2003).

The Mesozoic (Triassic, Jurassic, and Cretaceous periods) geological units crossed by the Project subroutes include the Tres Hermanos, McRae, Fort Crittenden, and Shellenberger Canyon formations; Mancos Shale; and Bisbee, Mesa Verde, and Colorado groups. These rocks include terrestrial and marine environments (AZGS 2000; Scholle 2003).

The Tertiary (Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs) geological units crossed by the Project subroutes include the Quiburis, Mineta, St. Davids, Camp Rice, Popotosa, Baca, Palm Park, and Palomas formations; and 111 Ranch Beds. The Tertiary is characterized by mountain-building events, continuing from the late Cretaceous, that allowed the neighboring valleys to fill with sediment (AZGS 2000; Scholle 2003).

Quaternary geological units within the Project study area include surficial alluvium and colluvium, surficial older alluvium and colluvium, aeolian deposits, and basalt of Pleistocene to Recent age (approximately 1.8 million years ago to the present) (AZGS 2000; Scholle 2003).

Table 3-9. Geological Units in the Study Corridors

Geological Age	Geological Units	Lithology
Quaternary	Terrace and alluvial deposits	Sand, gravel, and silt
Quaternary	Surficial older alluvium and colluvium	Sand, gravel, and silt
Pliocene	St. Davids Formation, 111 Ranch Beds, Gila Group, Camp Rice Formation, Palomas Formation, Tesuque Formation, Santa Fe Group	Mudstone, marl, tuff, lacustrine limestone, sandstone, conglomerate
Miocene	Quiburis Formation, Mineta Formation (possibly upper Oligocene), San Manuel Formation, Popotosa Formation	Mudstone, sandstone, conglomerate, tuff
Eocene	Baca Formation, Palm Park Formation	Mudstone, sandstone, claystone, conglomerate
Oligocene-Miocene volcanic	Unnamed	Volcanic rocks, rhyolitic rocks, silicic volcanic rocks, andesite, basalt
Cretaceous	Shellenberger Canyon Formation, Bisbee Group, Mancos Shale, Tres Hermanos Formation, McRae Formation, Mesa Verde Group, Colorado Group, Fort Crittenden Formation	Mudstone, siltstone, sandstone, shale
Triassic	Dakota Formation, Morrison Formation	Mudstone, limestone, sandstone
Permian	Abo Formation, Hueco Formation, Robledo Mountains Formation, San Andreas Formation, Yesa Formation, Glorieta Sandstone	Mudstone, siltstone, sandstone
Pennsylvanian	Panther Sheep Formation, Magdalena Group, Bar B Formation	Shale, conglomerate, limestone
Mississippian	Escabrosa Limestone, Paradise Formation, Caballero Formation, Lake Valley Formation, Ranchero Formation	Limestone, mudstone, sandstone
Devonian	Percha Formation, Martin Formation, Sly Gap Formation	Limestone, dolomite, mudstone
Ordovician	Cutter Formation, Aleman Formation, McKelligan Formation	Dolomite, limestone
Paleozoic	Unnamed	Metamorphic rocks
Sources: AZGS 2000; Scholle 2003		

3.3.3.2 Geological Hazards

Geological hazards in the Project study area generally consist of seismicity (earthquakes), Quaternary faults (ground rupture due to displacement), fissures (due to subsidence), and flooding. Each type of geological hazard is discussed in detail below.

Seismicity (Earthquakes)

Earthquakes are the surface expression of large energy releases that result from motion along faults. The USGS maintains archives of all earthquakes of detectable magnitude, and have made this data set available to the public since 1973. Seismicity is measured by the USGS as the probability of a certain degree of ground-shaking in terms of the percentage of acceleration due

to gravity (9.8 m/s^2), and the probability that an area will be affected by an earthquake (Peterson et al. 2008). Seismicity data and maps are available from the Geologic Hazards Team, a unit of the USGS Earthquake Hazard Program (USGS 2010).

The Rio Grande Valley (Rio Grande Rift) is the only area near the Project with measurable seismicity. The USGS considers the Rio Grande Valley between Socorro and Albuquerque to be the most seismically active area in New Mexico, having half of the state's larger earthquakes (magnitude 4.5 or greater). The most recent large earthquake in New Mexico occurred on February 21, 2010, in the southeastern corner of New Mexico near Artesia. Another recent earthquake with a magnitude 4.2 occurred on December 19, 2005, near Carlsbad. According to the USGS, earthquakes with magnitudes of 4.9 or less do not typically cause damage to structures[1].

In Arizona, very little seismic activity occurs in the southern half of the state. The largest earthquake detected in southern Arizona was a 7.2 magnitude event that occurred along the Pitaycachi fault near Sonora, Mexico. The earthquake, as experienced in Tucson, was rated a VII on the Modified Mercalli Intensity Scale (McGarvin 1987). Faults in the area of the 1887 Sonora earthquake epicenter have an estimated recurrence interval of 3,000 to 4,000 years.

Quaternary Faults

Quaternary faults are the most recent faults and are considered still active; therefore, they are more likely at some point in the future to have ground rupture, displacement, and/or earthquakes along their length than faults of pre-Quaternary age. The Project crosses several Quaternary fault zones. In New Mexico, the main areas for these faults in the Project study area are along the Rio Grande Valley and a region on both sides of the New Mexico-Arizona state line. In Arizona, Quaternary faults can be found west of the Santa Rita Mountains in Pima County, and west of Benson along the San Pedro River Valley.

Subsidence and Fissures

Subsidence is the gradual settling or sudden sinking of the ground due to subsurface movement. The principal causes of subsidence are aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing of permafrost[2]. Five areas are actively subsiding within the Project area—one in New Mexico and four in Arizona, along the Santa Cruz River and near Green Valley (Arizona Department of Water Resources [ADWR] 2010). According to the NMBGMR, there are currently no GIS data available to measure the amount of subsidence in the actively subsiding Mimbres Basin in New Mexico.

In Arizona, the USGS and AZGS have identified several areas in southern Arizona with existing fissures. A fissure is a crack in the ground that can be thousands of feet in length and hundreds of feet deep. They can be related to ground subsidence, where rapid depletion of aquifers and

[1] http://earthquake.usgs.gov/learn/topics/mag_vs_int.php
[2]http://water.usgs.gov/ogw/subsidence

down-dropping of the water table have occurred (Allison and Shipman 2008). According to the AZGS most fissures in Arizona are a result of subsidence (Slaff 1993). There are several large areas of subsidence with numerous fissures located east and west of I-10, in the area around Picacho and Eloy. One area with a concentration of fissures was identified within the Project study area near the proposed Pinal Central Substation.

Flooding

The 100-year floodplain was used in order to determine where flooding may be a hazard to the Project. A 100-year floodplain is defined as an area that will be inundated by a flood event having a 1 percent chance of being equaled or exceeded in any given year[1]. There are 100-year floodplains throughout the Project area, mostly associated with rivers and their tributaries, ephemeral washes, and some man-made irrigation canals. For the New Mexico portion of the Project, GIS data were available for Grant and Luna counties only. No GIS data were available for the Rio Grande. For Luna County, there are several areas along the Mimbres River, its ephemeral tributaries, and several other ephemeral washes that are within a 100-year floodplain. For Grant County, there are several small 100-year floodplain areas associated with small ephemeral washes. For Arizona, Federal Emergency Management Agency (FEMA) data were available for Cochise, Graham, Pima, and Pinal counties. In Graham and Cochise counties, there are 100-year floodplains located in the Project study area along the San Simon River and its ephemeral tributaries. There are several areas with 100-year floodplains in Aravaipa Canyon and Sulphur Springs valley near Willcox, associated with numerous ephemeral washes and man-made canals. The San Pedro and Santa Cruz rivers and their tributaries also have numerous 100-year floodplains associated with them. Localized areas of flooding, due to heavy rains, can occur in other areas not represented in the 100-year floodplains mapped by FEMA.

3.3.4 Mineral Resources

The mineral resources inventory for the Project presents an overview of the mineral resources, mining, and geothermal resources, and identifies the presence and location of these resources and the areas of possible occurrence within the Project study area. Mineral resources include locatable, leasable, and salable resources. Locatable minerals include a broad category of economically important minerals, such as precious and base metals (e.g., gold, silver, and lead); fissionable products (e.g., uranium); and industrial minerals. Certain gemstones may also be considered locatable minerals. Leasable resources include oil, natural gas, coal, geothermal resources, phosphorous, sodium, sulfur, and potassium. Salable mineral resources are typically used for construction and industrial purposes and include sand, gravel, stone, pumice, and cinder. Under the Materials Act of 1947, salable mineral resources are referred to as mineral materials. Mineral material resources may be acquired from federally owned or controlled land via free-use permit, by competitive bid, or by negotiated contract. Mineral materials extracted by utilization of a free-use permit cannot be sold.

[1]http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/flood_zones.shtm

3.3.4.1 New Mexico

Mineral resources can be found throughout the Project study area. Within New Mexico, 48 mining districts are present in the Project study area, most of which are for mining metals (McLemore et al. 2005). Numerous sand and gravel pits, several coal fields, several industrial mineral districts, and one uranium-mining district are also present. Two non-producing oil and gas leases are located northwest of Lordsburg and north of Deming; and one oil-producing and gas lease is located east of Bingham, southwest of the proposed SunZia East Substation. Although there are coal fields present within the Project study area in New Mexico, there are no active coal leases or mines. Almost the entire Project study area in New Mexico is within an area of known or potential geothermal resources, including 50 geothermal wells and springs. This large geothermal resource area extends from the eastern margin of the Rio Grande Rift to the New Mexico-Arizona border.

3.3.4.2 Arizona

In Arizona, 28 mining districts containing metals, precious metals, and minerals are present in the Project study area. The largest of these mining districts is in the San Manuel area. The San Manuel copper mine was once considered one of the largest copper mines in the world, but has been closed since 2003 and is now under reclamation. Other notable mining districts are located south of Tucson (San Xavier Mission area), an area southwest of Benson, and areas west and southwest of Willcox. Numerous sand and gravel pits are also present, with high concentrations along the Santa Cruz River. There are several operations that mine zeolite/chabazite, northeast of the Bowie townsite. The Project study area also includes five geothermal areas. No coal or oil and gas leases occur in the Arizona portion of the Project study area.

3.3.5 Soil Resources

The soil resource inventory presents an overview of soils that are susceptible to water and wind erosion and designated Prime or Unique Farmland. The Project area is dominated by three of the main soil groups: mollisols, entisols, and aridisols. Mollisols, typically associated with grasslands, occur in the eastern part of the Project area in New Mexico; whereas entisols (poorly developed soils with little to no structure) and aridisols (arid environment soils) occur throughout the Project area.

The proposed Project centerlines in New Mexico are restricted to the Chihuahuan Desert's ecoregion, which includes a large range of subregions such as basins and playas, lava malpais or badlands, grasslands, and the floodplain of the Rio Grande. The soils of the basins and playas formed in broad, shallow-sloped basins that currently contain or have contained playa lakes, whose soils are generally moderately to highly susceptible to wind erosion. The soils of the Chihuahuan grasslands typically exhibit moderate susceptibilities to both water and wind erosion and include designated Prime or Unique Farmland soils along Animas Creek and the Mimbres River.

The proposed Project centerlines in Arizona pass through the Madrean Archipelago ecoregion in the southeastern part of the state and the Sonoran Basin and Range at the western terminus of the route. Within the Madrean Archipelago region, the soils exhibit a wide range of characteristics

from moderate to high susceptibilities, to water erosion in river and stream bottoms, to high susceptibilities to wind erosion on playa plains. Designated Prime or Unique Farmland soils in the Madrean Archipelago are present along rivers such as the San Simon and San Pedro and in the vicinity of Willcox Playa. Within the Sonoran Basin and Range region, the soils exhibit moderate to high susceptibilities to water erosion along the Santa Cruz River, and moderate to high susceptibilities to wind erosion north of Tucson and east of the western terminus of the Project. Designated Prime or Unique Farmland soils in the Sonoran Basin and Range region are present near the western terminus of the route southeast of Casa Grande.

3.3.5.1 Erosion Susceptibility

Soil susceptibilities to water and wind erosion were assessed based on NRCS standards assigned to SSURGO-level soil map units. A soil map unit's susceptibility to water erosion is represented by the experimentally determined factor "K," which includes 14 classes ranging from 0.0 to 0.64, with increasing values corresponding to greater susceptibilities to water erosion. K factor is separated into two versions; K_f for the fine fraction of the surface soil (less than 2.0 mm in diameter), and K_w for the whole soil. K_f typically has an elevated value relative to K_w, because K_w is likely to include a rocky component that armors the surface soil against erosion by rainfall impact or surface flow. Soils assigned a K_w value of 0.40 or greater are highly susceptible to water erosion; whereas soils assigned a K_w value between 0.20 and 0.40 are moderately susceptible to water erosion. Soils assigned a K_w value less than 0.20 are slightly susceptible to water erosion. The susceptibility of a soil map unit to wind erosion is represented by the soil's wind erodibility group (WEG), which can range from 1 to 8. Soil map units assigned to a WEG of 1 or 2 are highly susceptible to wind erosion; soil map units assigned to a WEG of 3, 4, or 4L are moderately susceptible to wind erosion; soil map units assigned to a WEG of 5, 6, or 7 are slightly susceptible to wind erosion; and soil units assigned to a WEG of 8 are not susceptible to wind erosion.

Soils that are highly susceptible to water erosion occur within the Project area and are mostly restricted to the river valleys of the Rio Grande, San Pedro River, and Santa Cruz River. Areas of soils that are highly susceptible to wind erosion are common in New Mexico, but rare in Arizona. These soils are present in the Jornada del Muerto, in the areas to the southwest of the WSMR, and in the playa lakebeds in western New Mexico and eastern Arizona.

3.3.5.2 Designated Prime or Unique Farmland

Prime or Unique Farmlands are defined by the USDA (2011) as:

…land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

Prime Farmland includes, but is not limited to, grain, forage, fiber, oilseed, sugar beets, sugarcane, vegetables, tobacco, orchard, vineyard, and fruit crops. Unique Farmland is "land

other than Prime Farmland that is used for the production of specific high value food and fiber crops," and includes citrus, tree nuts, olives, cranberries, fruit, and vegetables (*ibid*). Farmlands of Statewide Importance are designated by state-level offices of the NRCS. They are often nearly qualified to be Prime Farmlands and economically produce high yields of crops. Within the Project study area, designated farmland soils include areas designated as Prime Farmland (if irrigated), Farmland of Statewide Importance, Farmland of Unique Importance, and Prime Farmland (if irrigated) and Protected from Flooding.

Areas with soils that have been designated as Prime or Unique Farmland are intermittently present throughout the Project study area, with major concentrations along the southern reaches of the Rio Grande Valley, within the Animas and Mimbres valleys, the Santa Cruz River Valley, and the vicinity of the western Project terminus at the Pinal Central Substation.

3.3.5.3 Biological Soil Crusts

Biological soil crusts are "a type of thin (<1cm), desiccation-tolerant microbial mat of cyanobacteria, subsequently colonized by mosses and lichens, living at the soil surface in drylands" (Bowker and Belnap 2008). They are susceptible to impacts related to surface-disturbing activities, including grazing, OHV use, and construction.

Bowker and Belnap (2008) established a method for mapping soil areas that have the greatest potential to support biological soil crusts. These three soil types include gypsiferous soils, noncalcareous sandy soils, and limestone-derived soils. Gypsiferous soils contain at least 10 percent gypsum, noncalcareous sandy soils have 5 percent or less calcium carbonate and are between 50 and 75 percent sand, and limestone-derived soils are directly derived from limestone bedrock.

Gypsiferous soils are rare within the Project area, occurring in small concentrations near the eastern terminus of the Project in Lincoln County, New Mexico. Noncalcareous sandy soils, while more common than gypsiferous soils within the Project area, are still rare. The greatest concentration of noncalcareous sandy soils is near the western terminus of the Project in Pinal County, Arizona and includes the Denure-Dateland complex, on 0 to 3 percent slopes and the Bucklebar-Hayhook complex, on 1 to 10 percent slopes. A second concentration of noncalcareous sandy soils is present to the east of Lordsburg and includes the Berin and Mohave soils and the Bluepoint-Onite association. The Project area crosses rare limestone geological units or soils derived from limestone in Pima County, Arizona.

3.3.5.4 Desert Pavements

Desert pavements are formed over long periods of time via deflation lag where fine particles are removed by wind, leaving behind pebbles and cobbles too large to be transported by wind or local overland water flows. These surfaces are typically stable over very long periods of time and are most likely to occur on previously undisturbed low-slope surfaces in arid environments. Desert pavements may be present within the Project area where disturbances from impacts such as grazing or construction have not previously occurred.

3.3.5.5 Clay and Sand Soils

Soils that are strongly skewed towards either clay (greater than 40 percent) or sand (between 50 and 75 percent) textures could potentially pose a hazard for access road stability. Clay soils have a greater potential to exhibit shrink/swell characteristics that could destabilize road surfaces. Clay soils are rarely crossed by the BLM-preferred alternative along Route Group 3 in Arizona and include such soil units as the Guest silty clay and Hantz complex. Loose sand soils may have low-bearing strength resulting in difficulty in maintaining access roads that support construction equipment transportation. Very sandy soils are crossed intermittently by the BLM-preferred alternative throughout the Project area, with the greatest concentration along Route Group 3.

3.3.6 Summary of Inventory Results

3.3.6.1 Route Group 1: SunZia East Substation to Midpoint Substation

The inventory results are summarized below. Resource inventory for geological hazards and mineral resources is listed in Table 3-10 and Table 3-11, and presented on Figure M 3-1E (see Map Volume). The resource inventory for soil resources is listed in Table 3-12 and presented on Figure M 3-2E (see Map Volume).

Subroute 1A1 – North River Crossing

Geological Hazards

Subroute 1A1 crosses several Quaternary faults in the Rio Grande Rift Valley. In particular, Link E133 crosses the West Joyita Fault Zone, which forms the eastern margin of the Rio Grande Rift in a narrow part of the rift known as the Socorro Constriction. In addition, links E180 and E200 cross the Socorro Canyon Fault Zone, which forms the western margin of the Rio Grande Rift. Several earthquakes have been recorded in the last 100 years for the Socorro area, an indication that this area is seismically active. These earthquakes ranged between 4.0 and 6.0 in magnitude. The seismicity mapping by the USGS shows this area as having a 2 percent chance in 50 years of exceedance of a 20% g peak acceleration earthquake[1]. Farther south, Link A161a crosses the Milligan Gulch Fault Zone and the Black Hill Fault. Several areas with 100-year floodplains are located along links A440 and A530. There are no FEMA data available for 100-year floodplains north of Luna County for the Project study area.

Table 3-10. Geological Hazards along Route Group 1

Subroute	Quaternary Faults (miles)	Slopes > 35%	Slopes 15%–35%	100-year Floodplain
1A1	2.3	0.5	36	2.2
1A2	2.3	0.7	28	2.2
1A	1.9	0.5	34	2.2
1B1	2.3	0.4	28	2.2
1B2	2.3	0.4	25.8	2.2
1B3	2.3	0.4	27.4	2.2

[1]http:earthquake.usgs.gov/earthquakes/states/new_mexico/hazards.php

Mineral Resources

There are four mines and four areas with active mining claims located within the study corridor of Subroute 1A1; two of the active mining-claim areas are crossed by the subroute centerline. Three of the mines are located in the Magdalena Mountains, west of Socorro, and are for extracting metals and precious metals. The others are scattered throughout the subroute. The two active mining claims crossed by the centerline are located along links A330a and A330b, west of Truth or Consequences.

Table 3-11. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 1

Subroute	Active Mines in Study Corridor	Miles of Active Mines Crossed by Centerline	Coal Resources in Study Corridor	Miles of Coal Resources Crossed by Centerline	Active Mining Claims in Study Corridor	Miles of Active Mining Claims Crossed by Centerline	Oil and Gas Leases in Study Corridor	Miles of Oil and Gas Leases crossed by Centerline
1A1	4	0	0	0	4	1.6	0	0
1A2	4	0	0	0	4	1.6	0	0
1A	4	0	0	0	4	1.6	0	0
1B1	2	0	2	2.1	5	0.1	0	0
1B2	2	0	1	2.1	5	2.1	3	6.7
1B3	3	0	1	1.3	5	2.1	1	6.3

Soil Resources

Subroute 1A1 crosses soils that are highly susceptible to water erosion, namely the Witt-Penistaja association located on the southwest flank of the Gallinas Mountains, the Gila clay loam located along the Rio Grande, and the Doña Ana-Tres Hermanos association located along Willow Spring Draw and north of the Goodsight Mountains. This subroute crosses soils that are highly susceptible to wind erosion, including the Berino-Doña Ana and Campana-Yesum associations located east of the Rio Grande, and Brazito loamy fine sand located along Palomas and Las Animas creeks. Designated Prime or Unique Farmland soils are crossed; namely the Harvey loam, Witt loam, and Witt clay loam along Link E84.

Table 3-12. Miles of Soil Limitations along Route Group 1

Subroute	High Water Erosion Potential	High Wind Erosion Potential	Moderate Water Erosion Potential	Moderate Wind Erosion Potential	Prime Farmland Soils
1A1	10.9	4.7	88.6	84.8	3.8
1A2	15.6	2.7	87.0	80.5	4.0
1A	9.2	7.5	82.9	86.0	0.6
1B1	10.5	21.6	95.2	96.0	0.0
1B2	16.6	19.9	79.7	82.1	0.0
1B3	13.5	18.8	74.5	75.4	0.0

Subroute 1A2 – BLM Preferred Alternative

Geological Hazards

Geological hazards along Subroute 1A2 are similar to those along Subroute 1A1.

Mineral Resources

Mineral resources along Subroute 1A2 are similar to those along Subroute 1A1.

Soil Resources

Subroute 1A2 crosses soils that are similar to those along Subroute 1A1, but would cross greater areas of soils with high susceptibility to water erosion along Link E86a and E86b.

Subroute 1A – North River Crossing

Geological Hazards

Geological hazards along Subroute 1A are similar to those along Subroute 1A1.

Mineral Resources

Mineral resources along Subroute 1A are similar to those along Subroute 1A1.

Soil Resources

Subroute 1A crosses soils that are similar to those along Subroute 1A1, except along links A22 and E80c. Subroute 1A would cross similar areas of soils that are highly or moderately susceptible to water erosion and would cross greater areas of soils that are highly or moderately susceptible to wind erosion at the northeastern end of the Jornada del Muerto, which Subroute 1A1 avoids. Subroute 1A would cross fewer areas of designated Prime or Unique Farmland soils than Subroute 1A1.

Subroute 1B – San Antonio Crossing

Geological Hazards

Geological hazards along Subroute 1B are similar to those along Subroute 1A1.

Mineral Resources

There are two mines and five areas of active mining claims located within the study corridor of Subroutes 1B1, 1B2, and 1B3. All of the subroute centerlines would cross at least three of the active mining-claim areas. Coal resource areas are located in the Jornada del Muerto and Carthage coal fields, southeast of Socorro (links A90 and A111). Three oil and gas leases are located west of the SunZia East Substation (links A30, A40, and A50).

Soil Resources

The 1B subroutes cross soils that are highly susceptible to water erosion. These soils include the Witt-Penistaja association along Subroute 1B1, the Rance-Tanbark silt loam along subroutes 1B2 and 1B3, and the Yesum very fine sandy loam and Anthony variant sandy clay loam along all 1B subroutes, which cross extensive regions of soil that are highly susceptible to wind erosion in the Jornada del Muerto area (Penistaja-Clovis fine sands and Campana-Yesum association). They also cross designated Prime or Unique Farmland soils in the same areas as those crossed by Subroute 1A.

Local Alternative and Crossover Links for Route Group 1

The local alternative links for subroutes 1A and 1B1 (Gran Quivira area) do not cross any mines or faults. No FEMA data are available for the local alternative links and crossover links for Route Group 1.

Within 1 mile of their centerline, local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 (A161b, A260, A361, A430, and A481) have one mine along Local Alternative Link A161b and seven mines along Local Alternative Link A260. Local Alternative Link A260 has three faults within 1 mile of the centerline, and Local Alternative Link A430 has one fault. Links A430 and A481 cross 100-year floodplains.

A single crossover link, A70, is available for subroutes 1B2 and 1B3. Crossover Link A70 does not cross any soils that are highly susceptible to water erosion, but does cross 5.2 miles of soils that are moderately susceptible to water erosion. This link also does not cross any soils that are highly susceptible to wind erosion, but does cross 2.9 miles of soils that are moderately susceptible to wind erosion. Crossover Link A70 does not cross any designated Prime or Unique Farmland soils.

3.3.6.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Resource inventory for geological hazards and mineral resources is listed in Table 3-13 and Table 3-14. The resource inventory for soil resources is listed in Table 3-15.

Subroute 3A2 – BLM Preferred Alternative

Geological Hazards

Subroute 3A2 crosses only one Quaternary fault; the Gold Hill Fault Zone located along Link B120b. Subroute 3A2 crosses numerous washes and channels that contain 100-year floodplains. Most of these floodplains are associated with the Mimbres and San Simon rivers, but numerous smaller ephemeral streams and washes have areas within 100-year floodplains. There were no FEMA data available for Hidalgo County.

Table 3-13. Geological Hazards along Route Group 3				
Subroute	Quaternary Faults (miles)	Slopes > 35%	Slopes 15%-35%	100-year Floodplain
3A2	0.5	0.3	1.0	6.2
3A	0.5	0.3	1.2	10
3B	0	0	3.1	6

Mineral Resources

Subroute 3A2 has 8 mines and 7 Active Mining Claims within its study corridor, none of which is crossed by the centerline. Subroute 3A2 has seven areas of active mining claims in the study corridor, 3.9 miles of which are crossed by the centerline. Subroute 3A2 crosses the Fluorite Ridge and Lordsburg Mesa mining districts in New Mexico and a zeolite mining district in Arizona. Subroute 3A2 has one oil and gas lease in the study corridor, 4.0 miles of which are crossed by the centerline.

Table 3-14. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 3								
Subroute	Active Mines in Study Corridor	Miles of Active Mines Crossed by Centerline	Coal Resources in Study Corridor	Miles of Coal Resources Crossed by Centerline	Active Mining Claims in Study Corridor	Miles of Active Mining Claims Crossed by Centerline	Oil and Gas Leases in Study Corridor	Miles of Oil and Gas Leases Crossed by Centerline
3A2	8	0	0	0	7	3.9	1	4
3A	6	0	0	0	7	3.9	1	4
3B	17	0	0	0	3	2.9	0	0

Soil Resources

Subroute 3A2 crosses soils that are highly susceptible to water erosion, as well as soils that are highly susceptible to wind erosion; namely the Berino and Mohave soils along B90 northwest of Deming, the Berino loamy sand along Link 121 northwest of Lordsburg, and the Bluepoint-Gothard complex along Link B160d. Designated Prime or Unique Farmland soils that are crossed by Subroute 3A2 include the Stellar-Mohave association along Link B120b east of Lordsburg.

Table 3-15. Miles of Soil Limitations along Route Group 3					
Subroute	High Water Erosion Potential	High Wind Erosion Potential	Moderate Water Erosion Potential	Moderate Wind Erosion Potential	Prime Farmland Soils
3A2	4.7	20.7	58.1	53.8	13.4
3A	4.7	19.6	64	53.3	13.4
3B	0.2	18.3	93.8	57.4	27.8

Subroute 3A – North

Geological Hazards

Geological hazards along Subroute 3A are similar to those along Subroute 3A2. However, Subroute 3A crosses more miles of 100-year floodplain than Subroute 3A2.

Mineral Resources

Subroute 3A has fewer mines within its study corridor than 3A2, but has the same number of active mining claims. The Subroute 3A centerline crosses no active mines, but crosses active mining claims totaling a distance of 3.9 miles. Subroute 3A crosses the Fluorite Ridge and Lordsburg Mesa mining districts in New Mexico.

Soil Resources

Soil resources along Subroute 3A are the same as those along Subroute 3A2 from the Midpoint Substation through Link B121. From Link B160a to the Willow Substation, Subroute 3A crosses a shorter distance of soils that are highly susceptible to wind erosion, including the Bluepoint-Gothard complex, and a slightly longer distance of soils that are moderately susceptible to water or wind erosion. Subroute 3A crosses the same areas of soils designated Prime or Unique Farmland as Subroute 3A2.

Subroute 3B – South

Geological Hazards

Subroute 3B does not cross any known Quaternary faults. Also, Subroute 3B crosses fewer 100-year floodplains than either Subroute 3A2 or Subroute 3A.

Mineral Resources

Subroute 3B crosses three areas of active mining claims totaling a distance of 2.9 miles; no active mines are crossed by this subroute. Subroute 3B would cross the Fluorite Ridge, Lordsburg, and Kimball mining districts in New Mexico, and a zeolite mining district in Arizona.

Soil Resources

Subroute 3B crosses fewer areas of soils that are highly susceptible to water erosion than subroutes 3A2 and 3A, but crosses more areas of soils that are highly susceptible to wind erosion than subroutes 3A2 and 3A, including the Pintura-Berino complex and Bluepoint-Onite association along Link B110a west of Deming. Subroute 3B crosses more areas of designated Prime or Unique Farmland soils than subroutes 3A2 and 3A, including the Stellar-Mohave and Bucklebar-Sonoita-Continental association along Link B110b southeast of Lordsburg.

Crossover Links for Route Group 3

Two crossover links, B111 and B140, are available for subroutes 3A and 3B; these links do not cross any known Quaternary faults. Crossover Links B111 and B140 do cross several small 100-year floodplain areas. Crossover Link B111 does not cross any soil highly susceptible to water erosion, but it does cross 3.2 miles of soil moderately susceptible to water erosion. This crossover link does not cross any soil highly susceptible to wind erosion, but it does cross 4.3 miles of soil moderately susceptible to wind erosion. Crossover Link B111 does not cross any soil that has been designated as Prime or Unique Farmland. Crossover Link B140 crosses 2.9 miles of soil highly susceptible to water erosion and 4.3 miles of soil moderately susceptible to water erosion. This crossover link also crosses 3.1 miles of soil highly susceptible to wind erosion and 4.2 miles of soil moderately susceptible to wind erosion. Crossover Link B140 crosses 1.5 miles of soils that have been designated as Prime or Unique Farmland.

3.3.6.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Resource inventory for geological hazards and mineral resources is listed in Table 3-16 and Table 3-17, respectively. The resource inventory for soil resources is listed in Table 3-18 and Table 3-19.

Subroute 4A – North of Mt. Graham

Geological Hazards

Subroute 4A crosses two Quaternary faults: the Safford Fault Zone along Link B153a and the Whitlock Wash Fault at Link C173, located east of Mammoth on the eastern side of the San Pedro River Valley. Subroute 4A crosses three fissures located along Link C850, as well as numerous areas with 100-year floodplains. A majority of these areas is associated with the San Simon and San Pedro rivers and their tributaries.

Table 3-16. Geological Hazards along Route Group 4

Subroute	Quaternary Faults (miles)	Slopes > 35%	Slopes 15%–35%	100-year Floodplain
4A	1.3	8.8	21.6	6
4B	0.1	7.6	25.8	7
4C1	0.1	3.3	21.9	8
4C2	0	3.3	24.9	9
4C2c	0	2.6	23.3	8.8
4C3	0	1.9	14.9	29

Mineral Resources

There are seven areas of active mining claims and two mines located within the study corridor of Subroute 4A, with five of these active mining claims crossed by the subroute centerline. These active mining-claim areas are located northeast of Mammoth in the Galiuro Mountains, and west of Mammoth where copper and other metals are mined.

Table 3-17. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 4				
Subroute	**Active Mines in Study Corridor**	**Miles of Active Mines Crossed by Centerline**	**Active Mining Claims in Study Corridor**	**Miles of Active Mining Claims Crossed by Centerline**
4A	2	0.2	7	19.4
4B	2	0.4	7	19.4
4C1	2	0.2	3	10.1
4C2	1	0.1	2	16.4
4C2c	1	0.1	2	16.4
4C3	5	0.2	1	13.5

Soil Resources

Subroute 4A only rarely crosses soils that are highly susceptible to water or wind erosion; namely, the Haplogypsids-Whitecliff-Badlands complex (water erosion) and Cascabel soils (wind erosion). This subroute crosses designated Prime or Unique Farmland soils in the San Pedro River Valley (Glendale-Hantz complex) unique to subroutes 4A and 4B, and in the vicinity of the planned Pinal Central Substation (Toltec fine sandy loam), which are common to all of the Route Group 4 subroutes.

Table 3-18. Soil Limitations along Route Group 4 (in miles)					
Subroute	**High Water Erosion Potential**	**High Wind Erosion Potential**	**Moderate Water Erosion Potential**	**Moderate Wind Erosion Potential**	**Prime Farmland Soils**
4A	0.2	0.4	66.4	56.5	7.6
4B	3.6	0.4	73.2	68.8	26.8
4C1	3.2	0.2	69.6	64.3	13.4
4C2	2.7	1.6	75.8	77.8	12.8
4C2c	2.6	1.8	75.0	76.1	12.8
4C3	2.3	6.7	95.2	73.0	40.4

Subroute 4B – Sulphur Springs Valley

Geological Hazards

Geological hazards along Subroute 4B are similar to those along Subroute 4A. Subroute 4B crosses numerous areas with 100-year floodplains. A majority of these areas is associated with Sulphur Springs Valley, Aravaipa Canyon, and the San Pedro River and its tributaries.

Mineral Resources

Mineral resources along Subroute 4B are similar to those along Subroute 4A.

Soil Resources

Subroute 4B crosses very similar soils to those of Subroute 4A, with the exception of the eastern portion of the subroute in Sulphur Springs Valley, where Subroute 4B crosses limited areas of soils that are highly susceptible to water or wind erosion. Subroute 4B also crosses designated Prime or Unique Farmland soils, including the Tubac sandy clay loam and Pima loam.

Subroute 4C2c – BLM Preferred Alternative

Geological Hazards

Subroute 4C2c does not cross any known Quaternary faults. This subroute crosses 8.8 miles of 100-year floodplains largely in the San Pedro River Valley.

Mineral Resources

Subroute 4C2c crosses 0.1 mile of active mines and 16.4 miles of active mining claims.

Soil Resources

Subroute 4C2c crosses 2.6 miles of soils that are highly susceptible to water erosion, including the Ripsey-Rock outcrop complex along Link C450 west of Mammoth; 1.8 mile of soils that are highly susceptible to wind erosion, including the Cascabel, Quiburi, and Typic Fluvaquents along Link C441 on the west side of the San Pedro River Valley; and 12.8 miles of designated Prime or Unique Farmland soils, including the Pima and McAllister loams along Link C110 in Sulphur Springs Valley and in the vicinity of the Pinal Central Substation, which are common to all of the Route Group 4 subroutes.

Subroute 4C1 – East of San Pedro River

Geological Hazards

Subroute 4C1 crosses a single Quaternary fault on the east side of the San Pedro River Valley. This subroute crosses 8.0 miles of 100-year floodplains, largely in the San Pedro River Valley.

Mineral Resources

Subroute 4C1 crosses two active mines over 0.2 mile and three active mining claim areas over 10.1 miles.

Soil Resources

Subroute 4C1 crosses 3.2 miles of soils that are highly susceptible to water erosion, including soils similar to Subroute 4C2c and soils such as the Haplogypsids-Whitecliff-Badlands complex along Link C660 where this subroute crosses the San Pedro River. It also crosses 0.2 mile of soils that are highly susceptible to wind erosion and crosses designated Prime or Unique Farmland soils.

Subroute 4C2 – West of San Pedro River

Geological Hazards

Subroute 4C2 crosses similar geological hazards as those crossed by Subroute 4C2c.

Mineral Resources

Subroute 4C2 would cross the same mineral resource areas that would be crossed by Subroute 4C2c.

Soil Resources

Subroute 4C2 crosses 2.7 miles of soils similar to Subroute 4C2c that are highly susceptible to water erosion; 1.6 miles of soils similar to Subroute 4C2c that are highly susceptible to wind erosion; and 12.8 miles of designated Prime or Unique Farmland similar to those crossed by Subroute 4C2c.

Subroute 4C3 – Tucson

Geological Hazards

Subroute 4C3 does not cross any Quaternary fault. Subroute 4C3 crosses the greatest amount (29.0 miles) of 100-year floodplain of the Route Group 4 subroutes. This is associated with the alignment of this subroute along washes and streams in the vicinity of Tucson.

Mineral Resources

Subroute 4C3 would cross five active mines over 0.2 mile and one area of active mining claims over 13.5 miles.

Soil Resources

Subroute 4C3 crosses 2.3 miles of soils that are highly susceptible to water erosion, including the Contention-Whitecliff complex along Link F40a in the San Pedro River Valley; 6.7 miles of soils that are highly susceptible to wind erosion, including the Durazo coarse sand association along Link F40A; and the greatest amount of designated Prime or Unique Farmland soils (40.4 miles) of any Route Group 4 subroute, including the Mohall loam along C810a, Sonoita-Tubac complex along Link 540, and Anthony sandy loam along Link 510.

Local Alternative and Crossover Links for Route Group 4

Geological Hazards

Three fissures are located along links C860 and C890, near the Pinal Central Substation site. Crossover Link C502, for Subroutes 4A, 4B, and 4C1, crosses one Quaternary fault. No other local alternative link or crossover link for Route Group 4 crosses a fault or fissure.

Local Alternative Link C790, for 4A, 4B, and 4C1, crosses several 100-year floodplains. Crossover links C500, C502, and C174, for 4A, 4B, and 4C1 cross several 100-year floodplains.

Local alternative links C860 and C870 (Pinal Central Substation) cross several 100-year floodplains. Crossover Link C671, for 4A, 4B, 4C1, and 4C2, crosses one 100-year floodplain.

Local alternative links C260 and C261 (Winchester Substation) cross two 100-year floodplains. Local Alternative Link C680 (Tortolita Substation) crosses one 100-year floodplain.

All of the local alternative links for Subroute 4C3 (Pantano/Rillito) and the Tortolita Substation cross 100-year floodplains, except for Link C812.

Local alternative links C90, C121, and C211 for Subroutes 4C1, 4C2, and 4C3 cross several 100-year floodplains.

Mineral Resources

There are four mines located within the study corridor for the Pantano-Rillito local alternative (links F40b, F51, F60a, F81a, and F81b), none of which would be crossed by the centerline. Local Alternative Link C790 crosses one active mining-claim area. Four local alternative links—C72, C90, C121, and C211—are available for subroutes 4C1, 4C2, and 4C3. No other local alternative links or crossover links for Route Group 4 have impacts to mineral resources.

Soil Resources

Local Alternative Link C790 for Subroutes 4A, 4B, and 4C1 would cross 8.7 miles of soil moderately susceptible to water erosion and wind erosion; it would not cross soils designated Prime or Unique Farmland.

Local Alternative Link C692 is available for Subroute 4C1. This alternative link crosses 1.0 mile of soils that are moderately susceptible to water erosion. Local Alternative Link C692 crosses 3.6 miles of soils that are moderately susceptible to wind erosion. No designated Prime or Unique Farmland is affected by this alternative. Five local alternative links—C72, C90, C121, C211, and C790—are available for subroutes 4C1 and 4C2; whereas five crossover links—C500, C501, C502, C174, and C671—are available for subroutes 4A, 4B, 4C1, and 4C2. The soil limitations along these local alternative and crossover links are listed in Table 3-19.

Table 3-19. Soil Limitations along Local Alternative Links for Routes 4C1 and 4C2 and Crossover Links for Routes 4A or 4B/4C1 or 4C2 (in miles)

Link	High Water Erosion Potential	High Wind Erosion Potential	Moderate Water Erosion Potential	Moderate Wind Erosion Potential	Prime Farmland Soils
C72	0	0	0	0	0
C90	0	0	0.8	0.8	0.8
C121	0	0	3.0	3.0	3.0
C211	0	0	0.5	2.0	0
C790	0	0	8.7	8.7	0
C500	0	0	3.9	0	0

Table 3-19. Soil Limitations along Local Alternative Links for Routes 4C1 and 4C2 and Crossover Links for Routes 4A or 4B/4C1 or 4C2 (in miles)					
Link	High Water Erosion Potential	High Wind Erosion Potential	Moderate Water Erosion Potential	Moderate Wind Erosion Potential	Prime Farmland Soils
C501	0	0	0	0.5	0
C502	0	0	0.1	0	0
C174	0	0	0.8	0.5	0
C671	0	0	4.6	3.7	0

Local Alternative Link C812 is available for Subroute 4C3. This alternative link crosses 3.2 miles of soil moderately susceptible to water erosion and 2.5 miles of soil moderately susceptible to wind erosion. Local Alternative Link C812 also crosses 2.3 miles of soils that have been designated Prime or Unique Farmland.

The Winchester Substation local alternative crosses 3.4 miles of soils that are moderately susceptible to water erosion. It crosses 0.7 mile of soils that are highly susceptible to wind erosion and 4.3 miles of soils that are moderately susceptible to wind erosion. No soils that have been designated as Prime or Unique Farmland are crossed by this local alternative.

The soils along the Pantano-Rillito local alternative are generally similar to those along Subroute 4C3, with the exception that susceptible soils are crossed along the Pantano Wash rather than along the Santa Cruz River. The Pantano-Rillito local alternative crosses 0.5 mile of soils that are highly susceptible to water erosion and 5.5 miles of soils that are moderately susceptible to water erosion. It also crosses 3.4 miles of soils that are highly susceptible to wind erosion and 19.7 miles of soils that are moderately susceptible to wind erosion, as well as 4.1 miles of soils that have been designated as Prime or Unique Farmland.

The Tortolita Substation local alternative crosses 5.9 miles of soils that have been designated as Prime or Unique Farmland, including the Denure sandy loam and Dateland fine sandy loam.

The Pinal Central Substation local alternative crosses 9.5 miles of soils that are moderately susceptible to water erosion and 9.0 miles of soils that are moderately susceptible to wind erosion. It also crosses 4.7 miles of soils that have been designated as Prime or Unique Farmland, including the Gilman fine sandy loam, La Palma fine sandy loam, and Casa Grande fine sandy loam.

3.4 PALEONTOLOGICAL RESOURCES

3.4.1 Introduction, Methods, and Regulatory Framework

3.4.1.1 Introduction

Paleontological resources are any fossilized remains, traces, or imprints of organisms preserved in Earth's crust, which provide information about the history of life on Earth. Fossils include bones, teeth, shells, leaves, wood, and trackways originally buried in sedimentary deposits. Paleontological resources include not only the actual fossils, but the sedimentary deposits as

well. General concern regarding potential effects on paleontological resources was expressed during agency and public scoping for the Project.

Paleontological resources occurring on federal and state lands are afforded protection by federal and state law and regulation. Protection for paleontological resources includes requirements for the (1) assessment of areas containing significant paleontological resources that could be directly or indirectly impacted, damaged, or destroyed by development prior to, and as a consequence of, authorization of ground-disturbing activities; and (2) formulation and implementation of measures to mitigate potentially adverse impacts, including permanent preservation of the discovered sites and/or permanent preservation of salvaged materials at federal- and state-approved institutions.

Based on the results of preliminary research, the public scoping process, and consultation with the BLM, the following paleontological resources and other areas of concern were identified:

- Numerous fossil localities representing several formations, particularly in the vicinity of the Rio Grande Valley (e.g., Camp Rice, Santa Fe Group, Palomas Formations)
- Fossiliferous 111 Ranch Beds and the fossiliferous Quiburis and St. David formations

3.4.1.2 Methods

Information for the paleontological inventory was obtained from a review of scientific literature and from record searches at paleontological institutions (Table 3-20). A review of relevant published and unpublished geological and paleontological reports, and of museum paleontological locality records was conducted. The New Mexico Museum of Natural History and Science, Arizona Museum of Natural History, and the BLM were contacted for a record search of any known paleontological localities within 1 mile of the centerline of the proposed transmission lines. Other agencies contacted regarding paleontological resources for the Project include the USGS, AZGS, and Arizona State Museum (ASM). Geological mapping is primarily from Scholle (2003) and the AZGS (2000). A search for paleontological localities within the Project study area was also conducted using records from the (1) Paleobiology Database[1], operated by the University of California, Santa Barbara; (2) MioMap Database, operated by the University of California Museum of Paleontology at Berkeley; and (3) FaunMap Database, operated by the Illinois State Museum. The Paleobiology Database provides collection-based occurrence and taxonomic data for marine and terrestrial animals and plants of any geological age[2]. MioMap is a GIS that records mammal taxa, localities, and associated data for the Miocene to Pleistocene epochs in the western United States[3]. FaunMap is a database that records the late Quaternary distribution of mammals in the United States[4]. No paleontological localities are displayed on Figure M 4-1 (see Map Volume), because of the sensitive nature of paleontological locality information.

[1] Available at http://paleodb.org
[2] http://paleodb.org/cgi-bin/bridge.pl
[3] www.ucmp.berkeley.edu/miomap
[4] www.museum.state.il.us/research/faunmap/aboutfaunmap.html

Table 3-20. Institutions that Contributed to the Paleontological Record Search		
Institution	**Number of Localities within 1 Mile of Centerline**	**Date Searched**
BLM Safford District Office	0	11/12/09
Paleobiology Database, University of California Santa Barbara	0	6/5/09
MioMap mapping project, University of California Museum of Paleontology	3	2/12/10
University of California Museum of Paleontology Database	0	3/02/10
Arizona Museum of Natural History	0	3/25/10
New Mexico Museum of Natural History and Science	24	10/8/09
Arizona State Museum	0	5/14/10
FaunMap, Illinois State Museum	0	8/01/10

Information regarding the geological units and known fossil localities in the region were used to identify the paleontological potential within 1 mile of the centerline. Paleontological potential levels have been assigned by the BLM to each geological unit, using the Potential Fossil Yield Classification (PFYC) system that was adopted by the BLM in 2007, for assessing paleontological potential on federal land. The PFYC is a five-tiered system that classifies geological units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their potential to be adversely impacted; with a higher class number indicating a higher potential. This classification system is applied to the geological formation, member, or other distinguishable map unit, preferably at the most detailed mappable level. This approach was followed in recognition of the direct relationship that exists between paleontological resources and the geological units within which fossils are entombed. By knowing the geology of a particular area and the fossil productivity of particular geological units that occur in the area, it is possible to predict where fossils will likely be found. Each class is defined below.

Class 1. Very Low Potential. Geological units not likely to contain recognizable fossils. These units include igneous, metamorphic, and Precambrian rocks.

Class 2. Low Potential. Sedimentary geological units not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils. These units include aeolian, diagenetically altered sediment, and Holocene deposits.

Class 3. Moderate or Unknown Potential. Fossiliferous sedimentary geological units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential. Class 3 is divided into two parts:

Class 3a. Moderate Potential. Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area.

Class 3b. Unknown Potential. Units exhibit geological features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or area is known. This may indicate

that the unit or area is poorly studied and that field surveys may uncover significant fossils.

Class 4. High Potential. Geological units that contain a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability.

Class 5. Very High Potential. Highly fossiliferous geological units that consistently and predictably produce vertebrate fossils, or scientifically significant invertebrate or plant fossils.

3.4.1.3 Regulatory Framework

Federal and state governments have enacted legislation providing for varying degrees of protection for paleontological resources. The Society of Vertebrate Paleontology (SVP) regards paleontological resources as "nonrenewable scientific and educational resources that, along with their accompanying contextual data, constitute part of our natural heritage" (SVP 2009). This paleontological resource inventory was conducted in accordance with the regulations that are applicable to the paleontological resources within the Project study area. As the Project study area is located on federal, state, and private lands, an approved right-of-way is required for the Project; therefore, all of the regulations discussed below must be adhered to throughout.

Federal

The American Antiquities Act of 1906 and the Paleontological Resources Preservation Act of 2009 (PRPA) serve as the primary federal legislation that provides for the protection and conservation of paleontological resources occurring on federally administered lands. The American Antiquities Act (16 USC 431 433) provides for protection of both historic and prehistoric items on federal lands. The PRPA was enacted as part of the 2009 Omnibus Public Land Management Act, and codifies specific protection for vertebrate fossil resources and scientifically significant plant and invertebrate fossil resources on federal lands. The PRPA created criteria for the issuance of paleontological collection permits and directed the U.S. Secretary of the Interior to ensure paleontological resources discovered on federal lands are properly curated into the collections of approved repository institutions. Other laws may also apply in special circumstances.

The BLM policy for addressing potential impacts to paleontological resources on lands they administer also applies, which is included in the following documents: (1) *Paleontological Resource Management Handbook* (H-8270); (2) *General Procedural Guidance for Paleontological Resource Management* (H-8270-1); (3) *Potential Fossil Yield Classification System for Paleontological Resources on Public Lands* (Instruction Memorandum [IM] 2008-009); and (4) *Assessment and Mitigation of Potential Impacts to Paleontological Resources* (IM 2009-011).

State

The Trust Land Archaeology Department of the NMSLO states that paleontological resources are among the many assets the Commissioner of Public Lands is responsible for on state trust lands. All assets are protected from unauthorized appropriation, damage, removal, or use.

Arizona State legislature (41-841) states: "On lands owned or controlled by this state or any agency of this state a person shall not knowingly excavate in or upon any historic or prehistoric ruin, burial ground, archaeological or vertebrate paleontological site, or site including fossilized footprints, inscriptions made by human agency or any other archaeological, paleontological or historical feature, except when acting as a duly authorized agent of an institution or corporation referred to in section 41-842."

Professional Standards

SVP has established professional best practices for vertebrate paleontologists, along with more specific guidelines for the assessment and mitigation of adverse impacts to significant, nonrenewable, paleontological resources. These standards and best practices were developed by SVP in cooperation with federal and state agencies. SVP Bylaws Article 12: Code of Ethics, sections 1 and 4 state:

> "Section 1: It is the responsibility of vertebrate paleontologists to strive to ensure that vertebrate fossils are collected in a professional manner, which includes the detailed recording of pertinent contextual data, such as geographic, stratigraphic, sedimentologic, and taphonomic information."
>
> "Section 4: Scientifically significant fossil vertebrate specimens, along with ancillary data, should be curated and accessioned in the collections of repositories charged in perpetuity with conserving fossil vertebrates for scientific study and education (e.g., accredited museums, universities, colleges, and other educational institutions)."

These standards establish the protocol for the assessment and mitigation of impacts to paleontological resources. SVP (1995) summarizes its expectations for professional paleontologists operating on assessment and mitigation projects as the following:

> "Vertebrate fossils are significant nonrenewable paleontological resources that are afforded protection by federal, state, and local environmental laws and guidelines. The potential for destruction or degradation by construction impacts to paleontological resources on public lands (federal, state, county, or municipal) and land selected for development under the jurisdiction of various governmental planning agencies is recognized. Protection of paleontological resources includes: (a) assessment of the potential property to contain significant nonrenewable paleontological resources that might be directly or indirectly impacted, damaged, or destroyed by development, and (b) formulation and implementation of measures to mitigate adverse impacts, including permanent preservation of the

site and/or permanent preservation of salvaged materials in established institutions."

3.4.2 Regional Overview

The Project lies mostly within the Basin and Range Physiographic Province, which is characterized by parallel, north-south trending mountain ranges separated by desert basins (Fenneman 1931). The eastern margin of the Basin and Range Province, a physiographic region in New Mexico, is located along the Rio Grande Rift. Because of its large scale, the Project traverses a number of geological formations and geological features (Table 3-21). The geological (rock) units within the Project study area range in age from the Paleozoic to Quaternary, and preserve a record of the great changes that have occurred in western North America; ranging from a marine environment during the Permian, to marine and terrestrial environments during the Cretaceous, to large lakes and their associated river systems and periods of uplifting during the Miocene and early Pliocene, and finally to a basin-filling period during the late Pliocene and Pleistocene. These geological units and their paleontological resources are described in detail below, for New Mexico and Arizona.

Table 3-21. Geological Units and Paleontological Resources in the Study Corridors

Geological Age	Geological Unit	Fossils Found in the Project Study Area	Number of Localities within 1 Mile	PFYC	Paleontological Sensitivity
Quaternary	Younger terrace and alluvial deposits, Otero Formation	Mastodon, mammoth, gomphothere, horse, bison, camel, carnivore, tortoise, bird, mollusks, rodents	1	2	Low
Late Pliocene-Early Quaternary	Camp Rice Formation, Sierra Ladrones Formation, Palomas Formation	Reptiles, birds, rabbit, carnivores, horse, peccary, camel, gomphothere	17	4	High
Pliocene	111 Ranch Beds, Gila Group, St. David Formation, Palomas Formation, Santa Fe Group	Gomphotheres, carnivores, horse, camel, peccary, rabbit, rodents, glyptodonts, birds, reptiles, sloth, llama, antilocaprid, felid, trackways	1	4	High
Miocene	Quiburis Formation, Mineta Formation, Popotosa Formation	Canids, bear, felids, rodents, rabbits, horse, camel, antilocaprid, oreodont, rhinoceros	0	3-4	Moderate or Unknown to High
Eocene	Baca Formation, Palm Park Formation, El Rito Formation	Rhinoceros, titanotheres, reptile, horse, creodont	0	4-5	High to Very High
Cretaceous	Tres Hermanos Formation, Mancos Shale, Chinle Group, Dakota Group, McRae Formation, Bisbee Group, Mesa Verde Group, Colorado Group	Invertebrates, dinosaur, turritellids, plants, ammonites, shark, bivalves	4	2-5	Low to Very High

Table 3-21. Geological Units and Paleontological Resources in the Study Corridors					
Geological Age	**Geological Unit**	**Fossils Found in the Project Study Area**	**Number of Localities within 1 Mile**	**PFYC**	**Paleontological Sensitivity**
Triassic	Moenkopi Formation, Chinle Group	Capitosaurid, Unionids, Archosaur, reptilian bones	4	5	Very High
Paleozoic	Abo Formation, Hueco Formation, Colina Formation, Madera Group, Yeso Formation, San Andres Formation, Peccha Group, Sly Gap Formation, Lake Valley Formation, Caballero Formation, Aleman Dolomite, McKelligan Formation, Yesa Formation, Cutter Dolomite, Glorieta Sandstone	Fusulinids, brachiopods, conodonts, shark, gastropods, trilobites, crinoids, coral, vertebrate trackways	2	2-3	Low to Moderate or Unknown
From sources listed in Table 3-20					

3.4.3 Paleontological Potential and Fossil Localities

3.4.3.1 New Mexico

The Rio Grande Valley within the Project study area is located between the Socorro area and El Paso, Texas, to the south. The Rio Grande lies within the Rio Grande Rift, which is a zone of faults that stretches from Mexico north to the Colorado-New Mexico state line. The Rio Grande Rift began forming approximately 24 million years ago and was initially a series of topographically closed basins that eventually filled with aeolian, alluvial, and volcanic deposits from the Tertiary through the Holocene (Bartolino and Cole 2002). Along the Rio Grande Valley are rocks that range in age from the Pliocene to the Holocene. Farther east and west of the Rio Grande Valley are scattered outcrops that range in age from the Paleozoic to Miocene.

Southwestern New Mexico is typical of the Basin and Range Province; it consists of several basins separated by mountains. The basins are filled with Pliocene-Pleistocene alluvium, and several have old playas. The Animas Basin, near Lordsburg, is a remnant of the Pleistocene Lake Animas (Hawley et al. 2000). The Mimbres Basin, which consists of rocks ranging from Precambrian to Quaternary in age, is bounded by the Black Range to the north, the Goodsight Mountains and West Potrillo Mountains to the east, and the Cedar Mountain Range to the west; its southern boundary extends into Mexico (Hanson et al. 1994). The Gila River Valley, near Duncan, is part of the Mexican Highland physiographic subdivision, which runs from southeastern Arizona to north-central New Mexico and includes Pliocene-Pleistocene alluvial and lacustrine deposits in the basins and Proterozoic through Cenozoic rocks in the mountains (Connell et al. 2005).

In New Mexico, 29 paleontological localities were found within the 2-mile-wide study corridors (as listed in Table 3-21), including a wide range of taxa from different time periods. The earliest fossil localities in the Project study area are Mississippian in age and come from the Keating

Formation in Hidalgo, Luna, and Grant counties. Brachiopods, corals, blastoids, bryozoans, trilobites, and gastropods have been found in the Keating Formation (Armstrong 1970). These fossils are from the Paleozoic Era (543 to 250 million years ago), when much of New Mexico was covered by a shallow sea. Tracks of Permian tetrapods have been found in the Abo and Hueco formations in southern New Mexico (Lucas et al. 1995; Braddy 1998; Cook et al. 1998; Lucas et al. 1998). Rocks of Triassic age near Carthage have produced dinosaur and invertebrate fossils (Lucas et al. 2000; Spielmann and Lucas 2009). The Bisbee Group of Cretaceous age has produced ammonites and bivalves in southwestern New Mexico (Lucas and Estep 1998). Plesiosaur teeth were reported from the Tres Hermanos Formation of Cretaceous age on the Sevilleta Grant north of Socorro (Spielmann and Lucas 2006). Ceratopsian dinosaur material was found in the McRae Formation of Cretaceous age east of Elephant Butte Reservoir (Lucas et al. 1998). The centrum of a mosasaur, a type of marine reptile, and associated coral were found in the Mancos Shale of Cretaceous age near Truth or Consequences.

The Baca and Hart Mine formations of Eocene age have produced Tertiary mammals, including titanotheres, rodents, horse, primates, and reptiles (Massing 1977; Lucas et al. 1981; Lucas and Williamson 1993; Prothero et al. 2004). An oreodont was found in the Popotosa Formation of Miocene age within the Bosque del Apache NWR, south of San Antonio (Morgan et al. 2009). The Camp Rice Formation of late Blancan age near Tonuca Mountain has produced fossil tortoise, birds, carnivores, horse, peccary, camel, and gomphothere (Morgan et al. 1998). The Palomas Formation of Blancan age near Socorro and Elephant Butte Reservoir has produced fossil horse, gomphothere, mastodon, antilocaprid, tortoise, camel, sloth, rodent, tapir, and reptiles (Tedford 1981; Lucas and Morgan 1999; Morgan et al. 2011). The Gila Group of late Pliocene age at Pearson Mesa near the New Mexico-Arizona state line in Hidalgo County has produced tortoise, sloth, felids, rodents, horse, peccary, camel, glyptodont, and gomphothere (Morgan and Lucas 2003).

There are numerous Pleistocene vertebrate localities scattered throughout each county in the Project study area, including cave sites in the southern portion of New Mexico (Harris 2005; Morgan and Lucas 2003).

3.4.3.2 Arizona

Southern Arizona is also typical of the Basin and Range Province, having wide basins separated by mountain ranges. One of these basins, the San Simon Valley, began forming approximately 17 million years ago and is filled with more than 10,000 feet of fluvial, playa, and lacustrine deposits ranging in age from Miocene to Pleistocene (Houser et al. 2004). The Peloncillo Mountains, northeast of the San Simon Valley, are mostly composed of Tertiary volcanic rocks. The Pinaleño Mountains to the west are predominantly Precambrian granitic rocks (*ibid*). West of the Pinaleño Mountains is Sulphur Springs Valley. As in southwestern New Mexico, old playas are found in this area. The Willcox Playa represents a remnant of the ancient Pleistocene Lake Cochise.

The area of the San Pedro and Santa Cruz rivers consists of several valleys separated by mountain ranges. The San Pedro River enters Arizona from Mexico just west of Naco, and travels northward to the towns of Benson and Mammoth, eventually emptying into the Gila River near Hayden. The San Pedro River Valley was formed during the late Miocene between

14 and 6 million years ago (Lindsay 1984). The valley is filled with basin-fill sediment ranging in age from late Miocene to Pleistocene. The Galiuro Mountains, east of the San Pedro River, consist mostly of Miocene volcanic rock, although Upper Jurassic through Paleocene sedimentary rock is present as well. Aravaipa Canyon lies north and east of the Galiuro Mountains. The Santa Cruz River valley was formed approximately 17 million years ago (Gettings and Houser 1997) and also consists of basin-fill deposits Miocene to Pleistocene in age. The Santa Rita Mountains lie east of the Santa Cruz River in Santa Cruz and Pima counties; they have a complex geological history dating to the Precambrian, with sedimentary, volcanic, and intrusive rock found there. West of the Santa Cruz River are the Tumacacori and Sierrita mountains, which consist of Mesozoic rock that overlies Paleozoic bedrock.

In Arizona, 3 paleontological localities were found within 1 mile of the centerline; 22 paleontological localities were found in the Project study area. These localities include a wide range of time periods and taxa. The smaller number of recorded fossil localities in Arizona, within 1 mile of the centerline, could be a result of a lack of a database for Arizona, such as that maintained by the New Mexico Museum of Natural History and Science for New Mexico.

The oldest rock formations containing fossils in southern Arizona are of Paleozoic age, with invertebrates and fish. This is a period in time when southern Arizona was sometimes covered by shallow seas. No Paleozoic fossil localities were found within 1 mile of the Project centerline in Arizona.

The oldest fossil land vertebrates in southern Arizona are Cretaceous in age. Iguanodontid dinosaurs have been found in the Empire, Whetstone, and Santa Rita mountains, southeast of Tucson (Moore and Miller 1960; McCord 1997; Lucas and Heckert 2005). A hadrosaur dinosaur have been found in the Bisbee Group of Cretaceous age in the Tucson Mountains (Lucas et al. 2005).

Two fossil localities of Miocene age near Mineta Ridge and Teran Wash in Pima County have produced rhinoceros teeth and footprints (Chew 1952; Lucas and Morgan 2005). The fossilized footprints are within 1 mile of the centerline of Link C266. Two fossil localities in the Quiburis Formation of Miocene age near Redington have produced fossil carnivore, rabbit, rodent, horse, camel, and mastodon material (Lindsay and Tessman 1974; Jacobs 1977; Morgan and White 2005). Several fossil localities in the St. David Formation of Pliocene age near Benson have produced fossil sloth, carnivore, felid, rabbit, rodent, horse, peccary, camel, cervid, and gomphothere material (Gidley 1926; Gazin 1942; Downey 1968; Lammers 1970; Lindsay and Tessman 1974; Lindsay et al. 1990). The St. David Formation extends farther north and is crossed by the alternative routes. Several fossil localities in the 111 Ranch Beds of Pliocene age in San Simon Valley in Graham County have produced fossil sloth, carnivore, glyptodont, bat, rabbit, rodent, horse, tapir, peccary, camel, cervid, antilocaprid, and gomphothere material along with track sites (Knechtel 1938; Wood 1962; Galusha et al. 1984; Tomida 1987; McCord et al. 2002; Pasenko 2007; Thrasher 2007).

Two Pleistocene fossil localities were found within 1 mile of the centerline for the subroutes in Arizona near Links C246 and B160B. Numerous other Pleistocene fossil localities occur throughout the study area in Arizona (Mead et al. 2005). A mastodon skull and several mammoth bones have been found in an area between the Bowie townsite and Safford, in Pleistocene

alluvium (Tegowski and White 2000; Pasenko 2012). Several Pleistocene localities are also known from the Willcox Playa (ancient Lake Cochise), containing mammoth, bison, camel, and horse material (Bryan and Gidley 1926; Saunders 1970; Mead et al. 2005). There are Pleistocene localities throughout the San Pedro River Valley in Cochise, Pima, and Pinal counties that contain mammoth, mastodon, horse, camel, and bison material. Nineteen documented mammoth sites are located along the San Pedro River Valley and its tributaries in Arizona (Haury et al. 1953; Haury et al. 1959; Hemmings and Haynes 1969; Saunders 1970; Cannon and Meltzer 2004; Haynes 2007). More than 25 percent of known mammoth sites in Arizona are found along the San Pedro River Valley and its tributaries (Saunders 1970). These 19 mammoth sites are found as far south as the Mexico border and as far north as Pinal County, Arizona; cumulatively, they contain at least 35 individual mammoths. Associated with the mammoths are fossils of mastodon, bison, camel, horse, dire wolf, peccary, and tapir. In addition, mammoth tracks were discovered at Murray Springs. In general, the mammoth sites are found in Pleistocene alluvial and lacustrine deposits. Similar Pleistocene deposits have been found throughout the San Pedro River Valley, including the Cerros Negros mammoth locality in southeastern Pinal County (*ibid*). Although Pleistocene alluvium is generally categorized with a PFYC of 2, given the high presence of fossil localities along the San Pedro River Valley, it is possible a chance discovery could be made during the construction phase of the Project.

Four Pleistocene mammoth localities along the San Pedro River Valley in southern Cochise County have cultural associations: Lehner Ranch, Murray Springs, Naco, and Escapule. These localities are interpreted to be kill sites, where ancient people killed and processed mammoths and other large land mammals (megafauna) approximately 13,000 years ago. Artifacts found at these sites include projectile points, bifaces, utilized flakes, tertiary flakes, cores, and tools made from bison and mammoth bone. At Murray Springs and the Lehner Site, hearths were discovered. The term "Clovis" was given to this type of Paleoindian, stone-age technology; named after a mammoth kill site located near Clovis, New Mexico. The mammoth kill sites are important because they represent the most direct evidence of human predation on extinct mammoths and other large land mammals that lived 13,000 years ago. A majority of the mammoth sites along the San Pedro River Valley represent a time during the late Pleistocene when much of the megafauna (e.g., mammoth, mastodon, ground sloth, glyptodont, dire wolf, saber-toothed cat, American lion, American cheetah, camel, and horse) were going extinct in North America. The San Pedro River Valley has the densest concentration of early Paleoindian sites with extinct megafaunal remains in North America (Cannon and Meltzer 2004), and probably in South America as well.

3.4.4 Potential Fossil Yield Classification

3.4.4.1 New Mexico

In New Mexico, geological units with a PFYC of 4 or 5 within the study corridors include the Paleocene Nacimiento Formation; Eocene Baca, Palm Park, and El Rito formations; Miocene Popotosa Formation; Pliocene Palomas Formation and Santa Fe Group; and Pliocene/Pleistocene Camp Rice and Sierra Ladrones formations. Geological units that have a PYFC of 3 include the Paleozoic Abo Formation, Cretaceous Tres Hermanos and McRae formations, and Chinle and Mesa Verde groups.

3.4.4.2 Arizona

In Arizona, geological units with a PFYC of 4 or 5 within the study corridors include the Miocene Quiburis Formation, and the Pliocene 111 Ranch beds, Gila Group, and St. David Formation. In Arizona, only the Mineta Formation has a PFYC of 3.

3.4.5 Summary of Inventory Results

The paleontological inventory results are summarized below and in Table 3-21. The paleontological resource inventory is illustrated on Figure M 4-1 (see Map Volume).

Table 3-22. Summary of Paleontological Resource Inventory Data

Alternative Route	Paleozoic Localities	Mesozoic Localities	Cenozoic Localities	Total Number Localities
Route Group 1: SunZia East Substation to Midpoint Substation				
North River Crossing	2	0	16	18
San Antonio Crossing	0	8	1	9
Route Group 3: Midpoint Substation to Willow-500 kV Substation				
North San Simon Basin	0	0	1	1
South San Simon Basin	0	0	0	0
Route Group 4: Willow-500 kV Substation to Pinal Central Substation				
North of Mt. Graham	0	0	0	0
Sulphur Springs Valley	0	0	0	0
San Pedro Valley	0	0	1	1
Tucson/I-10 Corridor	0	0	1	1
I-10 East – Pantano/Rillito	0	0	0	0

3.4.5.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the SunZia East Substation and proceeds west along links E82, E84, and E85 through the Gran Quivira area. From there, the subroute continues west along links E101a, E101b, and E133, and eventually crosses the Rio Grande at Link E180. From there it proceeds south along links E211, A161, A161, and eventually A260, near Elephant Butte Reservoir. Subroute 1A1 then continues south to Midpoint Substation. Subroute 1A1 has 18 fossil localities within 1 mile of the centerline (see Table 3-22); including two Permian localities in the Abo Formation (PFYC of 2), along Link E101a/b, that have produced fossil invertebrates, plants, and vertebrate tracks. Two localities are in the Blancan Sierra Ladrones Formation (PFYC of 4) along link E180. These localities contain a fossil proboscidean tusk, horse teeth, horse postcrania, and a camel phalanx. The remaining 14 localities are in the Blancan Palomas Formation (PFYC of 4) along Link E180, and contain numerous fossil horse teeth and postcrania, an antilocaprid metatarsal, and a llama metatarsal.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is similar to 1A1 throughout most of the route except between the SunZia East Substation and the Rio Grande, where Subroute 1A2 takes a more northern route along E86a and E86b. The fossil localities that are found within 1 mile of the centerline for 1A2 are the same as for 1A1, due to the shared links.

Subroute 1A – North River Crossing

Subroute 1A is similar to 1A1 throughout most of the route, except near the SunZia East Substation where Subroute 1A begins on a slightly more southern route along E80c, and uses instead the more western Link A270 in the Elephant Butte Reservoir area. The fossil localities that are found within 1 mile of the centerline for 1A1 are the same as for 1A, because of the shared links.

Subroute 1B – San Antonio Crossing

Subroute 1B1 begins at the SunZia East Substation along the same links as 1A1, but at Link E80d it proceeds south along links E90 and A90, before proceeding west across the Rio Grande. Subroute 1B1 utilizes Link A270 in the Elephant Butte Reservoir area. Subroute 1B2 is similar to 1B1 except at the beginning near the SunZia East Substation, where it begins along a more southern route using links A30, A50, and A60. Subroute 1B2 also utilizes Link A270 in the Elephant Butte Reservoir area. Subroutes 1B1 and 1B2 do not use Link E180, and as a result has fewer fossil localities within 1 mile of the centerline than does 1A1.

Subroutes 1B1 and 1B2 have 9 fossil localities different than 1A1 (see Table 3-22). Eight of these fossil localities are Mesozoic in age and are located within close proximity to Link A111. Two of these Mesozoic localities are within the Moenkopi Formation of Triassic age and contain fossil capitosaurids. Two other Mesozoic localities are within the Chinle Group of Triassic age and contain archosaur and reptile fossils. Four of the Mesozoic localities are within the Mancos Shale and Greenhorn Limestone of Cretaceous age. The last of the 9 localities is located along Link A112 in the Sierra Ladrones Formation of Pleistocene age, and contains fossil turkey, horse, and camel.

The local alternative links (E81, E83, E82, E84, and E85) for 1B1 (Gran Quivira area) do not have any fossil localities within 1 mile of the centerline.

The local alternative links for 1A, 1B1, 1B2, and 1B3—A161b, A260, A361, A430, A481—do not have any fossil localities within 1 mile of the centerline.

3.4.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 begins at the Midpoint Substation and proceeds west through the Deming area along links B60 and B90. From there it continues west along links B120a and B120b approaching the Lordsburg area, and then on to links B121, B160a, B160d, and B160c. There is

one fossil locality within 1 mile of this subroute located along Link B160d, which includes a camel ulna, a turtle shell fragment, and unidentifiable bone fragments. This fossil locality was found in sediments correlative to the 111 Ranch Beds.

Subroute 3A – North

Subroute 3A is similar to 3A2, but utilizes Link B160b instead of B160d. There is one fossil locality within 1 mile of this subroute located along Link B160b, which is the same as the one reported along Subroute 3A2.

Subroute 3B – South

Subroute 3B begins at the Midpoint Substation and proceeds west to Lordsburg along links B60, B80, B110a, B110b, and B112, generally south of subroutes 3A2 and 3A. Subroute 3B continues west-northwest to the Willow Substation along links B150a, B150b, B151, and B170. There are no known fossil localities within 1 mile of this subroute.

Crossover links B111 and B140, available for Route Group 3, do not have any fossil localities within 1 mile of the centerline.

3.4.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A proceeds north from the Willow-500 kV Substation along Link B153a, east of the Pinaleño Mountains. At a point north of the Pinaleño Mountains, Subroute 4A heads west along links B153b and C170, crosses the San Pedro River at Link C592, and continues west along links C595, C620, C760, and C780, eventually reaching the Pinal Central Substation. There are no recorded fossil localities within 1 mile of the centerline for Subroute 4A.

Subroute 4B – Sulphur Springs Valley

Subroute 4B proceeds west from Willow-500 kV Substation along links C71, C72, and C90. It continues north along links C130a and C130b, west of the Pinaleño Mountains. Beginning at Link C173, Subroute 4B is common to 4A. There are no recorded fossil localities within 1 mile of the centerline for Subroute 4B.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c proceeds west from the Willow-500 kV Substation along links C71, C71a, and C110, and continues southwesterly along C212, C260, and A261, where it eventually crosses the San Pedro River. From there it continues northward along links C201, C441, and C450. Subroute 4C2c proceeds west along Link C661 in the San Manuel/Oracle area, continues west to the Tortolita Substation, and then heads north along Link C820, eventually reaching the Pinal Central Substation. One fossil locality is located within 1 mile of the centerline for Subroute

4C2c at Link C201. This locality contains a fossil mammoth found in Pleistocene alluvium, which has a PFYC of 2.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is similar to 4C2c at the beginning and the end of the subroute, except that 4C1 proceeds northward, east of the San Pedro River along links C301, C331, C361, and C470. Subroute 4C1 crosses the San Pedro River south of subroutes 4A and 4B, and north of Subroute 4C2c, at Link C510. There are no recorded fossil localities within 1 mile of the centerline for Subroute 4C1.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to 4C2c, except between links C212 and C441 where 4C2 varies slightly along a more northern segment that includes links C270, C271, C266, and C276. There is one recorded fossil locality within 1 mile of the centerline for Subroute 4C2.

Subroute 4C3 – Tucson

Subroute 4C3 is similar to 4C2c from the Willow Substation through Link C261. From there Subroute 4C3 continues southwesterly along links F40a, F600, F60b, F82, F80, and F11 as it approaches the Tucson area. Here it continues northwesterly along links F112, F510, and F540 before reaching the Tortolita Substation. From there it proceeds north along links C816, C817, and C820 before turning west and reaching the Pinal Central Substation.

Local Alternative Link C201 has one fossil locality within 1 mile of the centerline. No other local alternative links or crossover links have fossil localities within 1 mile of the centerline.

3.5 WATER RESOURCES

3.5.1 Introduction, Methods, and Regulatory Framework

3.5.1.1 Introduction

This section presents an overview of the surface water and groundwater resources within the Project study area that may be affected by construction and operations of the proposed Project. Water resources include rivers, streams, lakes, other water bodies, groundwater, aquifers, wells, and springs.

Based on the results of preliminary research, the public scoping process, and consultation with the BLM, the following water resource issues were identified:

- Aravaipa Creek, Rio Grande, San Pedro River, and associated perennial and intermittent streams
- Water wells around the Tucson Sole Source Aquifer, and parallel to the Santa Cruz River

3.5.1.2 Methods

Information for the water resources inventory was obtained from the scientific literature and from government agencies and institutions, including the BLM, USFS, EPA, USFWS, USGS, New Mexico Office of the State Engineer, and the ADWR. Specific water resources were inventoried within a study corridor that is 2 miles wide (1 mile on either side of the centerline). Because of the large scale of the Project, the water resource maps show resources within a 6-mile-wide study corridor for each alternative, including watersheds, perennial and intermittent streams, lakes and reservoirs, sole source aquifers, springs, and wells. Within these study corridors, perennial and intermittent streams, water bodies, springs, and wells were identified for impact assessment within 600 feet of the Project centerline; whereas unique or impaired waters were identified for impact assessment within 0.25 mile of the Project centerline. The distance of a 0.25 mile was used for impaired and outstanding waters, since this is the minimum distance used by the ADEQ for discharges to impaired waters involving construction-related activities and possible permitting. There are no current policies or regulations for BLM or state lands in New Mexico or Arizona regarding construction activities and distance to streams or rivers. Six-hundred feet was used as a conservative measure to identify water resources that could be impacted by the Project.

Based on the National Hydrography Dataset obtained from the USGS, the Project crosses hundreds of intermittent streams. As a result, a sample of 20 percent of the intermittent streams was used to estimate the amount of disturbance for streams and jurisdictional waters. The width of these streams was measured using ArcGIS, providing an average width for each alternative route. This width was then used to calculate acreage of disturbance based on the access model.

3.5.1.3 Regulatory Framework

Federal

The Federal Water Pollution Control Act of 1972 (33 USC 1251-1387) is more commonly known as the CWA of 1977, after major amendments to the Act in that year. The objective of the CWA, as amended, is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Individual sections of the CWA maintain and protect the nation's water resources. The following sections of the Act may influence the construction and operations of the Project.

Section 302: Water Quality Related Effluent Limitations. Under Section 302, water quality standards designated by the state-set levels of allowable pollutants are called Total Maximum Daily Loads (TMDL). This pollutant allotment criterion is designated for a specific water body relative to its particular usage (e.g., recreation, water supply, aquatic life, agriculture). A water quality criterion (numeric pollutant concentrations and narrative requirements) is also designated to protect particular resource uses. If the Project has the potential to add pollutants to a particular water resource, it may be necessary to mitigate impacts to avoid exceeding the TMDL.

Section 303: Water Quality Standards and Implementation Plans, Designation of Impaired Waters. Water bodies not meeting state-mandated water quality standards are presented to the EPA for designation as impaired waters and issuance of federal protection under a TMDL.

Impaired waters that may potentially be affected by the Project are subject to limitations set forth by the TMDL issued for a particular impaired water. If there is a high probability that the Project will affect an impaired water, modification to the National Pollutant Discharge Elimination System (NPDES) construction general permit could be required.

Section 319: Effluent Limitations from Nonpoint Sources. Nonpoint source pollution management, under Section 319 of the CWA, was created following the 1987 amendments to the Act. Section 319 regulates the discharge of pollutants from various sources, which culminate to reduce water quality standards set by the state. If the Project has the potential to add nonpoint source pollutants to a particular resource protected by a TMDL, it may be necessary to mitigate impacts and potentially require the Project to be included into the TMDL permit.

Section 401: Water Quality Certification. An application for a federally permitted activity that may result in a discharge into Waters of the United States must obtain a 401 Certification from the state with jurisdiction, certifying the action will not violate state or federal water quality standards. In New Mexico, the 401 Certificate is issued by the New Mexico Pollutant Discharge Elimination System (NMPDES); in Arizona, the 401 Certificate is issued by the Arizona Pollutant Discharge Elimination System (AZPDES).

Section 402: National Pollutant Discharge Elimination System. The states of New Mexico and Arizona have been delegated permit authority over the federal NPDES and each maintains the NMPDES and AZPDES, respectively, which regulate water quality standards specifically by issuing and monitoring construction related permits.

Section 404: Dredge or Fill in Waters of the United States. The CWA regulates the dredging or filling of any material into Waters of the United States under the regulatory jurisdiction of the USACE. If the Project requires the dredge or fill in a Water of the United States as defined in the CWA, it may be necessary to obtain a federal permit to conduct the work. Waters of the United States are defined as waters that are "currently used or were used in the past or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide and all interstate waters including interstate wetlands" (33 CFR Part 328.3). An assessment of jurisdictional waters would be performed prior to construction. The inventory for the FEIS was conducted as described in Section 3.5.1.2.

EO 11990: No Net Loss of Wetlands. This EO directs federal management agencies to: (1) provide leadership and to take action to minimize the destruction, loss, or degradation of wetlands; (2) preserve and enhance the natural and beneficial values of wetlands; and (3) avoid direct or indirect support of new construction in wetlands, unless there are no practicable alternatives to such construction and the proposed action includes all practicable measures to minimize any harm done. This Project was sited so that there are no wetlands in the Project study area; therefore, this regulation is identified but is not further discussed.

Safe Drinking Water Act. The Safe Drinking Water Act (SDWA) is the main federal law that ensures the quality of drinking water. It was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986, and again in 1996. Many actions are required to protect drinking water and its sources, which include rivers, lakes, reservoirs, springs, and groundwater wells. Under the SDWA, the

EPA sets the standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards; the SDWA does not regulate private wells that serve fewer than 25 individuals (EPA 2004a). The SDWA also mandates that a groundwater wellhead protection program be developed by each state to protect groundwater resources that serve as sources for public drinking water. Section 1424(e) authorized the development of the Sole Source Aquifer Program. A sole source aquifer, as defined by the EPA, is one "that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. These areas may have no alternative drinking water source(s) that could physically, legally and economically supply all those who depend on the aquifer for drinking water" (EPA 2011e).

State

New Mexico Water Quality Control Commission. Protection of water resources in New Mexico for federal and state regulations is implemented at the state level through the New Mexico Water Quality Control Commission (NMWQCC). The responsibilities of the NMWQCC include the CWA, wellhead protection program, and the Sole Source Aquifer Program of the SDWA (§74-6-3.E, NMSA 1987).

Arizona Department of Water Resources. The ADWR enforces the Arizona groundwater code and surface-water rights, and oversees the use of surface and groundwater resources (including sole source aquifers) under state jurisdiction. The ADEQ has established the Wellhead Protection Program as a guide to prevent contamination of groundwater.

3.5.2 Regional Overview by Watershed

The Project lies mostly within the Basin and Range Province (Fenneman 1931). Within this province, the Project crosses one large principal aquifer system: the Basin and Range Aquifer. In New Mexico, this large principal aquifer includes the Rio Grande Aquifer system (Anning et al. 2009). Both systems are composed mostly of basin-fill, which consists of unconsolidated to consolidated gravel, sand, silt, and clay overlying consolidated rock (Robson and Banta 1995). In New Mexico, the Project crosses both systems; in Arizona, it lies completely within the larger Basin and Range Aquifer. In general, groundwater levels for areas within the Project study area range from 0 to more than 400 feet below ground surface. Surface water, represented by numerous perennial and intermittent rivers and streams, shows a strong relationship to seasonal trends in temperature and precipitation. Each watershed within the Project study area consists of several basins that contain numerous rivers, streams, and washes, most of which are not perennial throughout their length (Table 3-23).

3.5.2.1 New Mexico

There are eight watersheds within the study corridors in New Mexico. The Rio Grande-Albuquerque Watershed is located within an area from just north of Albuquerque to an area south of Socorro. The Middle Rio Grande-Albuquerque Watershed encompasses 959 square miles, and its annual precipitation ranges between 8 and 20 inches (Middle Rio Grande-Albuquerque Reach Watershed Group 2008). The Rio Grande flows throughout most of its length, but flow has declined considerably due to irrigation for agriculture. The Rio Grande is listed on the state's Impaired Waters List.

Table 3-23. Regional Surface-Water Features within the Study Corridors		
Watershed	**Main River**	**Perennial Streams or Washes Crossed by Alternative Routes**
New Mexico		
Rio Grande-Albuquerque	Rio Grande	Arroyo del Veranito, Nogal Arroyo, Torreon Arroyo
Tularosa Basin		None
Jornada del Muerto		Arroyo Seco, Chupadera Arroyo
Elephant Butte Reservoir	Rio Grande	Rock Creek, Spikey Arroyo, Indian Creek, Alamosa Creek
Caballo	Rio Grande	Cuchillo Negro Creek, Palomas Creek, Cañada Honda, Salado Creek, King Arroyo, Las Animas Creek, Seco Creek, Greyback Arroyo, Greenhorn Arroyo, Percha Creek
El Paso-Las Cruces	Rio Grande	Montoya Arroyo, Tierra Blanca Creek, Oak Spring Creek, Jaralosa Creek, Berrenda Creek
Mimbres River	Mimbres River	Walnut Creek
Animas Valley		None
Arizona		
San Simon		San Simon River, Dial Wash, Willow Spring Wash, Owl Wash
Willcox Playa		Bee Canyon Wash, Wood Canyon, Martin Wash, Sacaton Wash
Middle Gila	Gila River	Bogart Wash, Florence Casa Grande Canal, Suffering Wash, Tom Mix Wash, Coronado Wash, Parker Wash
Upper Gila-San Carlos Reservoir	Gila River	Stockton Wash, Ash Creek, Bear Springs Wash, Underwood Wash
Upper Santa Cruz	Santa Cruz River	Big Wash
Lower Santa Cruz	Santa Cruz River	None
Rillito		Rillito River, Pantano Wash, Cienega Creek, Tanque Verde Wash
Upper San Pedro River	San Pedro River	Ash Creek
Lower San Pedro River	San Pedro River	Whitlock Wash, Bloodsucker Wash, Camp Grant Wash, Fourmile Creek, Right Prong Fourmile Creek, Squaw Creek, Aravaipa Creek, Big Wash, Teran Wash, Pool Wash, Paige Creek, Palomas Wash
Source: USGS 2009; New Mexico Water Resources Research Institute 2010a; ADWR 2009, 2010		

The Jornada Del Muerto Watershed begins north of Bingham, New Mexico, and Highway 380; and continues south to an area where it is bordered by the Oscura and San Andreas mountains to the east. A portion of the WSMR is covered by this watershed. The Jornada del Muerto Watershed covers approximately 3,344 square miles (New Mexico Water Resources Research Institute 2010b).

The Elephant Butte Reservoir Watershed encompasses an area from just north of San Marcial, south to Truth or Consequences, and northwest to include the San Mateo Mountains. The Caballo Watershed begins at Truth or Consequences and continues south to the southern tip of Caballo Lake. The Caballo Reservoir is bordered on the east by the Caballo Mountains and extends northwest and west, including the Salado Mountains.

The El Paso-Las Cruces Watershed begins at the southern tip of Caballo Lake and has an irregular shape continuing south along I-25 and the Rio Grande, through Las Cruces and El Paso.

The Mimbres Watershed is centered on Deming and includes the western-most portion of Doña Ana County and most of Luna County, and extends south into Mexico. The Mimbres Watershed headwaters are in the Black Range on the west- and south-facing slopes. From there, it flows south toward Deming, where it intermittently flows aboveground and eventually reaches Mexico. A portion of the Mimbres River is perennial within Grant County (Hanson et al. 1994).

The Animas Valley Watershed is centered on Lordsburg, but continues south, in a narrow band almost to the Mexico border where it is bordered by the Peloncillo Mountains to the west and the Animas and Pyramid mountains to the east. This watershed includes parts of Luna, Grant, and Hidalgo counties.

3.5.2.2 Arizona

There are nine HUC-8 watersheds within the study corridors in Arizona. The Upper Gila River Watershed includes portions of Graham and Greenlee counties, and extends as far south as Safford and the Pinaleño Mountains. It extends northwest to include the San Carlos Reservoir. The Upper Gila River Watershed ranges in elevation from 2,990 to 10,028 feet; it receives 12 inches of rain annually (ADEQ 2008a).

The Willcox Playa Watershed is centered on the Willcox Playa, with its northern boundary bordered by the Pinaleño Mountains to the east and the Winchester and Galiuro mountains to the west. This watershed encompasses 1,911 square miles and averages between 11 and 21 inches of annual precipitation (ADWR 2009).

The Middle Gila River Watershed begins at the Coolidge Dam in the San Carlos Indian Reservation, and extends west through areas around Eloy, Coolidge, Picacho Peak State Park, and the southern Phoenix metropolitan area, and continues to Gila Bend. The watershed extends farther north of Phoenix, including areas around Dewey, Wickenburg, and Salome. The Middle Gila River Watershed encompasses 12,250 square miles and ranges in elevation between 1,100 and 7,400 feet. The watershed receives approximately 13 inches of rainfall annually (ADEQ 2008a). All of the rivers and streams within the Middle Gila River Watershed are intermittent, although there are some reaches of each that are considered perennial. The smaller streams are ephemeral.

The Lower San Pedro River Watershed begins near Dudleyville, Arizona, just south of Highway 177; and continues south along the San Pedro River through the area around San Manuel and east of the Santa Catalina Mountains, and as far south as North Cascabel Road near the junction of the San Pedro River and Redrock Creek. This watershed includes portions of Pinal, Graham, Pima, and Cochise counties. The Lower San Pedro River Watershed averages between 14 and 32 inches of annual precipitation (Arizona Water Atlas 2009). Aravaipa Creek enters the San Pedro River north of Mammoth, Arizona. The Upper San Pedro River Watershed begins at the southern boundary of the Lower San Pedro River Watershed, north of Benson, and continues south along the San Pedro River into Mexico.

The Lower Santa Cruz River Watershed includes the area around the Tortolita Substation and the area around Marana. The Upper Santa Cruz Watershed begins northeast of Tucson between the Santa Catalina Mountains to the southeast and the Picacho Mountains to the northwest. From there, it follows the Santa Cruz River through Tucson, south through Green Valley and into Mexico. Both Lower and Upper Santa Cruz River watersheds encompass approximately 11,100 square miles and range in elevation from 1,100 to 9,156 feet. They receive approximately 15 inches of rain annually (ADEQ 2008a). Major tributaries for this mostly ephemeral river include Rillito Creek, Cañada del Oro, and Big Wash. The Upper Santa Cruz Basin covers 4,616 square miles (Coes et al. 2002), and its basin-fill is generally more than 3,000 feet thick. The depth to groundwater ranges from 30 to 300 feet below ground surface, with shallower groundwater level located south of an "inferred fault" north of Tubac (*ibid*).

The Rillito Watershed is a small watershed between the Lower and Upper San Pedro River watersheds to the east, and the Upper Santa Cruz Watershed to the west. This watershed includes areas around the Santa Catalina Mountains, and south between the Whetstone Mountains to the east and the Empire Mountains to the west.

There are 11 named bodies of water within the study corridors, and numerous unnamed bodies of water within the study corridors (Table 3-24). These 11 bodies of water are small, man-made reservoirs or tanks used to collect and store water for subsequent municipal and agricultural use. There are no natural bodies of water in the study corridors.

Table 3-24. Named Bodies of Water within the Study Corridors

State	Body of Water	Link
New Mexico	Joe Pankey Reservoir Number 2	A260
	McDougal Tank	A60
	H Bierner Number 2 Reservoir	A270
	Barksdale Tank	B110a
	Cup Tank	A330b
	Big Tank	B121
Arizona	Gilman Tank	C90
	Dean Tank	B150a
	Seven Cross Tank	B153b
	Clemans Tank	C840
	Rattlesnake Tank	C690

3.5.3 Regional Overview by Groundwater Area

3.5.3.1 New Mexico

The study corridor crosses the large Rio Grande Aquifer system, which encompasses 70,000 square miles and flows through Colorado, New Mexico, and Texas. The Rio Grande Aquifer system in New Mexico is part of the Basin and Range Aquifer and "consists of a network of hydraulically interconnected aquifers in basin-fill deposits located along the Rio Grande Valley and nearby valleys" (Robson and Banta 1995). The Rio Grande Aquifer system is composed of numerous basins in New Mexico, six of which are crossed by the study corridors. These Declared Underground Water Basins, as defined by the New Mexico Office of State Engineer,

are the Tularosa, Middle Rio Grande, Lower Rio Grande, Mimbres, Lordsburg, and Animas basins. Also included in the study corridors is the Hot Springs Artesian (Noftsker 2005). The Lower Rio Grande Basin begins in El Paso, Texas, and extends north to the southern extent of the Elephant Butte Reservoir. The Lower Rio Grande basin contains mostly basin-fill alluvial deposits. The Middle Rio Grande hydrogeological region continues from the Elephant Butte area in Socorro County, northward to Cochiti in Sandoval County. The Rio Grande is the major drainage for both the Lower and Middle Rio Grande basins (Robson and Banta 1995).

The Middle Rio Grande's southern boundary is commonly defined, by some, as ending near San Acacia, New Mexico (Bartolino and Cole 2002); whereas others extend its southern boundary to the Elephant Butte area (Hawley 2001). The Middle Rio Grande Basin covers approximately 3,060 square miles; encompassing parts of Santa Fe, Sandoval, Bernalillo, Valencia, Socorro, Torrance, and Cibola counties (Bartolino and Cole 2002). For the study corridors, this includes an area north of Socorro south to Elephant Butte Reservoir. Like the Lower Rio Grande Basin, the Middle Rio Grande Basin consists of the Santa Fe Group, which varies in thickness from 1,400 to 14,000 feet and is the main water-bearing unit. Groundwater level varies from 2 feet below ground surface near the Rio Grande to 1,180 feet below ground surface beneath West Mesa. The annual precipitation ranges between 7 and 23 inches, and the average annual temperature ranges from 35 degrees Fahrenheit in January to 79 degrees Fahrenheit in July (*ibid*).

The Tularosa Basin, for SunZia, includes the area west of SunZia East Substation and north of the Chupadera Mountains. The Tularosa Basin covers approximately 17,000 square miles and has a mean annual precipitation of 11 inches (Huff 2005).

The small Animas and Lordsburg basins are located within the study corridors in Hidalgo and Grant counties. Several playas are present in these basins, including the ancient Lake Animas (Reeder 1957). The intermittent Animas Creek is the main drainage of the Animas sub-basin. In these basins, groundwater level varies between less than 100 feet below ground surface in areas of perched water, to greater than 200 feet below ground surface in other areas of the basin (*ibid*).

The Mimbres River Basin covers more than 5,000 square miles in Sierra, Luna, Doña Ana, and Grant counties; the southern portion of the basin extends into Mexico. The Mimbres River Basin is bounded by the Black Range to the north; Goodsight, Sierra de las Uvas, and West Potrillo mountains to the east; and Cedar Mountain Range to the southwest. Deming, New Mexico is located approximately in the center of the basin. The Mimbres River is the main drainage in the Mimbres River Basin, and is only perennial at its headwaters north of the Grant-Luna county line. Elevation ranges from 3,700 to 10,011 feet above sea level. The annual precipitation for the Mimbres River Basin is 9 to 24 inches, and the mean monthly temperature at Deming is 41 degrees Fahrenheit in January and 81 degrees Fahrenheit in July. The major uses of water are for agriculture, mineral processing, and the urban water supply. Thirty-three springs and an unknown number of seeps are scattered throughout this basin, commonly as a result of fractured bedrock. The main source of groundwater in the Mimbres River Basin is the bolson-fill aquifer, consisting mostly of the Gila Conglomerate. The bolson-fill varies in thickness from 50 to 3,770 feet; with groundwater level ranging from 7 to 140 feet below ground surface (Hanson et al. 1994).

3.5.3.2 Arizona

The hydrogeological areas in Arizona crossed by the study corridors are the Duncan and Eloy sub-basins; Safford, Willcox, Aravaipa, Lower San Pedro River, and Upper Santa Cruz River basins; and Avra Valley.

The Duncan Sub-basin is near the Arizona-New Mexico state line, which includes that portion of the basin between Duncan and San Simon. The major drainage is the Gila River near Duncan. Elevation ranges between 3,400 and 7,000 feet, and annual precipitation is between 9 and 16.4 inches (New Mexico Water Resources Research Institute 2010a). Groundwater level ranges between 21 and 500 feet below ground surface (Remick 1989) and groundwater flow is to the north. The Duncan Sub-basin, which is part of the Gila River Watershed, lies within parts of Greenlee and Cochise counties in Arizona, and Hidalgo and Grant counties in New Mexico.

The study corridors cross a large portion of the San Simon Sub-basin, which is part of the larger Safford Basin. The area from the Bowie townsite east across the New Mexico state line, and north to an area just south of Safford, is included in the San Simon Sub-basin. This sub-basin covers 1,930 square miles, with basin-fill ranging between 4,000 and 6,400 feet thick (Towne and Rowe 2004). Groundwater level ranges from 1 to 700 feet below ground surface. Groundwater flow is typically from the surrounding mountains to the middle of the basin, but groundwater pumping has lowered the water level in some areas, creating cones of depression that interrupt this movement (*ibid*).

The study corridors cross the northern half of the Willcox Basin, from Willcox north through the Winchester Mountains to the west, and the Pinaleño Mountains to the east. A topographical high at the north end of this basin separates it from the Aravaipa Basin to the north. Elevation ranges between 4,100 and 8,800 feet; and annual precipitation is between 10 and 48 inches. There are five perennial streams in the Willcox Basin, two of which are crossed by the subroute near Bonita (Grant and Big Creek). The USGS has identified as many as 92 springs within the Willcox Basin (ADWR 2010). Groundwater in the Willcox Basin is found in the basin-fill, stream deposits, and lake deposits; and groundwater level ranges from 34 to 649 feet below ground surface, with movement generally toward the Willcox Playa (Towne et al. 2001).

The study corridors for subroutes 4A and 4B cross the Aravaipa Basin from Klondyke southeast, between the Galiuro Mountains to the west and the Pinaleño Mountains to the east. The Aravaipa Basin covers 537 square miles and is drained by Aravaipa Creek, a tributary of the San Pedro River. Groundwater level ranges from 26 to 500 feet below ground surface (ADWR 2009).

The Tucson Active Management Area (AMA) is located in the area north of Oracle. Elevation ranges from 1,770 to 9,400 feet; and annual precipitation ranges between 8 and 38 inches. The Santa Cruz River is the major drainage for the Tucson AMA, but several perennial streams are also present, none of which is within the study corridor. The USGS reports that as many as 187 springs are present in the Tucson AMA (ADWR 2010). Groundwater level is between 4 and 633 feet below ground surface, with groundwater flow in the Oracle area generally toward the west and southwest (*ibid*).

The Eloy Sub-basin is one of several basins in the Pinal AMA, a portion of which is within the study corridor near Casa Grande, Eloy, and Picacho. The eastern boundary for this sub-basin is made up partly by the Picacho Mountains. Like all basins of the Pinal AMA, the Eloy Sub-basin contains up to several thousand feet of basin-fill consisting of sand and gravel (Towne et al. 2008). The Santa Cruz and Gila rivers are the main drainages in the Eloy Sub-basin, both of which are intermittent. There are six springs identified by the USGS within the Pinal AMA (ADWR 2010). Groundwater level is between 24 and 660 feet, with groundwater flow generally toward the Eloy-Casa Grande area (*ibid*). The Santa Cruz Sole Source Aquifer is the only one present within the study corridor, and is located in and around the greater Tucson area (EPA 2011e).

3.5.4 State-listed Impaired Waters and Unique or Outstanding Waters

There are three state-listed impaired waters in the study corridor. The first is along the Rio Grande from San Marcial to Rio Puerco; the second is along the Rio Grande in the Elephant Butte and Caballo Reservoir area; and the third is Percha Creek, from the perennial reaches of Caballo River to the middle fork (Table 3-25). The Mimbres River is considered impaired along several reaches, but the portion that is crossed by the alternative routes is considered not impaired. An impaired water is defined by the EPA as a body of water too polluted or otherwise degraded to meet water quality standards set by states, territories, or authorized tribes (Section 303(d) of the CWA). Impaired waters can be caused by point sources and nonpoint sources. Point sources are usually from a direct source to a lake, river, or stream, such as industrial or sewage treatment plants. Nonpoint sources come from different sources, usually caused by rainfall or snowmelt moving over and through the ground, picking up pollutants that are eventually deposited in lakes, rivers, and streams. These types of pollutants include (1) fertilizers, herbicides, and insecticides from agricultural lands; (2) oil, grease, and toxic chemicals from urban runoff; (3) sediment from improperly managed construction sites or eroding stream banks; (4) salt from irrigation practices; (5) acid drainage from mines; (6) bacteria and nutrients from livestock, pet wastes, or faulty septic tanks; and (7) atmospheric deposition or hydromodification (EPA 2010a).

There were no impaired waters in Arizona that are within the SunZia study corridor, but the San Pedro River south of Benson and north of Aravaipa Creek is attaining impaired status due to *E. coli* (ADEQ 2010). The closest link to an impaired area of the San Pedro River is Link F40a, which is approximately 1.6 miles from the impaired area.

Table 3-25. Impaired Waters within Study Corridor

Water Bodies	Links	Causes of Impairment
Rio Grande from San Marcial at USGS Gage to Rio Puerco, and in the Elephant Butte and Caballo Reservoir Area	E180, A140	Aluminum, *E. coli*
Percha Creek from perennial reaches at Caballo Reservoir to M Fork	A330b	Sedimentation/Siltation
Source: EPA 2011f; NMED Surface Water Quality Bureau 2010		

An Outstanding Natural Resource Water or, in Arizona, Outstanding Arizona Water (OAW) was originally called "unique waters" and is defined as:

> A surface water that is perennial, free-flowing, has water quality that meets or is better than applicable water quality standards, and meets on or both of the following: (1) The surface water is of "exceptional recreational or ecological significance," or (2) threatened or endangered (T & E) species are known to be associated with the water body and maintenance and protection of existing water quality is essential to the maintenance of the threatened or endangered species or the surface water provides critical habitat (AAC. R18-11-112[D]) (ADEQ 2011b).

3.5.4.1 New Mexico

According to the NMED, there are no outstanding waters listed for New Mexico within the Project area (NMED 2011c). The closest Outstanding Waters are in the Gila National Forest northeast of Lordsburg, and the Cibola National Forest southwest of Socorro, and are avoided by the alternative routes.

3.5.4.2 Arizona

Cienega Creek is an OAW, located in Pima County and southeast of Tucson, that is crossed by Subroute 4C3 (Link F600) and Local Alternative Link F51. Another OAW is Buehman Canyon Creek, which is crossed by Link C441. According to AZDEQ, the section of Buehman Canyon Creek that is considered an OAW is 2,500 feet from the nearest centerline for the Project. OAWs have special protection, including no new or expanded point-source discharge directly to an OAW. A permit is needed to discharge to an upstream tributary of an OAW and is only permitted if existing water quality is maintained. A discharge under Section 404 permit that may affect an OAW also would require a Section 401 water quality certification to ensure existing water quality is maintained and protected.

3.5.5 Summary of Inventory Results

The water resource inventory results are summarized below and shown on Figure M 5-1 (see Map Volume).

3.5.5.1 Route Group 1: SunZia East Substation to Midpoint Substation

Route Group 1 subroutes cross or are near many water resources. Most of these subroutes are located along or close to the Rio Grande, a major and regionally important water feature. The Rio Grande is considered impaired in several reaches crossed by all of the alternative routes in Route Group 1. Because of its close proximity to the Rio Grande, this route group crosses a large number of perennial and intermittent streams. Wells and springs are present throughout the study corridors of Route Group 1 subroutes, with local concentrations located in areas of agriculture.

Subroute 1A1 – North River Crossing

Subroute 1A1 proceeds west from SunZia East Substation along links E82, E84, and E85 through the Gran Quivira area, where it crosses several intermittent streams. It proceeds west and eventually crosses the Rio Grande at Link E180 before heading south on the west side of the Rio Grande to the Midpoint Substation. The subroute crosses numerous creeks, washes, and arroyos; some of which are considered perennial streams (Table 3-26). Subroute 1A1 crosses 1 perennial stream and 453 intermittent streams. Most of these streams are located within the Rio Grande Watershed. Subroute 1A1 could impact 37.2 acres of jurisdictional waters. One well is located within the study corridor of Subroute 1A1.

Subroute 1A2 – BLM Preferred Alternative

The impacts to water resources for Subroute 1A2 are similar to those of Subroute 1A1.

Table 3-26. Water Resources within Route Group 1

Subroute	Sole Source Aquifer (miles)	Perennial Streams	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
1A1	0	1	453 (14.07)	1	0	0.1
1A2 – BLM Preferred Alternative	0.0	1	462 (14.34)	1	0	0.1
1A	0.0	1	412 (12.25)	3	0	0.1
1B1	0.0	1	391 (11.55)	5	1	0.1
1B2	0.0	1	370 (11.77)	5	1	0.1
1B3	0.0	1	370 (11.77)	2	0	0.1

Subroute 1A – North River Crossing

Subroute 1A varies slightly from 1A1 by using Link E80c, south of Subroute 1A1. Subroute 1A also uses Link A270 rather than A260, in the area west of Elephant Butte Reservoir. As a result of these variances, 1A crosses fewer intermittent streams. Subroute 1A could impact 34.5 acres of jurisdictional waters. Three wells are located within the study corridor of 1A.

Subroute 1B – San Antonio Crossing

Subroute 1B1 is similar to 1A1 except after Link E80d, where it takes a southern route along links E90 and A90. It then proceeds west across the Rio Grande, at which point it proceeds south along the same links as 1A. Subroute 1B1 crosses 391 intermittent streams, and it could impact 32.0 acres of jurisdictional waters. One spring is located within the study corridor of Subroute 1B1, along Link A90. There are five wells located within the study corridor for 1B1.

Subroute 1B2 is similar to Subroute 1B1 for most of its length, except at the beginning near SunZia East Substation where it proceeds along a more southern route through links A30, A50, and A60. Subroute 1B2 could impact 30.3 acres of jurisdictional waters.

Subroute 1B3 is similar to Subroute 1B1 for most of its length, except at the beginning where it utilizes several different links (A40, A41, and A80). Subroute 1B3 could impact 30.3 acres of jurisdictional waters.

Local Alternative and Crossover Links for Route Group 1

The local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 include two links (A161B and A260) that are located within 600 feet of perennial and intermittent streams. Local Alternative Link A161B crosses 23 intermittent streams. Local Alternative Link A260 crosses 93 intermittent streams. These same local alternative links cross perennial streams Spikey Arroyo and Alamosa Creek, 2 unnamed streams, and 124 intermittent streams. Local alternative links A361, A430, and A481 do not cross any perennial or named streams, but do cross several small washes.

Crossover Link A70 crosses eight intermittent streams.

3.5.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroutes for Route Group 3 parallel each other for most of their length. There are two main areas where these subroutes cross perennial and intermittent streams. The first area is west of Deming, New Mexico, where the Mimbres River and its drainages are located; the second area is in Arizona, where these subroutes cross the San Simon River and its drainages. Subroute 3B – South crosses fewer streams than Subroute 3A – North.

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 proceeds west from Midpoint Substation along links B60 and B90, where it crosses the Mimbres River. It continues west along links B120a, B120b, and B121. From here it again heads west, entering Arizona in the San Simon Valley area along links B160a, B160d, and B160c. The BLM preferred alternative crosses 213 intermittent streams and would cross 17.5 acres of potential jurisdictional waters. Two wells are located within the study corridor along Subroute 3A2 (Table 3-27).

Subroute 3A – North

Subroute 3A crosses the same intermittent streams as Subroute 3A2, and would impact 17.5 acres of jurisdictional waters.

Table 3-27. Water Resources within Route Group 3

Subroute	Sole Source Aquifer (miles)	Perennial Streams	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
3A2 (BLM Preferred Alternative)	0.0	0	213 (3.5)	2	0	0.0
3A	0.0	0	213(3.7)	3	0	0.0

Table 3-27. Water Resources within Route Group 3						
Subroute	Sole Source Aquifer (miles)	Perennial Streams	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
3B	0.0	0	198 (4.2)	8	0	2.8

Subroute 3B – South

Subroute 3B crosses fewer intermittent streams than 3A2 and 3A, but has more wells located within its study corridor (see Table 3-27). Subroute 3B could impact 14.0 acres of jurisdictional waters.

Crossover Links for Route Group 3

Of the two crossover links available to subroutes 3A and 3B, Crossover Link B111 crosses 35 intermittent streams and Crossover Link B140 crosses 5 intermittent streams.

3.5.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Route Group 4 has five different routes in four distinct areas. Subroute 4C3 crosses the largest number of perennial and intermittent streams, as it crosses the Santa Cruz River twice and closely parallels the river, crossing many of its tributaries. Subroute 4C2 (west of the San Pedro River) crosses a larger number of streams than does Subroute 4C1 (east of the San Pedro River). Subroute 4A crosses a larger number of streams than does Subroute 4B.

Subroute 4A – North of Mt. Graham

Subroute 4A begins at the Willow-500 kV Substation and proceeds north-northeast of the Pinaleño Mountains. Subroute 4A crosses Aravaipa Creek at Link C170 and the San Pedro River at Link C592 (Table 3-28); it crosses 2 perennial streams and 231 intermittent and ephemeral drainages. Subroute 4A would cross an estimated 22.0 acres of potential jurisdictional waters. There are 17 wells and 2 springs located within the study corridor along links B153a, B153b, C170, C178, C173, C620, C780, and C880a. Subroute 4A crosses 21.1 miles of the Santa Cruz Sole Source Aquifer.

Table 3-28. Water Resources along Route Group 4						
Subroute	Sole Source Aquifer (miles)	Perennial Streams (miles)	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
4A	21.1	2 (.006)	231 (3.37)	17	2	0.0
4B	21.1	1 (.001)	232 (3.6)	17	3	0.0
4C1	25.4	0	254 (2.8)	28	0	0.0
4C2	42.0	1 (.02)	281 (2.5)	25	0	0.0

Table 3-28. Water Resources along Route Group 4						
Subroute	Sole Source Aquifer (miles)	Perennial Streams (miles)	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
4C2c – BLM Preferred Alternative	42.0	1 (.02)	323 (3.3)	11	0	0
4C3	87.6	0	400 (5.6)	169	0	0.2

Subroute 4B – Sulphur Springs Valley

Subroute 4B is similar to Subroute 4A for most of its length. Subroute 4B crosses 1 perennial stream and 232 intermittent and ephemeral drainages. Subroute 4B could impact 23.4 acres of jurisdictional waters.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c proceeds west from the Willow-500 kV Substation along links C71 and C71a through Sulphur Springs Valley. Subroute 4C2 continues southwest where it crosses the San Pedro River along Link C261, and then continues north to the Mammoth area. From there it proceeds west along links C661, C670, and C680 to the Tortolita Substation, proceeds north along Link C820, and eventually west to the Pinal Central Substation. The BLM preferred alternative crosses 1 perennial stream, 323 intermittent streams, and 42 miles of a sole source aquifer. Subroute 4C2c could impact 31.6 acres of jurisdictional waters. There are 11 wells and 2 springs within the study corridor for Subroute 4C2c.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 proceeds west of the Willow-500 kV Substation, utilizing the same Links as 4C2 and 4C2c, but proceeds north, east of the San Pedro River along links C361 and C470. At a point just northeast of Mammoth, Subroute 4C1 continues west across the San Pedro River along links C660 and C661, then heads northwest to the Pinal Central Substation utilizing links C690 through C880. This route crosses 254 intermittent streams and 25.4 miles of a sole source aquifer (see Table 3-28). Subroute 4C1 could impact 25.0 acres of jurisdictional waters. There are 28 wells located within the study corridor along Subroute 4C1.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to 4C2c except between links C212 and C441, where it proceeds north of Subroute 4C2c. This slight variation results in crossing fewer intermittent streams. Subroute 4C2 could impact 26.5 acres of jurisdictional waters. Subroute 4C2 also has more wells within its study corridor.

Subroute 4C3 – Tucson

Subroute 4C3 begins on a route common with subroutes 4C1 and 4C2, until it reaches Link C212. At this point, Subroute 4C3 continues on a southwesterly course, where it crosses the San Pedro River at Link F40a. At Link F600, Subroute 4C3 heads northwest, where it closely follows the Santa Cruz River. Link F600 crosses the Outstanding Water Cienega Creek. Subroute 4C3 continues to the north-northwest until it reaches Link C817, where it is then common with Subroute 4C2. Subroute 4C3 crosses 400 intermittent streams (more than any other subroute of Route Group 4) and 87.6 miles of a sole source aquifer, and could impact 35.6 acres of jurisdictional waters. There are 169 wells located within the study corridor along Subroute 4C3.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C790 is common to subroutes 4A, 4B, and 4C1. Link C790 crosses 11 intermittent streams and 2.1 miles of a sole source aquifer.

The Pinal Central Substation includes local alternative links C860, C870, and C890. Together, these links cross 8 intermittent streams. There are two wells located within 600 feet of the centerline for these links.

Local Alternative Link C692 is available for 4C1. Link C692 crosses 6 intermittent streams and 4.8 miles of a sole source aquifer.

Links C260, C261, and C201 cross 77 intermittent streams. Links F40b, F51, F60a, F81a, and F81b (Pantano-Rillito local alternative) cross 57 intermittent streams. This local alternative crosses 41.4 miles of sole source aquifer, and crosses the Outstanding Water Cienega Creek. There are 148 wells present within the study corridor.

The Tortolita Substation Local Alternative for 4C2 has nine links (C680, C815, C814, C816, C812, C813, C810, C810a, and C817), which cross 35 intermittent streams. There is 0.1 mile of water bodies crossed by the centerline of this subroute. This subroute crosses the Outstanding Water Cienega Creek.

The Tortolita Substation Local Alternative for 4C3 has six links (F40b, F51, F60a, F81a, F81b, and C812), which cross 62 intermittent streams and 1 perennial stream. These links also cross 38.7 miles of a sole source aquifer and are within 600 feet of 52 wells.

The Pantano/Rillito local alternative links for 4C3 include F40b, F51, F60a, F81a, and F81b; which include all links for the Tortolita Substation local alternative links for 4C3 (minus C812), representing 0.4 less mileage of intermittent streams that are within 600 feet of the centerline.

Four local alternative links (C72, C90, C121, and C211) are available for subroutes 4C1, 4C2, and 4C3. These links are located within 600 feet of perennial streams for 2.8 miles and intermittent streams for 6.2 miles. There are six wells located within 600 feet of these Links.

There are four crossover links available for 4A, 4B, and 4C1 (C500, C501, C502, and C174). These links are located within 600 feet of intermittent streams for 3.0 miles.

Crossover Link C671 is available for 4A, 4B, 4C1, and 4C2. This link is located within 600 feet of intermittent streams for 1.0 mile and crosses 0.1 mile of a wetland.

3.6 BIOLOGICAL RESOURCES

3.6.1 Introduction, Methods, and Regulatory Framework

3.6.1.1 Introduction

This section includes documentation and discussion of vegetation, wildlife, special-status species, and invasive species occurring in the 8-mile-wide study corridor (4 miles on either side of the reference centerline). Figures showing individual corridor links referenced in the text are found in the Map Volume.

Based on results of the public scoping process and in consultation with BLM resource specialists and cooperating agencies, the following areas of concern were identified with regard to biological resources:

- Migratory bird corridors at the Rio Grande and San Pedro River valleys
- Critical habitat for the Southwestern Willow Flycatcher along the Rio Grande and San Pedro River
- Critical habitat for the Rio Grande Silvery Minnow in the Rio Grande
- Critical habitat for ESA-listed fish in Cienega Creek, and Aravaipa, Hot Springs, and Redfield canyons
- Riparian habitat areas along major waterways: Rio Grande; Aravaipa and Cienega creeks; Pantano Wash; and San Pedro, Santa Cruz, and Rillito rivers
- Construction in remote areas with steep terrain, lacking existing access, within the Galiuro Mountains and west of the San Pedro River
- Grasslands and Pronghorn habitat in the northern Sulphur Springs Valley and Allen Flat
- Sandhill Crane roosting and foraging areas in the Sulphur Springs Valley and Willcox Playa
- Special-status species and riparian habitat within the Cienega Creek Natural Preserve
- Sonoran Desert Tortoise habitat in Arizona
- Pima pineapple cactus habitat in Pima County, Arizona

3.6.1.2 Methods

Preliminary review for the potential presence of special-status species included primary literature, regional references, publicly released county lists of species from wildlife management agencies, and direct contact from wildlife management agencies for all counties that fall within the study corridor (Doña Ana, Grant, Hidalgo, Lincoln, Luna, Otero, Sierra, Socorro, Torrance, and Valencia counties in New Mexico; and Cochise, Graham, Greenlee, Pima, and Pinal counties in Arizona). Sources for agency-managed data included the USFWS Southwest Region Ecological Services office, AZGFD Heritage Data Management System, and New Mexico Department of Game and Fish (NMDGF) – Biota Information System of New Mexico (BISON-M). The review also included GIS information provided by the USGS, USFWS, and New Mexico and Arizona offices of the BLM, NMDGF, and AZGFD.

Subsequent to the initial review, a focused review was conducted for the study corridor and each Project link, and the potential for presence of special-status species occurring within the vicinity of each link was evaluated. Approximately 700 special-status species were reviewed, with 269 species determined to have some potential for occurring within a study corridor that included a 4-mile buffer on either side of all proposed Project subroutes. A biological technical report that addresses all special-status species potentially occurring within the vicinity of this Project was produced and is incorporated as Appendix B1 of this document.

Direct agency input was solicited from the Las Cruces, Socorro, Safford, and Tucson field offices of the BLM, NMDGF, AZGFD, USFWS, and independent researchers familiar with some of the special-status species reviewed. Independent avian surveys were conducted at Project alternative crossings of the Rio Grande in New Mexico, during the winters of 2009-2010 and 2010-2011, by ornithologists at the University of New Mexico (Appendix B2). While none of the Project route groups crosses National Forest land, some of the subroutes are less than 1 mile from National Forest boundaries. Due to this proximity, the mobility of wildlife, and the potential for overlap of USFS sensitive plant species distributions onto adjacent land, USFS sensitive species were included in the Project review. Project scoping and other comments were reviewed, and appropriate information has been incorporated into this EIS.

Vegetation communities occurring within the study corridor are shown on Figure M 6-1 (see Map Volume). Vegetation data were obtained from the Resource Geographic Information System (RGIS) (New Mexico) and Arizona Land Resource Information System (ALRIS). Plant scientific and common names used in this document are referenced to the USDA Plants Database[1].

3.6.1.3 Regulatory Framework

Federal Laws

Federal legislation applicable to biological resources within the study corridor includes the NEPA (42 USC § 4321, et seq.; 40 CFR § 1500.1, et seq.); ESA (16 USC 460, et seq.), as amended; MBTA (16 USC 703, et seq.); BGEPA (16 USC 668); Sikes Act (16 USC §670g, et seq.); Fish and Wildlife Coordination Act (16 USC §662, et seq.); FLPMA (43 USC §1701); Federal Water Pollution Control Act Amendments of 1972 ([CWA] 33 USC §1251 et seq.); Carlson-Foley Act (PL 90-583); BLM Manual 6840 (Special-Status Species Management); and EO 13112 (Invasive Species).

- NEPA requires the federal government to assess the environmental impacts of most major federal actions, which includes actions undertaken (1) on federal land, (2) by a federal agency, (3) with federal funds, or (4) where the federal government will be issuing a permit.
- The ESA authorizes the USFWS to protect plant and wildlife species and the habitats on which these species depend. It requires federal agencies to ensure that their actions

[1] http://plants.usda.gov/index.html

(including permitting) are not likely to jeopardize the continued existence of a listed species or result in the destruction of the species' habitat.

- The MBTA protects more than 1,000 bird species native to North America and Hawaii by making it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale any listed bird, or the parts, nests, or eggs of such a bird. Provisions are given for regulated hunting and limited other activities, such as research and conservation.
- The BGEPA prohibits any form of possession or take (including many types of disturbance) of Bald and Golden Eagles. Certain exceptions for tribal cultural uses apply (16 USC 668-668c).
- The Sikes Act requires the military and federal land management agencies to coordinate with state wildlife agencies in the development of comprehensive plans for the conservation of wildlife. These plans may restrict uses of federal land, or require a plan amendment to allow an otherwise restricted use. The BLM will coordinate plan development and plan amendments with the state wildlife agency.
- The Fish and Wildlife Coordination Act requires consultation with the USFWS and state fish and wildlife agencies where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted...or otherwise controlled or modified" by any agency under a federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources."
- The FLPMA requires that public land be managed in a manner "...that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use; and that federal land management agencies provide meaningful public involvement with state and local agencies on land use decisions."
- The Federal Water Pollution Control Act requires compliance with state regulatory agencies responsible for Section 402 permits. The NMED Groundwater Pollution Prevention Section of the Ground Water Quality Bureau administers reviews and approves groundwater Discharge Permits for discharges that have the potential to impact groundwater quality, pursuant to Subparts III and V of the Water Quality Control Commission (WQCC) regulations (20.6.2 NMAC). In Arizona, permits are administered by the ADEQ under authority of the EPA. Projects may also require an AZPDES and/or a Stormwater Runoff permit from the ADEQ.
- The Carlson Foley Act directs federal land management agencies to destroy noxious plants growing on land under their jurisdiction, and provides a legal framework for reimbursement of expenses to state or local agencies for weed control on federal land.
- BLM Manual 6840 provides policy and guidance, consistent with applicable laws and regulations, for the conservation of special-status species and the ecosystems upon which they depend. Special-status species are defined as those "which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the ESA; those listed by a State in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each State Director as sensitive."

- EO 13112 requires that federal agencies prevent the introduction and spread of invasive species, detect and respond rapidly to control such species, monitor invasive species populations, and restore native species and habitat conditions in ecosystems that have been invaded. In addition, the order requires that a federal agency "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species."

State Laws

New Mexico

- The NMDGF is granted authority under Chapter 17, NMSA 1978, to regulate the take of fish and wildlife in New Mexico, and to manage those species and their habitat. For all game species, the state game commission establishes open and closed seasons, bag limits, and other rules relating to the take of those species.
- The New Mexico Wildlife Conservation Act of 1978 (NMSA 1978 § 17-2-37, et seq.) is administered by the NMDGF. The New Mexico Wildlife Conservation Act is the legal framework for establishing lists of species considered threatened or endangered within the state of New Mexico. ESA-listed species may be included in the list of state identified species, as appropriate. The Act requires the state to conduct a biennial review of the status of each designated threatened and endangered species, and requires the development of a recovery plan for each state-listed species. The Act provides for the purchase of land and support of research to meet recovery plan goals. The director of the NMDGF is the ultimate authority for the law; and enforcement is provided by conservation officers, county sheriffs, and the New Mexico State Police.
- Plant resources in New Mexico are covered under the 1985 New Mexico Endangered Plant Species Act (NMSA 1978 § 75-6-1), and are administered by the Forestry Division of the New Mexico Energy, Minerals, and Natural Resources Department.

Arizona

- Wildlife in Arizona is managed as trust property of the state by the AZGFD, as provided for in Chapter 17 of the ARS and by the Arizona Game and Fish Commission. Chapter 17 of the ARS provides authority to the Commission to set seasonal restrictions, bag limits, rules regarding methods of take, as well as other rules and regulations regarding fish and wildlife harvest, and to provide for proactive management of game and non-game fish and wildlife.
- The State of Arizona has no threatened and endangered species laws. The Arizona Game and Fish Commission provides protection for individual species of vulnerable conservation status by setting bag limits for species and through regulation of hunting seasons, including permanent hunting season closure for sensitive species.
- The Arizona Native Plant Law (ARS § 3-901-907) is administered by the Arizona Department of Agriculture (ADA), and lists plants protected under the law. The ADA defines four categories of protected native plants: Highly Safeguarded, Salvage Restricted, Salvage Assessed, and Harvest Restricted. The Highly Safeguarded category

is the highest category of protection provided for native plants in Arizona, and includes all species that are candidates for ESA listing. "Permits applicable to highly safeguarded native plants may be issued only for collection for scientific purposes or for the noncommercial salvage of highly safeguarded native plants whose existence is threatened by intended destruction, or by their location or by a change in land usage, and if the permit may enhance the survival of the affected species" (ARS 3-906 C). The remaining three categories allow plants to be moved or harvested, provided that ADA regulations are complied with. ADA jurisdiction over protected plants includes all lands within the state; but since native plants occurring on private land are the property of the landowner, their removal requires only that the ADA be notified prior to their removal. Movement of all ADA-listed plants must be conducted under permit, with tags and seals affixed to all plants prior to transport. The ASLD requires compensation for the loss to development of any individual ADA-listed plants on Arizona State Trust Land, and requires a compensation fee per acre for native vegetation, including all plants not ADA-listed.

3.6.2 Regional Overview

3.6.2.1 Ecological Overview

The Project area lies within the southern and eastern boundaries of the Basin and Range Province. The Basin and Range Province is a physiographic region characterized by mostly parallel, north-south trending mountain ranges separated by valleys filled with alluvial soils (Fenneman 1931), and transitions into the Great Plains in eastern New Mexico. A large area of uplift in the northern and western portion of New Mexico, and the northern and eastern portion of Arizona, is part of the Colorado Plateau. Because of its large scale, the Project traverses a number of geological formations and geological features that have had long-term effects on evolution and ecology within the biomes that occur in the area.

Significant aquatic resources in the study corridor, which support a wide variety of plants and endemic and migratory wildlife, include the Rio Grande and its reservoirs, the San Pedro River and numerous tributaries, waters of ephemeral playas, and several cienegas and spring habitats.

3.6.2.2 Climate

Climate in the vicinity of the study corridor is generally arid or semiarid, with variations in precipitation and temperature regulated by elevation and physiographic structure. There is a wide elevation range within the region. Elevations in the vicinity of the New Mexico portion of the study corridor vary from approximately 4,145 feet on the Lordsburg Playa to a high of 8,615 feet at Gallinas Peak west of Corona, New Mexico, near the proposed SunZia East Substation. In Arizona, elevations vary from approximately 1,350 feet north of Casa Grande at the Gila River to a high of 10,720 feet at Mount Graham in the Pinaleño Mountains southwest of Safford, Arizona.

Average annual temperatures vary considerably in the region. Generally, for every 1,000-foot increase in elevation, there is a 4-degree Fahrenheit decrease (adiabatic lapse rate) in temperature (Hendricks 1985; Lowe 1964). During the dry period of early summer, daytime high temperatures commonly exceed 100 degrees Fahrenheit. The clear nighttime skies allow daytime

heat buildup to radiate upward, causing the temperature in a single day to vary 25 to 35 degrees Fahrenheit in New Mexico, and as much as 50 to 60 degrees Fahrenheit in the lower deserts in southwestern Arizona (WRCC 2010).

Annual precipitation in the vicinity of the study corridor results from a regional bimodal precipitation pattern of localized, often intense storms during the summer monsoon season (July to mid-September) and Pacific winter storms (November to March), with gentle rains that are typically more widespread and of greater duration. Moisture supporting the summer monsoon comes from the Gulf of Mexico and, to a lesser extent, from the Gulf of California for the Arizona portion of the area (*ibid*). Leftover moisture from tropical hurricanes in both the Atlantic and Pacific often contribute significant amounts of moisture to the area, but this is infrequent and irregular (Lowe 1964). The combination of the dry air, high temperatures, and abundant sunshine results in high evaporation rates in the region (Hendricks 1985; WRCC 2010). Spring and fall are typically dry and hot, and extended droughts, often lasting several years, are not uncommon in the region.

3.6.2.3 New Mexico

The eastern section of the New Mexico portion of the Project is dominated by the Rio Grande Valley. The river flows north to south between similarly oriented mountain ranges. The perennial Rio Grande supplies water that supports the bulk of the human development and major metropolitan areas in the state. It is also a major avian migratory corridor that supports many thousands of wintering birds. Agricultural developments along the river have had substantial impacts on what was once a continuous thread of deciduous riparian habitat through the middle of the state.

The western portion of the Project in New Mexico passes through the southwestern corner of the state, and crosses the continental divide near the Grant-Luna county line. Vegetation on most of this portion of the study corridor is dominated by semidesert grassland habitat. The Lordsburg Playa between Lordsburg, New Mexico and the New Mexico-Arizona border is located in the Animas Valley, a closed basin. The Playa typically holds water only seasonally, from precipitation occurring during the winter rain or summer monsoon seasons.

3.6.2.4 Arizona

The Arizona portion of the Project passes through the region that is dominated by the southern Arizona "Sky Islands" physiography, which is a byproduct of geological metamorphic core complex and subsequent basin and range faulting that occurred between 25 and 10 million years before present. This physiography has significant orographic climatic effects that are a direct influence on the diverse vegetation present in the region, and the attendant wildlife that it supports. The Sky Island effect has driven speciation in a number of groups of organisms that are either of low mobility or lack adaptations that allow movement through the arid intervening valleys, effectively isolating mountain population ranges (Baker 2008; McCormack et al. 2008; Warshall 1994). Perennially flowing waters in the area are limited in number and extent and include the San Pedro River, Aravaipa Creek in the Galiuro Mountains, Cienega Creek, and several reaches of streams at high elevations in the mountains.

3.6.3 Vegetation

Vegetation data for the Project study area (Figure M6-1 see Map Volume) were obtained for New Mexico from RGIS, and for Arizona from ALRIS (University of New Mexico 2010; ALRIS 2010). The vegetation-based biome descriptions for the study corridor given below are primarily from Brown (1982a). Because of the generally small scale of most riparian habitats occurring within the study corridor, these areas were not mapped but have been included in the resource review. Species listed under the ESA and proposed or candidate species are discussed in Section 3.6.6.1.

3.6.3.1 Biomes

Eleven biomes occur within the study corridor, each discussed individually below (Figure M.6-1E/W; see Map Volume). While all of these biomes are present within the overall study corridor, Project subroutes are generally confined to lower elevations and thus may not cross biomes restricted to higher elevations.

Sonoran Desertscrub

The Sonoran Desertscrub biome is divided into two major subdivisions; the Lower Colorado River Valley subdivision and the Arizona Upland subdivision. The subdivisions are primarily separated by a variation in the total effective annual precipitation, and are a byproduct of the bimodal precipitation regime previously mentioned. Soil types are the primary determinant where the subdivisions meet and overlap in south-central Arizona, with the Arizona Upland subdivision restricted to rockier slopes, foothills, and desert mountains. Sonoran Desertscrub is typically bounded on the east by either Chihuahuan Desertscrub or semidesert grassland habitats. In the Project study area, this occurs respectively in the southern and northern segments of the San Pedro River Valley. With milder winters and additional rainfall, the region to the south of the Sonoran Desert merges into Sinaloan Thornscrub habitat, south of the United States-Mexico border. To the west, in southern California and northwestern Arizona, the Sonoran Desert borders the Mohave Desertscrub biome. Sonoran Desertscrub north of the Project study area (near Superior, Arizona) is bounded by areas of interior chaparral, but in the Project study area itself most Sonoran Desertscrub transitions to semidesert grassland as elevation increases. The presence of a variety of xeric-adapted sclerophyllous (having small leaves resistant to water loss) tree species and many species of cacti and other succulents distinguishes the Sonoran Desert from less diverse, shrub-dominated North American desert biomes (Turner 1982).

Lower Colorado River Valley Subdivision

The Lower Colorado River Valley subdivision is the warmer and drier of the two subdivisions of the Sonoran Desertscrub biome. It occurs at lower elevations and typically farther west, where regional geology limits annual precipitation. Precipitation falls mainly during winter from Pacific storms; moisture from monsoonal systems that occur in summer contribute only small amounts to total annual precipitation. Precipitation from monsoon events lessens in areas farther to the north and west from the sources of monsoonal moisture; the Gulf of Mexico and the Gulf of California. Because of the low annual precipitation, vegetation in the Lower Colorado River Valley subdivision is typically open and less diverse, with plant communities often dominated by

creosote bush (*Larrea tridentata*) and burrobush (*Ambrosia dumosa*), or they may occur as essential monocultures of creosote bush over very large areas. Cacti are an important group within this subdivision, but do not dominate as they do in the Arizona Upland subdivision (Turner 1982).

Arizona Upland Subdivision

The Arizona Upland subdivision of Sonoran Desertscrub is a mix of desertscrub and subtropical thornscrub elements. Precipitation is higher than in other North American desert communities, with a notably bimodal pattern. Approximately half of the precipitation occurs in winter, supporting diverse spring annuals; and approximately half falls in a summer monsoon period as heavy, localized thunderstorms. The Arizona Upland subdivision occurs from higher-elevation valley floors typically associated with Sky Island mountain ranges, up to the elevation limit where winter freezes exclude many succulent species. This plant community is best developed on upper bajadas and low montane foothills where proximity to steep, often high mountains results in increased annual precipitation. Small trees or shrubs are a dominant vegetative component, with a high diversity of Fabaceae, including yellow paloverde (*Parkinsonia microphylla*), blue paloverde (*P. florida*), several mesquites (*Prosopis* spp.), desert ironwood (*Olneya tesota*), catclaw acacia (*Acacia greggii*), and whitethorn acacia (*A. constricta*). Cactus diversity is relatively high, and cacti are often dominant or codominant. Prickly pears (*Opuntia* spp.) and chollas (*Cylindropuntia* spp.) may reach very high diversity. Common small or clumped cacti include several species of hedgehog cactus (*Echinocereus* spp.) and pincushion cactus (*Mammillaria* spp.). Larger cacti include the columnar saguaro (*Carnegiea gigantea*) and barrel cacti (*Ferocactus* spp.). Jojoba (*Simmondsia chinensis*), creosote bush, ocotillo (*Fouquieria splendens*), and numerous other shrubs are also present (Turner 1982).

Chihuahuan Desertscrub

Precipitation in Chihuahuan Desertscrub is largely from summer thunderstorms, although occasionally strong Pacific winter storms will reach the region. Dominant shrubs in finer soils include creosote bush, American tarwort (*Flourensia cernua*), and viscid acacia (*Acacia neovernicosa*). Rocky uplands and bajadas are dominated by species of *Agave*, *Yucca*, *Nolina*, and other succulent shrubs. Some prickly pear species are the most common large cacti, but the diversity of small globular cacti is higher in this plant community than any other in North America. Some major cactus genera are *Coryphantha*, *Echinocereus*, *Escobaria*, and *Mammillaria*. Perennial herbaceous plants may be a significant component of the community, and some annuals may occur in response to sufficient winter rains. Chihuahuan Desertscrub gradually intergrades into semidesert grassland with increasing elevation or rainfall (Brown 1982b).

Semidesert Grassland

Semidesert grassland, while dominated by grasses, has high shrub diversity; and in areas with fire suppression or heavy grazing, often converts to desertscrub. Precipitation is slightly greater in summer, and supports the majority of grass growth. Cacti may be common and include several species of cholla and prickly pear as occasional dominant plant species, particularly where

livestock grazing is heavy. Typical grasses include species of grama (*Bouteloua* spp.), three-awn (*Aristida* spp.), tobosa grass (*Pleuraphis mutica*), and others. Mesquite is generally the most dominant shrub species, with creosote bush, *Yucca* species, and the related sotol (*Dasylirion wheeleri*) and beargrasses (*Nolina* spp.), ocotillo, and several other shrubs common in places (Brown 1982c).

Plains and Great Basin Grassland

The western edge of the Plains biome within the study area is largely a shortgrass prairie plant association. Dominant plant species are grasses, including several gramas (*Bouteloua* spp.), galleta grasses (*Pleuraphis jamesi* and *P. rigida*), Plains lovegrass (*Eragrostis intermedia*), and numerous others. Shrubs, chollas, and some prickly pears can be abundant, particularly when facilitated by fire suppression or grazing pressure (Brown 1982d).

Interior Chaparral

Chaparral communities are dominated by evergreen shrubs, which may reach 90 percent ground cover. High shrub cover prevents the establishment of a significant understory of grasses or herbaceous plants, except in early-successional stages and rocky, open patches. Arizona Interior Chaparral is dominated by Sonoran scrub oak (*Quercus turbinella*), along with manzanitas (*Arctostaphylos* spp.), deerbrush (*Ceanothus* spp.), and many others. Interior Chaparral is subject to regular wildfires, and may depend on fire to prevent conversion to forests at the upper elevation limit of the community. Some shrub species depend on fire for germination, and nearly all regenerate post-fire from the root crown (Pase and Brown 1982a).

Great Basin Conifer Woodland

Outside of the Great Basin physiographic province there is a broad band of vegetative communities across the southern Rockies that have origins in the Great Basin proper. Great Basin Conifer Woodland is generally found above grasslands or chaparral, where fire frequency is low but precipitation is insufficient to support development of montane conifer forests. This plant community is typified by the dominance of two small evergreen trees: junipers (*Juniperus* spp.) and piñon pines (*Pinus edulis* and *P. monophylla*), with an understory of mixed shrubs, grasses, and herbaceous plants. Some cacti, particularly *Opuntia* species, also occur (Brown 1982e).

Petran Montane Conifer Forest

Within the study corridor, this plant community only occurs in small areas atop the Santa Catalina, Rincon, Galiuro, and Pinaleño mountains in Arizona. Montane conifer forest in the region is typically dominated by either ponderosa pine (*Pinus ponderosa*), typically in the lower reaches, or mixed conifer forest consisting of white fir (*Abies concolor*), aspen (*Populus tremuloides*), and limber pine (*Pinus flexilis*) at cooler, higher elevations. Lower portions of the ponderosa pine forests may be locally dominated by Gambel oak (*Quercus gambelii*) or New Mexican locust (*Robinia neomexicana*) (Pase and Brown 1982b).

Interior and Sonoran Riparian Woodland

Riparian woodlands are dominated by trees and shrubs dependent on surface water or shallow groundwater, and generally exist as narrow bands along major streams and rivers. The majority of the tree species are (at least regionally) riparian obligates, and do not occur in upland habitats within arid Southwestern biomes. The high productivity and cooler, more humid microclimate within riparian woodlands supports numerous herbaceous plant and wildlife species generally restricted to riparian zones as well.

Riparian plant communities do not change as rapidly with elevation as upland plant communities, as the woodlands provide thermal buffering not present elsewhere and competition for water is generally not a limiting factor. The shift between Interior and Sonoran Riparian Woodland is driven by elevation, although there is much overlap of the vegetative community. Interior Riparian communities are generally found above 3,900 feet elevation, often in montane canyons, while Sonoran Riparian communities surround valley and lowland rivers and streams.

Dominant tree species common to both communities include Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and velvet mesquite (*Prosopis velutina*). Large stands of velvet mesquite in particular are important components of lowland woodlands in the Southwest. Increasing elevation allows the occurrence of netleaf hackberry (*Celtis laevigata*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), Arizona alder (*Alnus oblongifolia*), velvet ash (*Fraxinus velutina*), and others.

Interior and Sonoran Riparian Scrubland

This community occurs as a transition between riparian woodlands and xeroriparian washes, and is present in areas where either disturbance is too great or water may be insufficient to support development of mature forest. Goodding's willow is one of the larger tree species, and several species of mesquite, desert willow (*Chilopsis linearis*), paloverdes (*Parkinsonia* spp.), catclaw acacia, and other native trees and shrubs are present. Some areas of riparian scrubland may have originally been riparian woodland, but have been converted to stands of invading saltcedar (*Tamarix* sp.).

Plains Riparian Wetlands

The Rio Grande and associated tributaries within the study area may support Plains Riparian Wetlands. Tree species in this habitat within the study area include Rio Grande cottonwood (*Populus deltoides wislizeni*), narrowleaf cottonwood (*P. angustifolia*), peachleaf willow (*Salix amygdaloides*), and narrowleaf willow (*S. exigua*).

Xeroriparian Scrubland

Numerous minor, ephemeral washes, found in Sonoran and Chihuahuan Desertscrub into semidesert grassland, do not represent entirely separate plant communities, as there is strong species overlap with surrounding uplands. However, they do represent shifts in species dominance to areas of higher density and productivity of shrub species, many of which may also

be present away from washes. Xeroriparian scrubland varies in its species components regionally and with elevation, but plant density and stature are similar in this biome. Such vegetation is too dense to be considered either desertscrub or strand habitats, and is reasonably qualified as a distinct biome (Minckley and Brown 1982). The increased shelter and food availability in this habitat results in a habitat disproportionately richer than adjacent uplands, and of importance to most wildlife species that are present.

3.6.4 Noxious and Invasive Weeds

Noxious and invasive weeds are identified as a major threat to native ecosystems and multiple-use public land resources. Their impacts include, but are not limited to, adverse effects on productivity, value, and management of publicly administered and private land and water resources; effects to both yield and quality of agriculturally important crops; livestock poisoning; impacts to threatened and endangered species and native biodiversity; adverse effects upon human health as allergens, through poisoning and by harboring plant disease vectors; reduction of water quality and habitat for fish and wildlife in streams, lakes, and reservoirs; interference with electrical power transmission and other utility functions; and detracting from the aesthetic and recreational values of wildlands, parklands, and other areas (DOI 1995).

Waterways, vehicles, and animals are the principal vectors for expansion of noxious and invasive weed species, which can only be adequately controlled when federal, state, county, and private interests work together, usually under a cooperative weed management plan. The Carlson-Foley Act (PL 90-583) and state and county laws hold the federal government responsible for control of designated weeds on federal land and provide direction for their control. Land management agencies typically prepare weed management plans that rely on currently accepted BMPs that can be used at the project level to reduce the occurrence and dispersion of weeds.

The current New Mexico and Arizona Departments of Agriculture and federal noxious weed lists were used as the baseline for review of noxious weed species potentially occurring within the study corridor (New Mexico Department of Agriculture 2009; ADA 2011; USDA 2010). The review was performed using the USDA PLANTS Database (USDA 2011) and the Invasive Plants Atlas (EDDMaps) (University of Georgia 2011) county-level maps to determine the potential for occurrence for each of these noxious weed species; no field surveys were conducted to identify these noxious weeds. Table 3-29 provides a list of noxious weed species known or potentially occurring in the study corridor. Other species of invasive plants, not listed as noxious weeds, may also be present in the study corridor.

Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor

Scientific Name	Common Name	Potential for Occurrence		Noxious Status
		New Mexico	Arizona	
Acroptilon repens	Hardheads (Russian knapweed)	moderate	moderate	P, R, B
Aegilops cylindrica	Jointed goatgrass	moderate	low	P, R, C
Ailanthus altissima	Tree of heaven	moderate	moderate (NL)	B
Alhagi maurorum (A. pseudalhagi)	Camelthorn	moderate (NL)	low	A, P, R,

Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor

Scientific Name	Common Name	Potential for Occurrence		Noxious Status
		New Mexico	Arizona	
Arundo donax	Giant cane	high	moderate (NL)	WL
Asphodelus fistulosus	Onionweed	moderate	high	NW
Brassica tournefortii	Asian (Sahara) mustard	low	high (NL)	WL
Bromus tectorum	Cheatgrass	high	high (NL)	C
Cardaria draba	Whitetop	high (NL)	high	P, R
Cardaria spp.	Hoary cress	very low	very low (NL)	A
Cenchrus echinatus	Southern sandbur	moderate (NL)	high	P, RG
Cenchrus spinifex *(C. incertus)*	Field sandbur	high (NL)	high	P, RG
Centaurea melitensis	Maltese star-thistle	high	high (NL)	B
Centaurea solstitialis	Yellow star-thistle (St. Barnaby's thistle)	very low	moderate	A, P, R,
Cichorium intybus	Chicory	low	low (NL)	B
Cirsium arvense	Canada thistle	moderate	NR	A, P
Cirsium vulgare	Bull thistle	moderate	low (NL)	C
Convolvulus arvensis	Field bindweed	high (NL)	high	P, RG
Cuscuta spp.	Dodder	moderate (NL)	moderate	P, R
Diplotaxis tenuifolia	Perennial wall rocket	very low	low (NL)	WL
Elaeagnus angustifolia	Russian olive	high	very low (NL)	C
Eragrostis lehmanniana	Lehmann lovegrass	high (NL)	high (NL)*	*
Euryops multifidus (*E. subcarnosus* ssp. *vulgaris*)	Sweet resinbush	very low (NL)	high	R
Helianthus ciliaris	Texas blueweed	high (NL)	moderate	P, R
Hydrilla verticillata	Hydrilla	low	moderate	NW
Ipomoea spp.**	Morning glory	high (NL)	high	P
Lepidium latifolium	Perennial pepperweed	moderate	very low (NL)	B
Leucanthemum vulgare	Oxeye daisy	moderate	very low (NL)	A
Lythrum salicaria	Purple loosestrife	very low	very low	A, P
Medicago polymorpha	Burclover	low (NL)	high	P, RG
Peganum harmala	Harmal peganum (African rue or Syrian rue)	high	very low	P, B
Pennisetum ciliare	Buffelgrass	low (NL)	high	P, RG
Pennisetum setaceum	Crimson fountaingrass	very low	moderate (NL)	WL
Portulaca oleracea	Little hogweed (Common purslane)	high (NL)	high	P, RG
Tagetes minuta	Wild marigold	very low (NL)	moderate (NL)	NW
Tamarix spp.	Saltcedar	high	high (NL)	C

Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor

Scientific Name	Common Name	Potential for Occurrence		Noxious Status
		New Mexico	Arizona	
Tribulus terrestris	Punctureweed	high (NL)	high	P, RG
Urochloa panicoides	Liverseed grass	moderate	low	NW
Xanthium spinosum	Spiny cocklebur	moderate	low (NL)	WL

P = Prohibited noxious weed (Arizona) – (Prohibited from entry into the state).
RG = Regulated noxious weed (Arizona) – (If found within the state, may be controlled or quarantined to prevent further infestation or contamination).
R = Restricted noxious weed (Arizona) – (If found within the state shall be quarantined to prevent further infestation or contamination).
A = Class A noxious weed (New Mexico) – Class A species are currently not present in New Mexico, or have limited distribution within the state. Preventing new infestations of these species and eradicating infestations is the highest priority.
B = Class B noxious weed (New Mexico) – Class B species are limited to portions of the state. In areas with severe infestations, management should be designated to contain the infestation and stop any further spread.
C = Class C noxious weed (New Mexico) – Class C species are widespread in the state. Management decisions for these species should be determined at the local level, based on feasibility of control and level of infestation.
WL = Watch List (New Mexico) – Watch List species may become problematic, but more data and distributional information is needed.
NW = Federal Noxious Weed List
NL = Species not listed for this state
NR = Neither EDDMaps nor USDA Plants Databases show records for counties within Project area.
*Inclusion requested by BLM Safford Field Office.
**All *Ipomoea* species except the ornamental species *Ipomoea carnea* (Mexican bush morning glory) and *Ipomoea arborescens* (morning glory tree); and the Restricted species *Ipomoea triloba* (three-lobed morning glory), not known to be present in New Mexico or Arizona.
Source: USDA 2011

3.6.5 Wildlife

Due to its great length (approximately 500 miles) and corridor alignment from east to west, the Project area encompasses a wide range of biomes and elevations in Arizona and New Mexico. This geographic and ecological diversity hosts a large suite of vertebrate species that potentially occur within the study corridor. The diversity of each major taxonomic group is briefly discussed below. Species listed as threatened or endangered and those that are proposed or are candidates for listing under the ESA are discussed individually in Section 3.6.6.1; all other special-status species are discussed in the biological technical report (Appendix B1).

3.6.5.1 Mammals

New Mexico

Within the New Mexico portion of the study corridor, a variety of biomes support approximately 74 species of mammals. This includes 1 insectivore, 17 bats, 3 lagomorphs (rabbits and hares), 35 rodents, 13 carnivores, and 4 ungulates (Findley et al. 1975); 1 marsupial, the Virginia Opossum (*Didelphis virginiana*), was likely introduced into New Mexico from eastern North America (Bermudez et al. 1995).

Bats are an important component of the mammalian fauna in the southwestern United States, with a higher number of species than occurs in other areas of the country. In the general Project study area, extensive mining over the last 150 years has created numerous mine shafts and adits that provide roosting habitat for a wide variety of bat species. Bats also occupy numerous caves in the region.

Arizona

The Arizona portion of the study corridor supports a slightly more diverse mammalian fauna than New Mexico, with 86 species potentially present. High vertebrate species richness in this region is, in part, a reflection of its "Sky Islands" physiography-driven speciation, along with a closer connectivity with the Sonoran Desert and Sierra Madre of north-central Mexico. Mammals likely occurring in the Arizona portion of the study corridor include 1 marsupial, 1 insectivore, 23 bat species including the endangered Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*), 4 lagomorphs, 35 rodents, 17 carnivores, and 5 ungulates. Although introduced into New Mexico and central Arizona, Virginia Opossums in southern Arizona may represent natural range expansion northward of the regional subspecies (*D. v. californica*) from Sonora, Mexico (Babb et al. 2004).

3.6.5.2 Birds

New Mexico

Approximately 259 bird species regularly occur within the New Mexico portion of the study corridor (National Geographic Society 2002). Additional species may occur less frequently, and numerous species reach the northern limits of their range in mountains along the international border outside the study corridor. Bird diversity is high and, to a great extent, associated with the avian flyway along the Rio Grande, which serves as a migratory route for many bird species. Extensive semidesert grassland in southwestern New Mexico provides wintering habitat for a number of prairie-nesting species.

Arizona

Bird diversity in the Arizona portion of the study corridor is naturally high, due to the large number of habitats that occur over a wide elevation range. Migratory species are a significant component of the total bird species diversity in the region, and approximately 267 bird species regularly occur within the study corridor (National Geographic Society 2002). Additional species may be present during migration or as accidentals, or typically occur only at higher elevations in Madrean "Sky Islands." Bird diversity is also enhanced in part due to proximity to Mexico, which contains other biomes within the Madrean and Sinaloan biogeographic provinces such as Sinaloan deciduous forest and thornscrub habitats, with some species ranging into the southern United States.

3.6.5.3 Amphibians

New Mexico

Eleven native amphibian species may occur within the New Mexico portion of the study corridor, including 1 salamander, 3 spadefoots, 4 toads, 1 treefrog, and 2 ranid frogs (Degenhardt et al. 1986). One additional species, the American Bullfrog (*Rana catesbeiana*), an introduced species, occurs widely in both New Mexico and Arizona in most locations that support permanent water.

Arizona

Ten native amphibian species may occur within the Arizona portion of the study corridor, including 3 spadefoots, 5 toads, 1 treefrog, and 1 ranid frog (Brennan and Holycross 2006). Three additional species, the American Bullfrog, Tiger Salamander (*Ambystoma tigrinum*), and Pacific Treefrog (*Pseudacris regilla*), have been introduced into the Arizona portion of the study corridor.

3.6.5.4 Reptiles

New Mexico

Native reptiles are moderately well-represented in the New Mexico portion of the study corridor and may include the following 63 species: 7 turtles, 26 lizards, and 30 species of snakes (Degenhardt et al. 1986). Introduced turtles of several species, often released pets, may be present in urban settings, canals, and other bodies of water in New Mexico and Arizona.

Arizona

There are 67 native reptile species that may occur within the Arizona portion of the study corridor, including 4 turtles, 29 lizards, and 34 species of snakes (Brennan and Holycross 2006). The introduced Mediterranean House Gecko (*Hemidactylus turcicus*) occurs in urban areas within the study corridor.

3.6.5.5 Fish

New Mexico

Perennial aquatic habitats within the New Mexico portion of the study corridor are dominated by the main stem Rio Grande and its man-made Elephant Butte and Caballo reservoirs. These waters support all of the 10 native fish species that occur within the New Mexico portion of the study corridor (Lee et al. 1980). Shallow, ephemeral waters occur in most years on the Lordsburg Playa, but support no fish species due to high salinity and a lack of continuous connectivity with perennial reaches higher in the watershed.

Arizona

There are numerous aquatic habitats that support native fish species in the Arizona portion of the study corridor. Aquatic resources include the San Pedro River, Aravaipa Creek in the Galiuro Mountains, and Cienega Creek. The 10 native fish species present within the Arizona portion of the study corridor all occur in these streams or smaller tributaries (Minckley and Marsh 2009). Reintroduction of native fish has taken place in Turkey Creek, Hot Springs Canyon, and Redfield Canyon, all within the Galiuro Mountains (TNC 2010; USFWS 2005a). The Desert Pupfish (*Cyprinodon macularius*) was extirpated from the study area, and now occurs only through reintroduction in the Galiuro Mountains and elsewhere (AZGFD 2001a; USFWS 2003a).

3.6.5.6 Invertebrates

The evaluation of impacts to invertebrates due to the development of a project is seldom addressed, except for those species that have been identified as special-status species by the federal government or other land management agencies. The regional geography has resulted in high levels of endemism among some invertebrate groups. Many species, including a number of special-status species, are restricted to small areas such as spring complexes, other isolated wetlands, caves, or upper elevations of mountain ranges. Attempts at quantifying numbers of species of invertebrates within a given habitat or region are usually little more than guesswork, as data regarding this element of biota are, for the most part, incomplete.

3.6.6 Special-Status Species

BLM manual 6840 defines special-status species as those that are "proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the ESA; those listed by a State in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each State Director as sensitive." This section addresses species listed under the ESA or those proposed or candidates for listing. Due to the large scale of the Project and large number of species present, all other special-status species are addressed in the biological technical report (Appendix B1).

Three additional species are included in Table 3-30 due to special circumstances: the Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*, petitioned as *G. ridgwayi cactorum*); the Arizona Striped Whiptail (*Aspidoscelis arizonae*); and the Chihuahua scurf-pea (*Pediomelum pentaphyllum*). The Cactus Ferruginous Pygmy-owl, formerly listed under the ESA, was delisted in 2006. The species was reviewed for relisting in response to a petition and proposed taxonomic revisions, but the USFWS determined that this is not warranted (USFWS 2011a). However, the species is listed as sensitive by the BLM, and potential habitat is widespread throughout much of the study corridor in Arizona. The Arizona Striped Whiptail and the Chihuahua scurf-pea were included in a 2007 petition to the USFWS for consideration for listing, and are also currently under review. All three of these species potentially occur within the study corridor and have thus been included in the review.

Most special-status species with some potential for occurrence within the study corridor have special status with multiple agencies. Status listings for all of the species reviewed are found in the biological technical report (Appendix B1). The ESA-listed, proposed, or candidate plant and

wildlife species that were identified as occurring or potentially occurring within the study corridor are listed in Table 3-30 and addressed in Section 3.6.6.1, as are the BGEPA-listed Bald Eagle and Golden Eagle. Only those species with potential for occurrence, or with designated critical habitat within the study corridor, are included in the Summary of Inventory Results (Section 3.6.9).

Figure M.6-2E/W (see Map Volume) shows designated and proposed critical habitat for ESA-listed species, as well as the numbers of threatened, endangered, proposed, or candidate species that may occur on each Project link, as determined from existing information or the presence of potential habitat within the known or expected range of the species. Figure M.6-3E/W (see Map Volume) shows the number of all special-status species that may occur on each link, as determined from existing information or the presence of potential habitat within the known or expected range of the species.

3.6.6.1 Endangered Species Act and Bald and Golden Eagle Protection Act

Table 3-30 includes species listed under the BGEPA and ESA, as well as species proposed or candidates for ESA listing, that are known to occur within the study corridor or for which suitable habitat may be present.

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor

Common Name Scientific name	Designated Critical Habitat	Potential (NM)	Potential (AZ)	Status
Mammals				
Lesser Long-nosed Bat *Leptonycteris curasoae yerbabuenae*	None	Moderate	Present	E, NMT, WSC, SGCN (NM), PVS
Mexican Long-nosed Bat *Leptonycteris nivalis*	None	Very low	Very low	E, NME, SGCN (AZ, NM)
New Mexico Meadow Jumping Mouse *Zapus hudsonius luteus*	N/A	Low	None	C, NME, BLMS (AZ, NM), FS, WSC, SGCN (AZ, NM)
Mexican Gray Wolf *Canis lupus baileyi*	None	Very low	Very low	E (NEP), NME, WSC, SGCN (AZ, NM)
Jaguar *Panthera onca*	Proposed (Outside Study Corridor)	Very low	Very low	E, WSC, SGCN (AZ, NM)
Ocelot *Leopardus* (*Felis*) *pardalis*	None	None	Low	E, WSC, SGCN (AZ)
Jaguarundi *Herpailurus yagouaroundi tolteca*	None	None	Very Low	E

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor				
Common Name Scientific name	**Designated Critical Habitat**	**Potential (NM)**	**Potential (AZ)**	**Status**
Birds				
Golden Eagle *Aquila chrysaetos*	N/A	Present	Present	BGEPA; SGCN (NM)
Bald Eagle *Haliaeetus leucocephalus*	N/A	Present	Present	DM, NMT, BGEPA; SC; BLMS (AZ); FS; WSC; SGCN (NM); BCC
Northern Aplomado Falcon *Falco femoralis septentrionalis*	None	Present	Low	E (NEP), NME, WSC, SGCN (AZ, NM)
Yuma Clapper Rail *Rallus longirostris yumanensis*	None	None	Low	E, WSC, SGCN (AZ)
Piping Plover *Charadrius melodus*	Outside Study Corridor	Very Low	None	T, NMT
Yellow-billed Cuckoo (Western DPS) *Coccyzus americanus*	N/A	Present	Present	C, BLMS (AZ), FS, WSC, NMS, PVS, SGCN (AZ), BCC
Mexican Spotted Owl *Strix occidentalis lucida*	Within Study Corridor	Moderate	Present	T, WSC, NMS, SGCN (AZ, NM)
Cactus Ferruginous Pygmy-owl *Glaucidium brasilianum cactorum*	N/A	None	Moderate	BLMS (AZ), FS, SC, WSC, SGCN (AZ), PVS
Southwestern Willow Flycatcher *Empidonax traillii extimus*	Within Study Corridor	Present	Present	E, NME, WSC, SGCN (AZ, NM), PVS
Sprague's Pipit *Anthus spragueii*	N/A	Present	Moderate	C, BLMS (AZ), WSC, SGCN (AZ, NM), BCC
Amphibians				
Chiricahua Leopard Frog *Lithobates chiricahuensis*	Outside Study Corridor	Very Low	Very low	T, WSC, NMS, SGCN (AZ, NM), PVS
Reptiles				
Sonoran Desert Tortoise *Gopherus morafkai*	N/A	None	Present	C, BLMS (AZ), FS, SC, WSC, SGCN (AZ)
Arizona Striped Whiptail* *Aspidoscelis arizonae*	N/A	None	Present	SGCN (AZ)
Tucson Shovel-nosed Snake *Chionactis occipitalis klauberi*	N/A	None	High	C, BLMS (AZ), SGCN (AZ), PVS

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor				
Common Name Scientific name	**Designated Critical Habitat**	**Potential (NM)**	**Potential (AZ)**	**Status**
Northern Mexican Garter Snake *Thamnophis eques megalops*	N/A	None	Present	C, NME, BLMS (AZ, NM), FS, WSC, SGCN (AZ, NM), PVS
Fish				
Apache Trout *Oncorhynchus apache*	None	None	Very Low	T, WSC, SGCN (AZ)
Gila Chub *Gila intermedia*	Within Study Corridor	None	Present	E, NME, BLMS (NM), WSC, SGCN (AZ, NM), PVS
Roundtail Chub (Lower Colorado River Basin DPS) *Gila robusta*	N/A	None	Present	C, NME, BLMS (AZ, NM), FS, WSC, SGCN (AZ, NM)
Rio Grande Silvery Minnow *Hybognathus amarus*	Within Study Corridor	Present	None	E, NME, SGCN (NM)
Spikedace *Meda fulgida*	Within Study Corridor	None	Present	E, NME, WSC, SGCN (AZ, NM)
Loach Minnow *Tiaroga cobitis*	Within Study Corridor	None	Present	E, NMT, WSC, SGCN (AZ, NM)
Desert Pupfish *Cyprinodon macularius*	Outside Study Corridor	None	Present	E, WSC, SGCN (AZ), PVS
Gila Topminnow *Poeciliopsis occidentalis*	None	None	Present	E, NMT, WSC, SGCN (AZ, NM), PVS
Invertebrates				
Chupadera Springsnail *Pyrgulopsis chupaderae*	Within Study Corridor	Present	None	E, NME, SGCN (NM)
Socorro Springsnail *Pyrgulopsis neomexicana*	None	Present	None	E, NME, SGCN (NM)
Plants				
Pima Pineapple Cactus *Coryphantha scheeri* var. *robustispina*	None	None	Moderate	E, HS, PVS
Kuenzler's Hedgehog Cactus *Echinocereus fendleri* var. *kuenzleri*	None	Moderate	None	E, NME
Acuña Cactus *Echinomastus erectocentrus* var. *acunensis*	Proposed (Outside Study Corridor)	None	Low	PE, BLMS (AZ), HS, PVS

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor

Common Name Scientific name	Designated Critical Habitat	Potential (NM)	Potential (AZ)	Status
Todsen's Pennyroyal *Hedeoma todsenii*	Outside Study Corridor	Low	None	E, NME
Pecos Sunflower *Helianthus paradoxus*	Outside Study Corridor	Low	None	T, NME
Huachuca Water-umbel *Lilaeopsis schaffneriana* var. *recurva*	Outside Study Corridor	None	Present	E, HS, PVS
Chihuahua Scurf-pea* *Pediomelum pentaphyllum*	N/A	Low	High	NME; BLMS (NM); FS; SC

Status

Endangered Species Act:
E = Endangered
T = Threatened
C = Candidate
PE = Proposed Endangered
DP = Delisted Taxon – Petitioned for re-listing
DM = Delisted Taxon – Population being monitored
DPS = Distinct Population Segment
E (NEP) = Nonessential Experimental Population

USFWS (non-ESA):
BGEPA = Bald and Golden Eagle Protection Act
BCC = Bird Species of Conservation Concern
SC = Species of Concern

BLM:
BLMS = BLM Sensitive Species

Forest Service:
FS = Forest Service Sensitive Species (Region 3)

AZGFD:
SGCN (AZ) = Species of Greatest Conservation Need
WSC = Wildlife Species of Concern

State of New Mexico:
NME = Endangered
NMT = Threatened

New Mexico Department of Game and Fish:
NMS = New Mexico Sensitive Species
SGCN (NM) = Species of Greatest Conservation Need

Arizona Department of Agriculture:
HS = Highly Safeguarded

Pima County, Arizona – Habitat Conservation Plan:
PVS = Priority vulnerable species

Mammals

Lesser Long-nosed Bat (Leptonycteris curasoae yerbabuenae)

The study corridor is near the northern limits of the range of the Lesser Long-nosed Bat as it is currently understood, and contains known roosts. There is the possibility that additional, undocumented roosts could also exist within the study area, as concentrations of agaves that could be used as food sources by this species are widespread in the region. The Lesser Long-nosed Bat is known to be capable of traveling long distances, in the range of 30 to 60 miles (USFWS 1994a) in a single night to forage. The proximity of the southern portion of the study corridor to other known roosts makes it likely that these populations forage within the study corridor regularly. Foraging areas used by the bats vary from year to year in relation to the annual productivity of the cacti and agave blooms.

While using maternity roosts in northern Mexico and southwestern Arizona, Lesser Long-nosed Bats feed primarily on nectar and pollen of columnar cacti blossoms. After the young become

able to fly, the bats move east to higher elevations, where they forage primarily on paniculate agave species (those with branching flower heads) for the remainder of the summer. This is the time when they would be at the highest abundance within the study corridor (Cockrum 1991; Rojas-Martinez et al. 1999). They are also known to use non-paniculate agave species, such as Schott's century plant (*Agave schottii*) (Barbour and Davis 1969), which gives them some flexibility in their foraging. The bats have commonly been recorded visiting hummingbird feeders during summer nights in Tucson (Lowery et al. 2009).

Within the study corridor, suitable foraging habitat for the Lesser Long-nosed Bat is likely to be present in the Arizona Upland subdivision of Sonoran desertscrub in southeastern Pinal County, particularly east of the Picacho Mountains, and east through the Tucson valley. There is a large, disjunct population of saguaros in the San Pedro River Valley that could provide foraging habitat for the species. These areas would likely only be used by small numbers of males and nonbreeding females, since the bulk of the population is at the maternity sites far to the southwest during the saguaro bloom. Late-season foraging is potentially available on paniculate agaves throughout a large portion of the study corridor from the Catalina–Rincon Mountain complex south and east through Arizona, and into far southwestern New Mexico (Cockrum 1991; Rojas-Martinez et al. 1999).

Mexican Long-nosed Bat (Leptonycteris nivalis)

Like the Lesser Long-nosed Bat, the Mexican Long-nosed Bat is a strong flier (Schmidly 1991), capable of flying long distances in a single night to forage. Known Mexican Long-nosed Bat roosts in New Mexico are approximately 45 to 70 miles south of the study corridor, in the Big Hatchet, Animas, and Peloncillo mountains (Bogan et. al 2006); however, an individual Mexican Long-nosed Bat was captured during mist-netting north of the study corridor, near the Grant-Hidalgo county line in New Mexico (M. Ramsey, personal communication). No other information indicates whether an unknown roost is present near the study corridor, or whether the capture represented a vagrant individual. There are no known areas within the portions of the study area (Peloncillo and Pyramid mountains) closest to known roosts for the species that contain large concentrations of agaves that would be attractive to it. The potential for the species occurring within the study corridor is very low, and would likely be limited to small numbers of foraging individuals if food resource patterns resulted in unusual movement patterns for the species.

New Mexico Meadow Jumping Mouse (Zapus hudsonius luteus)

Typical habitats for the New Mexico Meadow Jumping Mouse include marshes, wet meadows, and edges of streams or canals that support a diverse streamside or emergent vegetation. The species occurs in montane meadows at elevations up to nearly 7,000 feet (Morrison 1990). In New Mexico, the Meadow Jumping Mouse is recorded from the Jemez, San Juan, and Sacramento mountains, Bosque del Apache NWR, and several locations in the Rio Grande Valley, including Española, Isleta, Belen, and Socorro (BISON-M 2008). Habitat for the species potentially occurs in the study corridor along the Rio Grande at the San Antonio crossing (Link A140), but no New Mexico Meadow Jumping Mice have recently been recorded outside Bosque del Apache NWR.

Mexican Gray Wolf (Canis lupus baileyi)

Gray Wolves in the Southwest were extirpated from many regions before distribution and subspecific relationships could be fully determined. The Mexican Gray Wolf was present through southeastern and perhaps central Arizona, southern New Mexico, and the Rio Grande Valley to approximately the Big Bend region in Texas, and a broad range throughout the Sierra Madre in Mexico (USFWS 1982). The range of the Mexican Gray Wolf contracted continually through the nineteenth and twentieth centuries; and prior to the eventual capture of the last wild wolves, natural populations were only known from a few locations in the Sierra Madre.

Mexican Gray Wolves were generally found in montane forests; however, prior to increases in grazing and other human activities, they occurred in grasslands in the Southwest as well. Before the introduction of grazing livestock, wolves were primarily predators of medium to large mammals over a large hunting territory; although when opportunity presented itself, other small prey would be taken as well. Wolves are social, and cooperatively hunt and defend territories. Males and females generally mate for life, and reach reproductive age at 2 to 3 years. Litter size for Gray Wolves and captive Mexican Gray Wolves ranges from 3 to 6 in several populations (Mech 1981), but is much lower in wild Mexican Gray Wolves, at 2.1 pups per litter (USFWS 2008a).

The Gila National Forest in New Mexico is designated as a portion of the secondary recovery zone for the Blue Range Wolf Recovery Area. Surrounding areas outside of the Gila National Forest are within the boundary of the nonessential experimental population (NEP), but not the recovery area. Current management direction dictates that wolves dispersing beyond the recovery area boundary will be returned to the area, and those that do so repeatedly may be returned to captivity (USFWS 1998). Management rules relating to the NEP are currently being revised and the policy for removal of wolves outside the recovery area may change over the Project's timeline. However, changes to the overall NEP designation are not being considered, and will not change requirements pursuant to Section 7 consultation for the Project.

No portion of the Project enters the Gila National Forest or the wolf recovery zone, but much of the Project overlaps the established NEP boundary. Wolves are long-range dispersers and may enter the study corridor within the NEP boundary. In 2002, one male Mexican Gray Wolf was tracked moving into the Burro Mountains in Grant County, New Mexico, the closest portion of the recovery area to the Project. It was eventually captured outside the recovery area and returned to captivity (USFWS 2003b). No other Mexican Gray Wolves are regularly using areas near the study corridor (AZGFD 2012); however, Mexican Gray Wolves were reintroduced into northern Mexico (Arizona Daily Star 2011), and the potential exists for individuals to move northward into the United States. If any Mexican Gray Wolves of Mexican origin were to reach the study corridor, they would be within the boundary of the NEP.

Jaguar (Panthera onca)

Jaguar habitat outside of the United States can include nearly all warm Neotropical areas, with the exception of highly arid regions. Tropical rainforest, coastal plains, savannahs, wetlands, and montane canyons and woodlands are heavily used. In the United States, Jaguars were found in varied habitats from western New Mexico through southern Arizona, including Madrean

evergreen woodlands, semidesert grassland, desertscrub, and pine-oak woodland (McCain and Childs 2008; Ortega-Huerta and Medley 1999). However, the largest remaining blocks of suitable habitat are at moderate elevations in a number of mountain ranges near the United States-Mexico border. Male Jaguars have very large home ranges and engage in long-distance dispersal, leading to the occasionally reported individual far outside of the typical breeding range of the species.

Portions of the study corridor in southwest New Mexico and southeastern Arizona coincide with the Jaguar Conservation Emphasis Area (AZGFD and NMDGF 2007). This area was delineated based on GIS modeling that combined species records and habitat considered suitable to support the species, with consideration given to connectivity of habitats from northern Mexico into the southwestern United States (Johnson et al. 2009). All recent Jaguar records in the United States have been of single males and have come from mountains along the border with Mexico; none from within the study corridor. However, individuals could travel farther north into the study corridor in the future. Critical habitat for the Jaguar was proposed in several southeastern Arizona mountain ranges in 2012. No areas within or north of the study corridor were included in the proposal, after the USFWS considered the lack of recent records and barriers to dispersal formed by I-10 and other infrastructure (USFWS 2012a).

Ocelot (Leopardus pardalis)

Ocelots range from the coastal plains and lower Rio Grande Valley of south Texas into northern Argentina. Historically, Ocelots occurred in riparian areas and mountain foothills in Arizona, with a few scattered records in the twentieth century, and along a much greater extent of the Gulf Coast Plains and east Texas into Louisiana. A key habitat feature for the Ocelot is very high shrub cover. More than 95 percent canopy cover is preferred, and less than 75 percent cover is avoided (Harveson et al. 2004; Haines et al. 2006), except possibly at night (Murray and Gardner 1997). In the Southwest, sufficient levels of shrub cover are largely restricted to riparian corridors. Some fragmentation may be tolerated if a network of sufficiently dense patches of dense cover remains (Jackson et al. 2005). Primary food items are likely small mammals and birds; some medium-sized mammals may also be taken (USFWS 1990).

Recent records of Ocelots in Arizona probably represent transient individuals (AZGFD 2004a). Suitable habitat is likely limited to riparian areas such as remnant segments of gallery forest along the San Pedro River that have connectivity with habitat farther south in Mexico; however, successful dispersal within the region would necessitate crossing large areas of lower suitability. An Ocelot was recently documented in Cochise County, Arizona (Sky Island Alliance 2010). The precise location of the sighting is not available, but the sighting could be near or within the southern portion of the study corridor. A dead Ocelot was recovered in 2009 from Gila County, Arizona. If the cat was of wild origin, it would have traveled through the study corridor from Mexico (USFWS 2010a); other recent confirmed or anecdotal sightings have occurred south of I-10 and the study corridor. The potential for the Ocelot occurring within the study corridor is low in Arizona.

Jaguarundi (Herpailurus yagouaroundi tolteca)

The Jaguarundi occurs from South America to extreme southern Texas. No Jaguarundi specimens have been recovered in Arizona or New Mexico (AZGFD 2004b; de Oliveira 1998), but there are numerous anecdotal reports from the Chiricahua and Santa Rita mountains, along the upper San Pedro River, and on the Tohono O'odham Reservation (AZGFD 2004b). Jaguarundis use a variety of habitats throughout their range, but at the northern limits of their range they typically occur in thick often thorny vegetation, in which they hunt and find shelter from predators (Davis and Schmidly 1997; de Oliveira 1998). Potential for the Jaguarundi occurring within the study corridor is very low, and would likely be limited to the crossing area of the San Pedro River in Arizona.

Birds

Golden Eagle (Aquila chrysaetos)

Golden Eagles are widespread in the western United States and can be found in a variety of habitats, but prefer open ground or low hills where visibility is good for hunting (Ehrlich et al. 1988; Glinski 1998). They nest on cliffs, in large or small trees, and sometimes on transmission structures (Glinski 1998). The Golden Eagle feeds primarily on mammals, preferring rabbits and ground squirrels, but also will feed on snakes, birds, and large insects when mammals are unavailable (Ehrlich et al. 1988; Terres 1980; Glinski 1998). Suitable Golden Eagle nesting and foraging habitat is present in portions of New Mexico and Arizona through which the study corridor passes. Nesting records for Golden Eagles in Arizona are widely distributed in the southern portion of the state, and include the general Project study area (Corman and Wise-Gervais 2005). The Golden Eagle is present in the study corridor in both New Mexico and Arizona.

Bald Eagle (Haliaeetus leucocephalus)

The Bald Eagle occurs across nearly all of North America, with the exception of large areas of the Chihuahuan Desert where there are no large permanent water sources. It is also absent from portions of far northern Alaska and Canada. Bald Eagles are opportunistic feeders. Fish make up the majority of their diet, but water birds can also be an important food source (Brown et al. 1991). Bald Eagles also consume mammals, shellfish, and carrion (Hunt 1998; Hunt et al. 1992; Wheeler 2003), particularly in response to decreased fish availability (Driscoll et al. 1999). Foraging success for fish in the Southwest appears to be greatest in small to medium-sized streams and tributaries of larger rivers (Brown 1993).

The Bald Eagle nests near large bodies of water in most of its range in North America, and approximately 50 to 60 resident pairs breed in the Southwest (AZGFD 1996; Phillips et al. 1964). Bald Eagles occur in Arizona at lakes, reservoirs, and along perennial rivers. Large riparian trees (typically sycamore, cottonwoods, or willows) and cliffs are important structures used for nesting and perching, and nests must be within foraging range of rivers or lakes with large fish present.

Bald Eagles regularly occur within the study corridor along the Rio Grande in New Mexico and in the Sulphur Springs Valley in Cochise County, Arizona; and may occasionally be observed elsewhere. They are absent from large areas of the study corridor where permanent water is lacking.

Northern Aplomado Falcon (Falco femoralis septentrionalis)

Aplomado Falcons (*F. femoralis*) historically ranged from the southern tip of South America north to the southwestern United States, where the species occurred at the northern extent of its range (as *F. f. septentrionalis*) in west Texas, south-central New Mexico, and southeastern Arizona (Keddy-Hector 2000). The range of the species rapidly retracted from the United States to Mexico in the late nineteenth century, with only rare sightings through most of the twentieth century prior to recent reintroduction efforts in Texas and New Mexico. The Northern Aplomado Falcon occurs in desert grasslands in North America and prefers open, low-cover areas. The presence of shrubs and stem succulents such as yuccas is important to provide nest locations and support prey species, but areas of generally low ground cover are preferred for foraging (Macias-Duarte et al. 2004; Young et al. 2004). Aplomado Falcons do not construct their own nest, but modify old stick platforms placed in trees by other bird species; particularly those of other raptors or large corvids (Keddy-Hector 2000; Young et al. 2004).

Currently, the Peregrine Fund releases approximately 100 Northern Aplomado Falcons into NEPs in Texas and New Mexico each year, under permit from the USFWS (Peregrine Fund 2009). While the number of successful pairs in New Mexico is still modest, continued releases over time will likely result in an increase in the numbers of this species in southern New Mexico, as has occurred in southern Texas. The nearest release site to the Project is located a few miles west of Deming, New Mexico. A release site east of Bosque del Apache NWR (south of San Antonio, New Mexico) is within 15 miles of links A80 and A111. There is abundant suitable habitat for the Northern Aplomado Falcon in the Project study area from the Sulphur Springs Valley north of Willcox, Arizona, east through the Rio Grande Valley in New Mexico. The potential exists for future colonization or introduction of the falcon in Arizona, although this has not occurred to date.

Yuma Clapper Rail (Rallus longirostris yumanensis)

Yuma Clapper Rails in Arizona breed in freshwater marshes with dense vegetation exceeding 16 inches in height, including cattail (*Typha spp.*) and/or giant bulrush (*Scirpus californicus*). Pond openings, flowing channels, and emergent soils are important elements of suitable habitat for the species. Yuma Clapper Rails have been found in wetlands as small as 0.12 ha (0.3 acre) (Todd 1986).

The potential for the Yuma Clapper Rail occurring within the study corridor in Arizona is low. The only known records in the area are occasional sightings of individuals at Picacho Reservoir near the Pinal Central Substation and western terminus of the Project (AZGFD 2006; Todd 1986). This reservoir is used for surplus agricultural water storage for the San Carlos Irrigation Project and is not perennial, thus developing suitable Clapper Rail habitat only during very wet years.

Piping Plover (Charadrius melodus)

The Piping Plover requires open shoreline habitats suitable for nesting near waters that provide access to invertebrate prey species. Piping Plovers primarily inhabit sparsely vegetated, gravelly beaches, alkali, and sand flat habitats, but are also recorded using shores of reservoirs, lakes, and rivers, and human-modified habitats that include gravel pits and industrial ponds (Elliott-Smith and Haig 2004).

The Piping Plover is a rare spring migrant to New Mexico, reported near the study corridor only at the Bosque del Apache NWR south of Socorro (BISON-M 2008; New Mexico Ornithological Society 2012). There are no other areas within the study corridor where this species is anticipated to occur. Its potential for occurrence in New Mexico is very low.

Yellow-billed Cuckoo (Coccyzus americanus), Western Distinct Population Segment

Western populations of the Yellow-billed Cuckoo nest in dense riparian woodlands, primarily of cottonwood (*Populus fremontii*), willow (*Salix* spp.), and mesquite (*Prosopis* spp.), along riparian corridors in otherwise arid areas (Laymon and Halterman 1989; Hughes 1999). Dense undergrowth may be an important factor in selection of nest sites. Saltcedar-dominated stands are avoided, but saltcedar may be tolerated as a minor component of the understory (Kunzmann et al. 2000). Western Yellow-billed Cuckoos require relatively large tracts of riparian woodland, preferring tracts greater than 100 acres, with tracts less than 25 acres rarely used (Laymon and Halterman 1989). They forage primarily by gleaning insects from vegetation, but they may also capture flying insects (Hughes 1999; Laymon 1998).

The San Marcial reach of the Middle Rio Grande in New Mexico supports one of the most significant remaining populations of this species in the Southwest (Johanson et al. 2006). The San Marcial reach of the river extends from the southern boundary of the Bosque del Apache NWR south to Elephant Butte Reservoir dam, outside the study corridor. The Yellow-billed Cuckoo may also occur along the Rio Grande within the study corridor.

Within Arizona, Yellow-billed Cuckoos are occasionally reported along the San Pedro River, mostly in the southern reaches closer to the Mexico border where the most extensive areas of suitable habitat are present (Corman and Wise-Gervais 2005). They may occur within the study corridor along the Lower San Pedro River, and are most likely to occur in the northern portion of the study corridor where mature riparian vegetation with some dense understory is better-developed closer to the confluence of the San Pedro and Gila rivers. The species also occurs at Aravaipa Canyon in the north end of the Galiuro Mountains, just north of the study corridor (Sky Island Alliance 2005), and at the Cienega Creek Natural Preserve in Pima County.

Mexican Spotted Owl (Strix occidentalis lucida)

The Mexican Spotted Owl prefers old-growth forest in mixed conifer, pine-oak woodland, deciduous riparian, or a combination of these habitats that will support a home range of 1,400 to 4,500 acres (Gutierrez et al. 1995; Ehrlich et al. 1988). Mexican Spotted Owls are usually found in canyons with old-growth forest, but they may also be found in canyons with steep cliffs and relatively little forest habitat, if locations exist with a suitably cool and humid microclimate.

The Mexican Spotted Owl could potentially occur within the study corridor in the north end of the Galiuro Mountains in the vicinity of Aravaipa Canyon. Mexican Spotted Owls also nest in Turkey Creek at the east end of Aravaipa Canyon (BLM 2009a). Critical habitat is designated in several mountain ranges within or near the study corridor in Arizona and New Mexico.

Cactus Ferruginous Pygmy-owl (Glaucidium brasilianum cactorum)

Very few Cactus Ferruginous Pygmy-owls remain in southern Arizona. They no longer occur in most of the areas of suitable habitat in the northern parts of their range that they occupied within the last 30 years. Records of the species in the San Pedro River Valley have historically been few, with the most recent being an unconfirmed report in 2001-2002, and near Aravaipa Creek in the early 1980s. Other recent records of the species in the Project study area include one in northwest Tucson and one near Red Rock (Richardson 2009).

The status review completed in 2011 that determined listing of the species was not warranted also summarized the most recent survey efforts for the species (USFWS 2011a). Cactus Ferruginous Pygmy-owls are known to persist in the Altar and Avra valleys in Pima County. The species was detected in Pinal County during surveys for the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005), but no records for Pinal County were presented after that date. However, survey efforts were greatly reduced after the species was delisted, and the current status of the species is not well-known. The habitat of Cactus Ferruginous Pygmy-owls in Arizona and in Sonora, Mexico frequently includes dense vegetation along desert washes (Flesch 2003), adjacent to Sonoran Desertscrub supporting saguaros with nest cavities that may be used by the owls (Flesch and Steidl 2002). Mature riparian woodlands were historically important to the owls (Johnson et al. 2003), but reported observations in riparian woodlands have decreased (Johnson et al. 2000). Suitable habitat for the species is present within the study corridor from the vicinity of the flanks of the Picacho Mountains east to the limits of saguaro habitat along the west and north flanks of the Tortolita Mountains, and southeast to Marana and the northern fringe of Tucson along the mountain base. Additional habitat is present in the study corridor throughout the San Pedro River Valley.

Due to the lack of recent records of the species in the Project study area, and the small number of individuals that have historically occurred here, the potential for the Cactus Ferruginous Pygmy-owl occurring within the study corridor is moderate.

Southwestern Willow Flycatcher (Empidonax traillii extimus)

Southwestern Willow Flycatchers are nearly always found in dense riparian corridors, particularly during the nesting season (Sogge et al. 1997). Vegetation structure appears to be more important than species composition; sites with a corridor width greater than 30 feet, a tall overstory, and thick, brushy understory are strongly preferred, from riparian areas in low deserts up to elevations of approximately 8,000 feet (Sogge and Marshall 2000). Native broadleaf riparian woodlands were the most widespread natural habitat for the flycatcher prior to the twentieth century, but invasive saltcedar and Russian olive dominate many sites currently or formerly used by the species. Southwestern Willow Flycatchers normally build nests in thickets of shrubs and young or small trees between 5 and 25 feet in height, with dense foliage between ground level and 12 feet (Sogge et al. 1997). Females lay a clutch of three to four eggs (USFWS

2002a), and nestlings fledge 12 to 15 days after hatching (Sogge 2000). Like most other flycatchers, the Willow Flycatcher forages primarily by "hawking," or flying from a perch to capture flying insects, and may also pick arthropods directly from vegetation while remaining in flight (Durst 2004). Seeds and berries are occasionally consumed, although rarely as a substantial portion of the diet (Sogge 2000).

Designated critical habitat for the Southwestern Willow Flycatcher extends along the Rio Grande from Isleta Pueblo in Valencia County downstream to approximately 2 miles north of the Sierra County line (USFWS 2013). Locations where the Project may cross the Rio Grande are located within designated critical habitat.

Designated critical habitat for the Southwestern Willow Flycatcher on the San Pedro River is present within the study corridor through all but approximately the southern 3.5 miles of the river near Benson, Arizona (USFWS 2013). There is also a small portion (approximately 3 miles) of occupied habitat for the species in the lower portion of Aravaipa Creek at its confluence with the San Pedro River (*ibid*). Within the study area, the northern portions of the San Pedro River support larger contiguous patches of riparian vegetation that would be attractive to the species. Generally, riparian vegetation becomes less dense farther south along the river within the study corridor and would likely be progressively less suitable as nesting habitat. While all four potential crossings of the San Pedro River are within designated critical habitat, the southern two contain habitat of a lower suitability for nesting Southwestern Willow Flycatchers due to thinning and gaps in the vegetation cover along the river.

The overall potential for the Southwestern Willow Flycatcher occurring within the study corridor is moderate for Arizona (primarily along portions of the San Pedro River) and high for New Mexico (along portions of the Rio Grande).

Sprague's Pipit (Anthus spragueii)

The Sprague's Pipit occurs in Cochise County, Arizona as a winter visitor, where it inhabits shortgrass prairie habitat and pastures or agricultural fields with grasses of medium height (Alsop 2001). It is also present in winter in the grasslands in the Sonoita, San Rafael, and Sulphur Springs valleys (BISON-M 2008; AZGFD 1996). Most of the habitat used by Sprague's Pipit in southern Arizona is located south of the Project study area, but the species winters in and migrates through the study corridor in New Mexico (AZGFD 2001b; Robbins and Dale 1999).

Amphibians

Chiricahua Leopard Frog (Lithobates chiricahuensis)

The Chiricahua Leopard Frog is highly aquatic and is usually found in rocky streams with deep pools surrounded by oak woodlands, mixed pine-oak woodlands, and pine forests, generally at elevations between 3,500 and 8,530 feet (Sredl and Jennings 2005). Historically this species followed streams down into areas of chaparral, grasslands, or deserts, although introduction of non-native predators coupled with habitat reduction and fragmentation has nearly eliminated valley stream use in the United States (USFWS 2007a).

Within the study corridor, the Chiricahua Leopard Frog has been recorded from the Galiuro, Winchester, and Pinaleño mountains in Arizona. The species is recorded at numerous locations in southwestern New Mexico, but within the study corridor only on the Ladder Ranch in Cuchillo Negro Creek. Cuchillo Negro Creek contains permanent water and Chiricahua Leopard Frog habitat near the edge of the study corridor, at a distance of at least 3 miles upstream from the proposed Project centerline. Critical habitat was proposed for the species in March 2011 and finalized in March 2012 (USFWS 2012b), but none of the areas designated occurs within the study corridor. The Ladder Ranch was excluded from the final rule designating critical habitat, in recognition of the substantial conservation and recovery measures implemented by the Turner Endangered Species Fund, Turner Enterprises, and the Ladder Ranch.

Reptiles

Sonoran Desert Tortoise (Gopherus morafkai)

Originally considered a single species, the Sonoran Desert Tortoise is ecologically distinct and separated by the Colorado River from the listed endangered Mojave Desert Tortoise (*G. agassizii*). Genetic and morphological evidence supported the description of the Sonoran Desert Tortoise as a separate species in 2011 (Murphy et al. 2011). Sonoran Desert Tortoises occur primarily in the Arizona Upland and Lower Colorado River Valley subdivisions of Sonoran Desertscrub, as well as Mojave Desertscrub (Arizona Interagency Desert Tortoise Team 2000), and at elevations from 500 to more than 5,000 feet (AZGFD 2001e). Sonoran Desert Tortoises are most often found in a mixed cactus-paloverde scrub association on rocky hillsides (Barrett 1990), where large numbers of boulders provide shelter. Desert Tortoises use a range of burrow and shelter types, including existing rock structures, vegetation, and new or existing burrows (Averill-Murray et al. 2002). Deep burrows are used during the hottest summer temperatures (Barrett 1990).

Desert Tortoises are herbivores, and consume a variety of plant matter, including herbaceous parts of annuals and perennials, grasses, shrubs, flowers, fruit (particularly cactus fruit), and seeds (Van Devender et al. 2002). Both Mojave and Sonoran Desert Tortoises are long-lived, slow-growing, and have very low juvenile survival. Sonoran Desert Tortoises tend to live longer and grow more slowly, but to a larger size than Mojave Desert Tortoises (Curtin et al. 2009).

Sonoran Desert Tortoises are present within a large portion of the study corridor from the San Pedro River Valley west to the Picacho Mountains, although absent from low desert valleys. The BLM in Arizona mapped three categories for Desert Tortoise habitat, with Category 1 habitat being the highest quality and of the greatest conservation value (BLM 1988b). BLM Category 1 Desert Tortoise habitat near the study corridor includes only the southern Picacho Mountains. BLM Category 2 habitat includes the northern Picacho Mountains, and three areas on the east side of the San Pedro River. Only the section of Category 2 habitat near San Manuel, Arizona is crossed by one of the proposed Project alternatives. Approximately half of the length of Project alternatives west of Benson, Arizona is within BLM Category 3 Desert Tortoise habitat.

Arizona Striped Whiptail (Aspidoscelis arizonae)

Arizona Striped Whiptails are currently known from three locations in southeastern Arizona (Sullivan 2009; Sullivan et al. 2005). The species was discovered in 1896, but not observed again until 1962 at a location approximately 40 miles distant from the cited but possibly erroneous type locality (Wright and Lowe 1965). Arizona Striped Whiptails are restricted to semiarid grasslands, often in valley bottoms dominated by alkali sacaton (*Sporobolus airoides*) and saltgrass (*Distichlis spicata*) (Rosen et al. 1998). The Willcox Playa area, including dunes and areas near Cochise Lakes south of the town of Willcox, is the southernmost extant population center for the species. A population is located near Bonita in the northern Sulphur Springs Valley, and another may persist in the Whitlock Valley between the Whitlock Mountains and the western slope of the Peloncillo Mountains. The study corridor is within the known range of the Arizona Striped Whiptail, and suitable habitat is present.

Tucson Shovel-nosed Snake (Chionactis occipitalis klauberi)

The Tucson subspecies of the Western Shovel-nosed Snake is surface-active from late spring through midsummer, with collection records showing a strong decline in activity in late June to early July (Rosen 2003). Reasons for this pattern are not known, although it likely represents cessation of reproduction-related movements or a response to changing soil character following the onset of summer rains. Across the range of the Western Shovel-nosed Snake, preferred soil types are generally sandy and often include active aeolian dune systems (Klauber 1951). The species' morphology is highly adapted to locomotion, respiration (Norris and Kavanaugh 1966), and feeding in sandy soils (Glass 1972). Vegetation associations are predominately creosote-bursage, with some use of creosote-mesquite floodplains, in the Lower Colorado River Valley subdivision of Sonoran Desertscrub.

Suitable habitat exists for the species in the vicinity of the Pinal Central and Tortolita substations (USFWS 2008b). There are contemporary records for the species in the area, and south in the Santa Cruz Flats near Picacho Peak. Patches of suitable habitat exist in the vicinity of Marana and Red Rock, although recent surveys have failed to detect the species in that area within the study corridor. However, the potential for the Tucson Shovel-nosed Snake occurring within the study corridor is high near the Pinal Central Substation.

Northern Mexican Garter Snake (Thamnophis eques megalops)

Mexican Garter Snakes are strongly associated with permanent or near-permanent water sources as adults and juveniles. In the United States portion of their range, streams and rivers were the primary suitable habitat, although natural or artificial ponds and lakes are used when present. Most potential prey species of the Mexican Garter Snakes are aquatic or wetland-associated. Young largely prey on soft-bodied invertebrates such as earthworms and leeches; whereas adults take fish, frogs, and occasionally upland prey such as small mammals, in addition to invertebrate prey (Macias-Garcia and Drummond 1988).

The Northern Mexican Garter Snake is present within the study corridor at Cienega Creek Natural Preserve east of Tucson, Arizona. Small populations of the species may persist in the Upper San Pedro River Valley, but there is low potential for the species to occur within the Lower San Pedro River Valley portion of the study corridor.

Fish

Apache Trout (Oncorhynchus apache)

Historically, the Apache Trout inhabited the headwaters of the Salt and Little Colorado rivers in Arizona. The species currently remains in the White Mountains of east-central Arizona and in several introduced populations in the Pinaleño Mountains. Most extant populations of the species occur above approximately 5,780 feet in elevation (AZGFD 2001d; Minckley and Marsh 2009).

The Apache Trout was introduced to several high-elevation perennial streams in the Pinaleño Mountains southwest of Safford, Arizona in the 1960s. Viable populations of the species remain in the Grant, Ash, Marijilda, and Big Creek drainages (Porath et al. 2010). Although the Project crosses Grant Creek, it does so approximately 6 miles downstream from permanent water with trout. The potential for the Apache Trout occurring within the study corridor is very low in Arizona.

Gila Chub (Gila intermedia)

Gila Chubs are found in smaller creeks, cienegas, and springs of the Gila River Basin (AZGFD 2002; Minckley 1973). Habitat types used by this secretive species vary seasonally and with the fish's age; adults typically inhabit deeper waters or areas with cover. The Gila Chub is omnivorous, but feeds primarily on insects and algae (AZGFD 2002; Minckley 1973).

Critical habitat is designated for the Gila Chub in Hot Springs and Redfield canyons in the Galiuro Mountains, within the study corridor. No permanent water supporting the Gila Chub is present within the study corridor in the San Pedro River Valley. The Gila Chub and designated critical habitat are present in the Cienega Creek Natural Preserve, within the study corridor. The species does not occur within the study corridor in the New Mexico portion of the Project.

Roundtail Chub (Gila robusta)

Extant populations of the Lower Colorado River Basin distinct population segment (DPS) of the Roundtail Chub currently remain in central and eastern Arizona and in the Gila River Watershed of southwest New Mexico. The Roundtail Chub inhabits deep pools in the middle of medium- to large-sized streams and rivers. Roundtail Chubs are omnivorous and include fish, small invertebrates, detritus, and plant materials in their diet (Minckley and Marsh 2009). The only extant population of the Roundtail Chub occurring near the study corridor is in the Aravaipa Canyon watershed, outside of but downstream from the corridor.

Rio Grande Silvery Minnow (Hybognathus amarus)

The Rio Grande Silvery Minnow lives in medium to large rivers, and normally uses habitats where flows are of low to moderate velocity over mud, silt, sand, or gravel substrates, at depths less than 20 inches. The sole remaining natural population of the Rio Grande Silvery Minnow occurs in the Rio Grande in New Mexico, between the Cochiti Dam to the headwaters of Elephant Butte Reservoir north of Truth or Consequences, New Mexico (Sublette et al. 1990).

The Rio Grande Silvery Minnow is present within the study corridor where the Project would cross the Rio Grande. Crossing locations are also within designated critical habitat for the species.

Spikedace (Meda fulgida)

The Spikedace is a small fish that prefers shallow pools and riffles in mid-elevation (approximately 3,000 to 5,000 feet) streams. The Spikedace is native to the Upper Gila River Basin in Arizona and New Mexico, and was reported from the upper San Pedro River in Sonora, Mexico. The species is currently restricted to several isolated populations within the Gila River watershed. Spikedace occur within Arizona in the Verde River, Aravaipa Creek, and Eagle Creek, but appear to be largely extirpated from the middle and lower Gila River. In New Mexico, the Spikedace is restricted primarily to the upper Gila River (Minckley and Marsh 2009). Habitat use varies among populations, and may be controlled by the presence of non-native fish (Rinne 1991).

Critical habitat is designated in three streams within the study corridor (USFWS 2012c). The Spikedace is present in Aravaipa and Turkey creeks downstream from the study corridor. Link C170, which passes through the north end of the Galiuro Mountains, crosses Aravaipa Creek upstream from the designated Aravaipa Creek Critical Habitat Unit (CHU).

The Spikedace was translocated to Hot Springs and Redfield canyons in 2007, and both streams contain designated critical habitat. Link C331 crosses downstream from the Hot Springs Canyon CHU, and Link C470 crosses downstream from the Redfield Canyon CHU. Spikedace are present within the study corridor in both streams.

Loach Minnow (Tiaroga cobitis)

The Loach Minnow is endemic to the Gila River Basin of New Mexico and Arizona, and was reported from the upper San Pedro River in Sonora, Mexico. Populations in the Verde and San Pedro rivers appear to be extirpated. Loach Minnows currently persist in the upper Salt River and smaller tributaries of the Gila River in Arizona, and the Upper Gila River in New Mexico (Minckley and Marsh 2009).

Critical habitat is designated in three streams within the study corridor (USFWS 2012c). The Loach Minnow is present in Aravaipa and Turkey creeks downstream from the study corridor. Link C170, which passes through the north end of the Galiuro Mountains, crosses Aravaipa Creek upstream from the designated Aravaipa Creek CHU.

The Loach Minnow was translocated to Hot Springs and Redfield canyons in 2007, and both streams contain designated critical habitat. Link C331 crosses downstream from the Hot Springs Canyon CHU, and Link C470 crosses downstream from the Redfield Canyon CHU. Loach Minnows are present within the study corridor in both streams.

Desert Pupfish (Cyprinodon macularius)

The Desert Pupfish is found in shallow water in springs, small streams, and marshes, often in areas with soft substrates and clear water. They are able to survive under rapid and extreme

fluctuations in water temperature, salinity, and oxygen content that may preclude competitive or predaceous fish (Carveth et al. 2005). Their diet includes small invertebrates, insect larvae, detritus, algae, and aquatic vegetation.

The species is present within the study corridor as small populations of various genetic stocks that have been introduced into a few areas of suitable habitat. Some of these locations include Turkey Creek and other tributaries to Aravaipa Creek, and a population that was introduced on the Muleshoe Ranch CMA north of Willcox, Arizona, under a Safe Harbor Agreement (TNC 2010; USFWS 2005c). Link C170 crosses Aravaipa Creek in the northern Sulphur Springs Valley, approximately 9 river miles upstream of the perennial portion of Aravaipa Creek. Link C170 also crosses Turkey Creek at the uppermost portion of its watershed, outside the limits of perennial flow.

Gila Topminnow (Poeciliopsis occidentalis)

The historical distribution of the Gila Topminnow included much of the lower elevations of the Gila River drainage in Arizona and New Mexico as well as portions of northwestern Sonora, Mexico; although it has been extirpated from the majority of its former range (Minckley and Marsh 2009). Gila Topminnows are short-lived, usually less than 1 year, and reproduce rapidly and repeatedly as temperatures are adequate. Reproduction may occur year-round in warm springs. Topminnows are livebearers, and brood size ranges from 1 to more than 30. Successive broods may occur within 3 to 4 weeks (Schoenherr 1977).

Gila Topminnows are present within the study corridor in Cienega Creek. The species has also been translocated to several streams within the Aravaipa Creek watershed (USFWS 2005a). Link C170 crosses Aravaipa Creek in the northern Sulphur Springs Valley, approximately 9 river miles upstream of the perennial portion of Aravaipa Creek. Link C170 also crosses Turkey Creek at the uppermost portion of its watershed, outside the limits of perennial flow.

Invertebrates

Chupadera Springsnail (Pyrgulopsis chupaderae)

The Chupadera Springsnail occurred in two privately-owned spring complexes near the western boundary of the Bosque del Apache NWR, approximately 3 miles east of Link A161. The species has been extirpated from one spring complex, but is believed to be present in Willow Spring. Both springs were designated as critical habitat in 2012 (USFWS 2012d).

Socorro Springsnail (Pyrgulopsis neomexicana)

The Socorro Springsnail is extinct (as of 1987) at its type locality at Willow Spring, a thermal spring approximately 18 miles south-southwest of Socorro, New Mexico. It also no longer occurs at the springs approximately 3 miles southwest of Socorro where the species was also recorded (Taylor 1987). The species survives only at Torreon Spring, approximately 15 miles southwest of Socorro in the southeastern foothills of the Magdalena Mountains (USFWS 2008c). While the springsnails at Torreon Spring appear to be *P. neomexicana*, their identity remains uncertain due to a lack of comparative specimens (*ibid*). Link A161b passes within 500 feet of

Torreon Spring. Since the species was originally known from other springs in the Socorro area, there is a small possibility that the species may exist undetected at other springs in the area.

Plants

Pima Pineapple Cactus (Coryphantha scheeri var. robustispina)

The Pima pineapple cactus is found along ridges and level uplands in semidesert grassland and alluvial fans in the Arizona Upland subdivision of Sonoran Desertscrub, but rarely occurs in floodplains and washes or on steep slopes (Pima County 2004). The range of the Pima pineapple cactus is generally south of I-10 and west of SR 83 in Pima County, Arizona. The Pima pineapple cactus is present near Tucson within the study corridor.

Kuenzler's Hedgehog Cactus (Echinocereus fendleri var. kuenzleri)

The Kuenzler's hedgehog cactus is endemic to New Mexico, and occurs in isolated populations from the Guadalupe Mountains northward to the vicinity of Carrizozo. The species prefers rocky slopes and hilltops, typically facing south or east (May et al. 2008). Kuenzler's hedgehog cacti have not been recorded within the study corridor, but known populations are located approximately 15 miles southwest of the proposed SunZia East Substation. Suitable habitat may be present in the foothills of the Gallinas Mountains.

Acuña Cactus (Echinomastus erectocentrus var. acunensis)

The Acuña cactus occurs on low hills and gravel ridges on granitic or andesite-derived soils in the Arizona Upland subdivision of Sonoran Desertscrub habitat (Arizona Rare Plant Committee, no date) in two disjunct regions of Arizona, each with multiple small populations. A southern Arizona population center includes cacti in the Sauceda and Sand Tank mountains and other small ranges, largely within Organ Pipe Cactus National Monument and the Barry M. Goldwater Air Force Range. The cactus also occurs in central Arizona in two populations east of Florence, north and south of the Gila River. The southernmost of the central Arizona populations occurs in the Ninetysix Hills and around the adjacent Box O Wash area, where critical habitat was proposed outside the study corridor in 2012 (USFWS 2012e). Suitable habitat may be present within the study corridor, although the species has not been recorded there.

Todsen's Pennyroyal (Hedeoma todsenii)

Todsen's pennyroyal is found in two mountain ranges in southern New Mexico; 17 known populations exist on the west slope of the San Andres Mountains within the WSMR, and 15 scattered populations are currently known in the Sacramento Mountains east of Tularosa, New Mexico, in the Lincoln National Forest and on BLM-administered lands (Howard 2011). Although no known populations are in proximity to the study corridor, the recovery plan for the species suggests that populations could exist where appropriate soils and slopes are present on the Chupadera Mesa (USFWS 2001a), which is crossed by any of the Route Group 1 subroutes.

Pecos Sunflower (Helianthus paradoxus)

The threatened Pecos sunflower occurs in several isolated populations in New Mexico and Texas. Critical habitat has been designated for the species, outside the Project study area (USFWS 2008d). Pecos sunflowers are restricted to the margins of permanent or near-permanent wetlands, often with saline soils. A large, natural population is present at Sevilleta NWR, and a population was recently established south of Socorro, New Mexico through translocation of seeds as a conservation effort (Zenone 2012).

Huachuca Water-umbel (Lilaeopsis schaffneriana var. recurva)

At the time of its listing and critical habitat designation, the Huachuca water-umbel was only known from sites in the upper drainages of the San Pedro and Santa Cruz rivers and several sites in the Huachuca Mountains. In 2001, a disjunct population of the plant was discovered in Bingham Cienega (Titus and Titus 2008), a natural wetland managed by TNC and the Pima County Flood Control District. The Bingham Cienega Natural Preserve is located in the San Pedro River Valley north of the town of Redington, Arizona. The Bingham Cienega population was not known at the time critical habitat was designated for the species, and the designation was not revised to include the population. Link C470 is approximately 3.8 miles east of Bingham Cienega, and Link C441 is approximately 2.8 miles to the west of the cienega. Two potential Project crossings of the San Pedro River are equally spaced upstream and downstream (approximately 15 river miles) of the cienega. The species is also present within the study corridor in the Cienega Creek Natural Preserve.

Chihuahua Scurf-pea (Pediomelum pentaphyllum)

The Chihuahua Scurf-pea is recorded from Graham, Santa Cruz, and Cochise counties in Arizona; Hidalgo County, New Mexico; and in northern Mexico (AZGFD 2001c; Rare Plant Technical Council 1999; USDA 2011). Recent surveys for the species in Arizona and New Mexico have increased the known numbers of plants, rediscovered a population thought extirpated, and somewhat expanded the known range of the species (Howard 2011). The Hidalgo County, New Mexico population in the Hachita Valley is the most robust known population, with more than 1,000 plants within a 15-square mile area; a population southeast of Safford, Arizona contains approximately 160 plants within 10 square miles, and is within the study area; and a population near Sunizona, Arizona contains more than 200 plants within a 20-square mile area. The species is known near or in the study corridor on private land in the San Simon Valley in Graham County, Arizona (Welsh and Licher 2010; WildEarth Guardians 2008). Suitable habitat is probably present over a wide area within the study corridors in southeastern Arizona and southwestern New Mexico as far east as Gage, New Mexico, although surveys conducted by the BLM have not detected additional populations (Howard 2011).

3.6.6.2 State of New Mexico Threatened and Endangered Species

Forty-four species that are listed by the state of New Mexico as threatened or endangered were identified as potentially occurring within the New Mexico portion of the study corridor. These include 7 mammals, 19 species of birds, 2 amphibian, 3 reptiles, 6 fish, 2 invertebrates, and 5 plant species; 12 of these species are also ESA-listed. A discussion of each of these species, including its distribution within the study corridor as it is currently known, recognized threats to

the species, and its potential for occurring within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.3 Bureau of Land Management Sensitive Species

New Mexico

Ten species of plants and 19 wildlife species that are considered sensitive by the New Mexico Office of the BLM potentially occur within the New Mexico portion of the Project study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats to the species, and potential for occurrence within the study corridor can be found in the biological technical report (Appendix B1).

Arizona

Seven species of plants and 27 wildlife species that are considered sensitive by the Arizona Office of the BLM potentially occur within the Arizona portion of the Project study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats to the species, and its potential for occurring within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.4 U.S. Forest Service Sensitive Species

Eleven plant species and 58 wildlife species considered sensitive by Region 3 (Southwest) of the USFS may occur within the Project study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats to the species, and its potential for occurring within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.5 USFWS Species of Concern

Fifteen species of plants and 38 wildlife species that are USFWS species of concern potentially occur within the study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats, and potential for occurrence within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.6 USFWS Birds of Conservation Concern

The USFWS maintains lists of Birds of Conservation Concern (BCC), focusing on species that are not listed under the ESA but that are typically declining and have the potential to merit listing in the future if declines are not addressed. BCC lists are maintained at three geographic scales: Bird Conservation Regions (BCR) at the ecoregion scale, USFWS administrative regions, and a national list. A species may be listed at the BCR scale when certain regional populations are declining, but species on the national list may require conservation throughout their range.

Approximately 57 BCC may occur in the study corridor, which crosses the following BCRs: Southern Rockies-Colorado Plateau, Chihuahuan Desert, Sierra Madre Occidental, and Sonoran-

Mojave Deserts. The entire study corridor is within USFWS Region 2. Additional information is included in the biological technical report (Appendix B1).

3.6.6.7 AZGFD Wildlife Species of Concern

Thirty-nine species that are considered wildlife species of concern (WSC) by the AZGFD potentially occur within the Project study corridor. Additional information is included in the biological technical report (Appendix B1).

3.6.6.8 AZGFD Species of Economic and Recreational Importance

Thirteen wildlife species are currently managed by the AZGFD as Species of Economic and Recreational Importance. Wildlife viewing and hunting of these animals represents a significant recreational and economic resource for the state of Arizona. Management of these resources requires an understanding of the key elements necessary for the conservation of habitats supporting these species. Additional information is included in the biological technical report (Appendix B1).

3.6.6.9 Arizona Department of Agriculture Highly Safeguarded Plant Species

Three species of highly safeguarded plants potentially occur within the study corridor; the Pima pineapple cactus and Huachuca water-umbel (both discussed previously), and the crested form of the saguaro cactus. All of these species are discussed in the biological technical report (Appendix B1).

3.6.6.10 Species of Greatest Conservation Need

In an effort to stem a growing tide of ESA listing petitions and related litigation, the federal government provided an avenue for state wildlife management agencies to preserve nongame wildlife in the 1980 Forsythe-Chafee Act. Funding for development of individual state plans is provided for by the USFWS Wildlife Conservation and Restoration Program (USFWS 2001b) and the Association of Fish and Wildlife Agencies State Wildlife Grants Program (Association of Fish and Wildlife Agencies 2002). To receive federal funding under these programs, congress mandated that each state complete a 10-year Comprehensive Wildlife Conservation Strategy by 2005. A key element of these plans is the development of a set of species of greatest conservation need (SGCN), which are monitored by the state agencies to help preclude the need for future ESA listing needs. These species have been included in the review for this Project.

New Mexico

One-hundred-twelve wildlife species that may occur within the New Mexico portion of the Project study corridor are considered SGCN by the NMDGF. All of these species are discussed in the biological technical report (Appendix B1).

Arizona

One-hundred-three wildlife species that may occur within the Arizona portion of the Project study corridor are considered SGCN by the AZGFD. These species are discussed in the biological technical report (Appendix B1).

3.6.6.11 Pima County (Arizona) Priority Vulnerable Species

Thirty-four species that are recognized as Priority Vulnerable Species under the Pima County SDCP are known or have some potential to occur within the Project study corridor. These species are discussed in the biological technical report (Appendix B1).

3.6.7 Biological Resource Conservation Areas

The following discussion on conservation areas, managed in part for biological resources, focuses on those that occur in part or in their entirety within the study corridor and that are owned by federal, state, county, and nongovernmental organizations. A brief discussion of each of these managed areas, including some of their key resource values, is provided. Many of these areas are displayed on Figures M 6-3 (see Map Volume).

3.6.7.1 Sevilleta National Wildlife Refuge

Sevilleta NWR, established in 1973, contains approximately 230,000 acres of land that straddles the Rio Grande approximately 50 miles south of Albuquerque, New Mexico. Four major biomes meet within the refuge—Chihuahuan Desert, Great Plains shortgrass prairie, piñon-juniper woodland, and Colorado Plateau shrub steppe. Sevilleta NWR is managed to allow natural ecological processes to prevail, and portions of the refuge are used for education and long-term scientific research. The refuge supports waterfowl and dove hunting, and other wildlife-related recreation. The endangered Southwestern Willow Flycatcher and Rio Grande Silvery Minnow occur on the refuge, along with other sensitive species that include Desert Bighorn Sheep and American Pronghorn (USFWS 2011b). Link E101b follows the southern boundary of the Refuge, but comes no closer than approximately 0.85 mile. Link E86b approaches within approximately 1.6 miles of the refuge boundary.

3.6.7.2 Bosque del Apache National Wildlife Refuge

Bosque del Apache NWR, established in 1939, contains 57,331 acres of land that straddles the Rio Grande approximately 20 miles south of Socorro, New Mexico. The dominant features of the refuge are the active river floodplains, moist bottomlands, and developed wetlands and riparian forest habitats that support an enormous quantity of migratory birds, including Sandhill Cranes (*Grus canadensis*), Ross's and Snow Geese (*Chen rossii* and *C. caerulescens*), and many other species during winter (USFWS 2011c). The refuge is in the heart of the Rio Grande avian flyway; nearly 400 species of birds have been recorded within its boundaries (USFWS 1995). Habitat restoration is a key element of the ongoing management efforts at the refuge. The refuge supports nesting endangered Southwestern Willow Flycatchers, and the reach of the Rio Grande within the refuge is designated critical habitat for the endangered Rio Grande Silvery Minnow. Links A111 and A160 pass north of the refuge, north of SR 380.

3.6.7.3 Ladd S. Gordon Waterfowl Complex

The Ladd S. Gordon Waterfowl Complex, managed by the NMDGF, consists of four subunits (waterfowl areas) along the Rio Grande in New Mexico, between Belen and Socorro. The Bernardo (1,573 acres) and La Joya (3,550 acres) waterfowl areas are short distances north of Sevilleta NWR, and provide foraging and resting habitat for large numbers of waterfowl and Sandhill Cranes. Habitat is created through flooding farmland and riparian habitat management. Wintering birds may move freely between these sites and Bosque del Apache NWR.

3.6.7.4 Ladder Ranch

The Ladder Ranch, owned by Turner Ranch Properties L.P., comprises 156,439 acres of privately owned land due west of Truth or Consequences, New Mexico. The western boundary of the Ranch abuts the Gila National Forest; the property contains significant streams that have their headwaters on the eastern flank of the Black Range. These streams support some of the last remaining populations of the endangered Chiricahua Leopard Frog (*Lithobates chiricahuensis*) in New Mexico (Kruse and Christman 2007). A prerelease acclimatization facility for Mexican Gray Wolves is located on the Ladder Ranch, although all releases into the wild have taken place in Arizona. Link A330b crosses the Ladder Ranch.

3.6.7.5 Cluff Ranch Wildlife Management Area

The Cluff Ranch Wildlife Management Area (WMA), managed by the AZGFD, comprises 788 acres along Ash Creek on the northeast flank of the Pinaleño Mountains, approximately 6 miles southwest of Thatcher, Arizona. Approximately one third of the acreage in the wildlife area consists of mature cottonwood-willow riparian habitat along Ash Creek. The property supports two aquatic impoundments, totaling 14 acres, and is currently managed for public access for fishing, hunting, and wildlife viewing. No species listed under the ESA are recorded using the property. Special-status species documented using the property include American Peregrine Falcon (*Falco peregrinus*), Cave Myotis (*Myotis velifer*), Greater Western Mastiff Bat (*Eumops perotis californicus*), Arizona alum root (*Heuchera glomerata*), and branching penstemon (*Penstemon ramosus*) (AZGFD 2011a). The closest link to the Cluff Ranch is Link B153b, which passes approximately 0.25 mile south (upslope) of the south property boundary.

3.6.7.6 Bonita Grasslands Restoration Project

The Bonita Grasslands Restoration Project was initiated by the AZGFD in partnership with private land owners on an aggregation of Arizona State Trust Lands and private lands in the northern Sulphur Springs Valley, north of Willcox, Arizona. The project plan is to restore 20,000 acres of grassland habitat over the next 10 to 15 years, which will support an existing Pronghorn population and restore connectivity between the Bonita and Southern Greasewood Pronghorn herds. These populations have been the subject of intensive, active habitat management and monitoring. Populations have varied widely but declined overall since monitoring began in response to ongoing habitat degradation, development in the northern Sulphur Springs Valley, and other factors. Grassland habitat is also important for Scaled Quail (*Callipepla squamata*), Botteri's Sparrow (*Aimophila botterii*), Cassin's Sparrow (*A. cassinii*), and other Chihuahuan grassland bird assemblages and general wildlife (AZGFD 2010).

Funding for the project to date has been provided by the AZGFD, NRCS, and private landowners. Additional support from the NRCS and the Habitat Partnership Committee are being solicited, and ultimately the partners hope to restore 100,000 acres of grassland habitat in the northern Sulphur Springs Valley.

3.6.7.7 Aravaipa Wilderness and Ecosystem Management Area

The Aravaipa Wilderness contains 19,410 acres of BLM-administered land located approximately 12 miles northeast of Mammoth, Arizona. The Aravaipa Wilderness and Ecosystem Management Area are centrally located within one of the largest habitat blocks remaining in the Southwest that is unfragmented by highways, canals, residential development, and other major barriers to wildlife movement. The Galiuro, Winchester, Santa Teresa, and the northern Pinaleño mountains are not crossed by any paved roads or major infrastructure.

Aravaipa Creek supports seven native fishes and is considered the best remaining native fish habitat in Arizona (BLM 2009b). Aravaipa Creek downstream of Stowe Gulch is designated critical habitat for the Loach Minnow (*Tiaroga cobitis*) and Spikedace (*Meda fulgida*); this critical habitat ends at the Aravaipa-San Pedro River confluence (USFWS 2012c). The Aravaipa Wilderness and Ecosystem Management Area in the Galiuro and Santa Teresa mountains support a regionally important population of Desert Bighorn Sheep. White-nosed Coati (*Nasua narica*) and many other wildlife species are present, including 150 bird species documented within the wilderness boundary. The ESA-listed Southwestern Willow Flycatcher also occurs in the wilderness. Special-status species include the Cactus Ferruginous Pygmy-owl, Common Black-hawk (*Buteogallus anthracinus*), and the Northern Peregrine Falcon. Public uses of the wilderness include hiking, photography, and wildlife watching. Limited hunting is also permitted, with certain restrictions (BLM 2009b). Link C170 crosses a nonperennial portion of Aravaipa Creek approximately 4.5 stream miles upstream from the boundary of Loach Minnow-Spikedace critical habitat. Link C592 crosses the San Pedro River approximately 8 river miles upstream from the San Pedro-Aravaipa Creek confluence.

3.6.7.8 Muleshoe Ranch CMA

The Muleshoe Ranch CMA consists of 55,000 acres of private and publicly owned lands in the Galiuro Mountains, Winchester Mountains, and northern Sulphur Springs Valley; approximately 15 miles northwest of Willcox, Arizona. It is jointly managed by TNC, the BLM, and USFS. The seven perennial streams within the Muleshoe Ranch CMA support five native fish species, including the endangered Gila Chub (TNC 2011). The Muleshoe Ranch CMA also supports Desert Bighorn Sheep that are part of a metapopulation associated with herds in the Aravaipa Wilderness. All regulations and guidelines pertaining to public land apply to those lands within this CMA.

3.6.7.9 Lower San Pedro River Collaborative Conservation Initiative

The USFWS has conducted a scoping period from June to August, 2012 for this collaborative conservation initiative, which would include a network of lands owned by private individuals, nongovernmental organizations, and governmental agencies. This initiative would provide an opportunity for cooperative management of new or existing conservation efforts, mitigation

lands, and conservation easements. Some of these lands may be managed or acquired by the USFWS as a proposed NWR. Scoping was conducted for an area 2 miles on either side of the San Pedro River, from "The Narrows" USGS gauging station north of Benson to the confluence with the Gila River.

3.6.7.10 H & E Farm

The H & E Farm is a 570-acre parcel on the San Pedro River that is owned by TNC, located approximately 3 miles downstream of Mammoth, Arizona. The reach of the San Pedro River on the property does not currently support perennial flow (Haney 2005). The parcel is part of the San Pedro River corridor that supports wildlife and wildlife movement between northern Sonora, Mexico, and the interior highlands of Arizona.

3.6.7.11 7B Ranch

The 3,100-acre 7B Ranch on the San Pedro River is owned by Resolution Copper Company and is managed by TNC. The 7B Ranch contains significant mesquite bosque habitat.

3.6.7.12 Three Links Farm

The Three Links Farm, located approximately 15 miles north of Benson, Arizona, was recently purchased by TNC to place 2,209 acres (approximately 6 river miles) of San Pedro River deciduous riparian habitat under the protection of a conservation lease agreement. The lands have since been subdivided into five parcels that are privately owned and carry conservation easements. The San Pedro River riparian corridor supports important fish habitat and is an important avian migratory corridor. The ESA listing candidate Yellow-billed Cuckoo, Gray Hawk (*Buteo plagiatus*), and many other avian species use this reach of the San Pedro River. The American Beaver (*Castor canadensis*) was reintroduced to the San Pedro River upstream of the property, and has moved onto the property subsequent to the purchase of these lands by TNC (Headquarters West LTD 2011).

3.6.7.13 A7 Ranch

The A7 Ranch consists of approximately 46,898 acres of private, State Trust, Pima County, and other conservation easement lands. The property is a working ranch under a grazing lease from the ASLD that supports a variety of native wildlife, including four Pima County Priority Vulnerable Species identified in the Pima County SDCP: the Lowland Leopard Frog (*Lithobates yavapaiensis*), Giant Spotted Whiptail (*Aspidoscelis burti stictogrammus*), Bell's Vireo (*Vireo bellii*), and Mexican Long-tongued Bat (*Choeronycteris mexicana*). The A7 Ranch contains important riparian and grassland habitats that provide connectivity between the Buehman Canyon area and the San Pedro River corridor (Pima County 2011a).

3.6.7.14 Six Bar Ranch

The Six Bar Ranch, located 3 miles northwest of the A7 Ranch, consists of approximately 12,300 acres of State Trust and Pima County lands. Resources and management of the Six Bar Ranch

are similar to the A7 Ranch (Pima County 2011a). Link C450 crosses a small portion of the Six Bar Ranch, adjacent to an existing natural gas pipeline.

3.6.7.15 Bingham Ranch and Cienega

The Bingham Ranch, located in the San Pedro River Valley approximately 2 miles north of Redington, Arizona, was purchased in 1989 by the Pima County Regional Flood Control District to preserve Bingham Cienega, a spring-fed marsh on the property. Other valuable resources on this 285-acre parcel include significant wetlands, sacaton grassland, mesquite bosque, and riparian forest habitats (University of Arizona [UA] 2008). TNC manages the property under an agreement with the Pima County Regional Flood Control District.

3.6.7.16 Bar V Ranch

The Bar V Ranch, a combination of lands owned or leased by Pima County, surrounds a portion of the Cienega Creek Natural Preserve. The Bar V Ranch protects a perennial reach of Davidson Canyon with native fish present, as well as Sonoran desertscrub and semidesert grassland. A number of Pima County Priority Vulnerable Species are present.

3.6.7.17 Cienega Creek Natural Preserve

The Cienega Creek Natural Preserve is a 3,979-acre preserve owned by Pima County that provides protection for 12 miles of the Cienega Creek riparian area near Vail, Arizona (Pima County 2011b). Perennial waters in portions of the preserve provide habitat that supports a variety of important wildlife species, including three special-status fish species; the Longfin Dace (*Agosia chrysogaster*), and the endangered Gila Topminnow and Gila Chub. Other wildlife recorded within the preserve includes 174 species of birds (Pima County 2004).

3.6.7.18 Saguaro National Park

Saguaro National Monument was originally established in 1933, and was expanded concurrent with its designation as a National Park in 1994. Saguaro National Park consists of two units totaling 91,440 acres. The Tucson Mountain District is situated on the western flank of the Tucson Mountains west of Tucson, Arizona, and the larger Rincon Mountain District is in the Rincon Mountains at the east edge of the Tucson Valley. Park elevations range from a low point of 2,180 feet in the Tucson Mountain District, to 8,666 feet on Mica Mountain in the Rincon Mountain District. Saguaro National Park was established primarily to protect the forests of the saguaro cactus (*Carnegiea gigantea*) (NPS 2007). Because of the wide elevation range within the Park, many biomes are represented, and the lands support a large suite of plant and wildlife species. ESA-listed species occurring here include the endangered Lesser Long-nosed Bat, the threatened Mexican Spotted Owl, and the candidate Sonoran Desert Tortoise.

3.6.7.19 Ironwood Forest National Monument

Ironwood Forest National Monument, managed by the BLM, consists of 129,000 acres of Sonoran Desert west of Marana bordering the Tohono O'odham Nation, and was set aside in 2000 to preserve an example of forests of the desert ironwood tree (*Olnea tesota*). ESA-listed

species that occur here include the Lesser Long-nosed Bat, Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*), and the candidate Sonoran Desert Tortoise. Other notable special-status species include the Desert Bighorn Sheep and the Cactus Ferruginous Pygmy-owl (BLM 2009c).

3.6.8 Agency-identified and Other Biological Resource Areas

Several sensitive biological resources were identified within the study corridor through the resource inventory process and discussions with biologists from the NMDGF and AZGFD. These biological resource issues are presented below.

3.6.8.1 Wildlife Linkages

The concept of wildlife linkages identifies the importance of corridors connecting large areas of relatively undisturbed, protected natural habitat (wildland blocks) that are threatened by fragmentation resulting from a variety of human-induced impacts. Habitat fragmentation and loss are currently recognized as the principal threats to biodiversity.

Conservation of large wildland blocks that still support functional ecological communities, often retaining their full suite of native species, are in many cases dependent on movement corridors that provide connectivity between subcomponents of species' metapopulations. Without corridors between wildland blocks, ecological balance regulated by large predators cannot function. Interspecific competition, mutualism, energy flow, nutrient cycling, pollination, species dispersal, and long-term gene flow within metapopulations may be inhibited or lost. In addition, the presence of corridors allows ecosystems to recover from stochastic events such as fire, flooding, exotic species invasion, and climate change by allowing an escape to adjacent blocks; or, for species with more limited home ranges, within corridors themselves (Beier et al. 2006).

The Arizona Wildlife Linkages Workgroup, a collaborative effort of nine public agencies and nonprofit organizations initiated in 2004, resulted in the publication of Arizona's Wildlife Linkages Assessment; an analysis identifying important wildlife habitat areas needing connectivity (blocks), and the associated threats to that connectivity (ADOT 2010; Corridor Design 2010). The Wildlife Linkages Assessment identified potential linkage zones (corridors) that are important to Arizona's wildlife and natural ecosystems (ADOT 2010). Subsequently, the Arizona Missing Linkages Project operated through Northern Arizona University has created detailed linkage designs for 16 identified priority areas identified in the assessment. The detailed analysis includes habitat modeling for a suite of representative wildlife expected to use each linkage. Discrete linkage strands may be needed to provide suitable corridors for species with different habitat requirements (Beier et al. 2008).

The following four linkages would potentially be traversed by the Project: Galiuro–Pinaleño–Dos Cabezas, Rincon–Santa Rita–Whetstone, Tucson–Tortolita–Santa Catalina Mountains, and Ironwood–Picacho. Additional proposed linkages within the study corridor have not been analyzed or modeled in detail by the Arizona Wildlife Linkages Workgroup, and so are not discussed here.

Galiuro–Pinaleño–Dos Cabezas Linkage

The Galiuro–Pinaleño Linkage contains two principal strands, and the Pinaleño–Dos Cabezas Linkage contains three; any of which could be traversed by the proposed Project alignments. The linkage strand between the Galiuro and Pinaleño mountains crosses the grasslands of the northern Sulphur Springs Valley. In addition to the Pronghorn, other species that were used in developing the linkage model (both strands) and that may potentially be affected by the Project include Black Bear (*Ursus americanus*), Bobcat (*Felis rufus*), Mountain Lion (*Puma concolor*), and Mule Deer (*Odocoileus hemionus*). Two species that were modeled but are not known to currently be present in the area are the Jaguar and the Mexican Gray Wolf. Links C110, C130a, C130b, and Local Alternative Link C90 cross strands of the Galiuro–Pinaleño–Dos Cabezas Linkage.

Rincon–Santa Rita–Whetstone Linkage

Four of the six strands that make up this linkage are potentially crossed by Project alternatives (links F40a, F40b, F51, and F600). Some of the species that were used to model this linkage include Black Bear, Coues White-tailed Deer (*Odocoileus virginianus couesi*), Mountain Lion, Mule Deer, Pronghorn, Lowland Leopard Frog, Desert Box Turtle (*Terrapene ornata luteola*), Giant Spotted Whiptail (*Aspidoscelis burti stictogrammus*), Northern Mexican Garter Snake, Gila Topminnow, and Longfin Dace (*Agosia chrysogaster*). Species that were included in the linkage model but that do not currently occur in the study corridor include the Chiricahua Leopard Frog and the Jaguar. Suitable habitat for these two species is present.

Tucson–Tortolita–Santa Catalina Mountains Linkage

The Tucson–Tortolita–Santa Catalina Mountains Linkage contains two linkages; the Tucson–Tortolita linkage and the Tortolita–Santa Catalina Linkage. Only the Tucson–Tortolita linkage is potentially traversed by any Project alternatives. One subroute crosses the Tucson–Tortolita Linkage (links F510 and F540). Some of the species that were used to model this linkage include Black Bear, Bobcat, Mountain Lion, Mule Deer, Desert Tortoise, and the Gila Monster (*Heloderma suspectum*). Function of this linkage is compromised by the presence of existing linear developments, including the UPRR right-of-way and I-10. These features have a significant fragmentation effect on wildlife movements through the area.

Ironwood–Picacho Linkage

The Ironwood–Picacho Linkage contains two principal strands, one that connects the Picacho Mountains with the Ironwood Forest National Monument and the Silverbell Mountains, and the other that is between the Ironwood Forest National Monument and the Durham–Coronado Plains. Both of these strands are traversed by Project alternatives. Links C810, C810a, C812, C813, C814, C815, C816, and C817 pass through the eastern strand of the linkage, which connects Ironwood Forest National Monument with the BLM-designated Durham-Coronado Plains wildland block to the northeast. Some of the species used in modeling this linkage include Desert Bighorn Sheep, Mule Deer, Sonoran Desert Tortoise, and Tucson Shovel-nosed Snake. All links that occur within the wildlife linkage pass through suitable Tucson Shovel-nosed Snake

habitat. Links C813, C814, C815, and C816 all pass through BLM Category III Desert Tortoise Habitat. Function of this linkage is adversely affected by the presence of existing linear features that include the CAP canal, UPRR right-of-way, and I-10.

3.6.8.2 Picacho Reservoir Area

Picacho Reservoir, located south of Florence and east of Casa Grande, was originally constructed in 1889-1890 as part of the Florence Canal. The San Carlos Irrigation Project was initiated in 1924, incorporating the Florence Canal and the Reservoir. Picacho Reservoir is an approximately 50-acre site that serves as a water holding area and recharge site for diverted Gila River waters used by the Gila River Reservation and adjacent privately owned agricultural developments in the region. The Reservoir functions in regulating flows within the Florence–Casa Grande and Casa Grande Canals and provides a water storage reserve for the system (GRIC 2003). It is seasonally or completely dry in most years, but is filled when the Gila River system and San Carlos Reservoir contain a surplus of water. When water is present, the site becomes highly attractive to waterfowl and shorebirds. The endangered Yuma Clapper Rail is occasionally recorded at Picacho Reservoir (AZGFD 2006; Todd 1986), and the site is identified as potential Southwestern Willow Flycatcher habitat in need of surveys. The Yuma Clapper Rail and Southwestern Willow Flycatcher may only be present during very wet years. Hunting is permitted on the property. Link C880 passes within 0.25 mile of the northwestern edge of the Reservoir.

In addition, irrigation systems that serve the surrounding farmland provide temporary and permanent sources of water. The CAP canal and other canals are regularly used by waterfowl in winter, and temporary pools may form in adjacent washes against the upstream side of the canal banks where natural flow patterns have been blocked. These areas can support dense xeroriparian vegetation and relatively high densities of wildlife year-round.

3.6.8.3 Bird Habitat Conservation Areas

The Intermountain West Joint Venture, established in 1994, is a consortium of 11 partner states, public agencies, and bird conservation organizations. Participating organizations in New Mexico include New Mexico Partners in Flight, USFWS, NMDGF, Holloman AFB, USFS, BLM, and Hawks Aloft. The Intermountain West Joint Venture encompasses all or part of the 11 member states, including the western two thirds of New Mexico, where the group identified 20 Bird Habitat Conservation Areas (BHCA). Three of these BHCAs occur in part within the study corridor: Chupadera Mesa, Luna County Grasslands, and the Middle Rio Grande (Intermountain West Joint Venture 2005). The Sonoran Joint Venture is a similar collaborative effort that covers the Arizona portion of the study corridor; however, it has not mapped any BHCAs.

Chupadera Mesa

The Chupadera Mesa BHCA is located between Mountainair, New Mexico, and the WSMR in middle-elevation woodland and scrubland habitats. It contains a large area of high-quality, relatively pristine grassland-piñon juniper ecotone in a largely undisturbed area, although linear utilities such as natural gas pipelines cross the northern portion of the mesa. In addition, the northern part of the mesa may be affected in the future by tree harvest to support a proposed

biomass energy generation facility. Juniper removal for rangeland improvement is also ongoing in some areas. The Chupadera Mesa BHCA is considered a state Important Bird Area (IBA) (*ibid*).

Luna County Grasslands

The Luna County Grasslands BHCA covers large portions of Luna County, primarily east and south of Deming, New Mexico. The land cover is predominantly Chihuahuan Desert grasslands and adjacent shrubby upland areas, and includes the Florida Mountains southeast of Deming. Important grassland habitats in the Uvas Valley and elsewhere are important for wintering grassland birds; and agricultural areas in the Uvas Valley are important for Sandhill Cranes and geese. The Luna County Grasslands BHCA is considered a state IBA (*ibid*).

Middle Rio Grande

The Middle Rio Grande BHCA is located on the Rio Grande from near Los Alamos, New Mexico, south to the headwaters of Elephant Butte Reservoir. It contains extensive areas of middle-elevation riparian and wetland habitats, and is an important avian migratory corridor. Nearly 300 bird species have been regularly recorded in the region, the majority associated with the riparian corridor; approximately 100 other species have been recorded as accidentals. The area is important for wintering waterfowl, as well as migrant and resident waterbirds and shorebirds. It provides habitat for the Southwestern Willow Flycatcher, Western Yellow-billed Cuckoo, and many other special-status species. The Middle Rio Grande BHCA is considered a state IBA (*ibid*).

3.6.8.4 Important Bird Areas (Arizona)

Audubon Arizona lists 40 IBAs in Arizona. All or portions of three of these areas occur within the study corridor, including Sabino and Lower Bear Creek, Lower San Pedro River, and the Willcox Playa/Cochise Lakes IBAs (National Audubon Society 2011).

Sabino and Lower Bear Creek

The Sabino and Lower Bear Creek IBA is located low on the front range of the Santa Catalina Mountains, in the northeast portion of the Tucson Valley. The area is a popular local attraction and tourist destination. The stream in Sabino Canyon is perennial and supports a broadleaf deciduous riparian plant community in the canyon bottom that contrasts sharply with the Arizona Upland Subdivision Sonoran Desertscrub vegetation community on the adjacent hillsides. The Sabino Canyon/Bear Canyon area supports a large number of resident bird species, and the attraction of perennial water available in the riparian habitat draws many additional migratory species seasonally. The Sabino and Lower Bear Creek IBA is considered a state IBA (*ibid*).

Lower San Pedro River

The Lower San Pedro River IBA consists of 6,938 acres of riparian habitat along nearly 59 miles of the river from the "Narrows" (north of Cascabel, Arizona) downstream (north) to the junction

with the Gila River at Hayden, Arizona. This reach of the river contains significant segments of cottonwood-willow gallery forest interspersed among mesquite bosques. Important special-status species that use the river area include the Southwestern Willow Flycatcher and the Western Yellow-billed Cuckoo, and the largest populations of nesting Gray Hawks (*Buteo nitidus*) and Mississippi Kites (*Ictinia mississippiensis*) in Arizona. The entire San Pedro River corridor in Arizona is an important movement corridor for avian and other wildlife species. The Lower San Pedro River is designated as a globally significant IBA (*ibid*).

Willcox Playa/Cochise Lakes

The Willcox Playa/Cochise Lakes area encompasses somewhat more than 600,000 acres, consisting primarily of the Willcox Playa and surrounding vegetated avian habitat. Many species of shorebirds use the area in winter and as a stopover point during spring and fall migration. Small numbers of shorebirds occasionally breed in the IBA. The Willcox Playa/Cochise Lakes IBA is considered a state IBA (*ibid*).

3.6.8.5 Colossal Cave Area Karst Resources

The most significant known cave and limestone karst area in Pima County, Arizona, including the caves in Colossal Cave Mountain Park, occurs in the vicinity of Vail, Arizona. Caves and crevices developed in Paleozoic limestone strata in this area support a significant suite of endemic cave-inhabiting invertebrate species, including the Arkenstone Cave pseudoscorpion (*Albiorix anophthalmus*), a Pima County SDCP Priority Vulnerable Species (Pima County 2004, 2010). Portions of links F40b and F51 pass through at least 1 mile of this resource to the south of Colossal Cave Mountain Park and along the Agua Verde Creek drainage.

3.6.9 Summary of Inventory Results

This section describes existing vegetation, conservation areas, special-status species, and other biological resources that may occur within the study corridor for each subroute. Table 3-31 presents vegetation communities that are crossed by each subroute.

The subroute discussions that follow include a list of species listed under the ESA, or species proposed or candidates for listing, that may occur within the study corridor. Two species under review for ESA listing, the Arizona Striped Whiptail and the Chihuahua scurfpea, are also included. The Cactus Ferruginous Pygmy-owl is a BLM sensitive species with widespread suitable habitat within the study corridor, and is included as well (USFWS 2011a).

Following each species name is a potential habitat distribution within the study corridor by link. The potential distribution for each species is based on known records, as well as the presence of suitable habitat near known records or within dispersal distance. The potential distribution of birds is based on the presence of habitat elements typically used by each species, as migratory species may travel widely and are often recorded in unpredictable settings lacking such habitat elements. It should be noted that any species may not be distributed along an entire link, or may be absent despite the presence of suitable habitat. Additional information on the estimated mileage on each link where these species may occur is provided in Appendix B3.

3.6.9.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Vegetation Communities

The proposed SunZia East Substation and portions of Subroute 1A1 are located in northern Lincoln County, New Mexico, in a patchwork of plains-mesa grassland and juniper savanna. North of the Gran Quivira, Subroute 1A1 crosses juniper savanna and areas where junipers have been mechanically removed for rangeland improvement. The subroute continues west across Chupadera Mesa and intact juniper woodland, entering an area of low hills and mesas between the Sierra Larga and Los Piños Mountains. The upper slopes of the Rio Grande Valley are dominated by semidesert grassland, becoming Chihuahuan Desertscrub near the valley bottom. The subroute crosses the Rio Grande north of Socorro, New Mexico, in a location with a narrow band of riparian woodland along a narrow, channelized reach of the river. A small area of the floodplain at this crossing is active agriculture. Subroute 1A1 returns to Chihuahuan Desertscrub, roughly following Nogal Canyon between Polvadera Mountain and Socorro Peak. It then turns south through semidesert grassland between the Magdalena and Chupadera mountains until it nears I-25, where it crosses the southern foothills of the San Mateo Mountains. Subroute 1A1 passes through extensive Chihuahuan Desertscrub to the west of I-25, until near the Goodsight Mountains in southern Sierra County where semidesert grassland becomes dominant for the remainder of the subroute to the Midpoint Substation.

Conservation Areas and Other Biological Resources

Approximately 17 miles of Subroute 1A1 are located within the Chupadera Mesa BHCA. The subroute follows near the northern border of the BHCA with links E82, E84, and E85, through an area that has been affected by ranching activities and juniper removal. Dense, intact juniper woodland is present primarily near the juncture of links E85 and E80d. Between Chupadera Mesa and the Rio Grande, the subroute approaches within 1 mile of the boundary of Sevilleta NWR. This upland area of the refuge is reserved for research and generally closed to the public. The subroute crosses a relatively narrow point in the Rio Grande floodplain within an important bird flight corridor. Wintering waterfowl travel daily from Bosque del Apache NWR and the Ladd S. Gordon Waterfowl Complex to forage in farmland along the river. The river valley also sees heavy use as a migratory corridor and stopover for passerines and other birds. West of the Rio Grande between Polvadera Mountain and Socorro Peak, the subroute crosses a movement corridor for a reintroduced population of Desert Bighorn Sheep. West of Caballo Reservoir, the subroute crosses a portion of the Ladder Ranch, a conservation area managed by Turner Properties, L.P. Chiricahua Leopard Frogs are present in several streams flowing from the Ladder Ranch into the Rio Grande, upstream from Subroute 1A1.

- Northern Aplomado Falcon (A161, A161a, A260, A330a, A330b, A400, A440, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (E180)
- Sprague's Pipit (A361, A400, A440, A520, and A530)
- Rio Grande Silvery Minnow and designated Critical Habitat (E180)

Subroute 1A2 – BLM Preferred Alternative

Vegetation Communities

Subroute 1A2 is located within vegetation types identical to those on Subroute 1A1. Links E86a and E86b cross juniper savanna, with some dense patches of juniper woodland. Juniper removal for rangeland improvement has affected much of Link E86a. Similar to Subroute 1A1, a portion of Subroute 1A2 is located within approximately 1.6 miles of the southwestern boundary of Sevilleta NWR.

Conservation Areas and Other Biological Resources

Approximately 24 miles of Subroute 1A2 are located within the Chupadera Mesa BHCA. The subroute follows near the northern border of the BHCA with links E86a and E86b through a largely undisturbed area with little existing access.

- Northern Aplomado Falcon (A161, A161a, A260, A330a, A330b, A400, A440, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (E180)
- Sprague's Pipit (A361, A400, A440, A520, and A530)
- Rio Grande Silvery Minnow and designated Critical Habitat (E180)

Subroute 1A – North River Crossing

Vegetation Communities

Subroute 1A is largely identical to Subroute 1A1, but differs in two locations. On Chupadera Mesa, Subroute 1A crosses several large areas of relatively dense, mature juniper woodland. North and west of Elephant Butte Reservoir, Link A270 crosses steeper terrain but similar vegetation types compared to Link A260, used on Subroute 1A1. The remainder of Subroute 1A is identical to Subroute 1A1.

Conservation Areas and Other Biological Resources

Approximately 25 miles of Subroute 1A are located within the Chupadera Mesa BHCA, an informally designated area of conservation value.

- Northern Aplomado Falcon (A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (E180)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (E180)
- Socorro Springsnail (A161b)

Subroute 1B1 – San Antonio Crossing

Vegetation Communities

Subroute 1B1 is initially identical to Subroute 1A, but turns to the south through plains-mesa grassland after it crosses Chupadera Mesa. Near SR 380, the subroute turns to the west, entering Chihuahuan Desertscrub and the Rio Grande Valley, and crosses the Rio Grande north of San Antonio, New Mexico. The eastern floodplain of the river contains a large area of abandoned farmland, with a band of riparian woodland and mesquite bosque approximately 500 feet wide adjacent to the river. The west bank of the river contains a narrower band of riparian woodland adjacent to a canal and active farmland. The subroute continues west through Chihuahuan Desertscrub, crossing the Chupadera Mountains roughly following Walnut Creek (Nogal Canyon), after which it turns to the south and becomes identical to Subroute 1A.

Conservation Areas and Other Biological Resources

Biological features of the landscape crossed by Subroute 1B1 are identical to Subroute 1A. However, the crossing of the Rio Grande is located 1.5 miles north of San Antonio, New Mexico, and 4.8 miles north of the northern boundary of Bosque del Apache NWR. The subroute also approaches within approximately 2 miles of the northwestern boundary of Bosque del Apache NWR in the Chupadera Mountains west of the Rio Grande.

- Northern Aplomado Falcon (A111, A112, A140, A160, A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Socorro Springsnail (A161b)
- Southwestern Willow Flycatcher and designated Critical Habitat (A140)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (A140)

Subroute 1B2 – San Antonio Crossing

Vegetation Communities

Subroute 1B2 bears southwest through juniper savanna and plains-mesa grassland before it turns west to cross a relatively narrow portion of the Chupadera Mesa, after which it continues west to intersect with Subroute 1B1. The remainder of the subroute is identical to Subroute 1B1. Subroute 1B2a is identical to Subroute 1B2, but differs by using Link A260 northwest of Elephant Butte Reservoir.

Table 3-31. Vegetation Communities Crossed by Each Subroute														
Subroute	Miles (percentages shown in parentheses)	Arizona Upland Sonoran Desertscrub	Chihuahuan Desertscrub	Closed Basin Scrub	Great Basin Conifer Woodland	Interior Chaparral	Juniper Savanna (ecotone)	Lower Colorado River Valley Sonoran Desertscrub	Pine-Oak Woodland	Plains-Mesa Grassland	Plains-Mesa Sand Scrub	Semidesert Grassland	Urban/ Agriculture	Floodplain
1A1	228.8	—	93.1 (40.7)	—	—	—	55.7 (24.3)	—	6.2 (2.7)	6.9 (3.0)	—	63.1 (27.6)	2.6 (1.1)	1.2 (0.5)
1A2	230.3	—	93.1 (40.4)	—	—	—	57.2 (24.8)	—	6.2 (2.7)	6.9 (3.0)	—	63.1 (27.4)	2.6 (1.1)	1.2 (0.5)
1A	219.5	—	89.5 (40.8)	—	—	—	43.2 (19.7)	—	6.2 (2.8)	13.7 (6.2)	—	63.1 (28.8)	2.6 (1.2)	1.2 (0.6)
1B1	223.6	—	94.6 (42.3)	—	—	—	31.2 (14.0)	—	6.2 (2.8)	13.7 (6.1)	28.9 (12.9)	45.0 (20.1)	1.9 (0.9)	2.1 (0.9)
1B2	209.2	—	94.6 (45.2)	—	—	—	30.4 (14.5)	—	—	12.4 (5.9)	22.8 (10.9)	45.0 (21.5)	1.9 (0.9)	2.1 (1.0)
1B3	206.3	—	94.6 (45.9)	2.3 (1.1)	—	—	33.3 (16.1)	—	—	12.4 (6.0)	17.8 (8.6)	41.9 (20.3)	1.9 (0.9)	2.1 (1.0)
3A2	123.9	—	20.2 (16.3)	2.2 (1.8)	—	—	—	—	—	—	—	101.5 (81.9)	—	—
3A	123.4	—	19.8 (16.1)	2.2 (1.8)	—	—	—	—	—	—	—	101.4 (82.2)	—	—
3B	128.6	—	39.4 (30.6)	12.0 (9.3)	—	—	—	—	—	—	—	77.2 (60.0)	—	—
4A	132.9	41.6 (31.3)	—	—	1.0 (0.8)	7.2 (5.4)	—	6.0 (4.5)	2.1 (1.6)	—	—	67.4 (50.7)	5.6 (4.2)	2.0 (1.5)
4B	133.0	41.6 (31.3)	—	—	1.0 (0.8)	9.2 (6.9)	—	6.0 (4.5)	2.1 (1.6)	—	—	65.5 (49.3)	5.6 (4.2)	2.0 (1.5)
4C1	139.0	55.6 (40.0)	2.5 (1.8)	—	—	—	—	6.0 (4.3)	8.5 (6.1)	—	—	59.9 (43.1)	5.6 (4.0)	0.9 (0.7)
4C2	151.8	51.2 (33.7)	5.5 (3.6)	—	—	—	—	6.0 (4.0)	8.5 (5.6)	—	—	74.6 (49.1)	5.6 (3.7)	0.4 (0.3)
4C3	172.9	60.6 (35.1)	12.5 (7.2)	—	—	—	—	11.9 (6.9)	6.5 (3.8)	—	—	59.6 (34.5)	21.3 (12.3)	0.5 (0.3)
4C2c	161.2	51.2 (31.8)	7.5 (4.7)	—	—	—	—	6.0 (3.7)	6.5 (4.0)	—	—	84.2 (52.2)	5.6 (3.5)	0.2 (0.1)

Conservation Areas and Other Biological Resources

- Northern Aplomado Falcon (A111, A112, A140, A160, A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530
- Southwestern Willow Flycatcher and designated Critical Habitat (A140)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (A140)
- Socorro Springsnail (A161b)

Subroute 1B3 – San Antonio Crossing

Vegetation Communities

Subroute 1B3 is initially identical to Subroute 1B2, but continues to the southwest and west across a slightly wider portion of the Chupadera Mesa, until it nears SR 380. The subroute then turns west roughly parallel to SR 380 until it intersects subroutes 1A, 1B1, and 1B2. Vegetation types and other features are similar to Subroute 1B2.

Conservation Areas and Other Biological Resources

- Northern Aplomado Falcon (A111, A112, A140, A143, A160, A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (A140)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (A140)
- Socorro Springsnail (A161b)

Local Alternative and Crossover Links for Route Group 1

Vegetation Communities

Local Alternative Link A161b is located primarily in semidesert grassland and Chihuahuan Desertscrub, similar to subroutes 1A and 1B, Link A161. Vegetation on Local Alternative Link A260 is also very similar to the adjacent subroutes 1A and 1B, Link A270. Links A361-A430-A481 pass through the Uvas Valley and cross the low Goodsight Mountains. The Uvas Valley contains a small agricultural center, and the Goodsight Mountains are dominated by Chihuahuan Desertscrub similar to that on adjacent portions of Subroute 1A. However, topographic relief is greater and plant community composition may differ from surrounding lowlands. Crossover Link A70 is located in a mixture of plains-mesa sand scrub and juniper savanna, identical to surrounding links.

Conservation Areas and Other Biological Resources

Link A161b passes very near to Torreon Spring and its outflow ponds, which make up the sole known location for the ESA-listed Socorro springsnail. Sandhill Cranes often forage in the farmlands in the Uvas Valley during winter.

Much of the juniper savanna in the area along links E81, E82, E83, E84, and E85 was included within the Chupadera Mesa BHCA, and is crossed to some degree by each of these local alternative links. Link E81 crosses the greatest amount of high-density juniper woodland, followed by the combination of links E82-E83-E85. Links E82-E84-E85 take the most northern route, crossing some areas cleared of junipers, affecting the lowest amount of juniper woodland. No species with status under the ESA are known to occur on any of these links.

3.6.9.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Vegetation Communities

Subroute 3A2 begins at the Midpoint Substation in the Mimbres River Valley, part of the enclosed Guzmán Basin. The subroute passes through uniform semidesert grassland in Luna, Grant, and eastern Hidalgo counties, and then crosses small areas of closed basin scrub north of the Lordsburg Playa in north-central Hidalgo County. Crossing into Arizona, the subroute passes through mixed semidesert grassland and Chihuahuan Desertscrub. Subroute 3A2 crosses a low pass in the Peloncillo Mountains near the Whitlock Valley, and then crosses the San Simon Valley through Chihuahuan Desertscrub. West of the San Simon River, the vegetation returns to semidesert grassland until it reaches the Willow-500 kV Substation near the southern end of the Pinaleño Mountains.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by Subroute 3A2, although the subroute passes within approximately 1 mile of the Gila National Forest in the southern Big Burro Mountains.

- Lesser Long-nosed Bat (B160a, B160d, and B170)
- Mexican Long-nosed Bat (B150a)
- Jaguar (B160a)
- Northern Aplomado Falcon (B60, B90, B120a, B120b, B121, and B160a)
- Sprague's Pipit (B60, B90, B120a, B120b, B121, B160a, B160d, B160c, and B170)
- Arizona Striped Whiptail (B160d)
- Chihuahua Scurf-pea (B160d and B160c)

Subroute 3A – North

Vegetation Communities

Vegetation communities present on Subroute 3A are identical to those on Subroute 3A2.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by Subroute 3A.

- Lesser Long-nosed Bat (B160a and B170)
- Jaguar (B160a)
- Northern Aplomado Falcon (B60, B90, B111, B120a, B120b, B121, and B160a)
- Sprague's Pipit (B60, B90, B111, B120a, B120b, B121, B140, B160a, B160b, B160c, and B170)
- Chihuahua Scurf-pea (B160b and B160c)
- Arizona Striped Whiptail (B160b)

Subroute 3B – South

Vegetation Communities

Subroute 3B begins at the Midpoint Substation in the Mimbres River Valley, part of the enclosed Guzmán Basin. It passes through uniform semidesert grassland in Luna and Grant counties before it enters intermixed Chihuahuan Desert and closed basin scrub in the vicinity of Lordsburg Playa in Hidalgo County. After crossing Lordsburg Playa, the subroute passes through mixed semidesert grassland and Chihuahuan Desertscrub in the Peloncillo Mountains. Much of the remainder of the subroute in Arizona is located within areas affected by past farming and severe erosion in the San Simon Valley, but intact mixed semidesert grassland and Chihuahuan Desertscrub is present north of Bowie and near the Willow-500 kV Substation.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by Subroute 3B. However, Lordsburg Playa serves as a winter stopover site for migratory shorebirds, and provides habitat for sensitive plants and invertebrates.

- Lesser Long-nosed Bat (B150a, B151, and B170)
- Mexican Long-nosed Bat (B150a)
- Jaguar (B150a)
- Northern Aplomado Falcon (B60, B80, B110a, B110b, B111, and B112)
- Sprague's Pipit (B60, B80, B110a, B110b, B111, B112, B140, B150a, B150b, B151, and B170)
- Chihuahua Scurf-pea (B150b and B151)

Local Alternative and Crossover Links for Route Group 3

Vegetation Communities

Crossover Link B111 is located entirely within semidesert grassland, identical to surrounding links on subroutes 3A and 3B. Crossover Link B140 is located within a mixture of Chihuahuan Desertscrub and closed basin scrub, similar to Subroute 3B.

3.6.9.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Vegetation Communities

From the Willow-500 kV Substation, Subroute 4A follows US Route 191 north through semidesert grassland in the San Simon Valley. The subroute turns northwest and west as it enters the Gila River Valley north of the Pinaleño Mountains, continues west into the Aravaipa Valley, and passes through a small area of interior chaparral in the divide between the Pinaleño and Santa Teresa mountains. Subroute 4A crosses Aravaipa Creek in an ephemeral reach south of Klondyke, Arizona, and then crosses the northern Galiuro Mountains near the Fourmile Creek and Copper Creek drainages. Vegetation in the Galiuro Mountains is a patchwork of interior chaparral, Great Basin conifer woodland, and pine oak woodland. The subroute descends into the San Pedro River Valley through semidesert grassland into the Arizona upland subdivision of Sonoran Desertscrub, crossing the San Pedro River north of Mammoth, Arizona. Vegetation near the ephemeral river crossing is patchy mesquite bosque, with few riparian-associated trees and no developed riparian woodland.

Arizona Upland Sonoran Desertscrub continues on the west side of the San Pedro River, becoming semidesert grassland as elevation increases to the north of the Santa Catalina Mountains. The subroute crosses a small area of interior chaparral near Black Mountain, 15 miles northwest of Oracle, Arizona. Subroute 4A then travels west and northwest to the northern end of the Picacho Mountains. West of the Picacho Mountains, vegetation becomes the Lower Colorado River subdivision of Sonoran Desertscrub as the subroute approaches the Santa Cruz River Valley. The subroute crosses the CAP and Florence-Casa Grande Canal east of the Pinal Central Substation, where agriculture replaces all native vegetation cover.

Conservation Areas and Other Biological Resources

After leaving US Route 191, Subroute 4A follows parallel to or near the boundary of the CNF in the Pinaleño Mountains. The subroute passes between the CNF and AZGFD's Cluff Ranch WMA, within 0.35 mile of the WMA. The subroute remains near the CNF boundary until it enters the Aravaipa Creek watershed. In the northern Galiuro Mountains, the subroute is located approximately 1 mile to the south and outside of the Aravaipa Ecosystem Planning Area. The Turkey Creek ACEC and Table Mountain Research Natural Area (RNA) ACEC are approximately 2.5 miles north of the subroute, and the Aravaipa Wilderness boundary is approximately 4 miles north. The BLM mapped the eastern slope of the San Pedro River Valley as Category 3 Sonoran Desert Tortoise habitat. The San Pedro River crossing is located approximately 1,200 feet south and upstream from the boundary of TNC's H & E Farm. Category 2 Sonoran Desert Tortoise habitat continues west of the San Pedro River to approximately the point where the subroute crosses Arizona SR 79. Near this point, beginning at Link C830, all subroutes become identical. All subroutes pass within 500 feet of Picacho Reservoir, a seasonal wetland not directly managed for wildlife resources but used by wintering waterfowl.

- Lesser Long-nosed Bat (C170, C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)

- Jaguar (B153a, C170, and C178)
- Ocelot (B153a, B153b, and C170)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C592)
- Cactus Ferruginous Pygmy-owl (C173, C174, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C592)
- Sprague's Pipit (B153a and B153b)
- Sonoran Desert Tortoise (C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C760, C780, C790, C830, C840, and C850)
- Tucson Shovel-nosed Snake (C850)
- Spikedace and designated Critical Habitat (C170)
- Loach Minnow and designated Critical Habitat (C170)
- Roundtail Chub (C170)
- Acuña Cactus (C620)

Subroute 4B – Sulphur Springs Valley

Vegetation Communities

From the Willow-500 kV Substation, Subroute 4B travels southwest and west between the Fisher Hills and the southern foothills of the Pinaleño Mountains in semidesert grassland. It enters the Sulphur Springs Valley, travelling generally northwest through semidesert grassland along the western flanks of the Pinaleño Mountains. Subroute 4B intersects with Subroute 4A in interior chaparral in the southern foothills of the Santa Teresa Mountains. The remainder of this subroute is identical to Subroute 4A.

Conservation Areas and Other Biological Resources

After leaving the Willow-500 kV Substation and entering the Sulphur Springs Valley, Subroute 4B turns northwest through extensive, relatively intact semidesert grassland that has been identified as an important Pronghorn fawning area. The subroute intersects with Subroute 4A after entering the Aravaipa Creek watershed.

- Lesser Long-nosed Bat (C71, C72, C90, C130a, C130b, C170, C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)
- Jaguar (C130a, C130b, C170, and C178)
- Ocelot (C71, C72, C130a, C130b, and C170)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C592)
- Cactus Ferruginous Pygmy-owl (C173, C174, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C592)
- Sprague's Pipit (C130a and C130b)
- Sonoran Desert Tortoise (C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C830, C840, and C850)
- Arizona Striped Whiptail (C130a)

- Tucson Shovel-nosed Snake (C850)
- Spikedace and designated Critical Habitat (C170)
- Loach Minnow and designated Critical Habitat (C170)
- Roundtail Chub (C170)
- Acuña Cactus (C620)

Subroute 4C2c – BLM Preferred Alternative

Vegetation Communities

From the Willow-500 kV Substation, Subroute 4C2c heads southwest through semidesert grassland, partially converted to Chihuahuan Desertscrub by shrub invasion, between the Fisher Hills and the Pinaleño Mountains into the Sulphur Springs Valley. The valley bottom is currently a mixture of active and fallow agriculture. The subroute then crosses semidesert grassland with pine-oak woodland near the southern foothills of the Winchester Mountains. Vegetation shifts from semidesert grassland to Chihuahuan Desertscrub as the subroute descends into the San Pedro River Valley. Subroute 4C2c crosses the San Pedro River in an ephemeral reach approximately 0.5 mile downstream (north) from "The Narrows," a location where the floodplain is constrained between hills on both sides of the river. The floodplain is relatively narrow in this area, approximately 800 feet wide at the proposed Project crossing, and dominated by mesquite bosque. The subroute then proceeds northwest along the west side of the valley, in an ecotone between Sonoran Desertscrub and semidesert grassland. North of San Manuel, the subroute turns to the west and passes to the north of the Santa Catalina and Tortolita mountains, descending into Sonoran Desertscrub. Near the Tortolita Substation northeast of Red Rock, Subroute 4C2c turns to the north through an ecotone between Lower Colorado River Valley and Arizona Upland Sonoran Desertscrub. The subroute then turns to the west, passes north of the Picacho Mountains, and crosses an area entirely converted to farmland to the Pinal Central Substation.

Conservation Areas and Other Biological Resources

Subroute 4C2c crosses the Sulphur Springs Valley through active and fallow farmland used by large numbers of foraging Sandhill Cranes as well as other birds, particularly during winter. West of Willcox, Link C260 crosses Allen Flat, where a population of Pronghorn occurs with management concerns similar to the larger population present on Subroute 4B in the Sulphur Springs Valley. Link C201 crosses a narrow, ephemeral reach of the San Pedro River within designated critical habitat for the Southwestern Willow Flycatcher. Although none of the west slope of the San Pedro River Valley was mapped as Sonoran Desert Tortoise habitat by the BLM, the habitat is similar to the Category 2 habitat mapped on the east side of the river. After crossing Arizona SR 77, Subroute 4C2 remains in mapped Category 2 Desert Tortoise habitat to the vicinity of Desert Peak northeast of the Tortolita Substation. Subroute 4C2c passes within 500 feet of Picacho Reservoir, an area of local, seasonal importance to waterfowl. Yuma Clapper Rails have been recorded at Picacho Reservoir, although no nesting attempts have been recorded.

- Lesser Long-nosed Bat (C71, C71a, C110, C201, C212, C260, C261, C441, C450, C661, C670, and C680)
- Jaguar (C110, C201, C212, C260, C261, C441, and C450)
- Ocelot (C71, C71a, C110, C201, C212, C260, C261, C441, and C450)

- Yuma Clapper Rail (C880 and C880a)
- Cactus Ferruginous Pygmy-owl (C201, C441, C450, C661, C670, C680, C818, C820, C830, C840, and C850)
- Southwestern Willow Flycatcher designated Critical Habitat (C201)
- Sprague's Pipit (C110)
- Sonoran Desert Tortoise (C201, C261, C441, C450, C661, C670, C680, C818, C830, C840, and C850)
- Tucson Shovel-nosed Snake (C850)

Subroute 4C1 – East of San Pedro River

Vegetation Communities

Subroute 4C1 is initially identical to Subroute 4C2c, between the Willow-500 kV Substation and the foothills of the Winchester Mountains. Link C270 crosses semidesert grassland on Allen Flat. Vegetation shifts from semidesert grassland to the Arizona upland subdivision of Sonoran Desertscrub, as the subroute descends into the San Pedro River Valley and turns to the north. The subroute is located in the ecotone between Sonoran Desertscrub and semidesert grassland as it passes north through the San Pedro River Valley to the crossing point near San Manuel. The crossing is located at the lower end of a perennial reach of the river, surrounded by a wide mesquite bosque and former farmland. Little riparian woodland is present at or near the river crossing, although some young willows and cottonwoods are present.

Leaving the San Pedro River Valley, the subroute travels west and reenters semidesert grassland as elevation increases to the north of the Santa Catalina Mountains. North of Oracle, the subroute turns to the northwest, descending into the Arizona upland subdivision of Sonoran Desertscrub near Black Mountain. West of Black Mountain, Subroute 4C1 intersects Subroute 4A, after which the subroutes are identical.

Conservation Areas and Other Biological Resources

Hot Springs and Redfield canyons in the southern Galiuro Mountains contain designated critical habitat for the Gila Chub, Spikedace, and Loach Minnow. The subroute is located approximately 0.3 mile downstream from the lower limit of Gila Chub critical habitat in Hot Springs Canyon, and approximately 0.8 mile downstream from the lower limit of Gila Chub critical habitat in Redfield Canyon. The designated critical habitat for Spikedace and Loach Minnow in Hot Springs and Redfield canyons also ends upstream from the proposed crossing locations of links C331 and C470, and is not crossed by the subroute.

Much of the eastern slope of the San Pedro River Valley is mapped by the BLM as Category 3 Sonoran Desert Tortoise habitat, with a small area of Category 3 habitat where the subroute turns west to cross the river. Much of the perennial reach of the river immediately upstream from this river crossing is located on property owned by BHP Billiton, with management for biological resources by the Tucson Audubon Society. The 7B Ranch, a proposed addition to the San Pedro Riparian National Conservation Area through a land exchange, is located approximately 1.8 miles downstream from the river crossing. West of the San Pedro River, Category 3 Desert Tortoise habitat exists from approximately Arizona SR 77 to Arizona SR 79 on this subroute.

- Lesser Long-nosed Bat (C71, C71a, C72, C110, C111, C121, C174, C211, C212, C270, C301, C331, C361, C470, C500, C501, C502, C510, C660, C661, C670, C671, C690, C691, C692, C693, C760, C780, C790, C830, C840, and C850)
- Jaguar (C110, C121, C211, C212, C270, C301, C331, C361, and C470)
- Ocelot (C71, C71a, C72, C90, C110, C212, C270, C301, C331, C361, and C470)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C660)
- Cactus Ferruginous Pygmy-owl (C174, C331, C361, C470, C501, C502, C510, C660, C661, C670, C671, C690, C691, C692, C693, C760, C780, C790, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C660)
- Sprague's Pipit (C110 and C121)
- Sonoran Desert Tortoise (C174, C331, C361, C470, C500, C501, C502, C510, C660, C661, C670, C671, C690, C691, C692, C693, C830, C840, and C850)
- Arizona Striped Whiptail (C121)
- Tucson Shovel-nosed Snake (C850)
- Gila Chub designated Critical Habitat (C331 and C470)
- Spikedace designated Critical Habitat (C331 and C470)
- Loach Minnow designated Critical Habitat (C331 and C470)

Subroute 4C2 – West of San Pedro River

Vegetation Communities

Subroute 4C2 is initially identical to Subroute 4C2c, but differs in the links used from the Winchester Mountains until after crossing the San Pedro River. Similar to Subroute 4C2c, Subroute 4C2 crosses semidesert grassland and Chihuahuan Desertscrub as it descends into the San Pedro River Valley. The river crossing is within an ephemeral reach. Mature mesquite bosque is present on both sides of the river, and the riparian woodland consists of an early-successional mix of tamarisk and native tree species. Approximately 3.4 miles west of the Rio Grande at the end of Link C276, Subroute 4C2 becomes identical to Subroute 4C2c. Subroute 4C2a differs from Subroute 4C2 between Oracle and the Pinal Central Substation, and is identical to Subroute 4C1 beginning with Link C690. Subroute 4C2b is similar to Subroute 4C2a, but also uses the southern crossing of the San Pedro River similar to Subroute 4C2c.

Conservation Areas and Other Biological Resources

Subroute 4C2 crosses the San Pedro River near Cascabel, Arizona, within designated critical habitat for the Southwestern Willow Flycatcher. This reach of the river is ephemeral, and is not suitable nesting habitat at present. After crossing the San Pedro River, the subroute rejoins Subroute 4C2c near the boundary of the A7 Ranch.

- Lesser Long-nosed Bat (C71, C71a, C72, C110, C111, C121, C174, C211, C212, C266, C270, C271, C276, C441, C450, C500, C501, C502, C661, C670, C671, C680, C818, C820, C830, C840, and C850)
- Jaguar (C110, C211, C212, C266, C270, C271, C276, C441, and C450)
- Ocelot (C71, C71a, C72, C90, C110, C212, C270, C271, C441, and C450)

- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C276)
- Cactus Ferruginous Pygmy-owl (C174, C266, C276, C441, C450, C500, C501, C502, C661, C670, C671, C680, C818, C820, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C276)
- Sprague's Pipit (C110 and C121)
- Sonoran Desert Tortoise (C174, C441, C450, C500, C501, C502, C661, C670, C671, C680, C818, C830, C840, and C850)
- Arizona Striped Whiptail (C121)
- Tucson Shovel-nosed Snake (C850)

Subroute 4C3 – Tucson

Vegetation Communities

Subroute 4C3 is identical to Subroute 4C2c from the Winchester Substation until the San Pedro River. After crossing the river, Subroute 4C3 continues to the southwest roughly parallel to the San Pedro River and Ash Creek through intermixed Chihuahuan Desertscrub and semidesert grassland. The subroute passes to the south of the Rincon Mountains, crossing Cienega Creek and I-10 near the creek's confluence with Mescal Arroyo. The subroute continues west through semidesert grassland, turning north and northwest while crossing I-10 in two locations. The subroute then roughly parallels I-10 through the Tucson metropolitan area, using the bed of the Santa Cruz River after it crosses I-19. The Arizona Upland subdivision of Sonoran Desertscrub occurs where native vegetation remains in the Tucson region. Near the town of Marana, the subroute leaves the Santa Cruz River and continues parallel to I-10 near the CAP in the ecotone between the Arizona upland and Lower Colorado River subdivisions of Sonoran Desertscrub. After reaching the Tortolita Substation, the remainder of Subroute 4C3 is identical to Subroute 4C2c.

Conservation Areas and Other Biological Resources

Subroute 4C3 crosses the San Pedro River approximately 1,500 feet upstream from the southern boundary of TNC's Three Links Farm, using the same crossing location as Subroute 4C2c. The subroute passes between two disjunct parcels of the Pima County Cienega Creek Natural Preserve near I-10. Following parallel to the Santa Cruz River through Tucson, the subroute passes within approximately 0.25 mile of Sweetwater Wetlands, an artificial wetland supported by reclaimed water from the Roger Road Wastewater Treatment Plant and managed in part for wildlife use. After passing the Tortolita Substation, this subroute crosses a small area of Category 2 Sonoran Desert Tortoise habitat near Desert Peak.

- Lesser Long-nosed Bat (C71, C71a, C110, C212, C260, C261, C810, C810a, C812, C813, C816, C817, C820, C830, C840, C850, F40a, F40b, F51, F60a, F60b, F80, F111, F112, F510, F540, and F600)
- Jaguar (C110, C212, C260, and C261)
- Ocelot (C71, C71a, C110, C212, C260, C261, and F40a)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (F600)

- Cactus Ferruginous Pygmy-owl (C810, C810a, C813, C816, C817, C820, C830, C840, C850, F60a, F60b, F80, F82, F111, F510, F540, and F600)
- Southwestern Willow Flycatcher designated Critical Habitat (F40a)
- Southwestern Willow Flycatcher (F51 and F600)
- Sprague's Pipit (C110)
- Sonoran Desert Tortoise (C816, C817, C830, C840, C850, F51, F60a, and F60b)
- Tucson Shovel-nosed Snake (C810, C810a, C812, C850, and F540)
- Northern Mexican Garter Snake (F600)
- Gila Chub and designated Critical Habitat (F51 and F600)
- Gila Topminnow (F600)
- Pima Pineapple Cactus (F80, F82, and F111)
- Huachuca Water-umbel (F600)

Local Alternative and Crossover Links for Route Group 4

Local Alternative Links for Pinal Central Substation

These local alternative links may be used by any subroute within Route Group 4.

Vegetation Communities

The existing vegetation for these local alternative links is identical to the vegetation present on adjacent links used by all subroutes within Route Group 4.

Conservation Areas and Other Biological Resources

These local alternative links are located near Picacho Reservoir, a locally important waterfowl site and potential habitat for the Yuma Clapper Rail during wet years. Suitable habitat may be present for the Southwestern Willow Flycatcher, but no surveys for the species have been conducted. Link C880, used by all subroutes within Route Group 4, is located much closer and passes within approximately 400 feet of the reservoir, and would have a greater impact on waterfowl than any links within this local alternative.

- Lesser Long-nosed Bat (C860)
- Yuma Clapper Rail (C890)
- Cactus Ferruginous Pygmy-owl (C860)
- Sonoran Desert Tortoise (C860)
- Tucson Shovel-nosed Snake (C860)

Local Alternative Links in the Sulphur Springs Valley

The local alternative that includes links C72, C90, C121, and C211 takes a slightly more northern route through the Sulphur Springs Valley than the 4C family of subroutes.

Vegetation Communities

Native vegetation and agricultural use of the local alternative links is similar to the links used by the 4C family of subroutes, although the total mileage is greater with the local alternative links.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by these local alternative links, although Link C121 passes near two known locations for the special-status Arizona Striped Whiptail. Similar to Link C110 used by the 4C family of subroutes, Link C121 crosses farmland used by large numbers of foraging Sandhill Cranes and other birds that winter in the Sulphur Springs Valley.

- Lesser Long-nosed Bat (C72, C90, C121, and C211)
- Arizona Striped Whiptail (C121)

Local Alternative Links for Winchester Substation

These local alternative links may be used by Subroute 4C2, allowing a connection to the Winchester Substation and crossing the San Pedro River in a location without permanent water.

Vegetation Communities

Upon entering the San Pedro River Valley, links C260 and C261 proceed through semidesert grassland and Chihuahuan Desertscrub southwest to the Winchester Substation, then continue to the southwest and cross the San Pedro River east of the Johnny Lyon Hills. This river crossing is ephemeral and lacks riparian woodland, although mesquite bosque is present. Link C201 then turns to the northwest and intersects with Subroute 4C2 west of Cascabel, Arizona.

Conservation Areas and Other Biological Resources

Link C201 crosses the San Pedro River approximately 1,500 feet upstream from the southern boundary of TNC's Three Links Farm. After crossing the river, the local alternative turns northwest and intersects Subroute 4C2 near the southern boundary of the A7 Ranch.

- Lesser Long-nosed Bat (C201, C260 and C261)
- Jaguar (C201, C260 and C261)
- Ocelot (C201, C260 and C261)

Local Alternative Links for Tortolita Substation

These local alternative links provide options for multiple configurations to allow a connection to the Tortolita Substation in Pinal County.

Vegetation Communities

These local alternative links near Red Rock are located in an ecotone between the Arizona Upland and Lower Colorado River subdivisions of Sonoran Desertscrub.

Conservation Areas and Other Biological Resources

The vicinity of Desert Peak is mapped as Category 2 Sonoran Desert Tortoise habitat. No conservation areas are crossed by these local alternative links:

- Lesser Long-nosed Bat (C680b, C810, C810a, C812, C813, C814, C815 and C816)
- Cactus Ferruginous Pygmy-Owl (C680b, C810, C810a, C812, C813, C814, C815 and C816)
- Sonoran Desert Tortoise (C680b, C814, C815 and C816)
- Tucson Shovel-nosed Snake (C810, C810a and C812)

Local Alternative Links for Cienega Creek

These local alternative links may be used by Subroute 4C3, providing an alternative crossing location for Cienega Creek.

Vegetation Communities

Near the southern end of the Rincon Mountains, Link F40b roughly follows Agua Verde Wash, and Link F51 crosses Cienega Creek at its confluence with Agua Verde Wash. Vegetation transitions from Chihuahuan Desertscrub into the Arizona Upland subdivision of Sonoran Desertscrub moving from east to west. The crossing of Cienega Creek would affect some riparian-associated vegetation, primarily mesquite bosque at the mouth of Agua Verde Creek. Both streams are ephemeral at this location, and only support scattered individual cottonwoods and willows.

Conservation Areas and Other Biological Resources

These local alternative links cross a karst region and potential bat roost habitat in the Agua Verde Wash area, and then cross the Cienega Creek Natural Preserve at the confluence of Agua Verde Wash and Cienega Creek. No other conservation areas are crossed by these local alternative links.

- Lesser Long-nosed Bat (F40b, F51, and F60a)
- Yellow-billed Cuckoo (F51)
- Cactus Ferruginous Pygmy-owl (F51and F60a)
- Southwestern Willow Flycatcher (F51)
- Sonoran Desert Tortoise (F51and F60a)
- Northern Mexican Garter Snake (F51)
- Gila Chub and designated Critical Habitat (F51)
- Gila Topminnow (F51)
- Pima Pineapple Cactus (F40b, F51, and F60a)
- Huachuca Water-umbel (F51)

Local Alternative Links for Pantano to Rillito

These local alternative links would be used by Subroute 4C3 as an alternative route through the City of Tucson.

Vegetation Communities

These local alternative links are located within the Arizona Upland subdivision of Sonoran Desertscrub and urban areas. Link F81a begins northwest of Vail, travelling generally north parallel to and east of Houghton Road. A portion of Link F81 and all of Link F81b travels through urban Tucson in the streambeds of Pantano Wash and the Rillito River. The Rillito River crosses I-10 and flows into the Santa Cruz River, at which point Link F81b rejoins Subroute 4C3.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by this local alternative.

- Lesser Long-nosed Bat (F81a and F81b)
- Cactus Ferruginous Pygmy-owl (F81a)
- Sonoran Desert Tortoise (F81a)
- Pima Pineapple Cactus (F81a)

3.7 WILDLAND FIRE ECOLOGY AND MANAGEMENT

3.7.1 Introduction, Methods, and Regulatory Framework

3.7.1.1 Introduction

This section discusses past and current conditions relating to fire ecology, recent fire history, and current management directives within the Project area. Fire is a landscape-scale process, potentially affecting large areas across multiple jurisdictions. The discussion focuses on issues within a 20-mile buffer for this resource around all proposed alternatives, hereafter referred to as the study area, which was chosen in acknowledgment of the potential scale of the effects of large fires.

"Wildland fire" is a general term that describes any nonstructural fire that occurs in the wildland. Wildland fires are categorized into two distinct types:

- Wildfires: Unplanned ignitions or prescribed fires that escape and are declared wildfires.
- Prescribed Fires: Planned ignitions.

3.7.1.2 Methods

Although fire may cross administrative boundaries, federal and state management plans do not typically have jurisdiction outside their respective planning areas. In some cases, fire protection and planning may be conducted under cooperative agreements between federal and state or local agencies. All land management plans relating to fire management for land crossed by proposed

subroutes were reviewed. Federal interagency coordination on fire planning, such as between the BLM and USFS, is required under national directives. However, fire management planning on national forests, tribal lands, or any other land that would not be crossed by the proposed Project is beyond the scope of this analysis.

Peer-reviewed literature, agency publications, and remote sensing data on fire ecology and current vegetation conditions were reviewed. Remote sensing data was accessed primarily from LANDFIRE (also known as Landscape Fire and Resource Management Planning Tools), which is an interagency source of information on vegetation, fire behavior, fuels, and landscape-scale vegetation change. A number of geospatial datasets relating to those aspects of fire ecology were developed. One of the goals of LANDFIRE is to provide those datasets uniformly for the entire United States, at a resolution of 30 meters per pixel. A number of LANDFIRE datasets were reviewed, including fire regime group, Fire Regime Condition Class (FRCC), Vegetation Condition Class (VCC), fire return interval, canopy height, canopy cover, and vegetation departure[1].

Fire regimes represent the average frequency and intensity of fires in a given area, and are directly related to the vegetation community. A "fire cycle" is the process of burning and recovery, to the occurrence of the next fire; the average length of that period is referred to as the "fire return interval." Fire regimes are assigned to five groups, based on the fire return interval and typical severity:

- Group I: < 35-year fire return interval, low and mixed severity
- Group II: < 35-year fire return interval, replacement severity
- Group III: 35 to 200-year fire return interval, low and mixed severity
- Group IV: 35 to 200-year fire return interval, replacement severity
- Group V: > 200-year fire return interval, any severity

FRCC is a measure that uses three classes to describe the similarity between the current fire regime and the natural fire regime. Class I represents a substantial similarity to the natural fire regime, Class II represents a moderate departure from the natural regime (deviating by more than one fire cycle), and Class III represents a major departure (deviating by two or more fire cycles). However, FRCC does not quantify the exact degree or describe the direction of the departure. In the Southwest, many montane forests are mapped as Class III because fire frequency has decreased, although the fires are often more severe when they occur. In contrast, grass-invaded Sonoran desertscrub, where fire was naturally rare or absent, can also be mapped as Class III because fire frequency or potential has significantly increased.

VCC is similar to FRCC, assigning areas to three categories of low, moderate, and high levels of change from the natural vegetation community. Vegetation departure represents, on a scale of 1 to 100, the estimated change in composition of a given vegetation community from the natural composition.

[1] All layers except FRCC were from LANDFIRE version 1.1.1.0 (Refresh 2008). FRCC was developed during the 2006 Rapid Assessment, LANDFIRE version 0.5.0.

Any characterization or classification scheme may vary between mapping efforts. Each unique local, site-specific mapping effort of VCC, FRCC, or other subjective classes may be based on different assumptions of natural conditions, data sources, modeling parameters, or fine-scale measurements, and may result in unique outputs. LANDFIRE was selected as it is a uniform, multi-state dataset intended for use at a regional scale, and in this context is used to give a regional picture of current conditions. LANDFIRE does not provide the detail needed for site-specific analysis of conditions, and is not used to compare individual subroutes in this discussion.

3.7.1.3 Regulatory Framework

The Wildland Fire Leadership Council (WFLC) was established in 2002, as a federal interagency committee that develops and oversees national fire management planning. The Guidance for Implementation of Federal Wildland Fire Management Policy (WFLC 2009) was created by the WFLC as an update of earlier guidance developed in 2003. The Guidance sets standards for fire planning, interagency coordination, and other fire-related concerns, and requires that a Fire Management Plan (FMP) be developed by the managing agency for all areas of burnable vegetation. FMPs are implemented as a part of the existing land management plan for that area, and describe fire objectives, affected resources, and safety concerns.

The BLM's RMP Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a) and Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b) allow statewide planning for fire management. Both plans categorized BLM-administered land into four categories, with the Arizona plan also categorizing some surrounding state, private, and federal lands. Large, adjacent, or contiguous areas with similar fire management objectives were typically mapped as Fire Management Units (FMU) for planning purposes. The management objectives for the four categories are as follows:

- A: "Areas where fire is not desired at all." These may be areas with high resource sensitivity, or vegetation communities that are not fire-adapted.
- B: "Areas where unplanned wildland fire is not desired because of current conditions." These may be areas with sensitive resources, or areas that perhaps burned naturally but now have excessive fuel loads such that an unplanned fire would risk lives or severely damage resources.
- C: "Areas where wildland fire is desired, but there are significant constraints that must be considered for its use." Fire may benefit these areas as a management tool, but under controlled conditions. Fuels reduction may be required prior to reintroduction of fire.
- D: "Areas where wildland fire is desired, and there are few or no constraints for its use." Relatively unaltered vegetation communities without lives, property, or sensitive resources at risk that may benefit from an unmanaged, natural fire regime or from prescribed fire.

In coordination with the statewide planning efforts for Arizona and New Mexico, individual BLM field offices or district offices developed FMPs with additional detail specific to each planning area, sometimes including refined mapping of FMUs. The following BLM plans were reviewed:

- Resource Management Plan Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a)
- Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b)
- Las Cruces District Office: Mimbres Resource Management Plan (BLM 1993)
- Las Cruces District Office: Fire Management Plan (BLM 2010e)
- Rio Puerco Field Office: Fire Management Plan (BLM 2010f)
- Roswell Field Office: Fire Management Plan (BLM 2010g)
- Socorro Field Office: Socorro Resource Management Plan and Final Environmental Impact Statement (BLM 2008c)
- Socorro Field Office: Fire Management Plan (BLM 2010h)
- Safford District Office: Safford District Resource Management Plan and Environmental Impact Statement (BLM 1991)
- Safford District Office and Tucson Field Office: Safford-Tucson Fire Management Zone: Fire Management Plan (BLM 2004c)
- Gila District: Fire Management Plan (BLM 2010h)
- Tucson Field Office: Muleshoe Ecosystem Management Plan and Environmental Assessment (BLM 1998b)

The Southwest Coordination Center coordinates firefighting efforts among federal land management agencies in the Southwest. The Southwest Coordination Center is a regional office of the National Interagency Fire Center in Boise, Idaho, which coordinates national firefighting efforts for major incidents. Both centers may have operational jurisdiction over large wildfires within the study area, but are not otherwise directly involved in land management planning related to fire.

The New Mexico State Forestry Division and Arizona State Forestry Division are responsible for fire management on state trust land in their respective states. Fire management on some other lands, including adjacent federal lands or unincorporated private lands, may be conducted under cooperative agreements. State trust land is managed under constitutional mandate to provide revenue for specified beneficiaries. As such, fire planning is subject to its effects on that revenue. Prescribed fire may be employed when resources such as livestock forage are at risk from the absence of fire, potentially affecting revenue generation. Unplanned fires may be allowed to burn for the benefit of resources when this is the lowest-cost and safest option (Arizona State Forestry Division 2008).

Some counties or communities in the Project area have developed community wildfire protection plans, and other plans may be in development. Community wildfire protection plans identify communities with high fire risk, provide detailed vegetation or fuels maps, and provide for cooperative fire management with federal and state agencies. The following community wildfire protection plans cover portions of the Project area:

- Sierra County, New Mexico (Sierra County Community Wildfire Protection Plan Team 2012)
- Lincoln County, New Mexico (Walsh Environmental Scientists and Engineers 2008)
- Socorro County, New Mexico (Socorro County 2006)
- Middle Rio Grande Bosque, New Mexico (SWCA Environmental Consultants 2007)
- Luna County, New Mexico (Luna County 2010)
- Grant County, New Mexico (Grant County 2006)
- Hidalgo County, New Mexico (Hidalgo County 2009)
- Claunch-Pinto Soil and Water Conservation District (SWCA Environmental Consultants and Arid Land Innovation 2008)
- Torrance County, New Mexico (SWCA Environmental Consultants and Arid Land Innovation 2008)
- Pinal County, Arizona (Logan Simpson Design 2009)
- Cascabel, Arizona (Logan Simpson Design 2006)
- Pima County, Arizona – in progress
- Cochise County, Arizona – in progress
- Graham County, Arizona (Graham County 2005)
- Greenlee County, Arizona (Logan Simpson Design 2005)

3.7.2 Regional Overview

3.7.2.1 Natural Fire Conditions and Recent Changes

Fire regimes in the study area are diverse, reflecting the diversity of natural and altered vegetation communities present. Widespread, landscape-scale change from human activities has altered many vegetation communities throughout the Southwest. Deliberate fire suppression, grazing, and the introduction of non-native plants have all resulted in substantial changes to fire regimes. Altered fire regimes may also create a positive feedback loop under certain conditions, when increased fire frequency creates conditions that favor fire-adapted plants, including some invasive grasses, increasing fire frequency even further (Brooks 2008).

Fires in the pre-industrial Southwest were typically ignited by lightning, although Native Americans would also light fires for use in hunting, warfare, and numerous other purposes (Denevan 1992). Fires were only limited by fuel availability or weather conditions rather than by suppression. Fire was rare or absent from Sonoran or Chihuahuan desertscrub where fuel was typically too sparse to carry a fire across the landscape, and from communities such as riparian woodlands and high-elevation montane forests where fuel moisture generally remained high year-round. However, fire was an important feature in controlling the structure and function of grasslands and mid-elevation conifer or mixed woodlands.

Following the advent of modern fire suppression techniques, fires were often extinguished when possible. Fires in montane woodlands were perceived as threatening timber, and fires in grasslands often threatened residents, structures, fencing, and livestock. As a result of suppression, the total acreage in western North America that burned each year dropped dramatically through the middle of the twentieth century (Littell et al. 2009).

Fire suppression in montane woodlands allowed high recruitment of saplings, as well as the accumulation of litter such as pine needles and downed branches. The typical behavior of a fire prior to widespread suppression would burn most litter on the ground, but rarely damage mature trees. The unnaturally high fuel loads resulting from fire suppression often allowed fires, when they did occur, to become stand-replacing "crown fires" that could burn entire mature trees over very large areas (Arno 2000).

Grasslands are often dependent on fires for maintenance. Decreased fire frequency in the Southwest allowed widespread invasion of native shrubs and subshrubs previously excluded by fire. Selective grazing also favored shrubs that were less palatable to cattle. These and other factors led to a conversion of shrub-dominated landscape and resulted in large areas becoming less suitable for grassland wildlife and livestock (Wilson et al. 2001).

In the nineteenth and twentieth centuries, many species of plants from Europe, Africa, and Asia were introduced to North America. Plants such as buffelgrass (*Cenchrus ciliaris*), several species of *Bromus*, and other grasses were deliberately introduced, generally as potential forage sources or for erosion control and reclamation. These grasses were often perceived as beneficial for being more drought-tolerant or more productive than native forage plants. Other plants were accidentally introduced in livestock feed, stored grains, or other materials. Many of the species that were successfully established supported different fire regimes than were naturally present, and in some cases introduced fire to vegetation communities that were not adapted to it (Brooks and Esque 2000). Fire resulting from invasion of buffelgrass and other species into Sonoran Desertscrub can cause very high mortality of cacti and many other native species that define the community, converting the landscape to an arid savanna (McLaughlin and Bowers 1982).

Land managers became aware of these widespread, significant negative effects as fires shifted towards being larger, more destructive, and difficult to control. From the mid-century period when fire suppression was most successful, the acres burned each year began to trend upwards and now can be much higher than natural (Littell et al. 2009). Recent management and research is often dedicated towards returning to a natural fire regime where possible. However, ongoing population growth, urbanization, utility construction, and rural development have created an extensive and expanding wildland-urban interface (WUI); potentially in conflict with desired fire management and a safety hazard to residents in the WUI.

3.7.3 Inventory

The following sections discuss the current fire ecology and fire management planning in the vicinity of the proposed Project.

3.7.3.1 Vegetation and Fire Regime Conditions

The majority of each alternative subroute is within vegetation types that either rarely burn under natural conditions, or consist of fine, low-level fuels such as grasses and shrubs that can burn frequently. Dense, woody fuels that can support the most intense fires are sparsely distributed or absent.

Juniper-dominated woodlands and savanna on Chupadera Mesa are the most extensive woodlands crossed by any subroute, but canopy height is nearly always less than 30 feet. Juniper

woodlands can be a climax community that develops when juniper savannas remain unburned for long time periods (Paysen et al. 2000). Juniper-dominated areas were typically assigned by LANDFIRE to fire regime group III, and savannas with scattered junipers were typically assigned to group I. Portions of the Galiuro Mountains on subroutes 1A and 1B are within an open-canopy mixed juniper-pine-oak woodland and chaparral, a mixture of groups I, III, and IV. No other large, contiguous areas were mapped as forested by LANDFIRE.

Grasslands, particularly when shrubs are also common, can support intense fires. However, the light fuels that are present typically burn rapidly when compared with heavier fuels such as mature trees. The lower fuel masses and quick burning in grasslands also cause relatively lower soil heating, resulting in lower levels of erosion and water repellency that can occur after intense fires (DeBano et al. 2005). Grasslands naturally burn frequently, and were generally assigned to fire regime group I.

Riparian woodlands or mesquite bosques occur at each major river crossing. Riparian woodlands may have occasionally burned in the past, but fire severity was generally limited by high fuel moisture except during drought years. Mature mesquite bosques often have large areas with closed canopies, where fuel moisture is relatively high and fine understory fuels are often insufficient to carry a fire of sufficient intensity to damage healthy trees. If burned, mesquite trees can resprout from the root crown, although bosque recovery may take decades (Stromberg 1993). Riparian trees such as cottonwoods can be highly susceptible to fire damage, particularly when heavy or dense ground fuels such as downed logs and introduced Bermuda grass are present. Riparian woodlands may have burned occasionally in the past, but the loss of the majority of such woodlands has increased the importance of those remaining. Fire is now rarely a desired management tool, although some controlled burns may be effective (Quintana 2004).

Sonoran and Chihuahuan Desertscrub rarely burn under a natural fire regime, as native fine fuels between shrubs could not carry a fire under most conditions. Fires could occur after unusually wet years, when sufficient annuals and grasses were present (Paysen et al. 2000). Sonoran desertscrub is primarily within fire regime group V, and Chihuahuan desertscrub is primarily within group IV, except where it interfaces with semidesert grassland and experiences a higher fire frequency. However, increased presence of drought-tolerant invasive grasses in both ecosystems now allows fire to occur more frequently and over greater areas than under a natural fire regime.

Nearly all vegetation within the study area has diverged from the natural fire regime, as estimated by LANDFIRE's FRCC model (Table 3-32). Large blocks mapped as Class I only occur in the vicinity of Chupadera Mesa and west of Socorro, New Mexico. Nearly all montane woodlands and large areas of Sonoran desertscrub are mapped as Class III. The majority of semidesert grassland and shrub-invaded former grassland is mapped as Class II.

Table 3-32. Percent of Land Assigned to FRCC Classes within the Study Area[1]

	New Mexico	Arizona	Entire study area
Percent Class I	11	3	**7**
Percent Class II	66	49	**58**
Percent Class III	20	39	**29**

[1] Totals do not equal 100%. Barren and urban areas, agriculture, snow, and open water were not assigned an FRCC Class.

3.7.3.2 Recent fire history

The recent fire history of the Southwest has been shaped by human-caused changes in vegetation, in concert with an ongoing, multi-year drought and higher than average temperatures. Consecutive dry winters and unusually warm summers in 2011 and 2012 contributed to active fire seasons both years. In 2011, New Mexico experienced the largest fire (Las Conchas) in its recorded history to that date, and Arizona simultaneously experienced its largest fire (Wallow). However, in 2012, the Whitewater-Baldy Complex fire became the largest fire in New Mexico's recorded history at nearly twice the size of the Las Conchas Fire.

Fire history is derived from publically available information provided through the Geospatial Multi-Agency Coordination Group (GeoMAC). GeoMAC uses remote sensing infrared data as well as field reports to generate spatial data for wildfire perimeters and behavior. Historical wildfire perimeters dating to the initiation of the mapping project in 2000 through the end of 2012 form the basis for the following discussion (GeoMAC 2011, 2012). However, the data are largely limited to wildfires and do not include information on some prescribed burns that have occurred within the study area.

Fires between 2000 and 2012 burned 273,034 acres, or approximately 1.6 percent, of the entire study area, but several of the montane fires that occurred were catastrophic and stand-replacing events, much more severe than typical fires. Fires burned approximately 0.2 percent of the study area in New Mexico, within vegetation communities similar to those that would be crossed by the Project. Within Arizona, fires burned 3.3 percent of the study area, nearly all at higher elevations than the Project area in montane vegetation communities.

The following fires occurring in the study area since 2000 were unusually large or severe, and provide examples of the results of the existing unnatural fire regime. All except the Mitchell Fire occurred in Arizona. The majority of fires in New Mexico were relatively small and occurred in vegetation communities that can benefit from fire.

- Bullock (30,589 acres, 2002): This fire burned in the Santa Catalina Mountains near Subroute 4C2, primarily in the CNF. The fire was human-caused.
- Aspen (85,736 acres, 2003): This extremely costly, human-caused fire burned much of the Santa Catalina Mountains that did not burn in the Bullock fire the previous year. The town of Summerhaven suffered severe damage, including the loss of approximately 340 homes.
- Gibson–Nuttall Complex (29,474 acres, 2004): This pair of fires, both ignited by lightning, burned parts of the Pinaleño Mountains, threatening observatories on Mount Graham and severely damaging habitat for the endangered Mount Graham Red Squirrel. The eastern flank of the fire burned within 1 mile of the proposed route for Subroute 4A.
- Florida (23,201 acres, 2005): This lightning-caused fire burned a large part of the Santa Rita Mountains. Unlike many other recent fires, the majority of the fire was at a low, relatively healthy intensity.

- Mitchell (1,021 acres, 2005): This human-caused fire was relatively small, but burned from an area of invasive tamarisk into native riparian woodlands along the Rio Grande at the proposed San Antonio Crossing. Restoration is ongoing within the burned area.
- Distillery (7,567 acres, 2008): This lightning-caused fire burned at a relatively low intensity in the Rincon Mountains near Subroute 4C3, primarily in the CNF.
- Stanley (8,832 acres, 2011): This lightning-caused fire burned from the San Carlos Apache Indian Reservation into a small part of the CNF, in the Santa Teresa Mountains north of Aravaipa Canyon.
- Horseshoe II (223,213 acres, 2011): This human-caused fire was the fifth-largest in Arizona history, and burned much of the Chiricahua Mountains.
- Fox (7,474 acres, 2012): This lightning-caused fire burned semidesert grassland and pine-oak woodland in the Rincon Mountains, including a portion of the Rincon Mountain Wilderness, near the BLM preferred alternative.
- Grapevine (18,361 acres, 2012): This lightning-caused fire burned semidesert grassland and pine-oak woodland in the southern Pinaleño Mountains near Subroute 4B.

3.7.3.3 Fire Management Plans in New Mexico

In the RMP Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a), all BLM land in New Mexico was assigned to the four fire management categories defined in Section 3.7.1.3.

Category A in New Mexico was generally mapped to include riparian habitats and areas with very sensitive resources. No Category A land would be crossed by any alternative; the nearest being the Socorro Nature Area approximately 2.5 miles north of the proposed North Crossing. The majority of Category B land within the study area is concentrated in scattered parcels from the Nutt Valley west to near Lordsburg. Although the vegetation would benefit from burning, this area was designated Category B because the small parcel size of most BLM-administered land makes prescribed fire planning difficult. Category C land is the majority for every subroute, and includes much of the Rio Grande Valley and the Peloncillo Mountains. Lands in Category D are only crossed east of the Rio Grande, including parts of Chupadera Mesa and nearby plains-mesa grasslands. The Veranito WSA north of Socorro is Category D, and would be approached by Subroute 1A, 1A1, or 1A2. Table 3-33 presents the miles of BLM-administered land that would be crossed by each subroute within the four fire management categories.

Table 3-33. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in New Mexico

	A	B	C	D	Not categorized[1]
Subroute 1A1	0	6.9	103.2	0	118.7
Subroute 1A2 (BLM preferred alternative)	0	6.6	101.3	0	122.2
Subroute 1A	0	6.9	98	0	114.6
Subroute 1B1	0	6.9	107.1	0	109.6
Subroute 1B2	0	6.9	102.6	10.7	89

Table 3-33. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in New Mexico					
	A	**B**	**C**	**D**	**Not categorized[1]**
Subroute 1B2a	0	6.9	106.7	10.7	88.5
Subroute 1B3	0	6.9	98.1	17.4	83.9
Subroute 3A2 (BLM preferred alternative)	0	6.7	20	0	69.3
Subroute 3A	0	6.7	20	0	60.2
Subroute 3B	0	3.9	12.9	0	67.5
[1] BLM New Mexico only categorized BLM-administered land.					

3.7.3.4 Fire Management Plans in Arizona

The Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b) mapped FMUs on BLM land and some surrounding lands; in some cases combining multiple categories within a single FMU. Further detail on boundaries between categories within each FMU was not available. Table 3-34 presents the miles of BLM-administered land that would be crossed by each subroute within the four fire management categories or their combinations.

Table 3-34. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in Arizona						
	A	**ABD**	**B**	**BC**	**CD**	**Not categorized[1]**
Subroute 3A2 (BLM preferred alternative)	0	34.9	0	0	0	2.6
Subroute 3A	0	34.4	0	0	0	2.1
Subroute 3B	0	41.7	0	0	0	2.6
Subroute 4A	45	6	0	40.2	0	41.7
Subroute 4B	45	0	0	0	0	47.9
Subroute 4C1	39.6	0	0	0	0	40.9
Subroute 4C2	64.6	0	0	29.3	17	40.9
Subroute 4C2a	53.1	0	0	26.8	17	40.9
Subroute 4C2b	53.1	0	0	21.8	37.3	35
Subroute 4C2c (BLM preferred alternative)	64.6	0	0	24.3	37.3	35
Subroute 4C3	61.6	0	7.4	46.5	22.4	35
[1] BLM Arizona categorized BLM-administered lands and some additional federal, state, and private land, although not the entire study area. Some categories were combined by the BLM.						

3.8 CULTURAL RESOURCES AND TRIBAL CONCERNS

3.8.1 Introduction, Methods, and Regulatory Framework

3.8.1.1 Introduction

Cultural resources include archaeological sites, districts, and objects; standing historic structures; locations of important historic events; and places and living or nonliving things that are important to the practice and continuity of traditional cultures. Cultural resources may involve historic properties, traditional use areas, and places of traditional religious or cultural importance.

Based on results of preliminary research, the public scoping process, and consultation with the BLM, the following cultural resource issues and other areas of concern were identified:

- Salinas Pueblo Missions National Monument
- Historic rail line and several historic trails (Butterfield Overland Mail, Coronado, Anza, Zuñiga, El Camino Real de Tierra Adentro NHT)
- Mount Graham and surrounding culturally sensitive areas
- Known high-sensitivity sites, including numerous habitation sites
- Archaeological districts
- NRHP-listed historic districts and historic landmarks
- High density of cultural resources along rivers and other watercourses

3.8.1.2 Methods

The methods for the cultural resource study conducted for the EIS are described below. This includes a Class I records review, Class II sample inventory at locations where the Project crosses historically significant rivers and trails, and a cultural-visual assessment for the Gran Quivira. A sensitivity analysis is applied to the known cultural resource sites to assess the relative impact each alternative could potentially have on cultural resources.

Class I Records Review

A detailed Class I records review in support of the proposed Project was conducted to identify prior inventories, research, and previously recorded sites within the study corridor, which was 1 mile from the edge of the 1,000-foot corridor for each alternative. This review resulted in an enormous amount of data, so results for an area within 0.25 mile of the Project centerline were analyzed and are presented in the resulting report (Swanson and Rayle 2012). The records review was conducted from December 2009 through December 2010 and in May 2011, to include additional alternative corridors considered in the EIS studies.

The review involved a physical examination of records maintained by the following institutions:

- Arizona State Historic Preservation Office (AZ SHPO)/New Mexico State Historic Preservation Office (NM SHPO)
- NRHP

- Arizona State Register of Historic Places
- BLM – Lower Sonoran, Tucson, Safford, Socorro, Las Cruces, Roswell, and Rio Puerco field offices

The records review relied primarily on two GIS databases: AZSITE[1] and New Mexico Cultural Resources Information System (NMCRIS). The AZSITE Cultural Resources Inventory includes records of AZSITE Consortium members (ASM, Arizona State University, Museum of Northern Arizona, and the AZ SHPO) and other participating agencies, such as the BLM (AZSITE Consortium 2009). The AZSITE database includes information on properties listed in the Arizona Register and NRHP, as well as tens of thousands of other cultural resources recorded by many researchers for a variety of purposes over many decades. The NMCRIS database allows researchers to access the cultural site and project records of the Archaeological Records Management Section of the New Mexico State Historic Preservation Division. In addition, reports of selected prior studies were reviewed to supplement the information obtained from these two databases. Site records and General Land Office (GLO) plats on file at the BLM, and other historical maps were reviewed for indications of potential unrecorded historic resources.

Information was also provided by other interested groups (see below), as well as by Archaeology Southwest (formerly known as the Center for Desert Archaeology). Archaeology Southwest provided information on Priority Conservation Areas (see Figure M 8-1, Map Volume), which represent areas of cultural resources identified by Archaeology Southwest, in partnership with the National Trust for Historic Preservation, as cultural resource conservation priorities in the San Pedro River basin and adjacent areas. These consist of prehistoric sites and site complexes that meet one or more criteria for NRHP significance, maintain sufficient integrity to convey their significance, are unique or of limited occurrence, and are representative of a particular cultural manifestation for a time period and context.

Discussions with other members of the public and agency personnel provided additional information on the location and/or nature of specific historic or prehistoric resources:

- NPS (Salinas Pueblo Missions National Monument)
- New Mexico Archaeological Council (historic trails in Project area)
- Arizona Archaeological Council (historic trails in Project area)
- Deni Seymour (Protohistoric sites)
- John Madsen of ASM (Zuñiga trail)
- Steve Lekson and Katy Putsavage, University of Colorado, Boulder (Black Mountain site)
- Mogollon Prehistoric Landscapes Project, Arizona State University (Sierra County, New Mexico sites)
- BLM Field Office archaeologists (Camino Real de Tierra Adentro Trail, historic homesteads)
- Camino Real de Tierra Adentro Trail Association

[1] http://azsite.arizona.edu

The Class I review also provides information on previous projects that have been completed in the study corridor. From this, the percentage of the Project study area that has been previously investigated for cultural resources was calculated; it varies between 3 and 28 percent, depending on the subroute. Together, the amount of area that has been previously investigated for cultural resources and the length of each of the subroutes create a bias that certain subroutes could impact more sites than others. For example, Subroute 4B has 52 known sites, whereas Subroute 4C3 has 416 known sites. At quick glance, it would appear that 4C3 would impact a greater number of sites; however, Subroute 4B is 133 miles in length, and Subroute 4C3 is 173 miles long. In addition, only 5 percent of Subroute 4B has been previously inventoried for cultural resources, as compared to 28 percent of Subroute 4C3.

In order to normalize this bias, the estimated site density within each of the alternative subroute corridors was calculated by taking the number of sites identified in the inventoried area and dividing them by the amount of acres inventoried within the subroute corridor. This approach to site density assumes all routes have an equal potential for sites along all portions of the routes. Since areas were previously inventoried for other projects, the site densities obtained in the Class I data represent an average site density. It is probable that some previously inventoried areas contain high site density areas while others contain low site density areas.

Some of these inventories were conducted prior to the establishment of current ASM and NMCRIS criteria for intensive (Class II level) inventory (survey interval, transect width) and site definition criteria. These factors could also present additional biases in estimating site density projection. Specifically, cultural resources that were not considered sites in older surveys may now meet current site definition criteria, and sites that were not considered historic (older than 50 years) when recorded may have since crossed the 50-year threshold.

The lack of inventory coverage revealed by the Class I data led to the decision to conduct Class II studies. Information on the methodology and rationale behind the Class II sample inventories are presented below.

Class II Inventory

The Class I records review indicated that generally less than 10 percent of the alternative subroutes were inventoried for cultural resources. Although a Class III intensive pedestrian inventory will be conducted for the preferred route, a Class II judgmental sample inventory was completed to allow for a comparison between different alternative routes at areas that are known or predicted to be culturally sensitive. The Class III survey will take place once an alternative is selected and a right-of-way grant issued.

The methodology for selection of the Class II sample inventory parcels focused on areas where there is limited existing data, but for which there is a high expectation of cultural resources to be present. These include riverine settings known to have supported significant prehistoric and historic populations, and historically significant trails where proposed Project alternatives cross at multiple locations. The riverine settings included in the Class II inventory parcels are the San Pedro, Sulphur Springs Valley, San Simon, Mimbres, and Rio Grande. The inventory parcels included a 1,000-foot-wide corridor extending 0.5 mile on either side of the river or creek crossings to determine the density and types of cultural resources within the corridor. In addition,

the Class II inventory included areas where the proposed Project alternatives extend across the Butterfield Trail and the El Camino Real de Tierra Adentro NHT.

Visual Impacts to Historic Properties

The following is a description of the methodology used to inventory visually sensitive historic properties, characterize anticipated Project contrast, assess potential visual impacts, and identify potential mitigation measures.

Methodology is based on: (1) the BLM's VRM Manual (VRM 8400 Series 1986); (2) criteria for assessing both historic significance of, and adverse effects to historic properties under the rules of the Advisory Council on Historic Preservation (ACHP), implementing Section 106 of the NHPA (16 U.S.C. § 470 [f]); and (3) guidance on integrity and eligibility from the NRHP (Shrimpton 2002).

The methodology involves a screening process to identify potential adverse visual effects to historic properties and comprises the following components: (1) inventory and identification of historic properties associated with visual sensitivity; (2) visual contrast assessment; (3) determination of visual effects; and (4) mitigation or resolution of adverse visual affect.

Inventory and Identification of Historic Resources Associated with Visual Sensitivity

The inventory and identification of historic resources are based on Class I data (i.e., site records) collected for the Project. Class I data were gathered for 1 mile on either side of the centerline for all alternatives, but due to the enormity of the dataset, only data contained within a 0.25 mile of the centerline were analyzed. Historic resources that are eligible or potentially eligible under Criterion A, B, or C of the NHPA will be evaluated for visual sensitivity based on NRHP evaluation of integrity. For purposes of this methodology, to qualify as an adverse effect to a historic property a visual impact must alter, directly or indirectly, a characteristic of that property that qualifies it for inclusion to the NRHP, and does so in a manner that would diminish that property's integrity of setting, feeling, and/or association. Each historic property will be evaluated to determine the qualities of integrity and the historical significance of each property to accurately identify elements associated with visual sensitivity.

Integrity is defined as the ability of a historic property to convey its own significance. According to the guidelines of the NRHP, the evaluation of integrity must always be grounded in an understanding of a property's physical features and how the features relate to its significance. Of the seven aspects of integrity (36 CFR 60), setting, feeling, and association are closely linked with visual sensitivity because those aspects pertain to the physical environment, features, or aesthetic sense that conveys the property's historic character. Historic properties associated with visual sensitivity must retain the aspects of integrity necessary to convey significance (i.e., setting, feeling, and/or association), and those features must directly contribute to its NRHP eligibility. Under the Guidelines of the NRHP, a historic property's setting is the physical environment of that property, and setting refers to the character of the place in which the property played its historic role. A historic property's feeling and/or association is the property's own expression of the historic sense of a particular period of time, and results from the presence

of physical features of the property that, taken together, convey the property's historic character and association.

Sensitivity Analysis

Identification of known sites within each alternative is limiting, because it focuses only on the kind and number of cultural resources. It is important to assign a value to the sites in order to evaluate each of the alternatives, since not all sites have similar values. The relative value is considered its sensitivity.

The sensitivity of cultural resources within the study corridors was defined based on eligibility for listing on the NRHP, site type, and the presence of specific features (i.e., habitation structures and known locations of human burials). Previously recorded cultural resources have been ranked and assigned to one of five sensitivity categories:

- Low Sensitivity Level (1) – includes destroyed sites, sites that were determined not eligible, and twentieth-century trash scatters lacking features.
- Moderate-Low Sensitivity Level (2) – includes prehistoric artifact scatters with nondiagnostic artifacts, and historic trash scatters with associated features that may predate the twentieth century.
- Moderate Sensitivity Level (3) – includes prehistoric artifact scatters with diagnostic artifacts, caches, historic trails lacking physical traces, historic homesteads or structures, and historic transportation or utility related sites.
- High-Moderate Sensitivity Level (4) – includes archaeological districts, historic landscapes, historic trails, habitation sites with domestic structures, rock shelters, petroglyph sites, and Paleoindian sites.
- High Sensitivity Level (5) – includes NHTs, monuments (i.e., Salinas Pueblo Missions National Historic Monument), landmarks, cemeteries, habitation sites with known human remains, and known properties of traditional religious and cultural importance.

Sensitivity rankings were assigned to the cultural resource sites located within the study corridor for each of the proposed Project alternatives.

3.8.1.3 Regulatory Framework

Cultural resources are nonrenewable scientific, educational, and traditional use area resources that are protected by federal and state statutes (summarized in Table 3-35).

Table 3-35. Federal and State Laws and Regulations for Cultural Resources

Law/Regulation	Description/Summary
Federal	
Antiquities Act of 1906, 16 USC 431–433	Established the early framework for federal protection of cultural resources. It authorized permits for legitimate archaeological investigations and penalties for persons taking or destroying antiquities without permission.
National Historic	Established the ACHP, SHPOs, NRHP, and Section 106 review process.

Table 3-35. Federal and State Laws and Regulations for Cultural Resources	
Law/Regulation	**Description/Summary**
Preservation Act of 1966, 16 USC 470x–6	The ACHP is a federal agency created to address historic preservation issues and is staffed by presidentially appointed experts. The ACHP may elect to participate in projects that have high public interest. The State Historic Preservation Officer is a state level officer who evaluates and manages the historic properties that are listed or have potential to be listed on the NRHP. In addition, their office maintains a staff of archaeologists who are responsible for reviewing reports conducted as part of the Section 106 review process. The NRHP is the nation's official list of districts, sites, buildings, structures, and objects worthy of preservation. As a requirement of Section 106, cultural resources identified during inventory must be evaluated as to their eligibility for listing on the NRHP. Section 106 of the NHPA requires that federal agencies must take into consideration whether a proposed project would affect historic properties and provide the ACHP an opportunity to comment, should they choose to participate.
National Trails System Act of 1968, 16 USC 1241-1251	To create and preserve extended trails so located as to provide for maximum outdoor recreation potential, and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass.
National Environmental Policy Act of 1969, 42 USC 4321	Requires the assessment of potential impacts of a federal undertaking to the human environment, which includes cultural resources.
EO 11593, May 13,1971, *Federal Register* 36:8921	Requires federal agencies to administer cultural properties under their control and direct their policies, plans, and programs so that federally owned sites, structures, and objects of historical, architectural, or archaeological significance are preserved, restored, and maintained. Federal agencies were required to locate, inventory, and nominate to the NRHP all properties under their jurisdiction or control that appear to qualify for listing in the NRHP (ACHP 2009).
American Indian Religious Freedom Act of 1978, Public Law 95-341; 42 USC 1996	Establishes a national policy to protect the right of tribes and other indigenous groups to exercise their traditional religions.
Archaeological Resources Protection Act of 1979, 16 USC 470aa–470mm	Provides additional protection of archaeological resources from vandalism and unauthorized collecting on federal and tribal lands. Section 4 of the statute and Sections 16.5–12 of the uniform regulations describe the requirements that must be met before federal authorities can issue a permit to excavate or remove any archaeological resource on federal or tribal lands.
Native American Graves Protection and Repatriation Act of 1996, 25 USC 3001–3013	Provides for ownership of tribal graves and objects of cultural patrimony on federal lands. Assigns ownership and disposition of tribal graves, associated artifacts, and items of special cultural significance to appropriate tribes. Applies directly to all federal lands or federal undertakings.
EO 13007, May 24, 1996, *Federal Register* 61:26771 Indian Sacred Sites	Designed to protect, when practical, access to tribal sacred sites on federal land.

Table 3-35. Federal and State Laws and Regulations for Cultural Resources	
Law/Regulation	**Description/Summary**
New Mexico	
The Prehistoric and Historic Sites Preservation Act of 1989 Sections 18-8-1 through 18-8-8, NMSA 1978	Prohibits the use of state funds for projects or programs that would adversely affect sites on the State or National Registers, unless the state agency or local government demonstrates that there is no feasible and prudent alternative and that all possible planning has been done to minimize the harm to the site. The Historic Preservation Division works closely with local governments in particular, to find ways of accommodating development while still preserving the historic character of our downtown and historic districts.
Cultural Properties Protection Act of 1993 Sections 18-6A-1 through 18-6A-6, NMSA 1978	Encourages subdivisions of the state government to work with the Historic Preservation Division to develop programs for identifying cultural properties under their jurisdiction, and requires them to ensure that such properties are not inadvertently damaged or destroyed.
New Mexico Cultural Properties Protection Act of 1995 N.M. Stat. 18-6A-1 through 6; 18-6-11.2	This statute encourages state agencies to work with the Historic Preservation Division to develop programs for identifying cultural properties under its jurisdiction, and to ensure that cultural properties are not inadvertently damaged or destroyed. It also establishes a Cultural Properties Restoration Fund for the purpose of providing grants for interpretation, restoration, preservation, stabilization, and protection of cultural property belonging to the state. The statute also provides protection for unmarked burials and associated grave goods.
Arizona	
Arizona Antiquities Act of 1960 *ARS* §41–841 through 844	Preserves and protects historic and prehistoric resources in Arizona, and requires professional institutions to obtain permits to excavate. The Director of the ASM set the regulations for permitting; requires that discovery of human remains and associated funerary objects on state lands to be reported to the Director of the ASM.
State Historic Preservation Act of 1982 ARS 41-861 through 41-864	Requires state agencies to consider impacts of their programs on historic properties listed in, or eligible for, the Arizona Register of Historic Places, and to provide the SHPO an opportunity to review and comment on the Commission's actions that affect such properties.
State Historic Preservation Act of 1982 ARS 41-865	Requires discovery of human remains and associated funeral objects on private lands to be reported to the Director of the ASM. Requires tribal consultation for discovery of human remains and associated funerary objects.

In the context of the NHPA, as amended, a *historic property* is any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the NRHP. The definition also includes artifacts, records, and remains that are related to such a district, site, building, structure, or object. A *traditional use area* refers to an area identified by a cultural group to be necessary for the continuation of the traditional culture (see National Register Bulletin – Guidelines for Evaluating and Documenting Traditional Cultural Properties). The concept can include areas for the collection of food and nonfood resources, occupation sites, and ceremonial and/or sacred areas. *Sacred sites* apply to traditional sites and places that tribes or groups perceive as having religious significance. *Traditional cultural* and *sacred geographies* consist of conceptually related landforms important to a particular culture. A *Traditional Cultural Property* is a property associated with the historically rooted beliefs and practices of a living community that have been handed down through generations (Parker 2008).

Section 106 of the NHPA

Section 106 of the NHPA defines the legal process followed by federal agencies to identify and address the effects of a proposed project on cultural resources. Under the NEPA, agencies must also consider such effects; however, Section 106 provides statutory obligations independent of the requirements of the NEPA. Both processes share similar steps that are addressed concurrently: the identification and evaluation of affected resources with public and tribal participation, the assessment of the effects of the proposal, and the resolution and mitigation of any adverse effects.

- **Establishment of the Undertaking** – The BLM is the lead federal agency responsible for completion of the Section 106 process. Other federal agencies (ACHP, USACE, NPS), state agencies (SHPOs, ASLD, NMSLO), tribes, and the public have been notified and invited to participate in Section 106 consultations for the SunZia Project. In general, the Section 106 process is initiated when a federal agency identifies an undertaking or project that is located on federal land, requires a federal permit, or uses federal funding (36 CFR 800.16[y]), and is the type of activity that has the potential to cause effects on historic properties. The areas of potential effect (APE) are determined through Section 106 consultation and are presented in the Project-specific PA.
- **Identification and Evaluation of Historic Properties** – A Class I records review was conducted for a 2-mile-wide corridor on either side of the centerline for each of the alternatives; due to the size of the resulting dataset, however, only those data contained within a 0.25 mile were analyzed. This review identified known cultural resource sites located within the 0.25-mile-wide study area, as well as significant cultural resources outside of the Class I study area that could be affected by the Project (such as historic trails, NRHP-listed sites and districts, and places of traditional cultural importance). A Class II judgmental sample inventory was completed for all alternatives at selected locations known to be sensitive for cultural resources (i.e., river and historic trail crossings). A phased identification and evaluation approach is appropriate for projects "where alternatives under consideration consist of corridors or large land areas…" And, "the agency official may also defer final identification and evaluation of historic properties if it is specifically provided for in a…programmatic agreement executed pursuant to §800.14(b)" (§800.4[b][2]). An intensive Class III pedestrian inventory of any route that may be ultimately approved identifying all the cultural resources will be completed. These resources will then be evaluated for their eligibility to the NRHP (36 CFR §60.4). Eligibility determinations are made pursuant to the requirements of Section 106.
- **Assessment of Adverse Effects** – Sites determined "eligible" for the NRHP are defined as historic properties (36 CFR 800.16[l]) and are assessed for adverse effects. The assessment would take into consideration the anticipated disturbance resulting from the construction, operation, and maintenance of the BLM preferred alternative. A finding of "adverse effect" for a project is made if an undertaking alters, either directly or indirectly, any of the characteristics of a historic property that qualify it for the NRHP. For large complex projects such as SunZia, the federal agency often assumes an "adverse effect" early in the process, before the completion of studies.

- **Resolution of Adverse Effects** – Once a determination of "adverse effect" is made, steps are taken to resolve these effects. The agency continues to consult with the consulting parties, including tribes, to develop and evaluate alternatives or modifications to the undertaking that could avoid, minimize, or mitigate adverse effects on historic properties. The ACHP is notified of the effect determination, provided with the information specified in §800.11(e), and invited to participate in the consultations to resolve the adverse effects.

  Normally, a memorandum of agreement is developed to document how the adverse effects of the undertaking will be resolved, unless a PA is used. For this Project, a PA will be developed because the "effects on historic properties cannot be fully determined prior to the approval of" this undertaking (§800.14[b]). Adverse effects can be resolved through avoidance of a historic property, minimized by project redesign (selective pole placement to avoid direct site impacts) or through mitigation, or treatment of the affected historic properties. A project-specific HPTP is developed to guide the mitigation effort. For this Project, the HPTP will include a NAGPRA Plan of Action, and a Monitoring and Discovery Plan.

  A PA is a legally binding document that completes the Section 106 process. It is mutually accepted by various agencies with Section 106 compliance responsibility and project authorizations, and outlines a phased approach to the identification, assessment, and treatment of cultural resources. Nondestructive project planning activities, such as inventory and assessment of cultural resources, can be carried out prior to the completion of the Section 106 process.

NEPA

The NEPA process for the cultural resources is addressed in this EIS; it consists of establishing the baseline data (i.e., the affected environment), followed by assessing the impacts of the Project on cultural resources and evaluating the potential cumulative effects. The PA must be signed either prior to or at the same time as the ROD. Consultation is also a required part of the NEPA process. For this Project, under NEPA regulations, consultation with federal agencies, state agencies, tribes, and the public has been initiated and is ongoing.

3.8.2 Cultural History

In order to evaluate these resources, it is important to understand their prehistoric and historic (10,000 BC to AD 1960) context. Specifically, the Project study corridors extend across an area that has been an important place of human activity for approximately 12,000 years. These activities include exploration, trade, colonization, and communication, as well as military related activities and events, such as the first Spanish incursion into the Southwest. Consequently, archaeological investigations within the corridor should reveal a diverse array of prehistoric and historic site types associated with numerous cultural or ethnic groups. Potential site types include, but are not limited to: temporary campsites and habitation sites; ranches and homesteads; agricultural infrastructure; prospects and mines; trails, roads, and railroads; and telegraph, telephone, and power lines. Following is a discussion of the cultural history of the Project area.

3.8.2.1 Prehistoric New Mexico

Paleoindian Period (ca. 10,000 to 8000 BC)

The earliest occupation of New Mexico is known as the Paleoindian Period, a time marked by warming and cooling trends associated with the advance and retreat of continental and mountain glaciers. Much of the paleoenvironment in the Southwest consisted of lush grasslands and playas that sustained numerous, now extinct, megafauna herbivore populations such as mammoth, tapir, camel, horse, and bison (Haynes 1970; Mehringer and Haynes 1965). The prehistoric inhabitants of this period operated as highly mobile, nomadic groups, hunting large game animals and collecting native plant foods. Archaeologists defined the material remains of the earliest Paleoindian groups as the Clovis cultural tradition, which is distinguished by "fluted" lanceolate projectile points and a number of stone and bone butchering and processing tools that have been found in association with extinct Pleistocene megafauna dating 11,500 to 11,000 years ago (Boldurian and Cotter 1999; Bonnichsen and Turmire 1991). Physical remains of several Paleoindian cultural traditions, including the Clovis, Folsom, and Cody complexes dating from 10,000 BC to 8,500 BC, have been located throughout New Mexico (Cordell 1997); however, Folsom artifact assemblages are absent in southwestern New Mexico. It has been suggested that this dichotomy resulted from resident Paleoindian populations foregoing bison hunting in favor of subsistence strategies suited to the changing climate (Waters 1986).

Archaic Period (ca. 8000 BC to AD 300)

The extinction of Pleistocene megafauna marks the transition from the Paleoindian to the Archaic Period. With this episode of extinction is an abrupt change from lanceolate and stemmed projectile points to the less specialized side-notched points (Frison 1991). The presence of plant processing tools in association with this change suggests that the early inhabitants of the region increasingly relied on wild plants in their subsistence strategies (Cordell 1997; Hayden 1982; Rogers 1966).

Archaeologists defined several subregional cultural traditions for the Southwest, including the Cochise of southwestern New Mexico and the Oshara of north-central New Mexico (Beckett and MacNeish 1994; Irwin-Williams 1973; Rogers 1939, 1966; Sayles and Antevs 1941; Sayles et al. 1983). However, critics suggest that these subregional traditions, presumed to reflect prehistoric cultures, in truth represent archaeological constructs that appear more burdensome than useful (Berry and Berry 1986; Huckell 1984, 1988). This resulted in the first major revision of the Archaic Period chronology, which consisted of just three broad temporal divisions—Early, Middle, and Late (Huckell 1984). Most researchers of the Southwest have adopted this three-part scheme.

During the Early Archaic Period (8000 BC to 4800 BC) cultural groups adopted more varied hunting and gathering subsistence strategies, with an emphasis on plant processing and small game. This reliance on wild plant foods increased significantly during the Middle Archaic Period (4800 BC to 1500 BC), as evidenced by the frequency of groundstone artifacts and the presence of rock-filled hearths or roasting pits at sites dating to this period. The Late Archaic Period (1500 BC to AD 300)—most recently termed the Early Agricultural Period—represents the

beginnings of settled village life, farming, and the manufacture of pottery in the Southwest. However, there is not a strict dichotomy between the Middle Archaic and Late Archaic periods, as the timing of these developments varied among cultural groups and geographic area (Lockhart 1997; Seymour 2009a; Stuart and Gauthier 1981).

Pithouse/Pueblo Era (ca. AD 200 to AD 1600)

The production of pottery for containers and storage vessels, and the settlement of pithouse villages, highlights the transition from the Late Archaic Period to the agrarian way of life that typified the Pithouse/Pueblo era in the Southwest. During this era, farming populations increased and expanded into territories previously occupied by hunter-gatherers. Elaborate technological innovations for increasing crop yields were developed, and new ideas regarding property ownership, communal religious architecture, and symbols of different social status appeared (Cordell 1997; Plog 1997). In addition, numerous subregional cultural traditions emerged throughout the Southwest during this era, including the Anasazi and Mogollon, which are of particular relevance to the New Mexico portion of the Project.

Emerging from the Basketmaker cultural tradition, the Anasazi occupied settlements throughout the northern Southwest. Archaeologists recognize several Anasazi branches, including Chaco Canyon, Mesa Verde, Kayenta, and Rio Grande (Cordell 1997; Plog 1997; Reid and Whittlesey 1997). Distinct from the Anasazi cultural tradition, the Mogollon occupied the mountains and deserts of eastern Arizona, western New Mexico, and northern Mexico. Based on excavations along the San Francisco and Mimbres rivers, Haury (1936) defined the Mogollon as *in situ* cultural development from the preceding Cochise cultural tradition. The San Simon Mogollon branch of southeastern Arizona and the Mimbres Mogollon branch of southwestern New Mexico are of relevance for the Project area (Breternitz 1959; Haury and Sayles 1947; Martin and Rinaldo 1947, 1960; Sayles 1945; Wheat 1954). Although peripherally associated with one another, the San Simon and Mimbres branches represent distinctive subgroups with separate cultural histories after AD 1100.

Early Pithouse Era (AD 200 to AD 775)

The adoption of the bow and arrow, pottery production, and increased agricultural dependence characterize this time period in the Anasazi region (Cordell 1997). Changes in pithouse construction during this period consisted of the incorporation of more complex architectural elements such as cribbed log superstructures, vent shafts, wind walls, interior hearths, and storage pits and cists. Also during this period, the Anasazi of larger pithouse settlements constructed what may be considered the first public buildings used for group ceremonies and other non-domestic activities, as evidenced by the excavation of a great kiva at Juniper Cove (Cummings 1953). By AD 500, production of gray and whiteware pottery was widespread (Cordell 1997).

The Mogollon of the Early Pithouse era (AD 200 to AD 600) practiced a combination of hunter-gathering and farming strategies (Wills 1988, 1995), and were mobile some part of the year (Gilman 1983, 1987, 1997). Starting around AD 200, early pithouse settlements consisting of one to several dozen roughly oval or circular pithouses (not all occupied in the same period of time) were constructed along large and small drainages, and in upland areas far from streams

(Anyon et al. 2005; Lekson 2006). Mogollon potters of this time produced a plain brownware pottery; however, flaked and groundstone tools remained essentially unchanged from those of the earlier Cochise cultural tradition (Sayles 1945:65). Local redwares (plain brownwares with a red slip) appeared in southwest New Mexico between AD 450 and 550 (Diehl and LeBlanc 2001; Gilman 1997).

Late Pithouse Era (AD 600 to 1000)

In terms of regional patterns, this period marks an interval of major population growth and dispersion throughout most of the Southwest. Associated with a greater reliance on maize-based horticulture, these demographic trends lead to territorial reductions and constrained group mobility, resulting in more integrated sociopolitical structures and exchange networks (Smiley 2002). The region along the Upper Rio Grande Valley between Santa Fe and Elephant Butte, occupied during the Rio Grande Developmental Period (AD 600 to AD 1200), remained relatively free of human occupation in comparison to other Anasazi areas during this era. Sites dating to the early part of this period contain small groups of circular pithouses, sometimes with above-ground jacal rooms. The earliest pottery produced in the area consists of brownware and grayware cooking vessels, reflecting the mix of Mogollon and Anasazi traits prevalent in the region (Cordell 1997; Cordell and Gumerman 1989).

In the western Anasazi region, neck-banded grayware ceramics, unslipped mineral-painted whiteware ceramics, and cranial deformation resulting from the use of cradle boards in childrearing represent the typical archaeological traits of the Pueblo I Period (AD 700 to AD 900). In the Cibola area of western New Mexico, a mix of Mogollon and Anasazi cultural traits is gradually replaced by Anasazi-only characteristics such as grayware ceramics, pithouses with air shafts, jacal and slab storage units, and a lack of kivas (especially rectangular great kivas) by the AD 800s. After AD 900, aboveground habitations are common; perhaps influenced by architectural trends in Chaco Canyon (Cordell and Gumerman 1989).

In the Mogollon region, the Late Pithouse era (AD 600 to AD 1000) represents a time of increased contact between the Mogollon and their regional neighbors. While archaeologists characterize Early Pithouse era dwellers as seasonally mobile and only moderately dependent on agriculture (Gilman 1987; Wills 1991), it is believed that this changed over the course of the period, with people becoming more sedentary and more reliant on agriculture (Diehl and Gilman 1996; Gilman 1997; Mauldin 1993; Minnis 1985; Wills 1988, 1995).

Pueblo Era (AD 900 to 1600)

During the Pueblo II Period in the Anasazi region (AD 900 to AD 1100), demographic growth and expansion facilitated by ongoing developments in water management techniques allowed the Anasazi to inhabit areas previously deemed unviable. These demographic trends correlate with significant sociopolitical developments involving the emergence of political structures larger and more complex than previously developed. The "Chaco Phenomenon" that occurred at Chaco Canyon in the southern San Juan Basin exemplifies this trend where a new form of settlement, the "great house," appears contemporarily with villages or "small houses" around AD 900 (Lekson 1991). Numerous Anasazi communities in the northern Southwest, influenced by the architectural tradition developed at Chaco Canyon, constructed similar great houses in the late

eleventh century. One element of this new settlement pattern involves the proliferation of exotic prestige goods, which suggests widespread exchange and interaction networks, and some level of specialized production. An extensive network of well-marked roadways constructed during the Pueblo II Period may have facilitated the movement of such goods (*ibid)*.

The Pueblo III Period (AD 1100 to AD 1300) represents the peak of demographic and settlement trends initiated in the preceding Pueblo II Period, and ends with the precipitous collapse of regional societies and abandonment of large portions of the Four Corners region by the Anasazi. By AD 1150, Chaco was no longer the preeminent cultural center in the northern Southwest; by AD 1150 to AD 1180, deteriorating environmental conditions ultimately forced the collapse of the Chacoan system (Cordell 1997; Judge 1989). Despite this collapse, village size in other parts of the region increased from AD 1200 to 1275. Eventually, environmental and demographic conditions in the Eastern San Juan region reached a breaking point and the entire area was abandoned between AD 1300 and AD 1350. Many of the migrants settled among other populations in the northern and middle Rio Grande region.

In the beginning of the Pueblo IV Period (AD 1300 to AD 1600), substantial populations congregated in areas with arable land and water, such as the Zuni Pueblo, Hopi Mesas, Little Colorado River, and Rio Grande Valley. Sites dating to this period consisted of several hundred rooms configured as large room blocks situated around a central plaza or as parallel rows of rooms separated by open spaces that may have served as communal plazas. Important social changes are indicated by the decrease in kiva size and number and the appearance of the kachina cult. Corrugated graywares were replaced by plain gray ceramics, and black-on-white wares by red, orange, and yellow wares. Beginning around AD 1325, the region experienced a time of relatively abundant rainfall that was ended by a drought around AD 1425. By the time of the Spanish *entrada* (when the Spaniards first came to the country), the large communities in the greater region, except those on the Hopi Mesas, had been abandoned (Roberts 1996).

The Cibola Branch (or Ancestral Zuni) of the Anasazi lived in west-central New Mexico and eastern Arizona, and were clearly influenced by neighbors to the north (Chaco) and south (Mogollon). Before AD 900, the presence of brownware ceramics indicated contact with the Mogollon to the south; a shift to Chacoan-style architecture and ceramics occurs after AD 900. By AD 1000, inhabitants of the Cibola Branch area were indistinguishable from those in other parts of the region (Leonard 1998). Following the collapse of Chaco around AD 1150, it appears that contact with Mogollon neighbors resumed. By AD 1250 to AD 1300, the relatively small communities grew into larger villages, and ultimately very large, nucleated pueblos (Kintigh 1996); and by AD 1400, the large communities in the Cibola area had been abandoned.

The Mogollon Pueblo Period (AD 1000 to AD 1400) was a time of major cultural adjustments and transformations in subsistence, technology, architecture, settlement patterns, population size, and social interaction with outside groups. Specifically, Mogollon subsistence strategies shifted from the use of a broad spectrum of plant and animal resources to a primary dependence upon cultivated plants, especially corn and beans. While hunting and gathering did not disappear completely during this period, increases in local population size and density appear to have reduced the availability of wild resources in the immediate vicinity (Reid 1989; Tuggle et al. 1984; Welch 1991). The most apparent change during this period is the appearance of surface architecture and larger settlements exemplified by small room blocks with separate semi-

subterranean kivas. After AD 1200, these small communities were abandoned and populations aggregated into larger, more complex pueblos (Haury 1985; Reid and Whittlesey 1997, 1999; Rice 1980). These large pueblos, often consisting of hundreds of rooms, were built around several kivas or a single, centrally located great kiva (Rice 1980).

Changes in the Jornada Mogollon region during the Late Pithouse era—including parts of the western Trans-Pecos, south-central New Mexico, and northeastern Chihuahua—were similar to those taking place elsewhere in the Mogollon area, and among the Anasazi to the north. Pithouse villages grew larger and more complex, developing into the first pueblos around AD 1200. During the Pueblo Period, or El Paso phase (AD 1200 to AD 1450), numerous pueblos were constructed and agriculture was the main source of food. A variety of farming techniques were employed, including dry land, runoff diversion, floodplain, and irrigation agriculture. Non-local ceramics observed at Jornada sites suggest the development of extensive trade networks. As for neighboring areas, by the mid-1400s large communities had been abandoned and the population dispersed and reorganized into smaller habitations (O'Laughlin 2001).

"Mimbres" describes a branch of the Mogollon culture that was centered on the Mimbres River Valley, but extended northwest to the upper Gila River, southwest into southwestern New Mexico, and east to the Rio Grande. During the Classic Mimbres Period (AD 1000 to AD 1150), a shift occurred in domestic house construction, from pithouses to above-ground structures. Dependence on corn increased at this time, accompanied by reliance on small irrigation systems. Mimbres black-on-white pottery was produced and traded throughout the Mogollon region (Hegmon and Nelson 2003; Stuart and Gauthier 1981). By the twelfth century, a period of reorganization occurred, and the Mimbres Mogollon left the large pueblos and dispersed into smaller, less structured hamlets in the area (Hegmon and Nelson 2003; Nelson 1999). Between AD 1300 and AD 1400, households again began to aggregate into larger villages; but populations were still more mobile than they had been during the Classic Mimbres Period (Nelson 1999). During the post-Classic Mimbres era, U-shaped pueblos of puddle adobe replaced the cobble masonry of the Classic Mimbres Period, and kivas were no longer constructed (Stuart and Gauthier 1981). By 1450, southwest New Mexico was largely abandoned by the Mogollon peoples and the region was relatively uninhabited, until the arrival of the Apache and Spanish explorers (Fowler 1990).

In the Rio Abajo area, along the Rio Grande in southern New Mexico, the production of glazeware pottery signified the beginning of the Ancestral Piro, or Pueblo IV, Period (AD 1300 to AD 1600). Both the Pecos classification and Marshall and Walt's (1984) Rio Abajo phases are used to describe sites in the area, because both Anasazi and Mogollon traits have been observed. The Piro pueblos were large adobe villages with enclosed plazas (Earls 1987; Marshall and Walt 1984). The presence of grayware, similar to Anasazi ceramics and brownware that shares characteristics of Mogollon pottery, may indicate trade with, or immigration from, these neighboring groups. In contrast with the Mimbres area to the southwest, there was no dramatic shift from the preceding Pueblo III Period, though site number and density did increase.

3.8.2.2 Prehistoric Arizona

Paleoindian Period (ca. 10,000 to 8000 BC)

As is the case for New Mexico, the earliest occupation of Arizona is the Paleoindian Period. Physical remains of Paleoindian cultural traditions, dating from 10,000 to 8500 BC, have been located in southeastern Arizona. The cultural history of Paleoindians in Arizona parallels that of their counterparts in New Mexico, discussed previously.

Archaic Period (ca. 8000 BC to AD 300)

The cultural history of Archaic Period populations in Arizona parallels those identified and briefly discussed for New Mexico, particularly for the Early and Middle Archaic periods. By the second millennium BC, archaeologists have identified potential differences in the Archaic Period way of life for different subregions. Although Archaic groups in central and southern Arizona experimented with agriculture as one aspect of their subsistence strategy (Huckell 1995), radiocarbon dates taken from maize samples suggest significant agricultural subsistence in the Tucson Basin as early as 2100 BC (Gregory et al. 2001; Huckell et al. 1999; Mabry 2008; Thiel and Mabry 2006). Recent excavations in the western Tucson Basin revealed an Early Agricultural component with numerous canals, dating from 1250 to 500 BC. These early canals suggest an increasing reliance on irrigation-based agriculture along the Santa Cruz River (Mabry 2008).

Pithouse/Pueblo Era (ca. AD 200 to 1600)

As in New Mexico, pottery production, village establishment, and increased emphasis on agriculture mark the end of the Late Archaic Period. Elaborate technological innovations for increasing crop yields were developed during Pithouse/Pueblo eras, and new ideas regarding property ownership, communal religious architecture, and symbols of different social status appeared (Cordell 1997; Plog 1997). Numerous subregional cultural traditions emerged throughout the Southwest during this era. Of particular relevance for the Arizona portion of the Project are the cultural traditions identified as Hohokam, the San Simon branch of the Mogollon, and the archaeological tradition called Salado.

Increasing dependence on agricultural subsistence in southern Arizona led to significant socioeconomic changes by AD 300. At this point in time, semipermanent pithouse villages emerged throughout the river valleys of the Tucson and Phoenix basins, and pottery production increased considerably. This cultural tradition, referred to as Hohokam, employed a variety of farming practices, eventually constructing an elaborate network of irrigation canals for agricultural production (Fish and Fish 2006). Debate remains whether the Hohokam cultural tradition represents an *in situ* cultural development, or was the result of immigration to the region. Haury (1950) initially postulated an indigenous model for Hohokam origins, but after excavating Snaketown a second time, changed to the immigrant model, based on the presence of a fully developed irrigation system (Haury 1976). As such, a number of researchers believe that the Hohokam entered the Southwest from Mexico sometime between AD 750 and AD 900 (Crown and Judge 1991).

During the Early and Late Pithouse periods, the cultural history of the San Simon branch of the Mogollon generally parallels that of the Mimbres branch. One difference between these culturally related groups is that the San Simon culture appears to have had stronger connections with and influence from the Hohokam to their west. Cultural history in the San Simon regions diverges from the Mimbres around AD 1100, and is discussed in more detail below.

Originally conceived as a cultural group that colonized the Gila-Salt Basin in the late thirteenth century (Gladwin and Gladwin 1935), Salado now appears to more accurately reflect a ceramic tradition that spread as populations migrated south from the Colorado Plateau to the Gila-Salt Basin, and then east into southwestern New Mexico and southeastern Arizona (Cordell 1997). No consistent set of cultural traits (architectural, burial, etc.) appears to accompany the use of this pottery produced from the AD 1200s to the AD 1400s. The change in designs and motifs of the various pottery types may reflect influences of the various regions from which they were found. However, it is possible that they were manufactured in limited centers and widely traded. Crown (1994) suggests that this was a widely copied tradition with little variation, produced locally by and for the household.

Early Pithouse Era (AD 200 to AD 775)

Increasing variation and complexity in architecture and the emergence of specialized production characterize the Hohokam region during the Pithouse era. Early architecture consisted of small square constructions; later construction consisted of large jacal structures surrounded by a central plaza (Doyel 1991; Mabry 2000). By the end of the period, houses remained situated around central plazas, with either square, rectangular, or ellipsoidal houses with single-side entries generally centered along a long wall (Crown and Judge 1991). Early pottery production consisted of plain brown vessels and clay figurines. Potters later introduced polished redwares, as well as the earliest decorated wares (Wilcox et al. 1981). Improved firing methods in the latter part of the period enabled the production of distinctive red-on-buff ceramics manufactured through the paddle and anvil technique. In addition, new material traits emerged during the final phase of the Pithouse era, such as trash mounds capped with adobe and large-scale irrigation systems (Reid and Whittlesey 1997).

Late Pithouse Era (AD 600 to AD 1200)

Hohokam inhabitants during the Colonial Period (AD 775 to AD 975) arranged domestic architectural units into clusters or courtyard groups in the Gila-Salt and Tucson basins (Howard 1985; Wilcox et al. 1981). These courtyard groups typically consisted of two to four structures, with entries focused on a common area that often served as the center of cremation activities, trash disposal, and communal cooking activities (*hornos*) (Gregory 1984; Sires 1984). The presence of monumental architecture (e.g., ballcourts) at many Colonial Period sites suggests that permanent villages emerged during this period. The origin of the ballcourt phenomenon remains unclear; however, some archaeologists suggest that the idea may have been adopted from Mesoamerican peoples to the south (Gladwin et al. 1937; Wilcox 1991).

Colonial Period artifact assemblages suggest a more elaborate material culture, with craft specialization existing at the household and village level (Reid and Whittlesey 1997). Elaborate stone and shell bowls carved in the shape of frogs, toads, and snakes, often covered with

turquoise, are representative of this time. Stone palettes also became more elaborate during this period (Haury 1976; White 2004). Potters produced vessels consisting of incised exteriors on buff backgrounds with curvilinear scrolls, small design elements, and life forms in red paint. During the latter portion of the period, potters incorporated small repeated elements, forming spiral or circular bands of decoration as well as animal and human figures. Exotic forms introduced by Hohokam potters at this time included human and animal effigy vessels, thick-walled censors, rectangular bowls, and tripod plates (Reid and Whittlesey 1997).

Further expansion of settlements, the development of canal irrigation systems, and improvements in various alternate agricultural strategies characterize the Sedentary Period (AD 975 to AD 1150) of the Hohokam. Although the construction of ballcourts persisted at this time, Hohokam villagers began constructing another form of monumental architecture, the platform mound. Houses constructed during this period tended to be ellipsoidal. Also during this period, Hohokam artisans began using new technologies for working shell jewelry and designing more sophisticated mosaic mirrors (*ibid*). Copper bells traded from Mexico and new types of redware pottery also appear. Moreover, the ceramic technology of this period provided for a significant increase in pottery production.

Pueblo Era (AD 900 to AD 1600)

Contrasting sharply with the pre-Classic periods, the Hohokam Classic Period (AD 1150 to AD 1400) exhibited radical shifts in material culture, architecture, and settlement patterning. Previous settlements in outlying areas such as Gila Bend, the Lower Verde River, Flagstaff, and San Pedro River were abandoned at the end of the Sedentary Period (Wilcox and Sternberg 1983). Population increased in the Gila-Salt Basin at this time, probably with people from outlying areas migrating into the basin. Agricultural intensification occurred in the Gila-Salt and Tucson basins; it has been argued that the Tucson Basin increased in importance as a regional center during this time (Doelle and Wallace 1991). Doelle and Wallace view Cerro de Trincheras sites as evidence for warfare or at least hostilities between the Gila-Salt and Tucson basins; while a subsequent assessment by Downum and others (1994) concludes that evidence for the use of Cerro de Trincheras sites as defensive or fortified locations is not convincing.

At this time, Hohokam villagers began constructing several new forms of domestic architecture, consisting of houses with post-reinforced caliche walls, built-in pits, and freestanding walls of cobbles with adobe. Contiguous-walled pueblos of coursed adobe also were constructed, mostly associated with settlements containing ceremonial architecture within compound walls (Crown and Judge 1991). Platform mounds are found at a number of Tucson Basin villages dating from AD 1275 to AD 1300 (Gabel 1931), and are similar to mounds that occur throughout southern and central Arizona. Maize agriculture remained the primary subsistence focus; however, extremely large, rock-pile field systems associated with the cultivation of agave have been found in both the northern and southern portions of the Tucson Basin dating to this time (Doelle and Wallace 1991; Fish et al. 1992). Artifact assemblages dating to this period appear much less diverse (McGuire 2001; Mitchell 2003). Hohokam artisans no longer produced figurines, palettes, and elaborate projectile points, and there was a decline in the manufacture of red-on-buff ceramics. Polychrome vessels represent the dominant ceramic type at Classic Period sites; yet there was also an increase in the presence of redware ceramics and obsidian artifacts.

Village abandonment occurred between AD 1450 and AD 1500, and the Hohokam tradition as presently known disappeared from the archaeological record. Excavated sites dating to the subsequent Protohistoric Period remain either unrecognized or do not exist; however, a Late Classic or post-Classic occupation has been identified at a small number of sites in the Gila-Salt Basin, as well as along the middle Gila River Valley (Craig 2001; Crown and Sires 1984; Doyel and Fish 2000; Sires 1983). Researchers are still debating how to interpret this period, which is characterized by a return to pithouse architecture, an absence of enclosing compounds, low frequencies of buffware ceramics, high frequencies of Salado polychrome and redware, and an increase in obsidian procurement (Abbott et al. 1994; Chenault 2000; Henderson and Hackbarth 2000).

In the San Simon region, increases in growth, immigration, and agricultural productivity characterize the period spanning AD 1200to AD 1450 (Neely 2004). Large settlements emerged as groups migrated from the north and east, and previously occupied areas were abandoned. In the western portion of the Safford area, there is evidence of ties to the Hohokam civilization to the west, while the eastern portion displays evidence of a variety of Greater Southwest traditions. Of the decorated types present in sites dating to the period, locally made polychromes appear the most common. This period is thought to represent a merging of immigrant groups from the Point of Pines, White Mountains, and Little Colorado River areas, with the local population (Neuzil 2005). Towards the Late Classic Period there is a notable change, with the emergence of Puebloan-style structures such as room blocks and kivas. There was also Salado influence from the west and northern Chihuahua to the south, as evidenced by the presence of decorated ceramics of these regions at San Simon sites. The large pueblos appear to have been mostly abandoned around AD 1450.

3.8.2.3 Terminal Prehistoric, Protohistoric, and Historic Era (AD 1300 to 1960) in Arizona and New Mexico

The Protohistoric Period in the American Southwest represents a time of transition between the Prehistoric and Historic periods. Traditionally, this period has been roughly and conveniently estimated as ranging from AD 1450 to 1700; however, dates for the Protohistoric Period have varied widely (Di Peso et al. 1953; Gilpin and Phillips 1998; Ravesloot and Whittlesey 1987; Riley 1987; Wilcox and Masse 1981) because they have been based on guesses, lack of data, and differing criteria. This circumstance has derived from past uncertainty in dating sites that postdate AD 1450, which left a significant period of time unaccounted for between the end of the Prehistoric Period and the Spanish *entrada* (Whittlesey et al. 1994a:225).

In North America, the most common definition of the Protohistoric is the period that begins with the arrival of Europeans to the New World to the time of continuous occupation or contact with Europeans (Ravesloot and Whittlesey 1987). In the Southwest, this period begins with the landing of Spanish forces under the command of Hernán Cortés de Monroy y Pizarro in present-day Veracruz, Mexico, and his subsequent conquest of the México capital at Tenóchtitlán (1519 to 1521). The problem with this definition and the use of the term *protohistoric* is that we have learned that many of the adaptations, lifeways, and groups characteristic of this period in the southern Southwest begin at least a hundred years earlier, and fall within the terminal prehistoric period. There is an overlap with prehistoric cultural entities, either as an extension of earlier ways, or a replacement for, or a supplement to, earlier manifestations. Moreover, there is

mounting archaeological evidence and long-standing oral traditions that indicate interactions of a variety of types occurred between many newcomer groups and existing tribes. Changing adaptations of members of extant tribes complicates this transitional period even more as resident tribes, or subgroups of them, adjusted to new ways of life.

Recent work has revealed archaeologically recognizable signatures and chronometric dates that place the beginning of these so-called *protohistoric* adaptations in the terminal prehistoric period, beginning in the AD 1300s. An overlap with prehistoric cultures is evident, which is one reason the definition of these purported *protohistoric* groups has been so difficult (Seymour 2008, 2010, 2011, 2013a). In this sense, the term *protohistoric* actually hinders understanding of this period. Recognition that these groups were present much earlier means that we cannot use AD 1450 as a point of departure, expecting to see distinctive adaptations before and after this temporal divide. There is no divide but rather a considerable overlap between extant prehistoric cultural entities (Hohokam, Mogollon, Trincheras, Anasazi/Ancestral Pueblo) and those present in the Historic Period. Many of these historical groups changed drastically through time as well, which means that their archaeological signatures must be tracked temporally and spatially, while recognizing the basis for changes in landscape use, feature characteristics, and artifact types (Seymour 2012a).

The end of the Protohistoric, customarily defined as sustained contact with Europeans, is not consistent and cannot be readily applied to all parts of the region. New Mexico archaeologists broadly correlate the end of the Protohistoric with the establishment of the Spanish province of Santa Fé de Nuevo México at the turn of the seventeenth century. Conversely, Arizona archaeologists broadly correlate the end of the Protohistoric with the entrance of Spanish Jesuit missionaries into southern Arizona at the end of the seventeenth century (Gilpin and Phillips 1998).

These vague and varying notions of the Protohistoric Period result largely from a lack of archaeological sites and other forms of evidence on which to base assessments. More recently, however, a significant number of chronometric dates have been obtained from numerous intensively studied archaeological sites. These sites represent the historically referenced groups encountered by the first Europeans who occupied this region prior to Spanish arrival. Owing to new forms of data, our understanding of this period continues to improve and more refined labels have been applied to the temporal framework used for this period.

Misunderstandings have resulted from relying too heavily on the historic documentary record, which has skewed history towards that which focuses on Europeans. Along these same lines, the term *Protohistoric Period* pertains only to indigenous inhabitants, and once the Historic Period begins, scholars tend to focus on Europeans and only consider indigenous occupants in relation to Europeans. For this reason, some scholars extend the Protohistoric Period well into the historic period, terminating at perhaps the mid-1700s or 1800s, so as to remain focused on the natives. Still, the Native American historic period tends to be subsumed into and considered as a subset of European colonial history, with European-relevant phases and research themes focused on topics pertinent to Europeans. In mainstream historical archaeology, indigenous happenings are evaluated only with respect to their impact on and as a consequence of European history. For this reason, the term Protohistoric Period has maintained some relevance if for no reason other than to keep the focus on indigenous aspects of historical archaeology.

Representing an approximately 500-year record of culture history in the Southwest, the Terminal Prehistoric-Protohistoric-Historic Period includes various phases of cultural influence extending from the arrival of new peoples and new adaptations in the 1300s or before, and includes the Spanish *entrada* through to subsequent Spanish Colonial rule, Mexican Independence, and the entry of the United States into the region with the establishment of the New Mexico Territory in 1850 and the Gadsden Purchase of 1854. More recently, efforts have focused on breaking down these general periods even further to reflect fundamental changes that occurred from the terminal Prehistoric into the late Historic Period (Seymour 2011). Moreover, the period encompasses a wide diversity of cultural groups and language families that include Native Americans, Spaniards, Mexicans, and Anglos. Native cultural identities were greatly affected through biological and cultural exchange with Europeans throughout this period (*ibid*).

The time period from AD 1300 to 1500 marked the beginning of a period of mass abandonment, migration, and social reorganization throughout the Southwest. The Protohistoric Native American world at the time of the Spanish *entrada* represented a mix of sedentary and nomadic cultural groups occupying parts of present-day Arizona and New Mexico. Sedentary groups included the O'odham, situated along the Santa Cruz, San Pedro, Salt, and Gila river valleys; the Western Pueblos of the Hopi, Zuni, and Acoma-Laguna along the Little Colorado River Valley; and the Eastern Pueblos of the Rio Grande Valley. Extant nomadic groups included the Navajo, who lived among the Western Pueblos of the Colorado Plateau; various bands of the Apache, ranging across northern Mexico and the central and southern mountains of eastern Arizona and southern New Mexico; the Manso, Suma, Jano, and Jocome (and many other small groups) who ranged across a wide portion of northern Chihuahua, Sonora, southeastern Arizona, New Mexico, and Texas; and the nomadic Tohono O'odham, Hai-Ced O'odham, Kohatk, and others located in the western Arizona and Sonora deserts (Bolton 1949; Dozier 1983; Forbes 1959; Lockhart 1997; Seymour 2009a, 2011; Wells 2006). Although not present during the early *entradas*, the introduction and subsequent proliferation of the horse resulted in later Ute and Comanche groups entering the region (Kessell 2002). The following discussion of present-day Native American groups is limited to historic cultural groups known to have occupied areas within the current review area.

Northern Southwest: Pueblos

The Pueblos of New Mexico and Arizona represent the cultural descendants of the Anasazi and peoples of the Mogollon cultural tradition who lived in highly nucleated villages and practiced an agrarian lifeway. Hence, when the Spanish explorers arrived in the region, they referred to the indigenous inhabitants as "Pueblos." Linguistically heterogeneous, present-day Puebloans speak a variety of languages and dialects grouped within the Uto-Aztecan, Tanoan, Keresan, and Zunian language families (Dozier 1983).

At the time of the initial Spanish *entradas* in the sixteenth century, the Pueblo world consisted of numerous villages along the Rio Grande and the Little Colorado River valleys, representing the Eastern and Western Pueblos respectively. In 1598, the Pueblo villages unwillingly became incorporated into the Spanish colony of Santa Fé de Nuevo México, and for eight decades the indigenous inhabitants of the region endured Hispanicization and missionary efforts led by the Catholic Church and the secular government in Santa Fe. Dissatisfaction among the Pueblos reached a climax with the Revolt of 1680, resulting in the expulsion of the Spanish colonists and

their native allies from the region. However, the Pueblo victory was short-lived, and in 1692 a military campaign of reconquest was undertaken, resulting in the submission of all of the Eastern Pueblos by 1696. The provincial authorities were unable to reassert control over the Hopi, Zuni, or Acoma-Laguna Pueblos due to the encroachment of Navajo and Ute raiders into the region. The Western Pueblos remained outside of the Spanish cultural sphere in the Rio Grande Valley for the remainder of the Spanish Colonial and subsequent Mexican periods (Dozier 1983; Kessell 2002).

Despite the negative aspects of colonization, the Spanish provincial government issued land grants to all of the existing New Mexico pueblos during the period 1598 to 1821 (Dory-Garduño 2010). Following the Mexican-American War of 1846-1848, the United States was bound by the Treaty of Guadalupe Hidalgo to recognize the rights and property of Mexican citizens. In a report to Congress in 1858, the surveyor-general for New Mexico recommended 17 of 21 Pueblos as having legitimate claim to their lands. Congress confirmed the Pueblo grants the same year, and confirmed the GLO-issued patents in 1864 (Brayer 1939). Conversely, the Hopi of the Arizona Territory had no legal claims to Mexican citizenship, and their lands were subsequently subject to claims made by the United States. In 1882, the Hopi Reservation was established by a presidential executive order by Chester A. Arthur (Whiteley 1988).

Presently, there are 19 Pueblos in New Mexico: Acoma, Cochiti, Isleta, Jemez, Kewa (Santo Domingo), Laguna, Nambe, Ohkay Owingeh, Picuris, Pojoaque, Sandia, San Felipe, San Ildefonso, Santa Ana, Santa Clara, Taos, Tesuque, Zia, and Zuni (Vlasich 2005). In addition, the people of Ysleta del Sur Pueblo in Texas were displaced from New Mexico during the Pueblo Revolt.

Southern Southwest

Ethnohistoric and archaeological evidence suggests that three general Native American groups occupied the southern Southwest at the time of the first *entradas*. The Canutillo and Cerro Rojo complexes are archaeological cultures that represent mobile adaptations based on hunting-and-gathering, and raiding and trading with the contemporaneous sedentary Sobaípuri-O'odham or Cayetano complex peoples. Interpretation of the Canutillo complex identified in southern New Mexico and Arizona proposes that the material culture and settlement pattern of this cultural group possesses similarities to known non-Apache (non-Athabaskan-speaking) traditions identified in Texas and northern Chihuahua. Therefore, it is possible that the Canutillo complex may represent historically known, non-Athabaskan groups such as the Jano, Jocome, Manso, and Suma. Interpretation of the Cerro Rojo complex suggests a proto-Apache (Athabaskan) cultural group based on an expedient technology, with the use of retouched tools, relatively distinct side-notched and tri-notched projectile points, and discrete modes of landscape use (Seymour 2009a, 2013a).

O'odham

The O'odham represent a Uto-Aztecan speaking group occupying portions of present-day southern Arizona and northern Mexico. The first European contact with the O'odham occurred in 1539, when the Niza expedition is thought to have traversed the San Pedro Valley in search of

the fabled Seven Cities of Cíbola (see below); however, sustained contact with Europeans did not occur until the initiation of a Jesuit mission building program under the direction of Father Eusebio Francisco Kino in the late-seventeenth century (Seymour 2009b; Sheridan 1995). Referring to all the indigenous inhabitants of this zone as Pimas, the Spanish identified several groups speaking different dialects living in *rancherías* (dispersed settlements) throughout the region, including the Pima situated along the Altar and Santa Cruz rivers; the Sobaípuri along the Santa Cruz, San Pedro, and Gila rivers; the Gileño along the middle Gila River; the Papago (now Tohono O'odham) of the western desert; and the Soba of the San Ignacio River and the Gulf Coast of California (Seymour n.d.; Wells 2006:8). However, the Pima used none of these terms, calling themselves O'odham, which translates roughly as "the people" (Fontana 1974), and using indigenous names for adjacent O'odham groups. The Spanish referred to the Santa Cruz, San Pedro, and Gila valleys as the Pimería Alta, and the western desert region as the Papaguería (Barnes 1988). Other extant O'odham-speaking groups at the time included the Kohatk, occupying the northeastern periphery of the Papaguería south of the Gila River, and the Sand Papago (Hia-Ced O'odham) living in the westernmost reaches of the Papaguería (Dobyns 1974; Fontana 1983).

The cultural affiliation between the O'odham and the antecedent culture of the region, the Hohokam, has been debated (Bostwick et al. 1996). The Historic Period O'odham were thought to have lived in dispersed *ranchería*-type settlements, although archaeological evidence has revealed that the Sobaipuri-O'odham lived in well-organized, planned settlements along the rivers. Still, these villages are dissimilar to the highly nucleated Hohokam villages of compound walls, platform mounds, and great houses of the preceding centuries. This dichotomy suggests a lack of social stratification that such public architecture might reflect. Moreover, historic Tohono O'odham and some of the Gila River residents forewent the irrigation canal systems used by the Hohokam in favor of floodwater farming (Hackenberg 1983; Winter 1973), although the Sobaipuri-O'odham situated along the Santa Cruz, San Pedro, and Gila rivers used irrigation, producing bountiful harvests (Seymour 2011, 2013a). Some anthropologists argue against cultural continuity, suggesting that the O'odham migrated into southern Arizona following the collapse of Hohokam society. Conversely, O'odham legends tell of social strife and internal rebellion that led to the collapse of the Hohokam (Bahr et al. 1994; Teague 1993; Seymour 2011). Since 1973, contemporary O'odham tribal groups have considered themselves descendants of the Hohokam.

The Pima of the Gila River (like those on the San Pedro) were not subject to European settlement, and remained free of the missionization efforts of the Jesuits, and later Franciscans. However, they did adopt domesticated plants and animals introduced by the Spaniards. Of particular significance was winter wheat, which increased farm production to meet market demands of Spanish settlers in the Tucson Basin (Doelle 1984; Ezell 1983). Targets of nomadic raiders, both the Gila River tribes and Sobaípuri allied themselves with the Spaniards in fighting the Apache and their mobile allies. Therefore, much credit goes to the O'odham in facilitating the survival of Hispanic settlement in southern Arizona during the Spanish Colonial Period (Ezell 1983; Sheridan 1995). Likewise, the O'odham played a role in fighting the Apache during the subsequent Mexican and American periods, and provided needed food supplies to the U.S. Army and settlers throughout the early American Period (Pritzker 2000; Trimble 1989).

Affected by disease and Apache depredations during the Spanish Colonial Period, the Sobaípuri increasingly interacted with Tohono O'odham populations, many of whom have moved into Sobaípuri settlements along the Santa Cruz (Di Peso et al. 1953; Dobyns 1976; Seymour 2011). Populations to the north along the Gila River were recognized as Akimel O'odham (Pima) (Wells 2006). The Akimel O'odham and the Pee Posh (Maricopa) primarily reside at the Gila River Indian Reservation, established in 1859 along the Gila River between its confluence with the Salt River and Florence, Arizona. In 1871, river flows were diverted via irrigation canals that were built by Mormon farmers settling on the Gila River in the Florence and Safford areas upstream. As a result, some Akimel O'odham and Pee Posh moved north to the Salt River where another reservation was established in 1879—the Salt River Pima Maricopa Indian Reservation (DeJong 1992). The Maricopa (now Ak-Chin) Indian Reservation was created in 1912 and settled by members of the Akimel O'odham, Tohono O'odham, and Yoeme (Yaqui) tribes.

The modern Tohono O'odham and descendants of the Sobaipuri occupy four reservations in southern Arizona: (1) the main Papago Indian Reservation west of Tucson and south of Gila Bend; (2) the San Lucy District approximately 6.0 miles north of Gila Bend; (3) the San Xavier Reservation located east of the main reservation and south of Tucson; and (4) the Florence Village District, a 22-acre reservation located 2.0 miles west of Florence. A small group that identifies themselves as Hia-Ced O'odham (though they are not federally recognized as a tribe) lives at the San Lucy District and in the Ajo, Arizona area (Northern Arizona University 2010).

Apache

Athabaskan-speaking Apache groups ranged across a significant portion of the Southwest in the Terminal Prehistoric and Historic periods. Specifically, this range extended from northern Mexico into eastern Arizona and western New Mexico, and across the southern Great Plains to southwest Texas (Gunnerson 1979). Linguistically, Athabaskan is a branch of the Na-Dene language family of northwestern North America. Geographically, Athabaskan speakers reside throughout the interior of Alaska and western Canada, with outliers along the Pacific Coast of Oregon and California, as well as in the Southwest, as represented by Navajo and Apache cultural groups (Ruhlen 1998).

It remains unclear when the first Athabaskan-speaking cultural group migrations to the region occurred, particularly in regards to groups that would become the Apache of Arizona and New Mexico. Traditional views hold that following the abandonment of Mogollon settlements in eastern Arizona and western New Mexico in the late fourteenth century, the region remained depopulated, resulting in the *despoblado* (unsettled/uninhabited land) encountered by later Spanish explorers (Cordell 1984; Haury 1985; Reid and Whittlesey 1997; Seymour 2008). This has led some scholars to suggest that Apache groups only arrived in the region in the mid-1600s (Schroeder 1974a; Seymour 2008); however, others suggest Athabaskan migrations occurred prior to the arrival of the Spanish to the area and that Apache, or proto-Apache groups, were present at the time of Coronado's *entrada* in AD 1540 (Forbes 1960; Goodwin 1942; Oakes 1996; Seymour 2008, 2009b, 2013b). Recent research that focused specifically on this question provided a suite of radiocarbon and luminescence dates that show a continuous ancestral Apache presence beginning in the AD 1300s (Seymour 2013a).

The first Spanish explorers to enter into east-central, present-day Arizona (1539 to 1542) described an unpopulated wilderness north of the Gila River (*despoblado*). However, archaeological evidence indicates that mobile cultural groups, particularly the Athabaskan (proto-Apache), ranged across this area during the Protohistoric, exploiting the uplands. Therefore, it remains unclear if the term *despoblado* stems from a lack of encounters with indigenous inhabitants in the area, or simply reflects a Spanish bias against the recognition of nomadic cultural groups. It appears most likely that mobile Apache and non-Athabaskan groups were present in the *despoblado* during this period (Seymour 2008, 2009b, 2012b).

The various groups of Apache in the Southwest differed in dialect, social organization, and subsistence practices, resulting in distinct tribal groups. Major groups include the Western Apache, Chiricahua, Mescalero, Jicarilla, Lipan, and Kiowa-Apache (Roberts and Roberts 2006). Three of these Apache tribal groups—the Western Apache, Chiricahua, and Mescalero—ranged within the current review area during the Terminal Prehistoric-Protohistoric-Historic Period. The Western Apache occupied east-central Arizona and consisted of several subtribal groups, including the Cibecue, Northern and Southern Tonto, San Carlos, and White Mountain Apaches (Goodwin 1942). The Chiricahua occupied parts of northwest Mexico, southeast Arizona, and southwest New Mexico. Schroeder (Schroeder 1974a,b,c) identified five Chiricahua subtribal groups: Mogollon, Copper Mine, Mimbres, Warm Spring, and Chiricahua. The numerous bands of the Mescalero ranged from the Texas panhandle across the Southern Plains to the Rio Grande in New Mexico, and throughout parts of northern Mexico (Sonnichsen 1958).

Regardless of the exact timing of the appearance of Athabaskan speakers, the Apache that laid claim to a large part of the Southwest practiced a very different lifestyle from the agricultural groups already in the region. Living in temporary ranchería-type settlements, the Apache were mobile hunter-gatherers skilled at exploiting seasonal and spatial variations in resource availability (Basso 1983; Sonnichsen 1958). Although some of the more northern Apache adopted some small-scale agricultural practices from their sedentary neighbors (i.e., cultivation of corn) (Goodwin 1935), those in the south seem to have practiced no agriculture until much later (Seymour 2012c). Raiding became a significant part of the culture following the adoption of the horse. Mountain camps provided a safe base from which to conduct raids for livestock and grain from agricultural groups in the valleys below (Basso 1971; Spicer 1962).

For nearly two centuries, the Apache successfully resisted Spanish efforts to settle in their lands. Moreover, with the collapse of the Spanish presidio system in the 1830s, Apache raiding resulted in a significant depopulation of northern Sonora as well as southern Arizona and New Mexico (Acuña 1974; Sweeney 1992). However, with the successful conclusion of the Mexican-American War (1846 to 1848), immigrants from the United States poured into the region. These circumstances lead to inevitable conflicts with the military forces of the United States as well as with Mexican and Anglo ranchers, who for the first time began to successfully encroach on Apache lands, in part due to the protections afforded by the U.S. Army (Trimble 1989). It is within the context of this uncertain atmosphere that one of the formative events in the shaping of United States policy towards the Apache occurred: the Camp Grant Massacre.

Camp Grant was located at the confluence of the San Pedro River and Aravaipa Creek, approximately 50 miles northeast of Tucson. Assuming command of the camp in early 1871, First Lieutenant Royal Emerson Whitman proved sympathetic to the Apache by instituting a

ration policy that attracted some 500 Aravaipa and Pinaleño Apaches, including Chief Eskiminzin, to the camp. Under these conditions, Whitman created the Camp Grant Reservation in Aravaipa Canyon some 5 miles east of Camp Grant proper, where the placated and disarmed Apache worked cutting hay for the post as well as harvesting barley at nearby ranches. Despite this arrangement with the Aravaipa and Pinaleños, other Apache bands, particularly the Chiricahua, continued to raid ranches throughout southern Arizona. This situation created a toxic atmosphere in Tucson, resulting in a belief that the Camp Grant Apaches were the source of all native depredations in southern Arizona (Sheridan 1995).

The event that pushed Tucsonans to violence against the Camp Grant Apaches occurred on April 10, 1871, when an Apache raid on San Xavier resulted in the loss of a significant number of livestock. Following this raid, a party of 94 Tohono O'odham and 48 Mexicans, incited and led by 6 Anglos, marched on the Camp Grant Reservation. At dawn on April 30, the Tucsonans attacked the slumbering Apache camp, killing some 140 women and children, and taking a number of survivors as slaves to be traded into Mexico. The Camp Grant Massacre highlighted the failure of United States Indian Policy in southern Arizona, and prompted President Grant to take action in bringing an end to the violence. A show trial conducted in Tucson against some 100 perpetrators of the massacre resulted in acquittals for all the defendants (Sheridan 1995; Trimble 1989). The survivors of the Camp Grant Massacre relocated almost immediately to the San Carlos Apache Reservation, which became federally recognized the following year. The present-day San Carlos Apache Tribe regards the area of Camp Grant, the Camp Grant Reservation, and the massacre site in Aravaipa Canyon as a place of special significance (Rambler 2012).

Following a successful winter campaign in 1872-1873, native resistance in the region essentially collapsed, though it would take a decade and several more military campaigns against rogue Apache bands to finally bring peace to the region (Sheridan 1995; Trimble 1989). Presently, the Western Apache occupy several reservations in Arizona, including Fort Apache White Mountain (1870), San Carlos (1871), Yavapai-Apache (1910), Tonto-Apache (1972), and Fort McDowell Yavapai (1904) (Sheridan 1995). Following their release as prisoners of war from Fort Sill, Oklahoma in 1913, the majority of the remaining Chiricahua, along with a number of Lipan, relocated to the Mescalero Reservation (1873) in southeastern New Mexico (Sheridan 1995; Sonnichsen 1958). Those Chiricahua that remained at Fort Sill were given an allotment of land, and formed the Fort Sill Apache Tribe of Oklahoma (Griffin-Pierce 2010).

Non-Apache Mobile Peoples

The first Spanish settlers to arrive to the area documented their encounters with three groups of people and their specific adaptations in what is today southern New Mexico and Arizona. These groups are believed to be the Sobaipuri-O'odham and the ancestral Apache, along with another lesser known group. This third group, encountered by Coronado and his men along the San Pedro, was a relatively poor mobile group who gifted cacti to the explorers upon their first meeting. Past researchers, such as Bolton (1949), viewed the O'odham of this region to be mobile as well, and so assumed that these poor hunter-gatherers were Sobaipuri-O'odham. As we have learned more about the archaeological signatures of groups residing in this area at this time, we now understand that the Sobaipuri–O'odham were riverside farmers living in planned and well-organized villages overlooking irrigated fields on the San Pedro, Santa Cruz, and Gila

rivers. Their mobile neighbors were the ancestral Apache, and this third group encountered was probably ancestral Jano, Jocome, Manso, or Suma.

These non-Athabaskan groups and others are known from the ethnohistoric record, and until recently this was the main information available on these mobile residents. Chroniclers documented their presence, briefly noting certain behavioral characteristics and geographic locations. More recently their archaeological identity has been isolated. Archaeologically these Jano, Jocome, Manso, and Suma are known as the Canutillo complex, which has only been defined in the last decade (Seymour 2002, 2004, 2009, 2011). Residing along rivers, near lakebeds and swamps and in mountain zones, these Canutillo complex groups fished, hunted birds, small game, and large animals, and gathered. Small, triangular, indented-base points tipped their arrows. Finely-crafted bifaces were hafted for knives and lance heads. They lived in expedient housing, wandered across the landscape in search of food and shelter, and made no pottery.

Dozens of mobile groups were mentioned in documentary sources by different names through the years. European chroniclers often used the geographic location to name the groups they referenced, while at other times they recognized behavioral or cultural differences, such as in language, clothing, tattoos, or hair-style. Unlike farming groups, mobile peoples traveled over wide expanses, often using overlapping territories that changed through time. Alliances between groups also shifted. Some of these groups allied themselves with the Spanish, serving as scouts and auxiliaries; therefore, their material culture, especially projectile points, are often found through an especially wide geographic range. Raiding and trading also brought mobile travelers to other areas, all the while confusing and intermixing the distributions of their material culture.

Through time, these small groups began to intermarry with neighboring tribes. Disease, warfare, and famine meant that their numbers were too small to sustain viable populations. Some intermarried with the O'odham and Apache, while others intermixed with the Tigua and Piro of the post-Pueblo Revolt era in the El Paso area. By the mid-1700s these Canutillo complex groups had lost their distinctive identities, though many people in the El Paso-Las Cruces area recognize their heritage with these earlier-named groups.

Early Spanish Explorations through the Mexican Period (1539 to 1848)

Although the Spanish first entered the present-day American Southwest in 1539, they did not maintain a permanent presence in the region until the establishment of a New Mexico colony at the start of the seventeenth century. Six decades of sporadic exploration, culminating in several unsuccessful attempts to gain a foothold in the region, preceded the foundation of the colony. The following section provides a context and background for these early explorations, the foundation of the New Mexico colony, and Spanish settlement of the Santa Cruz Valley in present-day Arizona.

The Niza and Coronado Expeditions (AD 1539 to 1542)

The first historic reference to the lands encompassing present-day Arizona and New Mexico occurs during Nuño Beltrán de Guzmán's conquest of western Mexico (1529 to 1531), as tales of seven great cities lying to the north in the land of Cíbola were brought back to the Spanish. In

1536, Alvar Nuñez Cabeza de Vaca and several other survivors of the failed Narváez expedition to conquer Florida (1527 to 1528) returned to Spanish territory across the northern frontier of Nueva Galicia. Although the survivors' tales were not particularly embellished, they did speak of great cities north of the frontier, with houses four and five stories tall. These accounts served to further exaggerate the growing legend of the Seven Cities of Cíbola. Influenced by these events, the viceroy of Nueva España, Antonio de Mendoza, selected Franciscan friar Marcos de Niza to lead a reconnaissance expedition into the north to find, and establish relations with, the inhabitants of Cíbola in 1539 (Farish 1915; Kessell 2002).

Consisting of Niza, Estéban de Dorantes, and a contingent of natives that had travelled with Cabeza de Vaca across the northern frontier, the expedition departed northward from San Miguel de Culiacán, Nueva Galicia in March of 1539. Estéban, a Moor and slave of one of the survivors of the failed Narváez expedition, served as the expedition party's guide. Skirting the Sierra Madre Occidental, which lay to the east, the party followed the coastline along the Gulf of California through the present-day states of Sinaloa and Sonora, Mexico before turning northeast to the San Pedro Valley (Farish 1915; Kessell 2002). Estéban, leading a forward party several days ahead of Fray Niza, continued beyond the Gila River northeast across the despoblado to the lower Little Colorado River in present-day western New Mexico (Bolton 1949; Farish 1915). Shortly upon arrival at what he believed to be Cíbola, Estéban and most of the native contingent were killed by the town's inhabitants. Fearing a similar fate, Fray Niza approached the town at a distance where he erected a cross, claiming the land in the name of Spain, and hastily returned to Nueva Galicia (Farish 1915; Kessell 2002). Fray Niza's journey across the San Pedro Valley represents the first European contact with natives (the Sobaípuri and Jano or Jocome) in the area that is present-day southern Arizona. The Sobaípuri, a sedentary O'odham-speaking cultural group known to the Spanish as the Pima, occupied the river valleys of the Santa Cruz and San Pedro rivers during the Protohistoric Period (Bolton 1949; Seymour 2009a; Wells 2006).

Encouraged by Niza's claims of abundant gold and silver, and by the vision of the great city he had observed from a distance, Viceroy Mendoza and his newly appointed governor of Nueva Galicia, Francisco Vásquez de Coronado, immediately organized a military expedition to take Cíbola. Departing from Nueva Galicia in the spring of 1540, Coronado rode at the head of an army consisting of approximately 300 Spanish soldiers and 1,000 native allies, including Mexica, Tlaxcalan, and Tarascan warriors. Niza led a religious contingent of five Franciscans. In support of the army were hundreds of servants and followers leading spare horses, driving the pack mules, and herding 5,000 cattle, sheep, and pigs (Flint 2003; Kessell 2002). The army encountered indigenous cultural groups along the upper San Pedro River, and at the ruin of Chichilticali. Although it has generally been accepted that these encounters represent further contact with the Sobaípuri (Bolton 1949), Seymour (2009a) suggests that groups encountered along the San Pedro River were the mobile groups that have been identified archaeologically as Canutillo complex peoples, and later referred to as Janos and Jocomes. Furthermore, Seymour suggests that the indigenous group encountered by Coronado's army at Chichilticali was the Apache.

Traversing the despoblado, Coronado's army crossed into present-day New Mexico. Upon reaching Cíbola, the army found a modest-sized Zuni town (Háwikuh) defended by some 200 warriors. Although not aware of it at the time, Coronado had reached the western edge of the Pueblo world. Taking the village in less than an hour of fighting, Coronado promptly established

a headquarters to send out further expeditions in search of the wealthy and high civilization described by Niza. Captains Don Pedro de Tovar and Garcia López de Cárdenas were sent to the west, while Hernando de Alvarado explored to the east. Tovar made contact with the Hopi pueblos as Cárdenas followed the Colorado River to the Grand Canyon. In the east, de Alvarado passed through the Acoma, Tiguex, and Cicuyé pueblos. In each case, Niza's claims of great riches in the land of Cíbola proved to be greatly exaggerated. Conscious of the army's resentment and feelings of betrayal, Fray de Niza promptly returned to Mexico City (Kessell 2002; Prince 1883).

While at Cicuyé, native informants told Alvarado of Quivira, a land rich in gold and silver that lay across the plains to the east. Renewing the Spaniard's hopes of great riches, Coronado subsequently moved his headquarters to winter at the Tiguex pueblos before continuing the campaign east. Initially received peaceably by the Tiwa inhabitants at Tiguex, tensions between the army and the natives quickly escalated into open war. The conflict with the Tiwa was quickly put to an end, resulting in the destruction of one village and the abandonment of at least another dozen villages for the duration of the Spaniard's winter stay. In the spring of 1541, Coronado's army set out for Quivira, travelling east as far as the Arkansas River in present-day Kansas. However, Coronado eventually learned that the tales of gold and silver were a native ruse to lure the army away from the Pueblo lands. Disillusioned and broken, Coronado led the army back into Nueva Galicia in 1542 (Kessell 2002; Prince 1883). The failure of the Coronado expedition dispelled any further notions of great cities beyond the northern frontier, and several generations would pass before Spain returned to the region (Dozier 1983).

Nuevo México (AD 1595 to 1848)

In 1595, Don Juan de Oñate Salazar was awarded the colonization contract for Nuevo México. Leading a colonial force of approximately 700 soldiers, 130 families, 80 wagons, and thousands of head of livestock, Oñate took formal possession of the province of Santa Fé de Nuevo México on April 30, 1598 (Kessell 2002; NMOSH 2010b; Prince 1883). Oñate established the first provincial capital at the Tewa pueblo of Ohkay Owingeh, which was renamed San Juan and remained the capital for only a couple of years before being moved to San Gabriel (Yunge Owingeh) in 1600. With the founding of San Gabriel, Oñate officially established an approximately 400-mile extension of the Camino Real de Tierra Adentro (Royal Road to the Interior Land), the Spanish government's inland highway extending north from Mexico City to Nueva Vizcaya (Levine 1999). In 1610, Don Pedro de Peralta, the third governor of the province, moved the capital to Santa Fé (NMOSH 2010a). Other important Spanish settlements during this early period were established at La Cañada in the Tewa Basin, and within the region between San Domingo Pueblo and the mission at Nuestra Señora de Socorro (present-day Socorro) (Dozier 1983; Julyan 1996).

The establishment of the Nuevo México colony represents the beginning of a period characterized by economic exploitation and forced religious conversions of the indigenous inhabitants (Dozier 1983; Kessell 2002). The Franciscans vigorously pursued a mission building program throughout the western and eastern Pueblo world, where they amassed large herds and flocks of livestock. Workshops that employed native labor in such fields as leatherworking and blacksmithing were established at the larger mission centers. Competing with the missionaries was the civil administration, which implemented the *encomienda* system; an exploitative labor

policy entitling Spanish *encomenderos* to services provided by natives in the form of direct labor and tribute (Dozier 1983). Concurrently, the Franciscans aggressively attempted to supplant indigenous beliefs with Catholicism by imposing harsh disciplinary actions against Pueblo villagers accused of, or caught in, performing native religious ceremonies (Dozier 1983).

Pueblo resentment of Spanish rule led to open rebellion in 1680. Popé, a Tewa religious leader from San Juan Pueblo, directed the revolt from his headquarters at Taos Pueblo, issuing clear and simple instructions to kill all of the colonists (*ibid*). Alerted to the uprising, the colonists in the north fought a defensive retreat south to El Paso del Norte. In total, 21 missionaries and 380 settlers out of a population of 2,500 colonists were killed in the revolt. The Pueblo country remained free of the Spanish for more than a decade, but continuing harassment from Nuevo Mexicanos intent on the *reconquista* (reconquest) of the lost province eventually wore down native resistance. In 1696, Spanish colonists reoccupied the Eastern Pueblos; however, increasing raids by Navajos and Utes along the western frontier severed contact with the Western Pueblos, resulting in their autonomy throughout the remainder of the Spanish Colonial Period (*ibid*).

Although many negative aspects of Spanish rule continued into the eighteenth century, civil and religious authorities did alter their most extreme policies (e.g., eliminating the *encomienda* system, ending the suppression of native ceremonies and rituals, and the inclusion of native leaders in the political process) (*ibid*). However, these new policies of tolerance did not stem from Spanish altruism as much as from a growing need for native allies to counter the increasingly mobile and hostile nomadic tribes of the Apache and Navajo, as well as the Shoshonean-speaking Utes and Comanches who migrated into the Southwest from the Great Basin region in search of horses (Kessell 2002). These circumstances led the government in Santa Fé to enter into numerous treaty agreements and alliances with nomadic tribes throughout the period in an effort to bring an end to instability in the region (Dozier 1983; Torrez 2010a).

Assuming the governorship of Nuevo México in 1778, Juan Bautista de Anza immediately focused on subduing the hostile nomadic tribes of the region. Although Anza's advisors insisted on alliance with the Comanche to combat the Apache, the governor chose to actively campaign against the Comanches led by "the cruelest scourge of the colony," Cuerno Verde, as a show of force (Kessell 2002). Campaigning in the fall of 1779, Anza's army consisted of approximately 400 soldiers, Hispanic militia, and Pueblo auxiliaries that were augmented en route by some 200 Ute and Jicarilla Apache. The army located and destroyed Cuerno Verde's main encampment near present-day Colorado Springs. Returning from a raid in Nuevo México, Cuerno Verde's light cavalry was intercepted by Anza's army. All of the Comanche, including Cuerno Verde and his second-in-command, Jumping Eagle, were killed. Although not immediate, Anza's campaign against Cuerno Verde eventually brought Comanche leaders to the peace table, and in 1786 Comanche representatives signed a formalized treaty granting trade rights and alliance with the Spanish Province. Within a month of signing the treaty with the Comanche, similar terms were accepted by the Navajo (*ibid*).

Throughout much of the eighteenth century, expansion of the province remained confined to the Rio Grande Valley. In an effort to expand the province beyond the river, the provincial government awarded community grants to groups who agreed to establish settlements and cultivate land on the frontier. The primary recipients of community grants to settle the frontier

were *mestizos* and the *genízaro*, a cultural group consisting of Native Americans who no longer held any tribal identity. Settlements established by community grants include Tomé (1739), Santa Rosa de Lima de Abiquiú (1742), and San Miguel del Vado (1794). These settlements and others like them provided a significant contribution to the overall defense of the provincial frontier well into the nineteenth century (Torrez 2010b).

In the early years following the reconquest, transportation costs restricted exports of material goods to the south, and self-supporting ranches limited the internal market (Mosk 1942). Due to these limitations, sheep (which could easily be driven to external markets) became a medium of exchange for imported consumer goods. The estates of the *ricos* (upperclass land owners awarded individual land grants) came to be predominantly operated as sheep ranches, and the *ricos* came to dominate the livestock market within the province, gaining significant control over the local economy (Baxter 1987; Mosk 1942).

The first significant mining operation in the region occurred in the Pinos Altos in 1800, when Lieutenant Colonel José Manuel Carrasco and Don Manuel Francisco Elguea obtained a land grant for a copper mine called Criadero de Cobre (Copper Nursery). By 1805, 600 workers and their families lived near the mine at the settlement of Santa Rita del Cobre. Throughout this period, mule and ox teams transported smelted copper from the mine 400 miles south to Chihuahua City via the Janos Trail, where the copper was further refined for shipment to Mexico City along the Camino Real (Couchman 1990; Sinclair 1985).

It is estimated that the indigenous population in 1600 consisted of approximately 30,000 to 40,000 Pueblo inhabitants. By the end of the revolt in 1680, the population had been reduced to 14,000, resulting in the abandonment of villages that had been previously occupied for centuries. Pueblo society, as well as that of their nomadic neighbors, was greatly affected by the introduction of Spanish material culture, domesticates, and craft techniques (Dozier 1983). Of particular significance was the acquisition of horses by the nomadic tribes of the region. Mastery of the horse provided the Apache and Navajo greater mobility within their home ranges, and ultimately provided the means by which they could retain their autonomy (Kessell 2002; Rothman 1991). In fact, livestock became so important to the Navajo and Apache that neither community wished to drive the Spanish from the country, but rather exploit the source of supply (Basso 1971; Spicer 1962).

Pimería Alta (1691 to 1821)

The first sustained contact with Europeans in the territory encompassing present-day Arizona began in 1691, with the establishment of Padre Eusebio Francisco Kino's Jesuit mission program in the Santa Cruz and San Pedro valleys, a region known as the Pimería Alta to the Spaniards of the day (Doelle 1984; Trimble 1989; Whittlesey et al. 1994a). At this time, European settlement consisting primarily of miners and ranchers remained confined to the Santa Cruz River valley, due to the threat of Apaches on the frontier east of the San Pedro River (Ezell 1983; Whittlesey et al. 1994a).

Immigration to the region increased, following the discovery of silver at Planchas de Plata near Bernardo de Urea's *Arizona* ranch in 1736 (NPS 2010a; Trimble 1989). As more settlers moved into the Pimería Alta, tensions between O'odham groups and Spanish settlers increased,

culminating in the Pima Revolt of 1751. The uprising was quickly put down, and in 1753 Spanish authorities established a *presidio* (fort) at Tubac (Presidio San Ignacio de Tubac) (Trimble 1989; Whittlesey et al. 1994a). Increasing hostilities with the Apache forced the provincial government to begin the construction of Presidio San Agustín del Tucsón in 1775; and in 1776 military forces were moved from Tubac to the Tucsón presidio (Dobyns 1976; Whittlesey et al. 1994a). During this period, a policy of aggressive military action known as the Galvez Plan, combined with bribery in the form of rations, was used to placate the Apache. The policy brought relative peace to the region by the 1790s, as many Apaches came to live at rancherías established near the presidios. With the Apache threat curtailed, a period of unimpeded regional development occurred, bringing increased settlement centered on cattle ranching and mining operations (Bancroft 1889; Trimble 1989).

Mexican Period (1821 to 1848)

Following independence from Spain in 1821, economic instability and periodic civil war greatly affected the newly established Mexican government's ability to maintain control in the far northern reaches of the country. In Nuevo México, these circumstances fostered an atmosphere of semiautonomy characterized by the strengthening of provincial institutions such as *partido*, settlement expansion, and increasing economic dependence on the United States. In northern Sonora (Pimería Alta), revenue was diverted to the capital in Mexico City, and state payrolls that included provisions for the presidios and rations for the Apache were cut. Discontented, the Apache left their presidio *rancherías*; and by 1831, almost all of the Chiricahua Apache bands went to war. From 1831 to 1848, 3,000 to 4,000 Hispanic settlers fled the northern frontier of Sonora in response to Apache raiding. No Mexican settlement remained in the region except at the Tucson and Tubac presidios, where a few settlers managed to live under the protection of the garrisons' troops (Bancroft 1889; Lavender 1980; Trimble 1989). Following the annexation of Texas in 1846, the United States exerted pressure on Mexico to cede New Mexican territory east of the Rio Grande. Mexico refused to recognize any of the United States' claims west of the Nueces River in Texas, and war quickly followed (Prince 1883). In August of 1846, American forces took Santa Fé; and in December of that same year, an American cavalry regiment engaged and defeated a Mexican force at the Battle of El Brazito, just south of Mesilla, ending any further military actions in New Mexico for the course of the war (Lavender 1980; Simmons 1977).

American Period (post-1848)

The Mexican-American War ended with the signing of the Treaty of Guadalupe Hidalgo in 1848. Under terms of the treaty, Mexico ceded all land north of the Gila River in present-day Arizona and its New Mexico territory. With the Gadsden Purchase of 1854, the United States acquired the rest of the land south of the Gila River to the present-day international boundary with Mexico. This newly acquired territory remained a part of the New Mexico Territory. Following annexation, the United States government quickly established a series of military forts and began the first inventories to map waterways and springs, soils and climate, and search for potential wagon and railroad routes. Prior to the arrival of American forces in southern Arizona, a mining party led by Charles Poston arrived in the region, reopening old mines and establishing new ones in the Santa Rita and Cerro Colorado mountains. Proving successful, the mining ventures attracted a number of Mexican settlers to the area, particularly around Tubac, which became a

thriving community for a number of years. In 1856, the Army established Fort Buchanan south of Tucson near present-day Sonoita (Trimble 1989). In 1858, the Butterfield Overland Mail began twice weekly stage and mail service in the region. From Franklin, Texas (present-day El Paso), the stage route crossed New Mexico along a new road constructed under the direction of the Secretary of the Interior to link up with portions of the previously established Gila Trail to Yuma in the Arizona Territory (Lavender 1980; Trimble 1989).

Upon the South's secession from the Union in the spring of 1861, many enlisted men and officers of the South serving in the Army in Arizona left to return home to fight for the Confederacy. The Arizona forts were abandoned, and many Union soldiers joined their compatriots in New Mexico in expectation of a Confederate invasion. At this time, the Butterfield Overland Mail discontinued service through the territory. At the start of the Confederacy's New Mexico campaign in 1862, a company of mounted infantry under the command of Captain Sherod Hunter took Tucson. Approximately 2,300 federal troops from California immediately threatened Hunter's position. Captain Hunter attempted to destroy the Union's supply stores along the Gila River, in anticipation of the federal troop's advance on the territory. These events lead to the westernmost battle of the Civil War, the Battle of Picacho Pass, a 90-minute skirmish between two patrols of the California Volunteers and Confederate pickets encamped in the vicinity of Picacho Peak. The battle resulted in four deaths (two Union and two Confederate) and several wounded. With the California army approaching Tucson, Hunter gathered his outnumbered forces and retreated east to Texas. Eight months later on February 24, 1863, President Abraham Lincoln signed legislation giving Arizona legal territorial status with its present-day boundaries (Lavender 1980; Trimble 1989).

Following the subsequent federal reoccupation of Arizona and New Mexico, immediate concerns focused on tribe removal and resettlement. Subjugation and resettlement of the Apache, particularly the Chiricahua, proved difficult for the United States government, and final peace would not be achieved until surrender of Geronimo and the last of his band of some two dozen followers in 1886 (Lavender 1980; Trimble 1989). Although the sedentary Pima and Papago of southern Arizona had provided supplies to immigrants bound for California during the gold rush, labored on Anglo ranches in the Santa Cruz Valley, and fought with troops against the Apache throughout the 1860s, Anglo settlers insisted on appropriating Pima and Papago lands. To that end, the United States government instituted a system of reservation lands for the various tribal groups (Pritzker 2000). The Navajo were restricted to ancestral lands in northwestern New Mexico, while the Kiowas, Arapahos, and southern Cheyennes were forced to relocate to a reservation at Fort Sill, Oklahoma (Lavender 1980). Subjugation and resettlement of the Apache, particularly the Chiricahua, proved difficult for the government, and final peace would not be achieved until the surrender of Geronimo and the last of his band of some two dozen followers in 1886 (Lavender 1980; Trimble 1989).

Rural and industrial development increased unimpeded throughout the western territories in the 1870s. During this period ranching and homesteading expanded throughout the territory. Although gold and silver initially attracted mining development, copper was needed for emerging technologies, such as electrical cable and telephone wire, and became the most important mineral resource in the region (Lavin 2001; Roberts and Roberts 2006; Williams 1986). Following the arrival of the railroad in the 1880s, settlement and agricultural and industrial development increased exponentially. Hundreds of new settlements emerged alongside

the various railroad stations, depots, and sidings (Myrick 1990; Roberts and Roberts 2006). Beginning in the 1890s, the first of numerous reclamation projects to come were undertaken by the federal government, involving the construction of dams, reservoirs, and canals throughout the region's river valleys (Clark 1987; Trimble 1989).

On January 6, 1912, the Territory of New Mexico became the forty-seventh state admitted to the United States (Lavin 2001; Roberts and Roberts 2006). Populations continued to increase during this period, yet the state remained rural in character and economically dependent on mining and agriculture. Tourism helped boost New Mexico's economy throughout the 1920s; however, the Great Depression of the 1930s hit, agricultural prices fell, mines closed, and populations declined. On February 14, 1912, the Arizona territory became the last contiguous state admitted to the United States (Lavin 2001; Roberts and Roberts 2006). Following the United States' entry into World War II, natural resources of the Southwest were in high demand, and production of raw materials increased; but the greatest changes occurred in the manufacturing and service industries. With the expanding manufacturing sector, a significant portion of the rural population migrated to the major centers at Phoenix and Tucson, contributing to the loss of their small-town characters (Nash 1987; Sheridan 1995).

Following the United States' entry into World War II, natural resources of the Southwest were once again in demand. Production of raw materials increased; but the greatest changes occurred in the manufacturing and service industries. With the expanding manufacturing sector, a significant portion of the rural population migrated to Albuquerque, contributing to the loss of its small-town character (Nash 1987; Sheridan 1995). In the post-war years, hundreds of thousands of acres of land were either withdrawn from the public domain or condemned for various military programs deemed crucial for national defense. To this day, the Los Alamos and Sandia laboratories, WSMR, and Holoman and Kirtland AFBs sustain much of New Mexico's economy (Chávez 2002; Simmons 1977).

3.8.2.4 Cultural Landscape and Historic Trails

The following briefly discusses the known cultural landscape associated with the Salinas Pueblo Missions National Monument, El Camino Real de Tierra Adentro NHT and the Butterfield Overland Mail Trail. Although numerous historic trails are known to be located within the review area (e.g., Coronado, Anza, Zuñiga), the exact routes for many of these trails remain unknown.

Salinas Pueblo Missions National Monument – Gran Quivira

The Salinas Pueblo Missions National Monument contains the remains of pueblo ruins and large Spanish colonial mission complexes. The monument has four different periods of significance, including Pit House (AD 800 to AD 1200), Ancestral Puebloan (AD 1200 to AD 1629), Spanish Mission (AD 1540 to AD 1672), and Settlement (AD 1875 to AD 1909) (NPS 2010b). Prehistoric archaeological features include pit houses, jacal structures, a pueblo, kivas, and plazas. The Salinas pueblos served as a contact point and center of the salt trade between the Pueblo Indians, Plains Indians, and Spaniards. Prehistorically, the Salinas basin was settled by Tiwa and Tompiro-speaking Puebloans (Ivey 1998). Gran Quivira was an early site of Spanish contact and missionary activity; Franciscan priests from other missions were assigned to the

village to convert the locals to Catholicism (*ibid*). During the nineteenth century, homestead grants provided land to settlers in the area (NPS 2010a). The site of Gran Quivira plays an important role in the development of Southwest archaeology because Adolph Bandelier and Edgar L. Hewett conducted studies at the site.

Salinas Pueblo Missions National Monument – Gran Quivira Cultural Landscape Inventory

The NPS conducted a Cultural Landscape Inventory of the Gran Quivira in 2010 that defined the landscape as a 610-acre parcel containing pueblo ruins and Spanish mission structures. It is one of three identified component landscapes within the larger parent landscape that also includes Abó and Quarai. A detailed review of the archaeological and historical significance of Gran Quivira is provided, emphasizing the interrelationship of the architectural remnants with the human modified landscape elements (*ibid*). The integrity of the property is evaluated based on the seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. The cultural landscape for Gran Quivira includes the following 13 components:

- Archaeological sites
- Buildings and structures
- Circulation
- Cluster arrangement
- Constructed water features
- Cultural traditions
- Land use
- Natural systems and features
- Small-scale features
- Spatial organization
- Topography
- Vegetation
- Views and vistas

Gran Quivira, also known as Las Humanas, lies atop a ridge amidst the rolling piñon and juniper scrubland and grassland of central New Mexico. The site was historically used for hundreds of years by Native Americans, prior to Spanish colonization of the area in 1598. In that year, Franciscan missionary activity began with the designation of Las Humanas as a *visita* (settlement that lacked a resident priest) of the mission San Gregorio de Abó (Toms and Roop 2006:9). Missionary activities converted natives to Catholicism and used the native population to extract goods from the region following the encomienda system. Drought and famine resulted in the abandonment of the pueblos and mission by 1672; the pueblos remained so until the nineteenth century. From 1875 into the early twentieth century, homesteads were settled in the area, using the landscape for agricultural purposes. The first archaeological investigations of the site also began around this time. In 1909, Congress established the Gran Quivira National Monument, seeking to preserve the pueblo and mission ruins at Gran Quivira (NPS 2010b).

From its establishment, Gran Quivira has remained under federal management. Today, features at Gran Quivira include the buried remains of ancient pit houses; surface remnants of jacal structures; and a prehistoric and historic Tompiro Indian pueblo that developed over four hundred years, consisting of 20 house mounds (2 are fully excavated and 5 are partially

excavated), 14 kivas (6 stabilized), and several plazas. Also present are two Franciscan mission churches with accompanying conventos and a cemetery, which were part of the Spanish mission complex in place prior to the 1680 Pueblo Revolt. The pueblo and mission buildings are constructed of gray limestone, unique among the pueblos and missions. Additional resources include nineteenth- and twentieth-century homestead debris, archaeological excavations, dams, earthen detention basins, treasure pits, and contemporary visitor facilities (NPS 2010b). These features are listed either as contributing or non-contributing to the cultural landscape.

Interestingly, the site has no perennial water source, which causes much discussion of the survival strategies of the early village inhabitants. Apart from a modern well on NPS property, the nearest surface water source is a spring at Montezuma Ruin, 2 miles southwest of Gran Quivira (Hayes 1981:6; Toulouse 1943:3) (*ibid*).

The unit is categorized as both historic vernacular (Pueblo) and historic designed landscape (Spanish mission), and has national significance under National Register Criteria A, B, C, and D. There are four periods of significance associated with the site, including the Pit House Period (800-1200), Ancestral Puebloan Period (1200-1629), Spanish Mission Period (1598-1672), and Settlement Period (1875-1909) (*ibid*).

Overall, Gran Quivira is in good condition and retains integrity. The original materials and design are clearly evident in the ruins, although the height of the walls has lowered with time. The association with prehistoric people's adaptation to life in the landscape and with European exploration and colonization of North America is evident through the remaining landscape features (*ibid*). It is sited within a panoramic scenic vista with minimal visual intrusions or modifications to the south. Regional modifications to the north of Gran Quivira include a wind farm, pipelines, ranches, NM Highway 55, and other paved or unpaved roads.-

Gran Quivira is a contributing component of the NRHP-listed Salinas Pueblo Missions National Monument. The New Mexico SHPO concurred that the views from Gran Quivira to the surrounding landscape are a contributing element to the property as a whole.

Proposed transmission line corridor E84a/E86a/E86b extends east-west, approximately 4.3 miles north of Gran Quivira. Two alternative transmission line corridors (MOD-15 and MOD-10) remain under consideration. For a discussion of potential visual impacts, see Section 4.9.3.1.

Historic Roads and Trails

Contextually, Historic Period trails within the current study area represent transportation corridors associated with military exploration and economic activities. However, two specific historic properties (El Camino Real de Tierra Adentro [Royal Road to the Interior Land] NHT and the Butterfield Overland Mail Trail) are significant transportation corridors whose alignments are known with some degree of precision. The Camino Real has been designated a NHT, and the Butterfield Trail (AZ T:14:61[ASM]; LA 131080) has been determined to be eligible for the NRHP by both states.

In assessing potential effects to historic roads, Keane and Bruder (2003) suggest that if a linear property, such as a road, is largely eligible due to retaining its historic integrity in regards to

setting, then the installation of a new transmission line parallel to the property could be considered an adverse effect. As such, intact high potential segments of the Camino Real and Butterfield Trail that retain their historic integrity have the potential to be impacted not only through ground disturbing activities, but also visually by construction of transmission lines. Like many historic trails, the present-day alignment of these two trails consists of discontinuous segments, features, and associated sites that must be evaluated individually for integrity and significance; potential impacts can thus vary across the length of the trail. (The inventory and assessment of National Historic and Scenic Trails is included in Appendix L.)

El Camino Real de Tierra Adentro

Established at the turn of the seventeenth century, the New Mexico portion of the road represents an approximate 400-mile extension of the Royal Road that previously extended from Mexico City to Nueva Vizcaya (present-day Chihuahua, Mexico). As such, the road represented not only a means of support from the capital approximately 2,000 miles away, but a symbol of the Spanish Crown's commitment to the region. In the eighteenth century, the road became known as the Chihuahua Trail. From El Paso del Norte (present-day Ciudad Juarez), the road paralleled the Rio Grande north to San Gabriel, and later to Taos Pueblo (Levine 1999; Pike 2004). A present-day alignment derived from BLM and NMCRIS data and aerial photography indicates that the Camino Real trends along the eastern bank of the Rio Grande in southern New Mexico. At a fork just south of Mesa del Contadero, the Camino Real alignment splits into two separate roads. The westernmost alignment circles around the west side of the mesa, where it extends northwest across the Rio Grande and follows a northerly route approximately 1.0 mile west of the river. The easternmost alignment continues around the east side of the mesa and extends north along the east bank of the river. An east-west road connects the two Camino Real alignments on the north side of Mesa del Contadero.

Given the length of time the Camino Real was in service, it should exhibit a fairly strong archaeological signature at the surface. The predictive archaeological signature for the road includes, but is not limited to: a hard packed surface of varying width (up to 10.0 meters) that is largely devoid of vegetation; utilitarian and trade-ware ceramics/pottery attributable to Native American, Spanish/Mexican, and American producers spanning the sixteenth to the nineteenth centuries; weaponry (predominately Spanish); uniform paraphernalia, such as buttons, buckles, and cap devices; metal pots, pans, and flatware associated with food preparation and consumption; barrel hoops; glassware; metal wagon/cart parts; metal horse tack such as harness, bridle, and saddle parts; and trade goods. Spatially, these materials would be expected on the flanks of the road where clusters corresponding to campsites and springs (*parajes*) may also be encountered.

Proposed transmission line corridors E180 and A140 cross the Rio Grande near Socorro, New Mexico. The Camino Real closely parallels the river on the east and west banks.

Butterfield Overland Mail and Stage Route

Also known as the Butterfield Trail, this government-sponsored private enterprise began twice-a-week stage and mail service through the region in 1858. From Franklin, Texas

(present-day El Paso), the stage route crossed New Mexico along a new road constructed under the direction of the Secretary of the Interior to link up with portions of the previously established Gila Trail to Yuma. In Arizona, portions of the previously established Mormon Battalion Trail (later Gila) were used by the Butterfield Trail. Operating 24 hours a day, the twice-weekly stage crossed southern New Mexico and Arizona, stopping for fresh horse teams at stage stations located every 20 to 40 miles along the route. In service for 2.5 years, the stage only halted operations once during an episode of Chiricahua hostilities. Following the South's secession from the Union in the spring of 1861, the Butterfield Overland Mail discontinued service through the territories, and shifted its route north to the central overland route (Lavender 1980; Trimble 1989). Intersections of the proposed transmission line corridors with the Butterfield Trail are derived from BLM, AZSITE, and NMCRIS data, as well as from aerial photographs.

Short-lived as it was, the surface signature of the Butterfield Trail may not be as easily recognizable as the Camino Real; however, the material culture associated with the line may be quite substantial. According to Trimble (1989:98), many of the passengers drank excessively to pass the time on the long journey across Arizona, and modern pilots claim that the trail alignment is visible from the glitter of all the broken glass from the bottles tossed from the coaches. Although this anecdote may be hyperbole, the predictive archaeological signature for the trail includes, but is not limited to: remnants of the trail (i.e., ruts or unusual vegetative patterns associated with decayed ruts); architectural features associated with stage stations such as corrals/stables, water basins, packed-earth floors, masonry walls/foundations, and privies; tin, ceramic, and glass containers; and metal pots, pans, and flatware associated with food preparation and consumption.

The University of New Mexico, Office of Contract Archaeology, previously conducted survey along portions of the Butterfield Trail corridor in southern New Mexico. However, none of the previously recorded alignments (LA99184) was recorded in the proposed corridor segment locations (Gerow 1993).

Proposed transmission line corridors F40b, F600, B150a, B140, B111, B120b, A440, and A430/A481 cross segments of the Butterfield Overland Mail and Stage Route in New Mexico and Arizona.

3.8.3 Summary of Inventory Results

This section provides the results of the Class I study, Class II inventory, and sensitivity analysis within 0.25 mile of the route alternatives.

3.8.3.1 Class I Study Results

The Class I Study includes two components: the amount of previously inventoried area and the number of previously recorded cultural resource sites in the study corridor.

Previously Conducted Inventories

Approximately 8 percent of the Class 1 study corridors for all alternative subroutes have been inventoried for cultural resources. Table 3-36 highlights the small percentage of the area that has

been inventoried. Although there are data gaps for each of the subroutes, the Class I study does allow for calculations of site density for those sections of the subroutes that have been previously inventoried.

Table 3-36. Percentage of Previously Inventoried Areas within Study Corridors

Subroute	Total Acres	Acreage Not Inventoried	Acreage Inventoried	Percent Inventoried
1A1	73,270	67,349	5,921	8
1A2	73,744	67,729	6,015	8
1A	72,748	67,593	5,155	7
1B1	71,621	66,552	5,069	7
1B2	67,035	61,899	5,136	8
1B2a	68,162	62,304	5,858	9
1B3	66,072	61,018	5,054	8
3A2	39,774	38,512	1,262	3
3A	39,620	38,055	1,565	4
3B	41,244	39,123	2,121	5
4A	42,571	40,140	2,431	6
4B	42,593	41,588	1,005	2
4C1	44,541	41,711	2,830	6
4C2	48,650	43,168	5,482	11
4C2a	44,210	41,443	2,767	6
4C2b	47,207	43,863	3,344	7
4C2c	51,672	45,613	6,059	12
4C3	55,387	39,996	15,391	28
Percentage	—	**92**	**8**	—

Table 3-37 provides the information used to calculate the site density for each of the subroutes.

Table 3-37. Summary of Site Density by Subroute

Subroute	Acreage Not Inventoried	Acreage Inventoried	Sites in Area Inventoried [1]	Sites in Area Not Inventoried	Site Density (per 100 acres)
1A1	67,349	5,921	25	25	0.42
1A2	67,729	6,015	31	19	0.52
1A	67,593	5,155	33	39	0.64
1B1	66,552	5,069	34	38	0.67
1B2	61,899	5,136	35	27	0.68
1B2a	62,304	5,858	30	18	0.51
1B3	61,018	5,054	33	28	0.65
3A2	38,512	1,262	14	8	1.11
3A	38,055	1,565	22	11	1.41
3B	39,123	2,121	31	8	1.46
4A	40,140	2,431	53	29	2.18
4B	41,588	1,005	30	22	2.99
4C1	41,711	2,830	69	46	2.44
4C2	43,168	5,482	49	30	0.89
4C2a	41,443	2,767	51	11	1.84
4C2b	43,863	3,344	49	11	1.47

Table 3-37. Summary of Site Density by Subroute					
Subroute	**Acreage Not Inventoried**	**Acreage Inventoried**	**Sites in Area Inventoried [1]**	**Sites in Area Not Inventoried**	**Site Density (per 100 acres)**
4C2c	45,613	6,059	46	11	0.76
4C3	39,996	15,391	312	104	2.03

[1] Sites in this column only represent those sites that are identified within the previously inventoried area – so that the site density of inventoried areas could be calculated. Other sites are often located in other areas that have not been previously inventoried. Therefore, the total number of sites within this table will not be consistent with tables 3-35, 3-36, and 3-37.

Site density varies among the subroutes, ranging between 0.42 and 2.99 sites per 100 acres, and is not dependent on the amount of previous inventory or the length of the subroute.

Previously Recorded Sites

This section presents the previously recorded sites that were identified in the Class I records review. Results are presented by route group and subroute. Data include the types of sites present and their NRHP eligibility.

3.8.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

The records review identified 124 cultural resources within the study corridors of Route Group 1 (Figure M8-1E). These resource types are listed in Table 3-38 and discussed by subroute (below).

Table 3-38. Cultural Resources within Route Group 1 Study Corridors				
Resource Type	**Quantity**	**Percent Eligible**	**Percent Ineligible**	**Percent Unevaluated**
Archaeological district	1	100	0	0
Archaeological site, poorly documented	9	0	22	78
Cemetery or burial(s)	1	0	0	100
Feature(s) of indeterminate age	3	0	0	100
Historic feature(s) with artifacts	6	0	0	100
Historic homestead or structure(s)	11	36	9	55
Historic trail	3	33	0	67
Historic transportation or utility feature(s)	1	0	0	100
Historic trash scatter	10	0	0	100
National Historic Trail	1	100	0	0
Prehistoric artifact scatter	46	17	9	74
Prehistoric habitation site	20	15	0	85
Prehistoric site with feature(s)	12	8	8	84
Total Sites/Average Percent	**124**	**24**	**4**	**72**

Note: Percentages have been rounded to the nearest whole number and may not total exactly.

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the proposed SunZia East Substation, heads west across Chupadera Mesa to the Rio Grande crossing at Socorro, then heads south through the Rio Grande Valley to the

proposed Midpoint Substation. Subroute 1A1 passes across or near (within 0.25 mile) several well-known cultural resources, including 1 NHT (El Camino Real de Tierra Adentro) and 3 historic trails (Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion, and Butterfield). Another possible route for the El Camino Real de Tierra Adentro appears to parallel the subroute east of the Rio Grande for approximately 4 miles before it heads north through the Sevilleta NWR. Subroute 1A1 also passes through 2 habitation sites. Additional historic resources within 0.25 mile of Subroute 1A1 consist of 1 cemetery or burial, 8 homesteads or structures, 1 site with transportation or utility features, 2 trash scatters, 2 sites with features and artifacts, and 2 sites with features of indeterminate age. Prehistoric cultural resources within 0.25 mile of Subroute 1A1 consist of 15 habitation sites, 6 sites with features, 25 artifact scatters, and 3 sites for which little information is available.

Although not located within the Class I study area, the Gran Quivira is located approximately 4.25 miles south of Subroute 1A1. More discussion of potential visual impacts to the Gran Quivira is presented in Section 4.9.3.1.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 varies slightly from 1A1 by using links E86a and E86b, north of Subroute 1A1, from node 118 to node 143. Nine prehistoric and historic cultural resources are located within 0.25 mile of Subroute 1A2. Historic resources include 1 homestead and 1 site with features and artifacts; prehistoric sites include 1 habitation, 3 artifact scatters, and 3 multicomponent artifact scatters (including 1 with features). The historic homestead and one of the prehistoric artifact scatters are crossed by Subroute 1A2.

Subroute 1A – North River Crossing

Subroute 1A is similar to Subroute 1A1, with the exception of links A22, E80c, and A260. Another possible route for the El Camino Real de Tierra Adentro appears to parallel the subroute east of the Rio Grande for approximately 4 miles before it heads north through the Sevilleta NWR. Historic resources within the 0.25-mile-wide study corridor that are specific to Subroute 1A include 2 homesteads or structures; prehistoric sites within the 0.25-mile study corridor that are specific to Subroute 1A include 6 habitation sites, 2 sites with features, and 9 artifact scatters.

Additional resources identified within 5 miles of Subroute 1A that have the potential to be visually impacted are the Camino Real de Tierra Adentro NHT, the Gila Trail Route, the General Cooke's Wagon Road/Mormon Battalion Trail, and the Butterfield Trail. Although not located within the Class I study area, the Gran Quivira unit is located 5.6 miles north of Subroute 1A, and between 1.3 and 5.6 miles from several local alternatives of the subroute. More discussion of potential visual impacts to the Gran Quivira is discussed in Section 4.9.3.1.

Subroute 1B1 – San Antonio Crossing

Subroute 1B1 is similar to Subroute 1A1, except that the route follows the southern alternative around Gran Quivira, continues to Mesa Redonda (Link E90), and proceeds south to cross the Rio Grande at San Antonio (Figure M8-1E). Historic resources within the 0.25-mile study

corridor that are specific to Subroute 1B1 consist of 1 cemetery or burial, 6 homesteads or structures, and 2 trash scatters; prehistoric resources within the 0.25-mile study corridor that are specific to Subroute 1B1 include 8 habitation sites, 7 sites with features, 17 artifact scatters, and 3 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B1 that have the potential to be visually impacted are the Camino Real de Tierra Adentro NHT, the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, the Butterfield Trail, and the Playas Pueblos Archaeological District. Although not located within the Class I study area, the Gran Quivira is located 5.6 miles north of Subroute 1B1, and between 1.3 and 5.6 miles from several local alternatives of Subroute 1B1. More discussion of potential visual impacts to Gran Quivira is discussed in Section 4.1.3.2.

Subroute 1B2 – San Antonio Crossing

Subroute 1B2 differs from Subroute 1A1 as it proceeds west then south from the SunZia East Substation until it crosses the Rio Grande at San Antonio. Historic resources within the 0.25-mile study corridor specific to Subroute 1B2 include 4 homesteads or structures and 4 trash scatters; prehistoric resources within the 0.25-mile study corridor specific to this subroute include 2 habitation sites, 5 sites with features, 16 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B2 that have the potential to be visually impacted consist of the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, and Playas Pueblos Archaeological District.

Subroute 1B2a – San Antonio Crossing

Subroute 1B2a is similar to Subroute 1B2, with the exception of Link A260 in place of Link A270. Segment A260 follows an existing transmission line east of I-10 in Sierra County and crosses back west of I-10 and north of Truth or Consequences to reconnect with Subroute 1B2. Historic resources within the 0.25-mile study corridor specific to this subroute include 4 homesteads or structures, 7 trash scatters, and 1 site for which little information is available; prehistoric resources within the 0.25-mile study corridor specific to this subroute include 5 habitation sites, 5 sites with features, 23 artifact scatters, and 7 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B2 that have the potential to be visually impacted consist of the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, and Playas Pueblos Archaeological District.

Subroute 1B3 – San Antonio Crossing

Subroute 1B3 differs from Subroute 1A1 as it proceeds west then south from the SunZia East Substation until it crosses the Rio Grande at San Antonio. Subroute 1B3 crosses the Mockingbird Gap Archaeological District. Additional historic resources within the 0.25-mile study corridor specific to this subroute consist of 6 historic homesteads or structures, 4 historic trash scatters, and 2 sites of indeterminate age; prehistoric resources within the 0.25-mile study corridor specific to this subroute include 2 habitation sites, 4 sites with features, 11 artifact scatters, and 4 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B3 include the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, Janos Copper Road route, and Playas Pueblos Archaeological District.

Local Alternatives and Crossover Links for Route Group 1

Local alternatives for Route Group 1 include links A161b and A361-A430-A481, which include known prehistoric sites and historic trail alignments. One known site, LA 27569, which is a prehistoric artifact scatter with features, is located along Local Alternative Link A161b.

In the Las Cruces area (Link A430), field investigations for the Butterfield Overland Mail and Stage Route identified segments of a trail alignment west of Las Cruces with associated artifacts dating to the twentieth century. Link A430 does not parallel any existing transmission lines in this location.

Local alternative links A361-A430-A481 also extend across the Gila and General Cooke's Wagon Road/Mormon Battalion trail alignments. Field investigations were conducted along Local Alternative Link A430 for the presence of the Butterfield Trail, segments of which were identified in these areas. The Gila and General Cooke's Wagon Road/Mormon Battalion trails were not included in this study.

Crossover Link A70 for subroutes 1B2 and 1B3 connects with Link A50 from Subroute 1B2 and with Link A80 from Subroute 1B3. Crossover Link A70 includes the Mockingbird Gap Historic Archaeological District and known site LA 67452, a historic house foundation and associated trash scatter. Field investigations would be needed to identify whether the construction and operation of the Project would affect the cultural resources within the Mockingbird Gap Archaeological District and site LA 67452.

3.8.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

The records review identified 91 cultural resources within the study corridors of Route Group 3. These resources are listed in Table 3-39 and discussed by subroute (below).

Table 3-39. Cultural Resources within Route Group 3 Study Corridors				
Resource Type	**Quantity**	**Percent Eligible**	**Percent Ineligible**	**Percent Unevaluated**
Archaeological site, poorly documented	2	0	0	100
Cave or rock shelter	2	50	0	50
Historic feature(s) with artifacts	5	100	0	0
Historic homestead or structure(s)	2	0	60	40
Historic trail	4	0	0	100
Historic transportation or utility feature(s)	3	33	33	33
Historic trash scatter	4	0	33	67
Prehistoric artifact scatter	35	0	0	100
Prehistoric habitation site	5	28	3	70
Prehistoric site with feature(s)	29	52	4	45
Total Sites/Average Percent	**91**	**30**	**10**	**60**
Note: Percentages have been rounded to the nearest whole number and may not total exactly.				

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 begins at the Midpoint Substation and proceeds west through the Deming area along links B60 and B90. From there it continues west along links B120a and B120b as it approaches the Lordsburg area, and then onto links B121, B160a, B160d, and B160c. No historic resources were identified within the 0.25-mile study corridor specific to Subroute 3A2. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 3A2 include 4 habitation sites, 3 sites with features, and 14 artifact scatters.

Additional resources identified within 5 miles of Subroute 3A2 include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, and Janos Copper Road route.

Subroute 3A – North

Subroute 3A is the same as Subroute 3A2 from the Midpoint Substation to Link B160a near Lordsburg, where Subroute 3A takes B160b west instead of B160d to the Willow-500 kV Substation. Historic resources within the 0.25-mile study corridor specific to Subroute 3A include 2 sites containing features and artifacts; prehistoric resources within the 0.25-mile study corridor specific to Subroute 3A include 1 habitation site, 3 sites with features, 9 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 3A include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, Janos Copper Road route, and the ghost town of Shakespeare.

Subroute 3B – South

Subroute 3B is the same as Subroute 3A2, except from Lordsburg to the Midpoint Substation. Although Subroute 3A2 already crosses the Butterfield, Gila, and General Cooke's Wagon

Road/Mormon Battalion trails, and Janos Copper Road at Links B120a and B120b, Subroute 3B crosses them again at links B110a and B112. Additional historic resources within the 0.25-mile study corridor specific to Subroute 3B include 2 homesteads or structures, 1 site with historic transportation or utility features, and 3 sites with features and artifacts. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 3B include 2 sites with features and 8 artifact scatters.

Additional resources identified within 5 miles of Subroute 3B include the Zuñiga route and the ghost town of Shakespeare.

Crossover Links for Route Group 3

Crossover Link B111 for subroutes 3A, 3A2, and 3B connect with Link B120b from Subroute 3A and Link B110a from 3B. Crossover Link B111 includes two historic trails (Butterfield and Gila). Field investigations conducted for the Butterfield Trail along Link B111 did not identify any physical segments of the trail (the Gila Trail alignments were not included in the study). Although no physical segments of the Butterfield Trail were observed, historic artifacts were recorded. No existing utilities were noted in the area.

Crossover Link B140 for subroutes 3A, 3A2, and 3B connects with Link B121 for Subroute 3A and Link B112 from Subroute 3B. Crossover Link B140 includes the Butterfield Trail. Field investigations conducted for the Butterfield Trail did not identify any physical segments; however, rock cairns were observed at this location. No existing utilities were noted in the area.

Tribal Concerns

In addition to the historic resources identified along subroutes 3A and 3B, consultation with the San Carlos and White Mountain Apache tribes revealed concerns regarding traditional plant gathering areas in the vicinity of Deming, New Mexico (see Section 3.8.4).

3.8.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

The records review identified 501 cultural resources in the area of Route Group 4. These resource types are listed in Table 3-40 and discussed by subroute (below).

Table 3-40. Cultural Resources within Route Group 4 Study Corridors

Resource Type	Quantity	Percent Eligible	Percent Ineligible	Percent Unevaluated
Archaeological district	2	100	0	0
Archaeological site, poorly documented	11	0	0	100
Cave or rock shelter	1	0	0	100
Cemetery or burial(s)	2	50	0	50
Historic district	6	100	0	0
Historic feature(s) with artifacts	22	27	18	55
Historic homestead or structure(s)	22	36	14	50
Historic landmark	1	100	0	0

Table 3-40. Cultural Resources within Route Group 4 Study Corridors				
Resource Type	**Quantity**	**Percent Eligible**	**Percent Ineligible**	**Percent Unevaluated**
Historic monument	1	0	100	0
Historic trail	5	20	0	80
Historic transportation or utility feature(s)	49	45	34	20
Historic trash scatter	21	19	29	52
National Historic Trail	1	0	0	0
Petroglyph site	3	0	0	100
Prehistoric artifact scatter	141	16	2	82
Prehistoric habitation site	37	43	0	57
Prehistoric site with feature(s)	176	23	9	68
Total Sites/Average Percent	**501**	**26**	**10**	**64**
Note: Percentages have been rounded to the nearest whole number and may not total exactly.				

Subroute 4A – North of Mt. Graham

Historic resources within the 0.25-mile study corridor specific to Subroute 4A include the Tom Mix Historic Monument, 1 historic site with features (Klondyke), 1 homestead or structure, 9 transportation or utility features, 1 historic trash scatter, and 3 historic features with artifacts. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4A consists of 6 habitation sites, 24 sites with features, and 3 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4A include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Zuñiga route, Juan Bautista de Anza route, Verdugo Homestead Historic District, and Camp Grant, including the Camp Grant Reservation/Camp Grant Massacre site.

Subroute 4B – Sulphur Springs Valley

Historic resources within the 0.25-mile study corridor specific to Subroute 4B include the Tom Mix Historic Monument, 1 historic site with features (Klondyke), 1 homestead or structure, and 6 sites with transportation or utility features. Prehistoric resources within the 0.25-mile study corridor specific to the subroute include 12 sites with features and 1 site for which little information is available.

Additional resources identified within 5 miles of Subroute 4B include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Zuñiga route, Juan Bautista de Anza route, Verdugo Homestead Historic District, Fort Grant, and Camp Grant, including the Camp Grant Reservation/Camp Grant Massacre site.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 differs substantially from Subroute 4C2c, sharing only the beginning and ending segments. Subroute 4C1 shares the same alignment from the Willow Substation to Willcox (Link 212) and then diverges until Link C830, where it shares the same alignment into the Pinal Central Substation. Historic resources within the 0.25-mile study corridor specific to Subroute 4C1 include the Tom Mix Historic Monument, 1 homestead or structure, 8 sites with transportation or utility features, and 1 trash scatter. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C1 consist of 8 habitation sites, 24 sites with features, 11 artifact scatters, and 4 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C1 include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 shares most of the same alignment as Subroute 4C2c; it diverges at Willcox to cross the San Pedro River near Cascabel, and reconnects at Link 441 as it continues along the west side of the San Pedro River. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C2 include 1 habitation site and 2 sites with features.

Additional resources identified within 5 miles of Subroute 4C2 include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2a – West of San Pedro River

Subroute 4C2a is similar to 4C2, with the exception of the segment between Oracle and the Pinal Central Substation (C690, C691, C693, C760, and C780), which follows an existing pipeline corridor for approximately 30 miles in Pinal County. Historic resources within the 0.25-mile study corridor specific to Subroute 4C2a include the Tom Mix Historic Monument, 13 sites with transportation or utility features, and 1 trash scatter. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C2a consist of 3 habitation sites, 2 petroglyph sites, 18 sites with features, 24 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C2a include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2b – West of San Pedro River

Subroute 4C2b is similar to 4C2a, with the exception of the segment between a point north of Willcox and the San Pedro River where Subroute 4C2b continues parallel to the existing 345 kV transmission lines for approximately 20 miles, and crosses the San Pedro River south of the Three Links Ranch in Cochise County (links C260, C261, and C201). Historic resources within the 0.25-mile study corridor specific to Subroute 4C2b include the Tom Mix Historic Monument and 13 sites with transportation or utility features. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C1 consist of 2 habitation sites, 15 sites with features, 24 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C2b include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c begins at the proposed Willow Substation, heads southwest toward Willcox, crosses the San Pedro River near Cascabel, proceeds north along the San Pedro River toward Oracle, then proceeds west along Link C680 toward the Tortolita Substation. At the Tortolita Substation, Subroute 4C2c heads north along Link C820, and at the northern end of the Picacho Mountains heads west into the Pinal Central Substation. Subroute 4C2c passes across or near (within 0.25 mile) three cultural resources, including 1 archaeological district (McClellan Wash) and 2 historic trails, the Butterfield, Southern Pacific Mail and Stage Line (Picacho to Florence route) and Zuñiga. Historic resources within 0.25 mile of Subroute 4C2c include 2 homesteads or structures, 15 historic transportation or utility features, and 2 sites with historic features and artifacts. Prehistoric cultural resources within 0.25 mile of the subroute include 1 cave/rockshelter, 2 petroglyph sites, 2 habitation sites, 20 sites with features, 16 artifact scatters, and 3 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C2c include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Juan Bautista de Anza route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C3 – Tucson

Subroute 4C3 is the same as Subroute 4C2c, except where 4C3 continues south around Tucson before heading north to the Tortolita Substation, and then north still to the Pinal Central Substation. Historic resources within the 0.25-mile study corridor specific to Subroute 4C3 include 6 historic districts (El Presidio, Rillito Race Track, Winterhaven, Barrio Anita, El Presidio, and Menlo Park), 2 historic landmarks (Fort Lowell and Colossal Cave Mountain Park), 2 cemeteries or burials, 20 historic homesteads or structures, 15 historic features with artifacts, 19 trash scatters, and 37 historic transportation or utility features. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C3 consist of 17 prehistoric habitation sites, 117 sites with features, 109 artifact scatters, and 3 petroglyphs.

Additional resources identified within 5 miles of Subroute 4C2c include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Saguaro National Park, Tumamoc Hill Archaeological District/Desert Laboratory NHL, Pascua Cultural Plaza, Binghampton Historic Rural Historic Landscape, and 24 historic districts (Verdugo Homestead, Rancho Linda Vista, Aldea Linda, Armory Park, Barrio Libre, Blenman-Elm, Catalina Vista, Colonia Solana, El Encanto Estates, El Montevideo, Indian House, Iron Horse Expansion, Jefferson Park, John Spring, Pie Allen, Rincon Heights, Sam Hughes, San Clemente, Santa Rosa, Speedway-Drachman, University of Arizona Campus, Warehouse, West University, and DeGrazia Gallery in the Sun).

Local Alternatives and Crossover Links for Route Group 4

Local Alternative Link C790 crosses known low and moderate sensitivity sites. Local alternative links for the proposed Pinal Central Substation for subroutes 4A, 4B, 4C1, 4C2, and 4C3 include C860, C870, and C890, which cross known low and moderate sensitivity sites as well as the Southern Pacific Mail Line (links C850 and C860). A proposed 500 kV transmission line would parallel the Project along this link.

Local Alternative Link C692 of Subroute 4C1 crosses two known high sensitivity sites: a habitation site (AZ AA:8:21[ASM]) and a petroglyph site (AZ AA:8:370[ASM]). Site AZ AA:8:21(ASM) is a large habitation site that contains 15 to 20 trash mounds, a ball court, and 2 structures. Site AZ AA:8:370(ASM) is an anthromorphic petroglyph located south of site AZ AA:8:21(ASM). Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local Alternatives for Subroute 4C2

Local alternative links for 4C2 include variations around the Willow-500 kV and Tortolita substations. Local alternative links C260-C261-C201 cross known low and moderate sensitivity sites, as well as one moderate-high sensitivity site. Site AZ AA:8:331(ASM) is a rockshelter located along Link C680. Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local alternative links C680-C820 of Subroute 4C2 include known low and moderate sensitivity sites as well as two moderate-high sensitivity sites. Site AZ AA:8:331(ASM) is a rockshelter located along Link C680. Site AZ AA:3:136(ASM) is a probable habitation site with possible adobe walls and a trash mound. Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local Alternatives for Subroute 4C3

Local alternative links for 4C3 include variations along Pantano Wash and Rillito Creek. Local alternative links F40b-F51-F60a, F81a-F81b, and C812 for Subroute 4C3 include 3 historic trails, 3 habitation sites, and 2 historic districts. Known low and moderate sensitivity sites are also present in the local alternative links.

Local Alternative Link F40b crosses the Butterfield Trail, but field studies near Benson did not identify any physical segment of the trail. An existing 345 kV transmission line parallels the Project in this area.

Local Alternative Link F81b crosses 3 historic trails (Butterfield, Zuniga, and General Cooke's Wagon Road/Mormon Battalion), 3 habitation sites, and 2 historic districts (Fort Lowell Multiple Resource Area and Rillito Race Track). In this area, two existing 138 kV transmission lines and one existing 115 kV transmission line are perpendicular to Link F81b. Further evaluation of the Butterfield, Zuñiga, and General Cooke's Wagon Road/Mormon Battalion trails would require field studies to verify the presence or absence of segments in these locations along Link F81b.

Three known habitation sites (AZ AA:12:10[ASM], AZ AA:12:781[ASM], and AZ BB:9:14[ASM]) are located along Link F81b. Site AZ AA:12:10(ASM) is a prehistoric habitation site and historic homestead. The prehistoric habitation component includes pit structures, canals, an artifact midden, and burials. The historic homestead is the 1893 adobe house of Basilio Cuevas with associated trash scatter. Site AZ AA:12:781(ASM) is a burial eroding out of the bank of the Santa Cruz River. Site AZ BB:9:14(ASM) is a multicomponent site. The prehistoric component includes a habitation site with pit structures, pit features, trash mounds, a ball court, and cremations. The historic component of the site is Fort Lowell. Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local Alternative Link F81b crosses the Fort Lowell Multiple Resources Area and Rillito Race Track historic districts. An existing 138 kV transmission line parallels the Project near the Fort Lowell Multiple Resources Area, but no known utilities are identified in the vicinity of the Rillito Race Track. Further evaluations of these historic districts would require field studies to verify the presence or absence of contributing components of the districts within the proposed tower locations.

Local Alternative Link C812 is compared to links C810-C816-C813-C814-C815 of Subroute 4C3. None of these links is associated with any known cultural resources.

Local Alternatives for Subroutes 4C1, 4C2, and 4C3

Local alternative links for subroutes 4C1, 4C2, and 4C3 include C72-C90-C121-C211. A known moderate sensitivity site is present in these alternative links.

Crossover links for subroutes 4A, 4B, and 4C1 include links C500, C501, C502, and C174. None of these links include any known cultural resource sites. Link C671 is the crossover link for subroutes 4A, 4B, 4C1, and 4C2, and includes one moderate sensitivity site.

Tribal Concerns

In addition to the historic resources identified along these subroutes, consultation with the San Carlos and White Mountain Apache tribes have identified tribal concerns regarding subroutes 4A and 4B through the San Simon and Sulphur Springs valleys due to proximity to Mount Graham, which they would like to be listed as a traditional cultural property. In addition, both tribes have

expressed similar concerns regarding subroutes 4A and 4B near Klondyke, Arizona, which represents a traditional plant gathering area. Both tribes, as well as the GRIC and the Tohono O'odham Nation, have expressed concern regarding subroutes through the San Pedro Valley (4A, 4B, 4C1, 4C2, 4C2a, and 4C2b) due to archaeological and natural resources in the area (see Section 3.8.4). The GRIC Tribal Historic Preservation Officer expressed a concern that electrical fields along transmission lines could interfere with spiritual communications between sacred sites. Of particular concern for the San Carlos Apache Tribe is the proximity of subroutes 4A and 4B to the former Camp Grant and Camp Grant Apache Reservation, site of the Camp Grant Massacre (see Section 3.8.2.2), which is of great cultural significance to the tribe.

3.8.3.5 Site Sensitivity Analysis Results

The site sensitivity analysis results are provided in Table 3-41. A majority of the Class I sites were ranked as moderate sensitivity.

Table 3-41. Sensitivity of Previously Recorded Sites by Subroute

	Site Sensitivity (number of sites and percentage)					
Subroute	**Low**	**Low-Moderate**	**Moderate**	**Moderate-High**	**High**	**Total**
1A1	10 (20%)	10 (20%)	17 (34%)	12 (24%)	1 (2%)	**50**
1A2	3 (6%)	27 (54%)	9 (18%)	9 (18%)	2 (4%)	**50**
1A	13 (18%)1	16 (23%)	24 (33%)	18 (25%)	1 (1%)	**72**
1B1	12 (17%)	17 (24%)	28 (39%)	14 (19%)	1(1%)	**72**
1B2a	8 (17%)	13 (27%)	22 (46%)	5 (10%)	–	**48**
1B2	11 (18%)	19 (31%)	25 (40%)	7 (11%)	–	**62**
1B3	15 (25%)	19 (31%)	20 (33%)	7 (11%)	–	**61**
3A2	–	7 (32%)	11 (50%)	3 (14%)	1 (4%)	**22**
3A	3 (9%)	7 (21%)	19 (58%)	4 (12%)	–	**33**
3B	7 (18%)	14 (36%)	16 (41%)	2 (5%)	–	**39**
4A	10 (12%)	8 (10%)	49 (60%)	12 (15%)	3 (3%)	**82**
4B	8 (15%)	7 (13%)	32 (62%)	5 (10%)	–	**52**
4C1	27 (23%)	16 (14%)	58 (50%)	11 (10%)	3 (2%)	**115**
4C2	7 (9%)	14 (18%)	49 (62%)	8 (10%)	1 (1%)	**79**
4C2a	12 (19%)	11 (18%)	36 (58%)	3 (5%)	–	**62**
4C2b	12 (20%)	13 (22%)	32 (53%)	3 (5%)	–	**60**
4C2c	6 (11%)	11 (19%)	31 (54%)	8 (14%)	1 (2%)	**57**
4C3	27 (7%)	103 (25%)	251 (60%)	18 (4%)	17 (4%)	**416**

[1]Percentages represent proportion of sites for each subroute within each sensitivity category (e.g., 18% of the sites in Subroute 1A have a low sensitivity ranking). Converting the site counts to proportions facilitates comparison among subroutes.

Route Group 1, Subroute 1A2, the BLM preferred alternative, has the lowest overall sensitivity. Although subroutes 1A2 and 1B2a have similar total number of sites, the majority of sites along the preferred alternative have low or low-moderate sensitivity. In Route Group 3, Subroute 3A2, the BLM preferred alternative, has a lower overall sensitivity for cultural resources than the other subroutes due to a lower number of sites. In Route Group 4, Subroute 4C2c, the preferred alternative, along with subroutes 4C2a and 4C2b, has lower sensitivity for cultural resources than Subroute 4C3.

3.8.3.6 Class II Inventory Results

A total of 42 sites were identified during the Class II inventory, ranging from small artifact scatters to large habitation sites, as well as intact components of the trail segments. The detailed results of the Class II inventory are provided in a separate report (Swanson and Rayle 2012).

The Class II inventory provides additional information about cultural resources at river and trail crossings for each of the alternative subroutes. These areas were selected for their high potential for cultural resources. River and trail crossings within each of the three route groups were investigated during the Class II inventory. In Route Group 1, Class II parcels included the northern and southern crossing of the Rio Grande as well as two crossings of the Butterfield Trail and four crossings of the El Camino Real de Tierra Adentro; Route Group 3 Class II parcels included two crossings of the Mimbres and San Simon rivers and four crossings of the Butterfield Trail; and Route Group 4 Class II parcels included one crossing of Aravaipa Creek, two crossings of Sulphur Springs, and four crossings of the San Pedro River. In addition, Route Group 4 had one crossing of the Butterfield Trail.

Portions of these Class II inventory areas could not be inventoried because landowner permission was denied or not obtained. Site density values for the Class II inventory (Table 3-42) area range from 0.61 to 3.5 sites per 100 acres, and are reflected in the portions that were actually surveyed.

Table 3-42. Site Density of Class II Inventory Areas by Subroute

Subroute	Acreage	Sites[1,2]	Site Density (per 100 acres)
1A[2]	308.9	6	1.9
1A1/1A2	198.9	6	3.0
1B1[2]	274.1	4	1.5
1B2[2]	274.1	4	1.5
1B3[2]	274.1	4	1.5
3A/3A2	487.1	19	3.9
3B	496.2	12	2.4
4A[2]	153.0	2	1.3
4B[2]	153.0	2	1.3
4C1[2]	182.3	4	2.2
4C2[2]	41.2	6	1.5
4C2c	284.5	5	1.8
4C3[2]	283.6	7	2.5

[1]The sites do not include the trail segments as part of the purpose of the Class II inventories were to evaluate whether the route alignment noted for the trails contained intact segments of the trails in the proposed Project areas. Trails were only added as sites, if there was an intact segment of the trail or associated feature.

[2] The subroutes share many of the same links, so if sites are identified on a particular link that is shared with more than one subroute, the site was counted for each subroute, artificially inflating the number of sites in the table. Therefore, the table will show more than the total number of sites that were recorded during the inventory.

Table 3-43 provides sensitivity values for cultural resource sites located within the Class II inventory areas. Most of the sites identified during the Class II inventories are within the moderate sensitivity category.

Table 3-43. Sensitivity of Sites Recorded during Class II Inventories						
	Sensitivity					
Subroute	Low Sensitivity	Low-Moderate Sensitivity	Moderate Sensitivity	Moderate-High Sensitivity	High Sensitivity	Total Sites
1A	—	1	1	4	—	**6**
1A1/1A2	—	1	1	4	—	**6**
1B1	—	—	3	—	1	**4**
1B2	—	—	3	—	1	**4**
1B3	—	—	3	—	1	**4**
3A	—	6	11	1	1	**19**
3A2	—	8	5	2	1	**16**
3B	—	8	3	1	—	**12**
4A	—	—	2	—	—	**2**
4B	—	—	2	—	—	**2**
4C1	—	2	2	—	—	**4**
4C2	—	1	5	—	—	**6**
4C2c	—	1	4	—	—	**5**
4C3	—	1	6	—	—	**7**
The total number of sites will not match the total number of sites that were recorded during the Class II inventory, since the subroutes share many of the same links; some sites will be counted more than once.						

The Class I and Class II data comprise the baseline inventory used for the analysis of impacts to cultural resources, as described in Chapter 4.

Camino Real de Tierra Adentro National Historic Trail

Survey of the two proposed transmission line corridors near Socorro, New Mexico (E140 and A180) revealed only one possible remnant trail alignment of the Camino Real. This alignment is on the east side of the Rio Grande and is the present-day Bosquecito Road. Bosquecito Road is a north-south trending, bladed-gravel and partially paved road that now occupies the former Camino Real trail corridor. Although no remnant trail was observed west of the river, SR 408 generally follows the Camino Real trail corridor on this side. No other traces of the trail were detected during the inventory.

Butterfield Overland Mail and Stage Route

The Butterfield Trail is crossed by eight proposed transmission line corridors and links. One crossing identified a modern road that follows what appears to be the same alignment as the Butterfield Trail (B150a). Several of the crossings did not identify any physical traces of the trail (F40b, F600), but did contain historic artifacts (B111); some have rock cairns (B120b, B140). Physical traces of the trail segments were identified at two crossings in New Mexico, west of Las Cruces (A440, A430/A481).

3.8.4 Tribal Consultation Meetings

The BLM has held 14 meetings with interested tribes. This section focuses on the cultural concerns expressed by tribes during those meetings. Following is a brief summary of the concerns and issues discussed. Consultation with the tribes is ongoing.

- July 21, 2009 meeting with the Four Southern Tribes Cultural Resource Working Group (Tohono O'odham Nation, Ak-Chin Indian Community, GRIC, and Salt River Pima-Maricopa Indian Community) of which representatives from the Tohono O'odham Nation and Ak-Chin Indian Community were present. The meeting identified requests for an ethnographic study and use of tribal members during the inventory.
- August 13, 2009 meeting with the Pueblo of Zuni identified requests for a field visit to discuss traditional use areas and other areas of concern. A better quality map showing the previously recorded sites was also requested.
- August 25, 2009 meeting with the Pueblo of Isleta identified concerns about the Bosque del Apache and Mesilla Valley areas, and the Rio Grande. The tribe noted that all things are sacred, but there was a specific concern regarding Golden and Bald eagles. The tribe also noted that they feel culturally connected to the Navajo, Mescalero, and Hopi, and therefore are also interested in sites located in Arizona.
- October 16, 2009 meeting with the Apache (Fort Sill Apache Tribe, Mescalero Apache Tribe, and San Carlos Apache Tribe) identified concerns regarding the Project either crossing or being in proximity to the tribe's proposed substation project near Akela. The tribe requested more detailed maps to evaluate their traditional use areas and inquired about the BLM hiring members of the tribe to conduct inventory for these areas. Ethnographic areas were internally divided by the Apache: San Carlos and White Mountain with the western area, Fort Sill with the central area, and Mescalero with the eastern area.
- April 14, 2010 meeting with the Tohono O'odham Nation resulted in a request for a formal presentation to their district council. There was an inquiry as to whether the Project could benefit the tribe. It was noted that previous projects that did not benefit the tribe did not receive approval.
- July 10, 2010 meeting with the Schuk Toak District Council of the Tohono O'odham Nation to present Project information. On November 6, 2010, the Schuk Toak District Council approved a resolution to oppose the SunZia Project.
- October 4, 2011 meeting with the Apache (San Carlos Apache Tribe and White Mountain Apache Tribe) identified concerns over routes within the San Simon and Sulphur Springs valleys, due to their proximity to Mount Graham, an area of great cultural significance that the tribes would like to be listed as a traditional cultural property. Plant gathering areas near Klondyke, Deming, and Duncan were also mentioned. In addition, the San Pedro Valley was noted to be of concern, due to the archaeological and natural resources in that area. The Apache noted that the Four Southern tribes, the Hopi Tribe, and the Pueblo of Zuni would also be concerned with these areas. Interest in using existing routes was expressed.

- July 20, 2012 meeting with the Four Southern Tribes Cultural Resource Working Group to present Project information, including the BLM preferred alternative as described in the Draft EIS. Representatives from all four tribes were present. The tribes inquired about the need for two similar projects in the same areas (SunZia Southwest Transmission Project and the Southline Transmission Project).
- August 28, 2012 meeting with the Pueblo of Zuni to present information regarding the Draft EIS. The tribe indicated support for solar renewable energy projects; however, they had concerns regarding impacts to landscapes by wind-generated renewable energy developments. In addition, concerns regarding improving access conditions to otherwise remote areas could increase OHV use, which the tribes try to limit where possible.
- October 15, 2012 meeting with the Ysleta del Sur Pueblo to discuss the Project and the identified BLM preferred alternative. Concerns regarding impacts to views and unexcavated cultural resources in the Salinas Pueblos area, including Gran Quivira, Abo and Quarai, were identified.
- October 18, 2012 meeting with the San Carlos Apache Tribe to discuss the Project and the identified BLM preferred alternative in the Draft EIS. General concerns were expressed regarding sacred places as identified by the tribe that could be impacted. The tribe suggested ongoing communication through consultation could help avoid these impacts.
- November 09, 2012 meeting with the Pueblo of Isleta to discuss the BLM preferred alternative as identified in Draft EIS. The tribe expressed concern about cultural resources west of Tenobo and near Deming.
- November 27, 2012 meeting with the Tohono O'odham Nation Cultural Preservation Committee to discuss the BLM preferred alternative as identified in Draft EIS. The committee expressed concern that a Class III cultural resource survey would not be completed before a right-of-way grant would be issued.
- December 6, 2012 meeting with the Tohono O'odham Nation Legislative Council to discuss rationale for the BLM preferred alternative as identified in the Draft EIS. The council discussed concerns regarding health impacts associated with living in proximity to high-voltage transmission lines (HVTL). Clarification was requested about the public participation process, and other alternatives analyzed in the Draft EIS (i.e., impacts to residences associated with routes through Tucson).

3.9 VISUAL RESOURCES

3.9.1 Introduction, Inventory Methods, and Regulatory Framework

3.9.1.1 Introduction

This section focuses on the inventory and characterization of the affected environment associated with visual resources potentially affected by the construction and operation of the proposed Project. Consistent with methods based on the BLM's VRM System (Manual H-8410-1), the visual resource inventory focused on the identification of Project and planning level information. Project level inventory included scenery, viewing locations, and associated key observation

points (KOP). Planning level inventory focused on resource information established in relation to BLM RMPs that include scenic quality, sensitivity levels, distance zones, visual resource inventory (VRI) classes, and VRM classes. All visual resource information, excluding viewing locations and associated KOPs, were mapped within a 6-mile-wide study corridor (3 miles on either side of the reference centerline). Viewing locations and KOPs were identified with regard to visibility of the Project, and will be used to assess effects to the viewing public resulting from the construction and operation of the Project.

Based on results of the public scoping process and in consultation with the BLM, the following areas of concern were identified:

- El Camino Real NHT and National Scenic Byway
- El Camino Real International Heritage Center
- Juan Bautista de Anza NHT
- Arizona National Scenic Trail
- CDNST
- Gran Quivira
- Bosque del Apache NWR
- Fort Craig
- CNF
- Saguaro National Park (East and West) and Saguaro Wilderness
- Special Recreation Management Areas (SRMA)
- Scenery associated with Rio Grande, Aravaipa Canyon, Gila Valley, Pinaleño Mountains, Redfield Canyon, Sulphur Springs Valley, San Pedro River Valley, Galiuro Mountains, Catalina Mountains, and Tucson Mountains
- Residential views from communities of Socorro, San Antonio, Deming, rural areas south of Mountainair, San Pedro River Valley, Klondyke, Cascabel, and Tucson; views from recreation areas, including trails, Cluff Ranch Wildlife Area, and Pima County River Parks

3.9.1.2 Inventory Methods

To inventory and characterize the affected environment for visual resources for all alternatives regardless of jurisdiction, the following visual components were considered: scenery and viewing locations, including associated KOPs. In addition, planning-level VRIs and BLM VRM classifications were collected for lands administered by the BLM. The following tasks were undertaken to inventory these visual resources for the Project:

- Documentation of existing regional landform, vegetation, and water features (scenery)
- Identification of viewing locations and KOPs
- Identification of BLM VRI and VRM classifications

Figures in the Map Volume illustrate scenery (Figure M 9-1), viewing locations and KOPs (Figure M 9-2), VRI Classifications (Figure M 9-3), and VRM Classifications (Figure M 9-4) in the study corridor.

Scenery

Scenery reflects natural landscapes that would be affected by the Project. Typically, every landscape comprises varying levels of landform, vegetation, existence of water, scarcity, adjacent scenery, and cultural modifications; all of which combine to exhibit landscape character (BLM Manual H-8410-1). Inherent to landscape character is scenic quality, which is defined by the BLM as the aesthetic appeal of a tract of land and is expressed as Class A, B, or C. Class A scenery typically has a higher degree of landscape relief, diversity of water, and vegetation, which harmoniously combine and result in a high level of aesthetic appeal. Class B scenery has less variety in the elements that comprise the landscape, but still has some diversity and visual interest. Class C scenery typically does not have much diversity in terms of landscape features, and rates the lowest from an aesthetic perspective.

Developed areas, including residences and other land uses such as agriculture or industrial facilities, modify the natural landscape. An inventory of scenery within each of the alternative corridors was completed at a level of detail consistent with the scale and dimensions of the Project facilities, then compared to planning-level (BLM-generated) scenic quality data and adjusted appropriately. Scenery is illustrated on Figure M 9-1 (see Map Volume), and detailed Scenic Quality Rating Worksheets are provided in Appendix D.

Existing conditions (i.e., cultural modifications) within the Project study area range from natural to completely modified, based on the occurrences of transmission lines, substations, pipelines, travel routes, and other structural features that can modify the quality of natural settings. Existing conditions were evaluated by means of aerial photography and field reconnaissance to determine the location where modifications have affected natural settings.

Viewing Locations and Key Observation Points

The term "viewing locations" pertains to public areas (including KOPs) within the landscape where the Project could be visible, and where concern for changes to the landscape exists (see Concern Levels, below). In this regard, viewing locations are typically associated with residences, travel routes, and recreation areas. Other areas associated with viewers that typically have concern for changes to the landscape include public facilities, such as schools and religious institutions, and resorts.

KOPs represent a critical or typical viewpoint within, or along, an identified viewing location, and are required by the BLM to assess and mitigate visual impacts of a proposed action and to demonstrate compliance with designated VRM classes. The selection of KOPs for the Project considered the following criteria specific to transmission line projects (BLM Manual 8431-Visual Resource Contrast Rating):

- Most critical viewpoints (views from communities and road crossings)
- Typical views encountered in representative landscapes (scenic quality rating units)
- Any special project or landscape features such as skyline crossings, river crossings, substations, etc.

Other factors considered when selecting KOPs were angle of observation, number of viewers (use volume), length of time the Project is in view (viewing duration), relative Project size, season of use, and light conditions. Viewing locations and KOPs were inventoried within an 8-mile-wide study corridor (4 miles on either side of the reference centerline) and beyond.

Viewing locations and KOPs are illustrated on Figure M 9-2 and Figure M 9-3 (see Map Volume). The first part of the identification number for the KOPs refers to its associated BLM Field Office (SO – Socorro; RO – Roswell; RP – Rio Puerco; LC – Las Cruces; SA – Safford; and TU – Tucson). A detailed list, including location and use of each viewing location and associated concern level, as well as KOPs and Simulation Locations, is included in Appendix D.

Concern Levels

Concern levels relate to the importance of maintaining existing scenic quality and/or viewsheds associated with a specific viewing location, and are considered when assessing viewer impacts. For example, a National Monument is a viewing location that is associated with viewers who have a high degree of concern for maintaining scenic quality and/or viewshed, because the landscape setting is typically a key component to monument designation. In contrast, a viewing location associated with a state route would have moderate concern, because viewers are traveling at a high rate of speed, and arrival at their destination takes priority over a recreational experience. Concern levels for each identified viewing location and associated KOP were assessed based on the following five criteria: (1) volume of use, (2) viewing duration, (3) concern for aesthetics, (4) scenic or historic status, and (5) special status or designations.

Viewing Conditions

Viewing conditions relate to how the landscape is viewed from a given location, based on two key elements; orientation and screening. Orientation refers to the relative elevation of the viewing location as compared to landscape being viewed, which is described as inferior (below), neutral (level), or superior (above). Screening reflects the degree to which elements in the landscape, such as vegetation, topography, and development, inhibit the visibility of the landscape.

<u>BLM Resource Management Plans – Visual Resource Inventory</u>

The BLM VRM system requires the inventory of scenic values and the establishment of management objectives for those values through a visual resource management planning process. The VRI process and its resulting information provide the information necessary to characterize the existing or affected environment, and are required for management and Project level decisions. BLM VRI classifications were inventoried within a 6-mile-wide study corridor centered on the Project. The BLM's Manual H-8410-1 defines the criteria that define VRI components of scenic quality, sensitivity level rating units, distance zones, and VRI classifications. VRI data was provided by the BLM field offices (Socorro, Roswell, Rio Puerco, and Las Cruces) and incorporated into the inventory; and VRI data gaps (i.e., where agency VRI data does not exist or the BLM determines that existing data is insufficient) were identified and updated by the BLM field offices for inclusion in the Draft EIS. VRI classifications for all field offices are illustrated on Figure M 9-4 (see Map Volume). VRI data shown on Figure M 9-4

extends the study corridor and includes lands that are not managed by the BLM. VRI data, including scenic quality, sensitivity level rating units, distance zones, and resulting classifications, were inventoried by EPG for the Tucson Field Office, per BLM direction (see Appendix D).

Scenic Quality

Scenic quality as defined by the BLM is the measure of the visual appeal of a tract of land. In the VRI process, public land is given an A, B, or C rating, based on the evaluation of the following seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications.

Sensitivity Level Rating Units

Sensitivity levels are a measure of public concern for the maintenance of scenic quality associated with a given tract of BLM land. Public lands are assigned high, medium, or low sensitivity by analyzing the various indicators of public concern, including type of user, amount of use, public interest, adjacent land uses, and special areas, among other factors.

Distance Zones

Per BLM guidance, landscapes are subdivided into three distance zones based on relative visibility from KOPs. The three distance zones are foreground-middleground (0 to 5 miles), background (5 to 15 miles), and seldom seen (greater than 15 miles).

Visual Resource Inventory Classifications

VRI classes are created using GIS, incorporating the following components: (1) scenic quality, (2) sensitivity levels, and (3) distance zones. VRI classifications represent the inventoried scenic values of BLM-administered lands, and have similar objectives as compared to VRM classes.

Visual Resource Management Classifications

BLM VRM classifications and associated objectives define the levels of acceptable visual change (contrast) allowed on BLM-administered land, ranging from Class I to Class IV. These classifications are designated by the BLM, based in part on the inventoried scenic values (VRI) and other land use allocations during the resource management planning process. BLM VRM classifications were collected within a 6-mile-wide study corridor centered on the Project, and are used to demonstrate Project conformance with regards to established management plans.

Table 3-44 describes the management objectives associated with each class designation, per BLM Manual H-8410-1 (1986). VRM objectives are illustrated on Figure M 9-5 (see Map Volume). There are no formal guidelines for managing visual resources on state, private, or other nonfederal lands.

Table 3-44. BLM Visual Resource Management Objectives	
Class I Objective	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II Objective	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be very low. Management activities may be seen, but should not attract attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III Objective	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV Objective	The objective of this class is to provide for management activities that require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic elements.

3.9.1.3 Regulatory Framework

Visual resources on BLM-administered land are managed within the context of the VRM system, as described in BLM Manual 8400 – Visual Resource Management. In keeping with the FLPMA, the BLM is required to consider scenic values of public land as a resource that merits management and preservation where appropriate—including electric power-related projects—as determined through the land use planning process. The BLM VRM system requires the inventory of scenic values and the establishment of management objectives for those values through the VRM planning process. Based on the issuance of BLM IM No. 2009-167 (BLM 2009d), a completed VRI is required to serve as part of the baseline for NEPA analyses on BLM land. All field offices must have current VRI and VRM classes delineated as part of the land use planning process. If a field office does not have VRI data, then an inventory will need to be completed to process permit applications (*ibid*).

The West-wide Energy Corridor Programmatic EIS establishes Interagency Operation Procedures for visual resources that apply to the BLM. This document states that if VRM objectives have not been completed, then they should be developed by the proper agency. The field office manager will determine the role of SunZia in completing this task (DOE 2008).

Resource management goals for the Rio Grande Wild and Scenic River 2004 Final General Management Plan/EIS include the conservation and restoration of "wildlife, scenery, natural sights and sounds, and other resources of the river corridor and its immediate environment."

The White Sands Resources Area 1986 RMP identifies general management guidelines for visual resources: "Visual resources will be evaluated as a part of activity and project planning. Such evaluation will consider the significance of the proposed project, the visual sensitivity of the affected area, and the projected impacts of the project. Stipulations will be attached as appropriate to ensure compatibility of projects with management objectives for visual resources."

The Corridor Management Plan for the Patagonia-Sonoita Scenic Road identifies conservation and enhancement management goals for natural and scenic resources. One of the objectives is to "protect the beautiful vistas and open spaces experienced along the Scenic Road, including clean air and starry nights, and minimize visual inconsistencies that detract from the area's rural and natural character."

The Comprehensive Plan for the CDNST (which is managed by a number of federal and state land management agency jurisdictions) established the following guiding principles based on the nature and purpose for the trail: "…to provide high-quality, scenic, primitive hiking and horseback riding opportunities and to conserve natural, historic, and cultural resources along the CDNST corridor."

The General Management Plan for the Salinas Pueblo Missions National Monument, managed by the NPS, recognizes the extensive viewsheds of the three units that comprise the park: Gran Quivira, Abó, and Quarai. Primarily used for grazing, these landscapes provide a setting that has not significantly changed since the Spanish Colonial Period (AD 1598 to 1821). One of the park service's primary management goals is "to preserve and, where possible, to restore the historic setting. Development of these lands for uses other than grazing could seriously affect the historic setting and visitor experience" (NPS 1984).

The inventory and assessment of National Historic and Scenic Trails is included in Appendix L.

County

Goals, policies, or objectives regarding visual resources are included in some counties' general or comprehensive plans. Specific policies regarding visual resources that may affect the construction and operation of the Project are detailed below.

Unincorporated areas of Graham County, Arizona, in the Project area are managed under the 2008 General Plan. An objective identified in the plan includes "a healthy environment with open spaces and visual qualities within the County" (Graham County 2008). Unincorporated areas of Greenlee County, Arizona, in the Project area are managed under the 2003 Comprehensive Plan (Greenlee County 2003). Goals identified in the plan include the following:

- Use open space to preserve the rural character and protect those areas having significant environmental, scenic, or cultural values.
- Preserve and enhance such facilities as mountain roads, bridges, scenic overlooks, and landscape views for public enjoyment.

Pinal County, Arizona, adopted the Open Space and Trails Master Plan (Pinal County 2009) as an amendment to the 2001 Comprehensive Plan. The Master Plan outlines site design strategies that "…fit its physical setting and preserve scenic, aesthetic, historic, and environmental resources."

Unincorporated areas of Pima County are managed under the SDCP, which includes a science-based conservation plan, a comprehensive land use plan, and a multiple species conservation plan. The SDCP gives "high priority to preserving and protecting (Pima County's) most

important natural resources." Goals and objectives for the biological element of the SDCP include the following:

- Promote long-term viability for species, environments, and biotic communities that have special significance to people in this region, because of their aesthetic or cultural values, regional uniqueness, or economic significance (Pima County 2010a).

New Mexico counties, including Hidalgo, Grant, Luna, Sierra, Socorro, Lincoln, and Torrance, as well as Cochise County in Arizona, do not have visual resource goals, policies, or objectives identified in their plans.

City

Some city plans include goals, policies, or objectives for visual resources management in their general plans. Among the cities within the affected area of the Project alternatives, only the Tucson General Plan includes a visual resource element. In the Tucson General Plan, community character and design policies focus on major elements that help define Tucson's natural and built environments, such as views and community landmarks. General Plan Policy 3 requires preservation of "scenic views of natural features and community landmarks" (City of Tucson 2001).

3.9.2 Regional Overview

3.9.2.1 New Mexico

The Project is located within the Mexican Highland and Datil subdivisions of the Basin and Range and Colorado Plateau physiographic provinces, respectively (Fenneman 1931). The Basin and Range Province is characterized by its isolated, roughly parallel mountain ranges separated by closed (undrained) desert basins. The mountain ranges often run 50 to 70 miles in length and generally trend north-south. The Mexican Highland subdivision is also characterized by basin and ranges and intervening desert plains; however, most of the area has external drainage as opposed to draining internally to basins or bolsons.

The Colorado Plateau province is characterized by sparsely vegetated, horizontal plateaus, mesas, and canyons (*ibid*). The Datil subdivision contains a greater number of domed, volcanic features than elsewhere in the province. Mountains within the Datil subdivision include the San Mateo, Magdalena, and Black Range mountains. Major ecosystems in the Project area include short-grass prairie, Chihuahuan semidesert grasslands, mixed-desert thorn scrublands, riparian woodlands, and piñon-juniper woodland hills, foothills, and mountains (Brown 1982a).

Regional landscapes range from developed landscapes in the central and western portion of the Project area, to more natural intact landscapes in the north and east. Urban and suburban development is primarily concentrated along the Rio Grande and the I-25 and I-10 corridors, in the central and western portions of the Project area. Municipalities within proximity to the Project include Socorro, Deming, and Lordsburg. Agricultural landscapes are also heavily concentrated along the Rio Grande, in the Uvas Valley, and east of Deming. Small-scale mining operations are located throughout the region. More intact and naturally appearing landscapes

occur in the northern portion of the Project area, including parts of the Cibola National Forest, Bosque del Apache Wilderness Area, and Sevilleta NWR.

Agricultural activities such as center-pivot farming and dryland agriculture occur primarily around urban areas such as Deming in the western portion of the Project area; and along the Rio Grande near and around Socorro and San Antonio. Grazing lands dominate much of the Rio Grande Valley and Jornada del Muerto Valley landscapes.

Vegetation outside of developed landscape areas are typically dryland or naturally appearing grazing land. North and east of Socorro, vegetation is predominantly prairie grasslands and rolling piñon-juniper woodland. Vegetation transitions to the south, where expanses of sagebrush, creosote, desert grasses, and succulents such as agave and yucca occupy large areas of the Rio Grande Valley and Jornada del Muerto Valley. Piñon-juniper woodlands and plains grasslands dominate the lower elevations of the San Mateo, Magdalena, and Black Range mountains, with montane conifer forests dominating the higher elevations. Riparian areas are limited primarily to the Rio Grande and its tributaries.

3.9.2.2 Arizona

The Project area is partially located within the Mexican Highland subdivision of the Basin and Range Province and contains the same general landscape characteristics found within southwestern New Mexico. In Arizona, the Project is also located within the Sonoran Desert subdivisions of the Basin and Range Province (Fenneman 1931). The Sonoran Desert subdivision is characterized by mountain ranges and intervening desert plains; however, the ranges are smaller, rock pediments are much more prevalent, and undrained basins are less general than those typically characterized by the Basin and Range Province, such as in Nevada. Mountain ranges in the Project area include the Tortolita, Rincon, Santa Catalina, Galiuro, and Pinaleño mountains. Major ecosystems in the Project area include Palo Verde-Mixed Cacti Desertscrub basins, Chihuahuan semidesert grasslands, semi-arid hills, and piñon-juniper woodland foothills and mixed evergreen forests (Brown 1982a).

Regional landscapes have a range of developed and natural landscapes, from the highly urbanized areas in the Tucson metropolitan area to the relatively intact wilderness of the Galiuro Mountains. Urban development is most dominant in and around the Tucson metropolitan area, with some smaller urban and suburban development concentrations occurring in and near Eloy, Oracle, San Manuel, Cascabel, Safford, and San Simon. More intensive and large-scale industrial development typically occurs near larger urban areas and is most heavily concentrated in the western portion of the Project area along the I-10 corridor in and near Tucson and Eloy. There are a number of mining operations concentrated in the northern portion of the San Pedro River Valley, including Tiger Mine, Copper Creek Mine, Black Hills Mine, and the San Manuel Copper Mine complex (mine, mill, and smelter). More intact and natural appearing landscapes occur in the central portion of the Project area. Topography and vegetation associated with the San Pedro River Valley and the Galiuro, Santa Catalina, and Pinaleño mountains provide a more diverse landscape than the surrounding valley plains, which are relatively flat and often uniformly covered with creosote or desert grasslands.

Agricultural activities such as dryland and irrigated agriculture dominate the valley landscapes in southern Pinal County, southern Graham County, and northern Cochise County in the Project area. Irrigated agriculture occurs in the Santa Cruz Flats, San Pedro River Valley, Sulphur Springs Valley, and San Simon Valley.

Vegetation outside of developed landscape areas is typically either arid or natural appearing grazing land of creosote, tarbush, and other desertscrub. Within the San Simon Valley and Sulphur Springs Valley, vegetation can vary but is typically dominated by creosote, tarbush, and desertgrasses, and can include scattered succulents such as agave or yucca. Vegetation is often open to sparse exposed bare soils, desert pavement, and bare rock. Mixed desert cacti landscapes, which typically include yucca, barrel cactus, prickly-pear, and ocotillo, occur along bajadas within the San Pedro River Valley and the lower slopes of the Galiuro, Pinaleño, and Santa Catalina mountains. Oak and piñon-juniper woodlands occur on foothills and higher up the mountain slopes, with coniferous and aspen forested areas typically associated with the upper reaches of the mountain ranges. Open stands of saguaro, cholla, ocotillo, and paloverde become more prevalent west of the San Pedro River Valley, primarily occupying hills and bajadas, and becoming less dense as the land transitions to valley plains.

Dense riparian areas are found concentrated along the San Pedro River, Santa Cruz River, Aravaipa Creek, Cienega Creek, Pantano Wash/Rillito River, and the canyons of the Santa Catalina, Galiuro, and Pinaleño mountains. Riparian areas are also found along drainage ways that cut across bajadas and into the surrounding valley landscapes. There tends to be less variety and density of riparian vegetation along these smaller drainage ways.

3.9.3 Summary of Inventory Results

3.9.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Scenery

The majority of Subroute 1A1 (links E211, A161, A161a, A260, A330a, A330b) crosses Class B scenery associated with the Rio Grande Valley, characterized by slightly undulating terrain dissected by major tributaries of the Rio Grande. Other Class B landscapes crossed by Subroute 1A1 include juniper hills, rolling juniper-woodland savanna, rolling savanna plains, rolling savanna grasslands, gently sloping undulating bajadas, low mountain peaks north and east of Socorro, and agricultural landscapes within the Rio Grande floodplain (links A10, A21, E82, E84, E85, E80d, E101a, E101b, E133, E180, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class B scenery along Subroute 1A1 include HVTL (345 kV, 115 kV), pipelines, railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). Other cultural modifications associated with this Class B scenery include dispersed residences associated with Socorro, Mountainair, and the Rio Grande Valley. Link E180 also crosses the Rio Grande (Class A), which is characterized by the curvilinear form of the river and dense riparian vegetation along the river banks. There are no cultural modifications to the landscape associated with Class A scenery for Subroute 1A1. Class C landscapes crossed by Subroute 1A1 are primarily the large, expansive plains characteristic of

the region (links A400, A440, A530, A520, E133, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class C scenery along Subroute 1A1 include HVTLs (345 kV, 115 kV), railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). A total of 0.1 mile of Class A scenery, 188.6 miles of Class B scenery, and 40.1 miles of Class C scenery are crossed by Subroute 1A1 (see Figure M 9-1E, Map Volume).

Viewing Locations and KOPs

Dispersed rural residences are generally located along all portions of Subroute 1A1 and occur in large part within the Rio Grande Valley. A large concentration of high concern residential viewing locations was identified within the city of Socorro, along Link E180. High concern level recreation viewing locations (including Gran Quivira, Sevilleta NWR, Stallion WSA, Rio Grande, Veranito WSA, Johnson [Gordy's] Hill SRMA, Ladron Mountain/Devil's Backbone Complex ACEC, The Box SRMA, Cibola National Forest, Devil's Backbone WSA, Bosque del Apache NWR, Chupadera Wilderness, Indian Well Wilderness, El Camino Real International Heritage Center, El Camino Real Lands Recreation Trail and Trailhead, Fort Craig National Historic Site, Continental Divide Trail Society (CDTS) Route, and Butterfield Historic Trail have direct views of the landscapes in which the following links are located: E84, E101a, E101b, E133, E180, E200, E211, A161, A161a, A260, A330a, A330b, A400, and A440 (see Figure M 9-2, Map Volume). Elephant Butte State Park is associated with high concern recreation viewers; however, views of the landscape that are traversed by Subroute 1A1 would be limited due to terrain. High concern level travel routes with associated scenic designations include the Salt Missions Trail Scenic Byway (SR 55), Quebradas Back Country Byway, El Camino Real National Scenic Byway (portions of I-25, SR 478, SR 185, SR 187, US Route 85, and SR 1), Geronimo Trail National Scenic Byway (SR 152, SR 52), and the Lake Valley Back Country Byway (SR 27, SR 152). Generally, views of the landscape in which the Project would be located would be direct and unobstructed. Travel routes that provide access to recreation areas that have a focus on scenery include WSMR Route 3607, which provides access to the Stallion WSA, and WSMR Route 5, which traverses Johnson (Gordy's) Hill SRMA and provides access to the Veranito WSA. These travel routes provide predominately unobstructed viewing opportunities of the landscape in which Subroute 1A1 is located. Moderate concern level recreation viewers include the New Mexico Tech Golf Course located in Socorro near Link E180. Moderate concern level travel routes include I-25 (nonscenic portions), I-10, US Route 54, US Route 60, SR 14, SR 178 (Cienega Camp Road), SR 107, SR 142, SR 26, and Forest Road (FR) 255. Link A10 is near a US Route 54 rest area associated with a moderate concern level.

KOPs common to Subroute 1A1 include:

- SO4 – Route 7 Residence
- SO11 – Route 3607
- SO13 – Route 5
- SO14 – Johnson (Gordy's) Hill SRMA
- SO15 – Quebradas Back Country Byway SRMA
- SO16 – Rio Grande
- SO17 – El Camino Real/SR 408
- SO18 – Socorro

- SO19 – The Box SRMA
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area
- LC19 – El Camino Real/I-25
- LC20 – Elephant Butte State Park
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

KOPs specific to Subroute 1A1 include:

- SO4 – Route 7 Residence
- SO31 (b) – Gran Quivira

BLM VRI Classifications

Subroute 1A1 crosses 109 miles (approximately 47.6 percent) of BLM land within the Socorro, Roswell, and Rio Puerco field offices, and Las Cruces District office.

Scenic Quality: Subroute 1A1 primarily crosses Class C scenic quality on BLM land, most of which is associated with the Rio Grande Valley and an isolated portion in the Rio Puerco Field Office. North of the WSMR and near Socorro, this alternative crosses Class A and Class B scenic quality associated with the Rio Grande and rolling piñon-juniper areas, foothills, and small mountains.

Sensitivity Level Rating Units: Subroute 1A1 primarily crosses BLM land associated with low sensitivity north of the WSMR and an isolated BLM parcel in Rio Puerco Field Office. Moderate sensitivity BLM land crossed by this alternative is associated with BLM land near Socorro and an isolated parcel southeast of the Sevilleta NWR. Other isolated moderate sensitivity BLM lands include those associated with SR 107 (Link A161a) and the Deming Valley (links A440 and A530). Several areas containing BLM lands of high sensitivity crossed by this alternative include El Camino Real National Byway (Link A260), the Lake Valley Back Country Byway (links A400 and A440), and the Geronimo Trail Scenic Byway (links A330a and A330b).

Distance Zones: Subroute 1A1 is located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Overall, half of Subroute 1A1 crosses VRI Class IV land (3.3 miles of VRI Class II, 50.3 miles of VRI Class III, and 56.5 miles of VRI Class IV). No VRI Class I would be crossed by this route. In the Socorro Field Office, the BLM preferred alternative primarily crosses VRI Class IV land and a small portion of Class III land. In the Las Cruces District Office, Subroute 1A1 primarily crosses VRI Class III, and several parcels of VRI Class IV land. A limited area of VRI Class II land would be crossed in the Las Cruces District Office. An

isolated parcel of VRI Class IV land (E84b) in the Rio Puerco Field Office would be crossed by this alternative.

BLM VRM Classifications

Subroute 1A1 crosses approximately 11.1 miles of VRM Class II, 28 miles of VRM Class III, and 69.9 miles of Class IV lands within the Roswell, Rio Puerco, and Socorro field offices and the Las Cruces District Office. VRM Class II lands associated with Subroute 1A1 include terrain east of Socorro near the Veranito and Stallion WSAs, and northeast of Deming along the Butterfield Trail and in the Cooke's Range. Landscapes associated with VRM Class III include terrain north of Stallion WSA, Johnson (Gordy's) Hill SRMA, the foothills east of the Magdalena Mountains, and the valley plains west of Good Sight Mountains. VRM Class IV lands generally occur along all portions of this subroute.

Subroute 1A2 – BLM Preferred Alternative

Scenery

The majority of Subroute 1A2 (links E211, A161, A161a, A260, A330a, A330b) crosses Class B scenery associated with the Rio Grande Valley, characterized by slightly undulating terrain dissected by major tributaries of the Rio Grande. Other Class B landscapes crossed by the BLM preferred alternative include juniper hills, rolling juniper-woodland savanna, rolling savanna plains, rolling savanna grasslands, gently sloping undulating bajadas, low mountain peaks north and east of Socorro, and agricultural landscapes within the Rio Grande floodplain (links A10, A21, E82, E84, E86a, E86b, E101a, E101b, E133, E180, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class B scenery along the BLM preferred alternative include HVTLs (345 kV, 115 kV), pipelines, railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). Other cultural modifications associated with this Class B scenery include dispersed residences associated with the towns of Socorro, Mountainair, and the Rio Grande Valley. Link E180 also crosses the Rio Grande (Class A), which is characterized by the curvilinear form of the river and dense riparian vegetation along the river banks. There are no cultural modifications to the landscape associated with Class A scenery for the BLM preferred alternative. Class C landscapes crossed by the BLM preferred alternative are primarily the large, expansive plains characteristic of the region (links A400, A440, A530, A520, E133, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class C scenery along the BLM preferred alternative include HVTLs (345 kV, 115 kV), railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). A total of 0.1 mile of Class A scenery, 190.2 miles of Class B scenery, and 40.1 miles of Class C scenery are crossed by Subroute 1A2 (see Figure M 9-1E, Map Volume).

Viewing Locations and KOPs

Dispersed rural residences are generally located along all portions of Subroute 1A2 and occur in large part within the Rio Grande Valley. A large concentration of high concern residential viewing locations was identified within the city of Socorro, along Link E180. Similar to Subroute 1A1, dispersed rural residences would be located along links E86a and E86b where

views of the landscape are direct and primarily unobstructed. High concern level recreation viewing locations (including Gran Quivira, Sevilleta NWR, Stallion WSA, Rio Grande, Veranito WSA, Johnson [Gordy's] Hill SRMA, Ladron Mountain/Devil's Backbone Complex ACEC, The Box SRMA, Cibola National Forest, Devil's Backbone WSA, Bosque del Apache NWR, Chupadera Wilderness, Indian Well Wilderness, El Camino Real International Heritage Center, El Camino Real Lands Recreation Trail and Trailhead, Fort Craig National Historic Site, CDTS Route, and Butterfield Historic Trail) have direct views of the landscapes in which the following links are located: E84, E101a, E101b, E133, E180, E200, E211, A161, A161a, A260, A330a, A330b, A400, and A440 (see Figure M 9-2, Map Volume). Links E82a and E82b are generally associated with few recreation viewers, although local travel routes near these links may be used to access designated recreation areas such as WSAs and SRMAs near Socorro. Elephant Butte State Park is associated with high concern recreation viewers; however, views of the landscape traversed by Subroute 1A2 would be limited due to terrain. High concern level travel routes with associated scenic designations include the Salt Missions Trail Scenic Byway (SR 55), Quebradas Back Country Byway, El Camino Real National Scenic Byway (portions of I-25, SR 478, SR 185, SR 187, US Route 85, and SR 1), Geronimo Trail National Scenic Byway (SR 152, SR 52), and the Lake Valley Back Country Byway (SR 27, SR 152). Generally where the Project crosses these scenic travel routes, views of the landscape would be direct and unobstructed. Travel routes that provide access to recreation areas that have a focus on scenery include WSMR Route 3607, which provides access to the Stallion WSA; and WSMR Route 5, which traverses Johnson (Gordy's) Hill SRMA and provides access to the Veranito WSA. These travel routes provide predominately unobstructed viewing opportunities of the landscape in which Subroute 1A2 would be located. Moderate concern level recreation viewers include the New Mexico Tech Golf Course located in Socorro near Link E180. Moderate concern level travel routes include I-25 (nonscenic portions), I-10, US Route 54, US Route 60, SR 14, SR 178 (Cienega Camp Road), SR 107, SR 142, SR 26, and FR 255. Link A10 is near a US Route 54 rest area associated with a moderate concern level.

KOPs specific to the BLM preferred alternative include:

- SO11 – Route 3607
- SO13 – Route 5
- SO14 – Johnson (Gordy's) Hill SRMA
- SO15 – Quebradas Back Country Byway SRMA
- SO16 – Rio Grande
- SO17 – El Camino Real/SR 408
- SO18 – Socorro
- SO19 – The Box SRMA
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- SO31 (c) – Gran Quivira
- RP2 – SR 55 Residences
- RP3 – SR 55 Salt Missions Trail Scenic Byway
- RP4 – County Road B001 Residence
- RO1 – County Road A020 Residence

- RO2 – US Route 54 and Rest Area
- LC19 – El Camino Real/I-25
- LC20 – Elephant Butte State Park
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

BLM VRI Classifications

The BLM preferred alternative crosses 108 miles (approximately 46 percent) of BLM land within the Socorro and Roswell field offices, and Las Cruces District office. The subroute would not cross BLM land within the Rio Puerco field office.

Scenic Quality: The BLM preferred alternative primarily crosses Class C scenic quality on BLM land, most of which is associated with the Rio Grande Valley. North of the WSMR and near Socorro, this alternative crosses Class B scenic quality associated with rolling piñon-juniper areas, foothills, and small mountains, and an isolated Class A area associated with the Rio Grande.

Sensitivity Level Rating Units: The BLM preferred alternative primarily crosses BLM land associated with low sensitivity north of the WSMR, as well as portions of the Rio Grande Valley. Moderate sensitivity BLM land crossed by this alternative is associated with land near Socorro and an isolated parcel southeast of the Sevilleta NWR. Other isolated moderate sensitivity BLM lands include those associated with SR 107 (Link A161a) and the Deming Valley (links A440 and A530). Several areas containing BLM lands of high sensitivity crossed by this alternative include El Camino Real National Byway (Link A260), the Lake Valley Back Country Byway (links A400 and A440), and the Geronimo Trail Scenic Byway (links A330a and A330b).

Distance Zones: The BLM preferred alternative is located entirely in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Overall, half of Subroute 1A2 crosses VRI Class IV land (4.6 miles of VRI Class II, 86.1 miles of VRI Class III, and 111.5 miles of VRI Class IV). No VRI Class I would be crossed by Subroute 1A2. In the Socorro Field Office, the BLM preferred alternative primarily crosses VRI Class IV land and a small portion of Class III land. In the Las Cruces District Office, Subroute 1A2 primarily crosses VRI Class III and several parcels of VRI Class IV land. A limited area of VRI Class II land is crossed in the Las Cruces District Office, where Class B scenery associated with high sensitivity (designated scenic byway travel routes) would occur.

BLM VRM Classifications

The BLM preferred alternative crosses approximately 11.1 miles of VRM Class II, 28.6 miles of VRM Class III, and 68.4 miles of Class IV lands within the Roswell and Socorro field offices and the Las Cruces District Office. BLM land in the Rio Puerco Field Office would not be crossed by the BLM preferred alternative. VRM Class II lands associated with Subroute 1A2 include terrain east of Socorro near the Veranito and Stallion WSAs, and northeast of Deming along the Butterfield Trail and in the Cooke's Range. Landscapes associated with VRM Class III include terrain north of Stallion WSA, Johnson (Gordy's) Hill SRMA, the foothills east of the

Magdalena Mountains, and the valley plains west of Good Sight Mountains. VRM Class IV lands generally occur along all portions of the BLM preferred alternative.

Subroute 1A – North River Crossing

Scenery

The majority of Subroute 1A crosses Class B scenery associated with the Rio Grande Valley. This subroute is similar to the BLM preferred alternative, except that it includes links A22 and E80c in the Gran Quivira area, and Link A270 in the Rio Grande Valley. Links A22 and E80c would cross Class B scenery characterized by rolling juniper-woodland savanna and rolling savanna. Link A270 would also cross Class B scenery associated with the Rio Grande Valley. Cultural modifications that have locally modified the landscapes associated with Class B scenery along this subroute are similar to the BLM preferred alternative. A total of 0.1 mile of Class A scenery (Rio Grande), 179.4 miles of Class B scenery, and 40.1 miles of Class C scenery are crossed by Subroute 1A (see Figure M 9-1E, Map Volume).

Viewing Locations and KOPs

This subroute is similar to Subroute 1A1, except that it includes links A22 and E80c in the Gran Quivira area, and Link A270 in the Rio Grande Valley. In addition to the residences noted in the BLM preferred alternative, Subroute 1A would occur near smaller residential developments located in Claunch and Cuchillo, along links E80c and A330a. Similar to the BLM preferred alternative, high concern level recreation viewing locations associated with Subroute 1A (including the Salinas Pueblo Missions National Monument, Sevilleta NWR, Stallion WSA, Veranito WSA, Johnson [Gordy's] Hill SRMA, Ladron Mountain/Devil's Backbone Complex ACEC, The Box SRMA, Cibola National Forest, Devil's Backbone WSA, Bosque del Apache NWR, Chupadera Wilderness, Indian Well Wilderness, El Camino Real International Heritage Center, El Camino Real Lands Recreation Trail and Trailhead, Fort Craig National Historic Site, CDTS Route, and the Butterfield Historic Trail) have direct views of the landscapes in which the following links are located: E80c, E101b, E133, E180, E200, E211, A161, A161a, A270, A330a, A330b, A400, and A440 (see Figure M 9-2, Map Volume). High concern level travel routes with associated scenic designations include the Quebradas Back Country Byway, El Camino Real National Scenic Byway (portions of I-25, SR 478, SR 185, SR 187, US Route 85, and SR 1), Geronimo Trail National Scenic Byway (SR 152, SR 52), and the Lake Valley Back Country Byway (SR 27, SR 152). Generally, views of the landscape in which Subroute 1A would be located would be direct and unobstructed for these recreation viewers. Travel routes that provide access to recreation areas that have a focus on scenery include WSMR Route 3607, which provides access to the Stallion WSA; and Route 5, which traverses Johnson (Gordy's) Hill SRMA and provides access to the Veranito WSA. These travel routes provide predominately unobstructed viewing opportunities of the landscape in which Subroute 1A would be located. Moderate concern level recreation viewers include the New Mexico Tech Golf Course located in Socorro near Link E180. Moderate concern level travel routes include I-25 (nonscenic portions), I-10, US Route 54, US Route 60, SR 14, SR 178 (Cienega Camp Road), SR 107, SR 142, SR 26, and FR 255. Link A10 is near a US Route 54 rest area associated with a moderate concern level.

KOPs specific to Subroute 1A include:

- SO1 – Claunch
- SO2 (a) – Gran Quivira
- SO11 – Route 3607
- SO13 – Route 5
- SO14 – Johnson (Gordy's) Hill SRMA
- SO15 – Quebradas Back Country Byway SRMA
- SO16 – Rio Grande
- SO17 – El Camino Real/SR 408
- SO18 – Socorro
- SO19 – The Box SRMA
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Local Alternative Link A161b viewing locations are similar to Subroute 1A, with the exception that A161b is located closer to the Ladron Mountain/Devil's Backbone Complex ACEC, Cibola National Forest, and Devil's Backbone WSA. Willow Springs (SO24) is the only KOP associated with a high concern level for this local alternative link.

BLM VRI Classifications

Subroute 1A crosses 104.9 miles (approximately 48 percent) of BLM land within the Socorro and Roswell field offices, and Las Cruces District office.

Scenic Quality: Subroute 1A primarily crosses Class C scenic quality on BLM land, most of which is associated with the Rio Grande Valley. North of the WSMR and near Socorro, this subroute crosses Class B scenic quality. These Class B landscape types are primarily made up of rolling piñon-juniper areas, foothills, and small mountains. Class A scenic quality would not be crossed by Subroute 1A.

Local alternative link A161b primarily crosses Class C scenic quality associated with the Rio Grande Valley. In addition, Local Alternative Link A161b crosses an isolated portion of Class B scenic quality associated with the foothills of the Magdalena Mountains. Local alternative links A361-A430-A481 primarily cross Class B scenic quality associated with Uvas Valley and the Good Sight Mountains. This local alternative also crosses a small portion of Class C scenic quality associated with the Deming and Rio Grande valleys.

Sensitivity Level Rating Units: Subroute 1A primarily crosses BLM land associated with low sensitivity north of the WSMR. Moderate sensitivity BLM land crossed by this subroute is associated with land near Socorro. Other isolated BLM land associated with moderate sensitivity crossed by Link A161a includes SR 107 and the Deming Valley (links A440 and A530). Several areas of high sensitivity crossed by this subroute include El Camino Real National Byway (Link A270), the Lake Valley Back Country Byway (Link A400), and the Geronimo Trail Scenic Byway (links A330a and A330b).

Local Alternative Link A161b crosses BLM land associated with low and moderate sensitivity. Local alternative links A361-430-A481 primarily traverse BLM land associated with low sensitivity, an isolated portion of moderate and high sensitivity along I-10.

Distance Zones: The subroutes and local alternative links are located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: The majority of BLM land crossed by Subroute 1A in the Socorro Field Office is VRI Class IV, with isolated areas of VRI Class III near Socorro and east of the Rio Grande. In the Las Cruces District Office, this subroute primarily crosses VRI Class II. No VRI Class I is crossed by Subroute 1A. This subroute crosses several BLM parcels inventoried as VRI Class IV in the Las Cruces District Office (links A330A, A330b, A440, and A530).

Local Alternative Link A161b crosses similar VRI Classes as Subroute 1A. Local alternative links A361 and A430 cross VRI Class IV, and Local Alternative Link A481 cross VRI Class III.

BLM VRM Classifications

Subroute 1A crosses approximately 11.1 miles of VRM Class II, 26.6 miles of VRM Class III, and 66.2 miles of Class IV lands within the Roswell and Socorro field offices and the Las Cruces District Office. VRM Class II lands associated with this subroute include terrain east of Socorro near the Veranito WSA and Stallion WSA, as well as the Butterfield Trail and terrain near Cooke's Range. Landscapes associated with VRM Class III include terrain north of Stallion WSA, Johnson (Gordy's) Hill SRMA, the foothills east of the Magdalena Mountains, and the valley plains west of Good Sight Mountains. VRM Class IV lands generally occur along all portions of this subroute.

Subroute 1B – San Antonio Crossing

Scenery

Scenery crossed by Subroute 1B1 is identical to Subroute 1A, except for the area northwest of the WSMR (links E90, A90, A111, A112, A140, A143, and A160). In this area, Subroute 1B1 crosses similar Class A, B, and C rating scenery as Subroute 1A, including the Rio Grande, agricultural lands within the Rio Grande floodplain, and desert valley plains, respectively; however, it is located farther south, near San Antonio. Cultural modifications that have locally modified landscapes associated with Class B scenery include HVTLs (345 kV), pipelines, railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). Other cultural modifications associated with this Class B scenery include dispersed residences associated

with the town of San Antonio and the Rio Grande Valley. Cultural modifications that have locally modified the landscapes associated with Class C scenery along this subroute include HVTLs (345 kV, 115 kV), railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25 and US 380). In addition, Subroute 1B1 crosses less Class B and more Class C scenery than does Subroute 1A. A total of 165.7 miles of Class B scenery, 57.8 miles of Class C scenery, and 0.1 mile of Class A scenery (Rio Grande) are crossed by this subroute.

Subroute 1B2 is identical to Subroute 1B1, except for links A30, A50, and A60 east of the proposed SunZia East Substation. These links are located to the south of Subroute 1B1, and cross similar Class B and Class C scenery, including juniper hills, rolling savanna grasslands, and desert valley plains. In addition, cultural modifications that have locally modified the landscapes along this subroute are identical to cultural modifications within Class B and Class C scenery associated with Subroute 1B1. A total of 153.0 miles of Class B scenery, 56.1 miles of Class C scenery, and 0.1 mile of Class A scenery (Rio Grande) are crossed by this subroute.

Subroute 1B3 is identical to Subroute 1B2, except for links A40, A41, and A80 west of the proposed SunZia East Substation. These links are located above the northern boundary of the WSMR and cross similar Class B and Class C scenery as Subroute 1B2. The total of Class B and Class C scenery crossed by this subroute is almost the same as that crossed by Subroute 1B2. A total of 154.6 miles of Class B scenery, 51.6 miles of Class C scenery, and 0.1 mile of Class A scenery (Rio Grande) are crossed by this subroute. Cultural modifications are similar to Subroute 1B2.

Local alternative links in the Gran Quivira area (links E81, E82, E83, E84, and E85) cross similar Class B scenery as Subroute 1A1 and 1A, including rolling juniper-woodland savanna and rolling savanna plains. Cultural modifications that have locally modified the landscape in this area include ranching, pipelines, paved and unpaved roads, and a wind farm.

Local alternative links A161b and A260 cross Class B scenery, including undulating bajadas supporting grasses and creosote, southern foothills of the Magdalena Mountains, and the Rio Grande Valley. Cultural modifications that have locally modified Class B scenery along these alternative links include HVTLs (115 kV), major transportation corridors (e.g., I-25), and paved and unpaved roads. Local alternative links also cross Class B scenery, including the Rio Grande Valley (Link A361), agricultural lands (Link A430), and undulating grassland hills (Link A481). Links A430 and A431 also cross Class C scenery associated with semidesert grassland plains.

Crossover Link A70, between subroutes 1B2 and 1B3, primarily crosses Class B landscapes, defined by gently to moderately rolling topography covered with grasses, yuccas, prickly-pear, and scattered stands of juniper. A small portion of the link crosses Class C landscape. Cultural modifications are similar to Subroute 1B1.

Viewing Locations and KOPs

Viewing locations from the proposed SunZia East Substation to links E90 and A161 to Midpoint Substation are similar to Subroute 1A. Subroute 1B1 residences associated with a high concern level are located in San Antonio, Laborcita, and San Antonito, along Link A140.

Smaller residential developments are located in Claunch near Link E80c. Dispersed rural residences are generally located along all portions of the subroute. High concern level recreation viewing locations associated with Subroute 1B1 (including Cibola National Forest, Bosque del Apache NWR, Little San Pasqual Wilderness, Chupadera Wilderness, Antelope WSA, Sierra de las Canas WSA, Gran Quivira, and the Stallion WSA) would generally have direct views of the landscape in which the Project would be located. There are no moderate concern level recreation areas along Subroute 1B1. Scenic designated travel routes associated with a high concern level include the southern portion of the Quebradas Back Country Byway and the El Camino Real National Scenic Byway (SR 1). Travel routes associated with moderate concern level viewing locations include US Route 54, SR 14, and US Route 380, near links A10, E80c, A140, A112, and A111. These travel routes provide viewing opportunities of the landscape in which Subroute 1B1 would be located. Link A10 is near a US Route 54 rest area associated with a moderate concern level; and Trinity Historic Marker along US Route 380 is near links A111 and A90.

KOPs specific to Subroute 1B1 include:

- SO1 – Claunch
- SO2 (a) – Gran Quivira
- SO4 – Route 7 Residence
- SO5 – Route 3617 Residence
- SO8 – Route 18 Residence
- SO9 – Quebradas Back Country Byway SRMA
- SO10 – Trinity Historic Marker
- SO20 – San Antonio West
- SO21 – San Antonio East
- SO22 – US Route 380
- SO23 – Bosque NWR
- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area

KOPs common with Subroute 1A from Link A161 to Midpoint Substation include:

- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Viewing locations for Subroute 1B2 are similar to Subroute 1B1 from Link A111 to Midpoint Substation.

KOPs specific to Subroute 1B2 include:

- RO1 – County Road A020 Residence
- SO6 – Route 3508 Residence
- SO8 – Route 18 Residence
- SO9 – Quebradas Back Country Byway SRMA
- SO10 – Trinity Historic Marker

KOPs common with Subroute 1B1 from Link A111 to Midpoint Substation include:

- SO20 – San Antonio West
- SO21 – San Antonio East
- SO22 – US Route 380
- SO23 – Bosque del Apache NWR
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Viewing locations for Subroute 1B3 are similar to Subroute 1B1 from Link A111 to Midpoint Substation. High concern level residences are located in the town of Bingham, near links A41 and A80. Travel routes associated with a moderate concern level include US Route 54, SR 14, and US Route 380 along links A10, A30, A41, and A80.

KOPs specific to Subroute 1B3 include:

- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area
- SO7 – Bingham
- SO9 – Quebradas Back Country Byway SRMA
- SO10 – Trinity Historic Marker

KOPs common with Subroute 1B1 from Link A111 to Midpoint Substation include:

- SO20 – San Antonio West
- SO21 – San Antonio East
- SO22 – US Route 380
- SO23 – Bosque del Apache NWR
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Local Alternative and Crossover Links for Route Group 1

Local Alternative Links for Subroutes 1A, 1A1, and 1B1 (Gran Quivira area)

Scenery

The majority of the local alternative links near the Gran Quivira area traverse Class B landscapes that are characterized by juniper hills, rolling savanna grasslands, and gently sloping to undulating terrain. Cultural modifications south of the Gran Quivira area are limited to unpaved roads. North of the Gran Quivira area, modifications that have locally modified the landscape include pipelines, ranching, unpaved roads, and a windfarm.

Viewing Locations and KOPs

A cluster of dispersed residences are located to the north of Gran Quivira, near local alternative links E82, E83, E84a, E84b, and E85. Dispersed rural residences are generally located north of Claunch, near Local Alternative Link E81. High concern level recreation viewing locations include Gran Quivira, which has direct views of the landscapes where local alternative links E81, E83, E84a, and E84b are located. Scenic designated travel routes associated with a high concern level include the Salt Missions Scenic Byway (SR 55, north of Gran Quivira). Travel routes associated with moderate concern level viewing locations include SR 55 (south of the monument) and FR 167, which provides access to the Cibola National Forest. These travel routes provide viewing opportunities of the landscape in which these local alternatives are located.

KOPs specific to local alternative links for subroutes 1A, 1A1, 1A2, and 1B1 (Gran Quivira area) include:

- SO2 (b) – Gran Quivira
- SO31 (a, b) – Gran Quivira
- RP01 – SR 55 Salt Missions Trail Scenic Byway
- RP02 – SR 55 Residences

BLM VRI Classifications

Local alternatives E83, E84a, and E84b near the Gran Quivira area would cross Class C scenic quality, characterized by flat terrain occupied by grassland with some piñon-juniper. These local alternatives are within the foreground-middleground distance zone, and traverse low sensitivity BLM land (approximately 2 percent). Two small parcels of BLM land crossed by links E83 and E84 within the Rio Puerco Field Office cross VRI Class IV. Local alternative links E81, E82, and E85 do not cross BLM land.

BLM VRM Classifications

Local alternatives links for Gran Quivira (E83 and E84) cross interim VRM Class IV lands in the Rio Puerco Field Office. Local alternative links E81, E82, and E85 do not cross BLM land.

Local Alternative Links for 1A, 1B1, 1B2, 1B3

Scenery for local alternative links A161b, A260, A361, A430, and A481 are similar to Subroute 1A. Viewing locations for local alternative links A161b and A260 are similar to Subroute 1A. Dispersed rural residences occur in the Uvas Valley (Link A430). Moderate concern level travel routes include SR 26, along Link A430.

KOPs specific to local alternative links for subroutes 1A and 1B1 include:

- LC14 – County Road A030 Residence
- LC19 – El Camino Real/I-25
- LC20 – Elephant Butte State Park

Crossover Links for 1B2, 1B3

Scenery and viewing locations for Crossover Link A70 are similar to subroutes 1B2 and 1B3.

KOPs specific to Crossover Link A70 include:

- SO06 – Route 3508 Residence

BLM VRI Classifications

BLM land within the Socorro and Roswell field offices, and Las Cruces District office are crossed by subroutes 1B1, 1B2, and 1B3 for 113.9 miles (approximately 51 percent), 120.1 miles (approximately 57 percent), and 122.2 miles (approximately 59 percent), respectively. Local alternative links A161b and A260 cross 8.4 miles (approximately 45 percent) of BLM land within the Socorro Field Office and Las Cruces District office. Crossover Link A70 traverses 4 miles (approximately 52 percent) of BLM land in the Socorro Field Office.

Scenic quality, sensitivity level rating units, distance zones, and VRI classes for subroutes 1B1, 1B2, and 1B3, and Crossover Link A70 are similar to Subroute 1A. Subroutes 1B2 and 1B3 along links A30 and A111 cross Class B scenic quality associated with rolling piñon-juniper hills, and Class C scenic quality characterized by flat terrain occupied by grassland with some piñon-juniper. Subroutes 1B1, 1B2, and 1B3 are within the foreground-middleground distance zone. These subroutes primarily traverse low sensitivity BLM land and isolated areas associated with moderate sensitivity (links A41, A50, and A70). These links primarily cross VRI Class IV and isolated areas of VRI Class III.

BLM VRM Classifications

Subroutes 1B1, 1B2, and 1B3 cross 7.4 miles of VRM Class II land within the Roswell and Socorro field offices and the Las Cruces District Office. VRM Class II lands associated with these subroutes include the San Pedro ACEC, Rio Grande and adjacent agricultural land, Butterfield Historic Trail, and terrain near Cooke's Range. Subroute 1B1 crosses approximately 33.8 miles of VRM Class III and approximately 72.8 miles of Class IV land. Subroute 1B2 crosses approximately 34.4 miles of VRM Class III and 78.2 miles of Class IV land. Subroute 1B3 crosses approximately 42.6 miles of VRM Class III and 72.3 miles of VRM Class IV land.

Land associated with VRM Class III includes terrain east of San Antonio to Bingham and the valley plains, west of Good Sight Mountains. VRM Class IV land generally occurs along all portions of these subroutes.

Local alternative links A161b and A260 associated with Route Group 1B cross approximately 2.5 miles of VRM Class III and approximately 11.5 miles of VRM Class IV land.

Crossover Link A70 associated with Subroute 1B crosses approximately 2.9 miles of Class III and 1.1 miles of VRM Class IV land.

3.9.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Scenery

Scenery crossed by Subroute 3A2 has been inventoried primarily as Class C, which includes the Animas and San Simon valleys. These Class C landscapes are characterized by relatively level topography and vegetation dominated by grasses, with scattered occurrences of succulents and short and tall shrubs such as creosote and mesquite. Cultural modifications that have locally modified the landscapes associated with Class C scenery include HVTLs (345 kV and 115 kV), local transportation routes, unpaved roads, and substations. Other cultural modifications associated with this Class C scenery includes development and residences associated with the town of Deming. Link B160a crosses the northern foothills of the Peloncillo Mountains (Class B), characterized by moderate slopes and undulating peaks covered with swaths of perennial grasses and succulents, with occurrences of juniper scattered about the upper slopes. Link B120a crosses a bajada (Class B), which is defined by gently sloping to rolling terrain covered with a variety of grasses, shrubs, succulents, and cacti. A total of 52.3 miles of Class B scenery and 71.6 miles of Class C scenery are crossed by this BLM preferred alternative; no Class A scenery is crossed.

Viewing Locations and KOPs

High concentration residential viewing locations, which are associated with a high concern level, are located in Deming, including related dispersed residences south of Link B90. Subroute 3A2 would be visible on links B120b and B121 from high concern level recreation viewers, including the CDNST, portions of the Gila National Forest, and Peloncillo Mountains Wilderness (including Peloncillo Mountains WSA and moderate concern Northern Peloncillo Mountains ACEC). Moderate concern level travel routes include portions of I-10; New Mexico SR 26, SR 90, and SR 464; and US Routes 70, 180, and 191. Link B120a is near the I-10 Rest Area, which is associated with a moderate concern level.

KOPs specific to Subroute 3A2 include:

- LC27 – SR 180
- LC28 – Unnamed County Road at Hidalgo
- LC29 – SR 90
- LC33 – CDNST

BLM VRI Classifications

BLM land within the Las Cruces and Safford field offices are crossed by Subroute 3A2 for 65.6 miles (approximately 40.7 percent).

Scenic Quality: The majority of Subroute 3A2 crosses Class C scenic quality in the Las Cruces District Office associated with the Deming and Lordsburg valleys. This subroute crosses Class B scenic quality associated with the San Simon Valley in the Las Cruces and Safford field offices.

Sensitivity Level Rating Units: Subroute 3A2 primarily crosses low to moderate sensitivity BLM land within the Las Cruces and Safford field offices. An isolated area of BLM land associated with moderate sensitivity is crossed by links B90 and B170, near each substation terminus. High sensitivity BLM land is associated with the I-10 corridor and Peloncillo Mountain ranges and is crossed by this BLM preferred alternative.

Distance Zones: Subroute 3A2 is within the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Overall, half of Subroute 3A2 crosses VRI Class IV land. The BLM preferred alternative crosses 12.6 miles of VRI Class II land, 9.7 miles of VRI Class III land, and 101.6 miles of VRI Class IV land.

BLM VRM Classifications

Subroute 3A2 crosses approximately 61.5 miles of BLM land within the Las Cruces District Office and Safford Field Office. This route crosses 0.5 mile of VRM Class II lands, 23.2 miles of VRM Class III lands, and 41.9 miles of VRM Class IV lands. The Butterfield Historic Trail is designated as VRM Class II and is crossed by the preferred alternative. VRM Class III lands occur near the I-10 corridor, and the towns of Deming, Lordsburg, and San Simon. Some isolated VRM Class IV lands crossed by Subroute 3A2 are associated with the Animas Valley east of Deming and the San Simon Valley. This BLM preferred alternative crosses the foothills of the Peloncillo Mountains, which are designated as VRM Class IV.

Subroute 3A – North

Scenery

Scenery along Subroute 3A has been inventoried primarily as Class C, which includes the Animas and San Simon valleys. This subroute is identical to Subroute 3A1 from the Midpoint Substation up to and including Link B121, and Link B170 located near the Willow-500 KV Substation. Links B160a and B160b cross similar Class C scenery, north of the BLM preferred alternative. Cultural modifications that have locally modified the landscapes associated with Class C scenery are similar to the BLM preferred alternative and include HVTLs (345 kV and 115 kV), pipelines, major transportation routes (e.g., U.S. Highway 70), local transportation routes, and unpaved roads. This subroute (Link B160a) also crosses the foothills of the Peloncillo Mountains (Class B), north of the BLM preferred alternative. There are no cultural modifications to the landscapes associated with Class B scenery for Subroute 3A (Links 160b and 160a). A

total of 4.9 miles of Class B scenery and 118.5 miles of Class C scenery is crossed by this subroute; no Class A scenery is crossed.

Viewing Locations and KOPs

Subroute 3A is identical to Subroute 3A1 from the Midpoint Substation up to and including Link B121, and Link B170 located near the Willow-500 kV Substation. Additional high concern level recreation viewers that would have views of the Project include the Hot Dunes Recreation Area – SRMA/Campground near Link B160b. Hackel Road is a moderate concern travel route near Link B160b.

KOPs specific to Subroute 3A include:

- LC27 – SR 180
- LC28 – CDNST
- LC29 – SR 90
- SA3 – Hackel Road

BLM VRI Classifications

BLM land within the Las Cruces and Safford field offices are crossed by Subroute 3A for 58.1 miles (approximately 47 percent).

Scenic Quality: Subroute 3A crosses Class C scenic quality in the Las Cruces District Office associated with the Deming and Lordsburg valleys. Subroute 3A crosses Class B scenic quality associated with the San Simon Valley in the Safford Field Office.

Sensitivity Level Rating Units: This subroute primarily crosses low sensitivity BLM land within the Las Cruces and Safford field offices. An isolated area of BLM land associated with moderate sensitivity is crossed by links B90 and B170, near each substation terminus. Two areas of high sensitivity are crossed along Link B160b in the Safford Field Office and are generally associated with the Peloncillo Mountains.

Distance Zones: Subroute 1A is within the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Subroute 3A crosses VRI Class IV land in both the Las Cruces and Safford field offices. Isolated portions of VRI Class III (links B160b and B170) and VRI Class II (Link B160b) are crossed by this subroute.

BLM VRM Classifications

Subroute 3A crosses approximately 13.1 miles of VRM Class III land and approximately 45.0 miles of Class IV land within the Las Cruces District Office and Safford Field Office. VRM Class III and Class IV lands crossed by this subroute are associated with the Animas Valley east of Deming and the San Simon Valley. Subroute 3A crosses the foothills of the Peloncillo Mountains, which are designated as VRM Class IV.

Subroute 3B – South

Scenery

Subroute 3B crosses primarily Class C scenery within the Animas and San Simon valleys. From Link B150a to the Willow-500 kV Substation, Subroute 3B is identical to Subroute 3A1. The remainder of this subroute (links B60, B80, B110a, B110b, and B112) crosses similar Class C scenery as Subroute 3A. Cultural modifications that have locally modified the landscapes associated with Class C scenery are similar to the BLM preferred alternative and include HVTLs (345 kV and 115 kV), pipelines, major transportation routes (e.g., I-10), local transportation routes, and unpaved roads. Other cultural modifications associated with this Class C scenery include development and residences associated with the town of Lordsburg. Class B scenery crossed by Subroute 3A includes rolling semidesert grassland hills just south of Lordsburg (Link B112), and the southern foothills of the Peloncillo Mountains (Link B150a). Cultural modifications that have locally modified landscapes associated with Class B include pipelines, paved and unpaved roads, and mining operations. Subroute 3B does not cross any Class A scenery. A total of 7.6 miles of Class B scenery and 121.0 miles of Class C scenery are crossed by this subroute.

Crossover Link B111 crosses 6.9 miles of Class C scenery associated with the Animas Valley. Crossover Link B140, also within the Animas Valley, crosses 0.2 mile of Class B scenery and 8.1 miles of Class C scenery. Cultural modifications that have locally modified the valley associated with Class C include HVTLs (115 kV), local transportation routes, and unpaved roads.

Viewing Locations and KOPs

Subroute 3B is identical to Subroute 3A1 from Link B150a to the Willow-500 kV Substation. Residential viewers would be identical to the BLM preferred alternative (and the eastern portion of Subroute 3A), with the exception of being in closer proximity to Subroute 3B. Links B112 and B110b could affect high concern level recreation viewing locations associated with the CDNST near Lordsburg. Moderate concern level recreation viewers include the Shakespeare Ghost Town near Link B112. Moderate concern level travel routes include Hackel Road.

KOPs specific to Subroute 3B include:

- LC27 – SR 180
- LC30 – Lordsburg
- LC31 – CDNST
- LC32 – Shakespeare Ghost town
- SA02 – San Simon Residences

Crossover links associated with the Midpoint Substation to Willow-500 kV Substation subroutes have a high concern level associated with smaller residential concentrations associated with Lordsburg, and are located to the west of Link B111. Similar conditions exist for the CDNST near Link B111 as for Link B112.

BLM VRI Classifications

BLM land within the Las Cruces and Safford field offices are crossed by Subroute 3B for 5.8 miles (approximately 43 percent). Crossover links B111 and B140 cross 2.8 miles (approximately 18 percent) of BLM land within the Las Cruces District Office.

Scenic Quality: Subroute 3B primarily crosses Class B scenic quality associated with the San Simon Valley, the Peloncillo Mountains, and the Pyramid Mountains. Class C scenic quality crossed by Subroute 3B is associated with the Deming and Lordsburg valleys.

Crossover links B111 and B140 cross Class C scenic quality associated with the Lordsburg Valley.

Sensitivity Level Rating Units: Subroute 3B primarily crosses BLM land inventoried as high sensitivity for land associated with I-10 (links B110a, B112, B150a, and B150b). The Hot Well Dunes Recreation Area (Link B150b) is associated with moderate sensitivity. Several smaller BLM parcels inventoried as low sensitivity are crossed by links B110b, B150a, B151, and B170.

Crossover links B111 and B140 cross high sensitivity areas associated with I-10.

Distance Zones: Subroute 3B and crossover links B111 and B140 are located in the foreground-middleground distance zone.

VRI Classes: Subroute 3B crosses VRI Class IV (links B110a, B150a, B150b, and B170), VRI Class III (links B110a, B150a, and B150b), and VRI Class II lands associated with the Pyramid Mountains (Link B112), the Peloncillo Mountains (Link B150a), and the I-10 corridor in the Safford Field Office (link B150a).

Crossover links B111 and B140 go through VRI Class III land.

BLM VRM Classifications

Subroute 3B crosses approximately 1.0 mile of VRM Class II land, approximately 19.3 miles of Class III land, and approximately 35.5 miles of Class IV land within the Las Cruces District Office and Safford Field Office. VRM Class II land is associated with the CDNST near Lordsburg. VRM Class III and IV lands crossed by this subroute are associated with the Animas Valley east of Deming and the San Simon Valley. Subroute 3B crosses the foothills of the Peloncillo Mountains, which are designated VRM Class IV.

Crossover Link B111 crosses approximately 1.6 miles of VRM Class IV land associated with valley plains east of Deming. Crossover Link B140 crosses approximately 0.5 mile of VRM Class II land, which is associated with the Butterfield Trail, and 0.7 mile of VRM Class III land within the Animas Valley west of Lordsburg.

3.9.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Scenery

Scenery along Subroute 4A is primarily Class B. Class C landscapes are crossed in the San Simon Valley (Link 153a) north of the Willow-500 kV Substation, and in the creosote dominated valley plains north of the Picacho Mountains (Link C850). Cultural modifications that have locally modified landscapes associated with Class C include HVTLs (345kV and 230 kV), pipelines, major transportation routes (e.g., US Route 191), and paved and unpaved roads. Other cultural modifications that occur within Class C scenery include development associated with Swift Trail Junction. Class B landscapes crossed by this subroute include the eastern foothills and piedmont of the Pinaleño Mountains, the southern portion of the Aravaipa Canyon and Aravaipa Creek, and the lower peaks of the northern Galiuro Mountains. This subroute also crosses the San Pedro River Valley (Class B), characterized by highly dissected bajadas and alluvial fans covered with a variety of vegetation ranging from succulents, desert cacti, and low shrubs, to piñon-juniper and mesquite. West of the San Pedro Valley, this subroute continues to cross Class B landscapes, including the Falcon Valley, characterized by gently to moderately rolling bajadas; juniper covered foothills of the Black Mountain; Sonoran Valley plains defined by the variety and density of vegetation; and irrigated lands near the planned Pinal Central Substation. Cultural modifications that have locally modified landscapes associated with Class B include HVTLs (500 kV and 115 kV), pipelines, local transportation routes (e.g., SR 77), unpaved roads, substations, mining operations, development associated with the town of Mammoth, and agricultural lands north of Eloy. Link C592 crosses the San Pedro River and Floodplain, which are the only Class A landscapes crossed by this subroute. These landscapes are characterized by the meandering form of the San Pedro River and the diverse riparian vegetation that is adjacent to and interwoven within the river itself. Cultural modifications that have locally modified landscapes associated with Class A scenery include pipelines, local transportation routes (SR 77), unpaved roads, a water treatment facility, and dispersed residences associated with the town of Mammoth. A total of 0.9 mile of Class A scenery, 99.5 miles of Class B scenery, and 32.4 miles of Class C scenery are crossed by Subroute 4A.

Local Alternative Link C790 is within the Sonoran Desert Valley landscape (Class B) characterized by level topography, densely vegetated with a wide variety of desert species including paloverde, mesquite, saguaro, cholla, ocotillo, prickly-pear, grasses, and other herbaceous species. A portion of this alternative parallels the Pinal Pioneer Parkway. Other cultural modifications that have locally modified this landscape include HVTLs (115 kV), pipelines, and unpaved roads.

Viewing Locations and KOPs

High concentration residential viewers, which are associated with a high concern level, are located in Eloy, Lebanon, La Palma, and Swift Trail Junction (including Artesia) along links C880a, B153b, B153a, and B153b. Smaller residential concentrations are located in Klondyke and Mammoth along links B153b, C170, C592, and C595. The Project would be visible on links B153a, B153b, C170, and C620, from high concern level recreation viewers, including the

Arizona Trail (National Scenic Trail); Arcadia Campground (CNF); Trails 313, 66, 70/Deadman Creek Trailhead (CNF); Aravaipa Canyon Wilderness; Santa Teresa Wilderness; Bear Springs Badlands ACEC; Roper Lake State Park; and the Dankworth Pond State Park.

Travel routes with associated scenic designations include Stockton Pass Road, Klondyke Road, Swift Trail Parkway (SR 366), Redington Road, and Pinal Pioneer Parkway (SR 79). The Anza NHT auto tour route is designated along SR 87 near Casa Grande. Recreation access travel routes associated with a high concern level includes Rug Road, which provides access to the Aravaipa Canyon Wilderness. Moderate concern level recreation viewers include the Frye Mesa Reservoir (CNF), Cluff Ranch Wildlife Area, Mount Graham Municipal Golf Course, and Tierra Grande Country Club near links B153b and C880a. Moderate concern level travel routes include US Routes 191 and 287, SR 77, 4 Mile Road, Cluff Ranch Road, Bluebird Mine Road, and Tripp Canyon Road/FR 286. Other areas of moderate concern level include the San Simon Rest Area, Tom Mix Memorial/Rest Area, and Table Mountain RNA ACEC near links B153a, C170, C760, and C780.

KOPs specific to Subroute 4A include:

- SA04 – Artesia
- SA05 – Swift Trail Parkway/SR 366
- SA06 – Lebanon Residences
- SA07 – Cluff Ranch Wildlife Area
- SA08 – Bear Springs Badlands ACEC
- SA12 – Klondyke Road East
- SA13 – Klondyke Road North
- SA14 – Rug Road
- TU01 – Mammoth Residences
- TU02 – SR 77
- TU03 – Arizona National Scenic Trail – Black Hills
- TU30 – Pinal Pioneer Parkway/SR 79
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residence
- TU36 – Freeman Road

Local Alternative Link C790 has similar viewing conditions to those identified for links C780 and C830. These conditions include a travel route with associated scenic designation, the Pinal Pioneer Parkway (SR 79), and moderate concern viewers associated with the Greek Orthodox Monastery.

BLM VRI Classifications

Subroute 4A crosses 11 miles (approximately 8 percent) of BLM land within the Safford and Tucson field offices. Local alternative links C790, C860, C870, and C890 do not cross BLM land.

Scenic Quality: In the Safford Field Office, Subroute 4A only crosses BLM land along Link B153a, which is a Class B landscape associated with the San Simon Valley.

Sensitivity Level Rating Units: Subroute 4A crosses moderate sensitivity BLM land associated with the Hot Well Dunes Recreation Area and US Route 191.

Distance Zones: Subroute 4A is located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: The BLM land crossed by the subroute is VRI Class II.

BLM VRM Classifications

Subroute 4A crosses approximately 11 miles of VRM Class III land within the Safford and Tucson field offices; this subroute does not cross VRM Class II or Class IV lands. VRM Class III land crossed by this Subroute 4A is associated with the San Simon Valley south of Swift Trail Junction and Sonoran Desert Valley east of the Pinal Pioneer Parkway. Local Alternative Link C790 does not cross BLM land.

Subroute 4B – Sulphur Springs Valley

Scenery

Scenery crossed by Subroute 4B is identical to Subroute 4A in Aravaipa Canyon, San Pedro Valley, and Falcon Valley, and near the planned Pinal Central Substation. West of San Simon Valley, this subroute crosses the southern foothills of the Pinaleño Mountains (Class B) and up through the undeveloped landscape of the Sulphur Valley (Class C), defined by level topography dominated by grasses and creosote. This subroute also crosses Class B landscape at the southern end of the Aravaipa Canyon, defined by gently rolling bajadas covered with a variety of vegetation, including desert cacti and piñon-juniper at higher elevations. Cultural modifications along this alternative are similar to Subroute 4A, with the exception of Sulphur Valley, where the majority of the subroute crosses undeveloped landscapes. Areas where cultural modifications have locally modified the landscape associated with Class B scenery are concentrated south of the Pinaleño Mountains and Sulphur Springs Valley, and include HVTLs (345 kV), pipelines, unpaved roads, and local transportation corridors (e.g., SR 266). Other cultural modifications include development associated with Sulphur Springs Valley, which is primarily characterized by agriculture and associated residences/structures. A total of 0.9 mile of Class A scenery, 100.4 miles of Class B scenery, and 31.6 miles of Class C scenery are crossed by Subroute 4B.

Scenery for Local Alternative Link C790 is similar to Subroute 4A.

Viewing Locations and KOPs

High concentration residential viewers, which are associated with a high concern level, are located in Eloy, Lebanon, and La Palma along links C890, C880, and C880a. Smaller residential concentrations are located in Bonita, Klondyke, and Mammoth along links C130a, C130b, C170, and C592. Dispersed rural residences are generally located along links C71, C130a, C130b, C170, C592, C620, and C840. The Project would be visible on Link C170 and from high concern

level recreation viewers, including the Arizona Trail (National Scenic Trail); Trails 298, 305, 313, and 66, and Cottonwood Canyon Trailhead (CNF); Aravaipa Canyon Wilderness; and the Santa Teresa Wilderness. Travel routes with associated scenic designations include Stockton Pass Road, Bonita Aravaipa Road, Klondyke Road, Swift Trail Parkway (SR 366), Redington Road, and Pinal Pioneer Parkway (SR 79). Recreation access travel routes associated with a high concern level include Rug Road, which provides access to the Aravaipa Canyon Wilderness. Moderate concern level recreation viewers include the Tierra Grande Country Club near Link C880a. Moderate concern level travel routes include US Route 191, Fort Grant Road, 4 Mile Road, High Creek Road, and the Bluebird Mine Road. Other areas associated with a moderate concern level include the Tom Mix Memorial/Rest Area and the Table Mountain RNA ACEC near links C170, C760, and C780.

KOPs specific to Subroute 4B include:

- SA09 – Bonita Aravaipa Road East
- SA11 – Bonita Aravaipa Road West

KOPs common with Subroute 4A from Link C170 to the planned Pinal Central Substation include:

- SA12 – Klondyke Road East
- SA13 – Klondyke Road North
- SA14 – Rug Road
- TU1 – Mammoth Residences
- TU2 – SR 77
- TU3 – Arizona National Scenic Trail (Black Hills)
- TU30 – Pinal Pioneer Parkway/SR 79
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residence
- TU36 – Freeman Road

Viewing locations and KOPs for Local Alternative Link C790 is similar to Subroute 4A.

BLM VRI Classifications

Subroute 4B crosses 5 miles (approximately 4 percent) of BLM land within the Tucson Field Office. Local alternative links C790 and C692 do not cross BLM land. Subroute 4B does not cross BLM land in the Safford Field Office.

Scenic quality, sensitivity level rating units, distance zones, and VRI Class information for Subroute 4B is similar to Subroute 4A for the Tucson Field Office.

BLM VRM Classifications

Subroute 4B crosses approximately 5 miles of VRM Class III land associated with the Sonoran Desert Valley east of the Pinal Pioneer Parkway, within the Safford and Tucson field offices. This subroute does not cross VRM Class II or Class IV lands.

Local Alternative Link C790 does not cross BLM land.

Subroute 4C2c – BLM Preferred Alternative

Scenery

Primarily Class B scenery has been identified along this BLM preferred alternative. Class C landscapes crossed by Subroute 4C2c are limited to the Sulphur Springs Valley and plains south of the Galiuro Mountains (links C110 and C260, respectively), and in the creosote dominated valley plains north of the Picacho Mountains (links C850 and C860). Cultural modifications that have locally modified landscapes associated with Class C include HVTLs (345kV), pipelines, and paved and unpaved roads. Class B landscapes primarily crossed by Subroute 4C2c are associated with the San Pedro Valley, east of the Rincon and Santa Catalina mountains (links C201, C441, C450, and C661). This area is characterized by moderately to highly dissected bajadas covered with a wide range of vegetation, including desert cacti, piñon-juniper and oak, and riparian species. Cultural modifications that have locally modified landscapes associated with Class B scenery within the San Pedro Valley include HVTLs (115 kV), pipelines, Tiger Mine, San Manuel Substation, major transportation corridors (e.g., SR 77), and unpaved roads. Other cultural modifications include development associated with Cascabel and San Manuel, characterized by agriculture and associated residents/structures. Other Class B scenery crossed by Subroute 4C2c includes the southern foothills of the Pinaleño Mountains (links C71, C71a, C110) and the southern foothills of the Galiuro Mountains (Link C212). West of the San Pedro Valley, Subroute 4C2c continues to cross Class B landscapes, including the Falcon Valley, characterized by gently to moderately rolling bajadas; paloverde and cacti covered foothills of the Tortolita Mountains; Sonoran Valley plains defined by the variety and density of vegetation; and irrigated lands near the planned Pinal Central Substation. Cultural modifications that have locally modified landscapes associated with Class B include HVTLs (500 kV and 115 kV), pipelines, local transportation routes (e.g., SR 79), unpaved roads, substations, mining operations, development associated with the town of Oracle, and agricultural lands north of Eloy. Links C201 and C261 cross the San Pedro River and Floodplain, which are the only Class A landscapes crossed by this BLM preferred alternative. These landscapes are characterized by the meandering form of the San Pedro River and the diverse riparian vegetation that is adjacent to and interwoven within the river itself. Cultural modifications that have locally modified landscapes associated with Class A scenery include HVTLs, pipelines, local transportation routes (SR 77), and unpaved roads. A total of 0.9 mile of Class A scenery, 132.1 miles of Class B scenery, and 28.1 miles of Class C scenery are crossed by Subroute 4C2c.

Viewing Locations and KOPs

Subroute 4C2c high concentration residential viewers, which are associated with a high concern level, are located in Eloy, La Palma, Oracle, San Manuel, and Willcox, along links C110, C450, C670, C680, and C880a. Smaller residential concentrations are located in Cascabel along links C261 and C201, Redington along Link C441, and San Manuel along Link C450. Dispersed rural residences are generally located along all segments of Subroute 4C2c. The Project would be visible on links C441, C450, C661, C670, and C680 from high concern level recreation viewers, including: Arizona Trail Trailhead (Tiger Mine); Arizona Trail; CNF (including Last Chance Wilderness Trailhead, Trail 9 and associated trailhead); Rincon Mountains Wilderness; Saguaro

National Park (East); Oracle State Park (including Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the Historic Kannally Ranch House); and the Biosphere. Travel routes with associated scenic or auto tour route designations include Redington Road, SR 79 (Pinal Pioneer Parkway), SR 87, and Control Road (Mount Lemmon Highway FR 38). Moderate concern level recreation viewers include the YMCA Triangle Y Ranch Camp and Retreat Center, Bellota Ranch (A7 Ranch), Saddlebrook Ranch Golf Club, San Manuel Golf Club, and Tierra Grande Country Club near links C441, C450, C680, and C880a. Moderate concern level travel routes include Fort Grant Road, US Routes 191 and 287, Three Links Road, Cascabel Road, Ocotillo Road, SR 76 (San Pedro River Road), and SR 77, and the Tom Mix Memorial Rest Area. Moderate concern level recreation access/four-wheel drive roads include Black Hills Mine Road/Catalina Ridge, Buehman Canyon Trail, and Muleshoe Ranch Road.

KOPs specific to Subroute 4C2c include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU4 – Oracle Residences
- TU5 – Arizona National Scenic Trail (Tiger Mine Trailhead)
- TU7 – San Manuel Residences
- TU8 – Control Road (Mount Lemmon Highway FR 38)
- TU9 – San Pedro River Valley North
- TU11 – Cascabel Road (South)
- TU27 – Biosphere
- TU28 – Longhoen Trail Residence (Red Rock)
- TU29 – Park Link Drive
- TU31 – Tom Mix Memorial Rest Area
- TU32 – St. Anthony's Orthodox Monastery
- TU33 – Earley Road Residences
- TU34 – SR 77
- TU35 – Pinal Pioneer Parkway/SR 79

BLM VRI Classifications

Subroute 4C2c crosses 14.9 miles of land (approximately 9.2 percent) in the Tucson Field Office. It does not cross BLM land in the Safford Field Office.

Scenic Quality: Subroute 4C2c primarily crosses Class B scenic quality, with an area of Class C in the Tucson Field Office on one large BLM parcel (links C680, C818, and C820).

Sensitivity Level Rating Units: Subroute 4C2c crosses moderate sensitivity BLM land for the majority of the route.

Distance Zones: Subroute 4C2c is located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Subroute 4C2c crosses 10.5 miles of VRI Class III and 4.3 miles of VRI Class IV land in the Tucson Field Office; VRI Class I and II land is not crossed. BLM land in the Safford Field Office is not crossed by the BLM preferred alternative.

Sensitivity Level Rating Units: Subroute 4C2c crosses the Pinal Pioneer Parkway (Link C693), an area associated with high sensitivity in the Tucson Field Office. This alternative also crosses areas associated with moderate sensitivity level rating units (links C680, C818, and C820), as well as a small area of high sensitivity in the Tucson Field Office (Link C820).

BLM VRM Classifications

Subroute 4C2c crosses approximately 14.9 miles of VRM Class III land. This alternative does not cross VRM Class I, II, or IV land. VRM Class III land crossed by the preferred alternative is primarily associated with the Sonoran Desert Valley east of the Picacho Mountains.

Subroute 4C – San Pedro Valley and Tucson

Scenery

Primarily Class B scenery has been identified along Subroute 4C1. Class C landscapes crossed by this subroute are identical to Subroute 4C2c in the Sulphur Springs Valley and north of the Picacho Mountains. Subroute 4C1 also crosses grassland plains (Class C) south of the Galiuro Mountains and the BLM preferred alternative (Link C270). Class B scenery crossed by this subroute within the San Pedro Valley is similar to Subroute 4C2c; however, Subroute 4C1 is located east of the San Pedro River near the base of the Galiuro Mountains. Cultural modifications within the San Pedro Valley are similar to Subroute 4C2c. The San Pedro River and floodplain crossing (Class A) is similar to Subroute 4A, but is located farther south and is adjacent to developed landscapes, including the San Manuel Copper Mine complex (Link C660). Other Class A scenery includes steep desert canyons with perennial streams and riparian species concentrated along the bottom. There are no cultural modifications to the desert canyon landscape associated with Class A scenery. West of the San Pedro Valley, landscape scenery crossed by this subroute is similar to Subroute 4A, but is located farther south. Cultural modifications west of the San Pedro Valley are also similar to Subroute 4A. Scenery is identical to Subroute 4A, beginning with Link C760, west to the planned Pinal Central Substation. A total of 2.9 miles of Class A scenery, 117.8 miles of Class B scenery, and 18.2 miles of Class C scenery are crossed by Subroute 4C1.

Local Alternative Link C692 crosses similar Class B scenery as does Subroute 4C1; however, it crosses a more natural setting than Subroute 4C1, as it does not parallel an existing pipeline route.

Scenery along Subroute 4C2 is identical to Subroute 4C2c, except south of the Winchester Mountains (links C111, C266, C276, and C270). Subroute 4C2 crosses similar Class B and Class C scenery as the BLM preferred alternative, but is located farther north. The San Pedro River and floodplain crossing (Class A) is also similar to the BLM preferred alternative, but is located farther north and is in a more natural setting (Link C276). A total of 0.6 mile of Class A scenery,

126.7 miles of Class B scenery, and 24.4 miles of Class C scenery are crossed by Subroute 4C2. Cultural modifications are similar to the BLM preferred alternative.

Local alternative links C72, C90, C121, and C211 cross similar Class B scenery as Subroute 4C2, south of the Pinaleño Mountains. These links also cross identical Class B and Class C landscapes within Sulphur Valley.

Crossover links C500, C501, C502, and C174 cross Class B landscapes within the eastern portion of the San Pedro Valley. Crossover Link C671 crosses Class B scenery on the western side San Pedro Valley; however, this link is adjacent to the Tiger Mine.

A large portion of Subroute 4C3 crosses developed landscapes associated with the Tucson metropolitan area (links F111, F112, and F510). In more natural settings north and south of Tucson, Class B scenery is typical. Subroute 4C3 is identical to Subroute 4C1 south of the Pinaleño Mountains, within the Sulphur Springs Valley and south of the Winchester Mountains (links C71a, C110, and C212). It is also identical to Subroute 4C2c from the Tortolita Substation, north to the planned Pinal Central Substation (links C820, C830, C840, C850, C880, and C880a). This subroute crosses similar Class A and Class B scenery in the San Pedro Valley as subroutes 4C1 and 4C2. The San Pedro River and floodplain crossing (Class A) is identical to the BLM preferred alternative (Link 261). Other Class B scenery crossed by this subroute includes the area south of the Rincon Mountains, characterized by rolling foothills and gently sloping to rolling bajadas (links F40a and F600), and the Sonoran Valley plains west of the Tortolita Mountains (Link F540). Cultural modifications that have locally modified the landscapes associated with Class B scenery include HVTLs (345 kV, 230 kV, 138 kV, and 115 kV), pipelines, the Winchester Substation, major transportation corridors (e.g., I-10), and unpaved roads. Class C landscapes along this subroute include the valley plains south of the Winchester Mountains (Link 260), and the creosote dominated valleys near the Tortolita Substation (links C810a and C810) and the Rincon Valley (links F60b, F82, and F80). Cultural modifications that have locally modified the landscapes associated with Class C include HVTLs (500 kV, 345 kV, 230 kV, 138 kV, and 115 kV), pipelines, substations (e.g., Vail and Tortolita), Saguaro Power Plant, major transportation corridors (e.g., I-10), and unpaved roads. Class A scenery crossed by this subroute includes Cienega Creek (Link F600) southeast of Vail, and is characterized by a meandering, perennial creek with dense, riparian vegetation, including cottonwood and willow trees, adjacent to and within the creek bed. This subroute crosses the Cienega Creek near the I-10 crossing. Cultural modifications that have locally modified this landscape setting include HVTLs (345 kV), pipelines, major transportation corridors (e.g., I-10), railroad corridors, and trails. A total of 0.8 mile of Class A scenery, 101.7 miles of Class B scenery, and 51.9 miles of Class C scenery are crossed by this alternative. This subroute crosses 18.5 miles of developed lands generally associated with Tucson.

Local Alternative Link C812 crosses 1.4 miles of Class B scenery, 1.5 miles of Class C scenery, and 0.5 mile of developed land.

Viewing Locations and KOPs

For Subroute 4C1, high concentration residential viewers, which are associated with a high concern level, are located in Eloy, La Palma, Oracle, San Manuel, and Willcox along links C110,

C660, C670, and C880a. Smaller residential concentrations are located in Cascabel, Redington, and Mammoth along links C331, C470, and C660. Dispersed rural residences are generally located along links C71, C110, C270, C470, C510, C690, and C693. Future residences include Willow Springs near links C690, C691, and C693. The Project would be visible on links C331, C361, C470, C661, and C670 from high concern level recreation viewers, including trails within the Muleshoe Ranch, the Arizona Trailhead (Tiger Mine), Arizona Trail, Trail 289 (CNF), Galiuro Wilderness, Redfield Canyon Wilderness, Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the historic Kannally Ranch House at the Oracle State Park. Travel routes with associated scenic or auto tour route designations include the Pinal Pioneer Parkway (SR 79), I-10, and SR 87. Moderate concern level recreation viewers include the Tierra Grande Country Club near Link C880a; and travel routes include Fort Grant Road, Muleshoe Ranch Road, SR 76 (San Pedro River Road), SR 77, and US Routes 191 and 287. Other areas associated with moderate concern levels include the Willow Springs (future development) and the Tom Mix Memorial/Rest Area near links C690, C691, C693, C760, and C780.

KOPs specific to Subroute 4C1 include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU4 – Oracle Residences
- TU5 – Arizona Trail/Tiger Mine Trailhead
- TU6 – San Manuel/San Pedro River Valley
- TU9 – San Pedro River Valley North
- TU30 – Pinal Pioneer Parkway/SR 79
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residences
- TU34 – SR 77
- TU36 – Freeman Road

Local Alternative Link C692 has similar viewing conditions to those identified for links C690, C691, and C693. These conditions include a moderate concern level associated with Willow Springs (future development).

For Subroute 4C2, high concentration residential viewers, which are associated with a high concern level, are located in Eloy, La Palma, Oracle, San Manuel, and Willcox along links C110, C450, C670, C680, and C880a. Smaller residential concentrations are located in Cascabel and Redington along Link C441. Dispersed rural residences are generally located along links C71, C110, C276, C441, C450, and C680. The Project would be visible on links C441, C450, C661, C670, and C680 from high concern level recreation viewers, including the Arizona Trail Trailhead (Tiger Mine), Arizona Trail, Last Chance Wilderness Trailhead, Trail 9 and associated Trail Head, Rincon Mountains Wilderness, Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the Historic Kannally Ranch House at the Oracle State Park, and the Biosphere. Travel routes with associated scenic or auto tour route designations include SR 87 and Control Road (FR 38). Moderate concern level recreation viewers include the YMCA Triangle Y Ranch Camp and Retreat Center,

Bellota Ranch (A7 Ranch), Saddlebrook Ranch Golf Club, San Manuel Golf Club, and Tierra Grande Country Club near links C441, C450, C680, and C880a. Moderate concern level travel routes include Fort Grant Road, US Routes 191 and 287, Park Link Drive (which provides access to dispersed recreation in the Desert Peak area), SR 76 (San Pedro River Road), and SR 77. Moderate concern level recreation access/four-wheel drive roads include Black Hills Mine Road/Catalina Ridge, Buehman Canyon Trail, and Muleshoe Ranch Road.

KOPs specific to Subroute 4C2 include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU4 – Oracle Residences
- TU5 – Arizona National Scenic Trail (Tiger Mine Trailhead)
- TU7 – San Manuel Residences
- TU8 – Control Road (FR 38)
- TU9 – San Pedro River Valley North
- TU10 – Cascabel Road (North)
- TU27 – Biosphere
- TU28 – Longhoen Trail Residence/Red Rock
- TU29 – Park Link Drive
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residences
- TU34 – SR 77
- TU35 – Pinal Pioneer Parkway/SR 79

Local alternative links C72, C90, C121, and C211 have similar viewing conditions to those identified for links C71a and C110. Local Alternative Link C90 is a common link with Subroute 4B, and Local Alternative Link C790 is a common local alternative with the Sulphur Springs Valley Subroute. High concentration residential viewers, which are associated with a high concern level, are north of Willcox near Local Alternative Link C121. Moderate concern level travel routes include Fort Grant Road.

As previously described, Local Alternative Link C790 could affect viewers in a similar manner to those viewers identified for links C780 and C830. Specific viewing locations associated with this link include a travel route with associated scenic designation, the Pinal Pioneer Parkway (SR 79), and a moderate concern level associated with the Greek Orthodox Monastery.

Crossover links C500, C501, C502, C174, and C671 are associated with similar viewing locations as those identified for links C510, C173, C661, and C670. High concern level recreation viewing locations associated with Link C671 include the Arizona Trail, Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the Historic Kannally Ranch House at the Oracle State Park. Moderate concern level recreation access/four-wheel drive roads includes the Copper Creek Road.

For Subroute 4C3, high concentration residential viewing locations, which are associated with a high concern level, are located in Eloy, La Palma, Tucson (including the associated cities of Mountain View, Vail, Little Town, Drexel-Alvernon, South Tucson, Flowing Wells, Cortaro, Casas Adobes, Rillito Tortolita, Dobson), and Marana along links C880a, F40a, F80, F82, F111, F112, F510, F540, and F600. Smaller residential concentrations are located in Pantano along Link F600. Dispersed rural residences are generally located along links C71, C110, C260, C810a, C810, C813, C816, C817, F40A, F600, and F540. The Project would be visible on links F40a, F60b, F80, F111, F112, F510, and F600, from high concern level recreation viewing locations that include Saguaro National Park West, Saguaro National Park East, Arizona Trail, Juan Bautista de Anza NHT, Rincon Mountain Wilderness, Arthur Pack Regional Park, Augie Acuña-Los Niños Park, Cienega Creek Preserve, Colossal Cave Mountain Park, Feliz Paseos Park, Rillito River Park (includes Mehl, Brandi Fenton, Children's Memorial, Curtis, Dan Felix Memorial, and Flowing Wells parks), Santa Cruz River Park (includes El Paseo de los Arboles Commemorative Park), Sunset Pointe Park, Tucson Mountain Park, Sentinel Peak Park, Christopher Columbus Park, Greasewood Park, John F. Kennedy Park, Silverbell Regional Park, Juhan Park, Joaquin Murrieta Park, Southwest Regional Park (Pima County Fairgrounds), and the Sweetwater Wetlands Park. Travel routes with associated scenic or auto tour route designations include I-10 (isolated segments through Tucson), SR 87, Patagonia-Sonoita Scenic Road (SR 83), Gates Pass Road, Marsh Station Road, Old Sonoita Highway, Houghton Road (I-10 to Sahuarita Road, and isolated portions near Escalante and Tanque Verde roads), Silverbell Road (isolated portions), Sunset Road, Valencia Road (Alvernon Way to east of Kolb Road), Vail Road/Wentworth Road (Colossal Cave Road to Sahuarita Road), and West Pictured Rock Road. Moderate concern level recreation viewing locations include the Urban Loop Trail System (planned), CAP National Recreation Trail, Silverbell Golf Course, Pines Golf Club at Marana, and the Tierra Grande Country Club near links F111, F112, F510, and C880a. Moderate concern level travel routes include I-10 (non-scenic portions), I-19, US Routes 191 and 287, Ocotillo Road, Three Links Road, Fort Grant Road, and Cascabel Road. Other areas associated with moderate concern levels include the JW Marriott Starr Pass Resort and Spa Tucson, Omni Tucson National Golf Resort and Spa, and Ritz-Carlton Resort Dove Mountain Golf Course near links F112, F510, and F540.

KOPs specific to Subroute 4C3 include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU11 – Cascabel Road (South)
- TU12 – Wrong Mountain Road Resident
- TU13 – Arizona National Scenic Trail (Cienega Creek)
- TU14 – I-10
- TU17 – Alvernon Residences
- TU18 – Gates Pass Road
- TU19 – Santa Cruz River Park/Anza NHT
- TU24 – Silverbell Road Residences
- TU25 – Saguaro National Park West
- TU26 – Ritz-Carlton Resort
- TU28 – Longhoen Trail Residence
- TU29 – Park Link Drive

- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residences
- TU37 – Arizona National Scenic Trail – Davidson Canyon

No viewing locations are associated with Local Alternative Link C812.

BLM VRI Classifications

Within the Safford and Tucson field offices, BLM land would be crossed by Subroute 4C1, Subroute 4C2, and Subroute 4C3 for 5.2 miles (approximately 4 percent), 14.9 miles (approximately 10 percent), and 13.1 miles (approximately 7 percent), respectively. Local alternative links C260, C261, C201, C680, C810a, C812, C813, C814, C815, C816, and C817 cross 5.7 miles (approximately 8 percent) of BLM land within the Tucson Field Office. Local Alternative Link C692 for Subroute 4C1 does not cross BLM land within the Tucson Field Office. Local alternative links C72, C90, C211, and C121 do not cross BLM land within the Safford Field Office. Crossover links C500, C501, C502, and C174 cross 0.1 mile (approximately 0.5 percent) of BLM land within the Tucson Field Office. Crossover Link C671 does not cross BLM land. Local alternative links F40b, F51, F60a, F81a, and F81b for Subroute 4C3 do not cross BLM land within the Tucson Field Office.

Scenic Quality: In the Safford Field Office, Subroute 4C1 only crosses BLM land along Link C361, which is Class A scenic quality associated with Redfield Canyon. In the Tucson Field Office, Subroute 4C1 crosses Class B scenic quality in two areas (link C510, C660, and C693). Subroute 4C2 primarily crosses Class B scenic quality with an area of Class C in the Tucson Field Office on one large BLM parcel (links C680, C818, and C820). Subroute 4C3 mainly crosses Class B scenic quality (links F540, C810, C813, C816, C817, and C820) and an area of Class C scenic quality in the Tucson Field Office (C820). Crossover Link C502 crosses a small area of Class B scenic quality in the Tucson Field Office (approximately 0.1 mile).

Sensitivity Level Rating Units: Subroute 4C1 crosses an isolated area of high sensitivity associated with Muleshoe Ranch in the Safford Field Office. Subroute 4C1 also crosses two areas of high sensitivity in the Tucson Field Office. One area is associated with the San Pedro River Valley (links C510 and C660), and the other area is associated with the Pinal Pioneer Parkway (Link C693). Subroute 4C2 primarily crosses moderate sensitivity level rating units (links C680, C818, and C820) and a small area of high sensitivity in the Tucson Field Office (Link C820). Subroute 4C3 primarily crosses moderate sensitivity areas (links F540, C810, C813, C816, C817, and C820) and a small area of high sensitivity in the Tucson Field Office (Link C820). Crossover Link C502 crosses a small area of high sensitivity in the Tucson Field Office (approximately 0.1 mile).

Distance Zones: Subroute 4C1 is in the foreground-middleground distance zone where BLM land is crossed, with the exception of a small isolated area (approximately 0.2 mile) in the Tucson Field Office, due to landform screening (Link C693). Subroutes 4C2 and 4C3 and Crossover Link C502 are in the foreground/middleground distance zone on BLM land.

VRI Classes: Subroute 4C1 crosses primarily VRI Class II BLM land in the Safford and Tucson field offices, and a small isolated area of Class III (approximately 0.2 mile, Link C693). Subroute 4C2 crosses mainly Class III (links C680, C818, C820) and an area of Class IV (Link C820). Subroute 4C3 crosses two areas of Class IV (links F540 and C820) and three areas of Class III in the Tucson Field Office (links F540, C810, C813, C816, C817, and C820). Crossover Link C502 crosses a small area of VRI Class II in the Tucson Field Office (approximately 0.1 mile).

BLM VRM Classifications

Subroute 4C1 crosses approximately 1.4 miles of VRM Class II and approximately 3.9 miles of VRM Class III lands within the Safford and Tucson field offices. This subroute does not cross VRM Class IV land. Subroute 4C1 crosses the southwestern edge of the Muleshoe Ranch CMA ACEC, which is associated with VRM Class II land. VRM Class III land crossed by this subroute is associated with the Sonoran Desert Valley east of the Pinal Pioneer Parkway.

Subroute 4C2 crosses approximately 14.8 miles of VRM Class III land, and Subroute 4C3 crosses approximately 13.2 miles of VRM Class III land. These subroutes do not cross VRM Class II or Class IV lands. VRM Class III land crossed by these subroutes is primarily associated with the Sonoran Desert Valley east of the Picacho Mountains.

All local alternative and crossover links for Subroute 4C do not cross BLM land; therefore, VRM classifications are not applicable.

Local Alternative for Subroute 4C2 (Winchester Substation)

Scenery

This local alternative is identical to Subroute 4C3 south of the Winchester Mountains (links C260 and C261). It also crosses similar landscapes within the southwestern portion of the San Pedro Valley (Class B), as do subroutes 4C1 and 4C2; however, this local alternative for Subroute 4C2 also crosses alluvial fans and the southeastern foothills of the Rincon Mountains (Link C201). Class A scenery crossed by this local alternative subroute includes the San Pedro River and floodplain, and is similar to the Subroute 4C3 crossing. Cultural modifications are similar to Subroute 4C2.

Viewing Locations and KOPs

Dispersed rural residences associated with a high level of concern are generally located along links C260, C261, and C201. The Project would be visible on Link C201 from high concern level recreation viewing locations of the Rincon Mountain Wilderness. Moderate concern level local access travel routes include Ocotillo Road, Three Links Road, Cascabel Road, and Muleshoe Ranch Road.

KOPs specific to the Winchester Substation subroute include:

- TU10 – Cascabel Road, North
- TU11 – Cascabel Road, South
- SA15 – Muleshoe Ranch Road

BLM VRI Classifications

The Winchester Substation is not associated with BLM land; therefore, VRI data is not identified.

BLM VRM Classifications

The Winchester Substation is not associated with BLM land; therefore, VRM classifications are not applicable.

Local Alternative Links for Subroute 4C2 (Tortolita Substation)

Scenery

Scenery along this alternative was inventoried as primarily Class B and is associated with the Sonoran Valley plains. Link C810a and portions of links C810 and C812 cross level valley plains dominated by creosote (Class C). Link C810a is also immediately adjacent to the Saguaro Power Plant.

Cultural modifications are similar to Subroute 4C3.

Viewing Locations and KOPs

Dispersed residences associated with high concern levels are located east of Red Rock near the Tortolita Substation. Viewing locations associated with moderate concern levels include I-10. There are no recreation areas or KOPs associated with the Tortolita Substation.

BLM VRI Classification

The Tortolita Substation is not associated with BLM land; therefore, VRI data is not identified. The local alternatives near the Tortolita Substation for 4C2 links pass through approximately 7.2 miles of BLM land in the Tucson Field Office. Where BLM land is crossed, the local alternatives pass through Class B scenery, moderate sensitivity level rating units, the foreground/middleground distance zone, and Class III VRI classes (links C680b, C810, C813, C814, C815, C816, and C817).

BLM VRM Classifications

The Tortolita Substation is not associated with BLM land; therefore, VRM classifications are not applicable. The local alternatives for 4C2 pass through approximately 7.2 miles of Class III VRM (links C680b, C810, C813, C814, C815, C816, and C817).

Local Alternative Links (Pinal Central Substation)

Scenery

Local alternative links C860, C870, and C890 are located to the north of subroutes 4B and 4C, and cross similar Class B and Class C scenery.

Cultural modifications are similar to Alternative 4A.

Viewing Locations and KOPs

Dispersed rural residences associated with a high level of concern are generally located along links C860, C870, and C890. KOPs associated with high concern levels include the Earley Road Residence (TU33).

High concern level travel routes include SR 87 which is a designated auto tour route for the Anza NHT. Moderate concern level travel routes include US Highway 287.

BLM VRI Classifications

The local alternative links are not associated with BLM land; therefore, VRI data is not identified.

BLM VRM Classifications

The local alternative links are not associated with BLM land; therefore, VRM classifications are not applicable.

Local Alternative Links for Subroute 4C3 (Pantano-Rillito)

Scenery

A large portion of this local alternative crosses developed landscapes (approximately 23.2 miles) in the Tucson metropolitan area (links F81a and F81b), similar to Subroute 4C3; except this alternative is located to the east near the Santa Catalina Foothills. Link F81a crosses Class C scenery similar to Subroute 4C3 in the Rincon Valley. Links F40b, F51, and F60a are located in Class B scenery similar to Subroute 4C3, south of the Rincon Mountains. Link F51 crosses the Cienega Creek (Class A) northeast of Vail in a more natural setting than the Subroute 4C3 crossing. Cultural modifications are similar to Alternative 4C3.

Viewing Locations and KOPs

High concentration residential viewing locations, which are associated with a high concern level, are located in Tucson (including the associated cities of Mountain View, Vail, Catalina Foothills, Flowing Wells, and Casas Adobes) and Oro Valley, along links F40b, F51, F60b, F81a, and F81b. The Project would be visible on links F40b, F51, F60b, F81a, and F81b, from high concern level recreation viewing locations, including Saguaro National Park West Trailhead (36th Street and Valley View Overlook Trail), Tucson Mountain Park (Gates Pass Overlook Trail), Arizona Trail, Sabino Canyon Trail, Rincon Mountain Wilderness, Cienega Creek Preserve, Colossal Cave Mountain Park, Rillito River Park, Chuck Ford Lakeside Park, Lincoln Park, and Michael Perry Park. Travel routes with associated scenic or auto tour route designations include I-10 (isolated segments through Tucson), Mt. Lemmon Highway (Catalina Highway/Sky Island Parkway), Redington Road, Oracle Road, Colossal Cave Road, Freeman Road, Marsh Station Road, Old Spanish Trail, Houghton Road, Ina Road, Kolb Road/Craycroft Road, River Road, Sabino Canyon Road, Skyline Drive, Snyder Road, Sunrise Road, and Swan

Road. Moderate concern level recreation viewing locations include the Pantano River Park (planned) and the Urban Loop Trail System (planned), near links F81a and F81b. Other areas associated with moderate concern levels include Omni Tucson National Golf Resort and Spa near Link F81a.

KOPs specific to Pantano-Rillito local alternative include:

- TU13 – Arizona National Scenic Trail (Cienega Creek)
- TU15 – Civano Residence
- TU14 – I-10
- TU16 – Saguaro National Park East
- TU20 – Sky Island National Scenic Byway
- TU21 – Mehl Park Residence
- TU22 – River Road
- TU23 – Oracle Road
- TU24 – Silverbell Road Residence

BLM VRM Classifications

The Pantano-Rillito local alternative is not associated with BLM land; therefore, VRM classifications are not applicable.

3.10 LAND USE AND RECREATION RESOURCES

3.10.1 Introduction, Methods, and Regulatory Framework

3.10.1.1 Introduction

This section summarizes land use and recreation resources within the Project area. Existing and planned uses have been documented for the entire 6-mile-wide study corridor (3 miles on either side of the reference centerline) on federal, state, county, city, and private land. Land uses are shown on figures M 10-1 to M 10-4 (see Map Volume).

Based on results of the public scoping process and in consultation with the BLM, the following areas of concern were identified regarding land use:

- BLM RMP right-of-way exclusion and avoidance areas
- Maximize use of existing utility corridors
- Right-of-way conflicts with existing residential areas, irrigated farmland, and commercial/industrial areas
- Recreation uses, including OHV areas
- Military testing and training operations
- Pima County conservation lands
- TNC allotments/easements
- Muleshoe Ranch CMA, Swamp Springs-Hot Springs Watershed ACEC

- Winkelman and Redington NRCD plans restrict new utilities within the San Pedro River and Aravaipa Creek watersheds (NRCD boundaries include 814,279 acres of lands within the relevant study corridors)
- Ranching and livestock grazing

3.10.1.2 Methods

Land and resource use data (i.e., primary data) that identify existing and planned land uses were collected within the study corridor; while the collection, review, and refinement of additional secondary data was used to conduct the inventory. Information was obtained from various federal, state, and local agency staff and documents, including:

- BLM land and RMPs and information concerning land use classifications, special management areas (SMA), SRMAs, active mining sites, prior existing rights-of-way, designated OHV areas, WSA, and other authorized land uses
- DOD base plans and Memoranda of Understanding (MOU)
- New Mexico and Arizona state parks and lands
- City and county land use plans, and NRCD plans
- Private development plans
- Aerial Imagery
  - Digital Globe Satellite Imagery
  - Esri

Field investigations were conducted throughout the study corridors for all of the transmission line subroutes. Federal, state, regional, and local governmental agencies and organizations were contacted to obtain and discuss specific land use data and plans. Existing and future land use categories that occur within the study corridor include:

Residential – low, medium, and high density single-family residential, multi-family residential (e.g., apartment complex), rural residential, and mobile home parks. Residences are found scattered throughout the Project study corridor, with concentrations near towns and cities such as Deming, New Mexico, and Tucson, Arizona. For the purpose of this inventory, residential densities were defined as:

- Rural residential/low density: 0 to 2 dwelling units per acre
- Medium density: >2 to 8 dwelling units per acre
- High density: >8 dwelling units per acre

Commercial – restaurants, gas stations, banks, grocery stores, motels and hotels, and other businesses. Within the Project study corridor, concentrations of commercial use mainly occur in populated areas (e.g., Lordsburg, New Mexico and Tucson, Arizona) and along major transportation corridors (e.g., I-25 and I-10).

Grazing/Multi-Use/Vacant – all land uses that did not fit under a specific category, or were not specifically designated for a specific use by the responsible jurisdiction or land management agency.

Industrial – warehouse businesses, manufacturing companies, storage facilities, and other uses. Industrial uses occur near populated areas such as Socorro, New Mexico, and Tucson, Arizona.

Public/Quasi Public – places of worship such as churches, community centers, and libraries. Public/quasi-public uses occur near populated areas such as Deming, New Mexico and Tucson, Arizona.

School/Educational Facilities – preschools, primary schools, secondary schools, and colleges. Schools/educational facilities are typically located near population centers such as Deming, New Mexico, and Tucson, Arizona.

Air Facilities – airports, airstrips, and heliports, such as Tucson International Airport in Arizona.

Military – managed by the DOD and includes bases, missile launch facilities, and firing ranges such as the WSMR in New Mexico.

Agriculture – ranching, farming, and dairy operations. Agricultural land uses within the Project study corridor are primarily ranching and grazing.

Utilities – power plants, substations, transmission lines, pipelines, canals, designated utility corridors, and wind and solar farms. Utility land uses are found throughout the study corridor and include pending right-of-way applications for solar and wind projects proposed on BLM-administered land in New Mexico.

Communication Facilities – cellular, radio, and television facilities. A variety of communication facilities are scattered throughout the study corridor.

Transportation – minor roads (county highways, city streets); major roads (interstates, state highways); railroads; trails; etc. Though transportation land uses occur throughout the study area, the main features are I-10, I-25, and the UPRR.

Recreation – federal, state, and local recreational trails and designated OHV areas. Recreation land uses within the study corridor include BLM SRMAs designated for multiple recreational activities such as rock climbing and bouldering.

Parks/Preservation – federal, state, and local parks, open areas, and areas protected from development. Parks and preservation areas within the study corridor include the Sevilleta NWR in New Mexico, and the Catalina and Orange state parks in Arizona.

Performance Zone District – a specific zoning classification established by Doña Ana County, New Mexico, to allow flexibility for land use activities in rural areas of the county while protecting residents and property values. In the Performance Zone District, any use may be approved, provided all standards are met for that particular use and the use is consistent with the character of the surrounding areas (Doña Ana County 2005). These areas are located within the 6-mile-wide study corridor.

Rural Preservation – a zoning classification, modified from the Cochise County Comprehensive Plan. A large majority of the land in Cochise County is Rural Zoning, which was established to

preserve the character of designated rural areas in the County. These designations were also established to preserve the agricultural character of areas that were capable of resource production, and to preserve the rural environment of outlying unincorporated areas.

3.10.1.3 Regulatory Framework

The following BLM, National Forest Service land, state regulations, and county and local plans were reviewed.

BLM

New Mexico

Las Cruces District Office, Mimbres Resource Management Plan (BLM 1993). This plan was prepared to formally record the BLM's decisions for managing approximately 3 million acres of public land in Doña Ana, Grant, Luna, and Hidalgo counties.

Las Cruces District Office, White Sands Resource Area Resource Management Plan (BLM 1986; amended by McGregor Range RMP in 2006). This plan establishes land use decisions, terms, and conditions for guiding and controlling future management actions in Sierra and Otero counties.

Rio Puerco (Albuquerque) Resource Management Plan Revision and Environmental Impact Statement (BLM 1985). This plan was prepared to formally record the BLM's decisions for managing approximately 8.6 million acres of land; including 896,480 acres of public land in Bernalillo, Cibola, Torrance, Valencia, Sandoval, McKinley, and Santa Fe counties.

Socorro Field Office, Socorro Resource Management Plan and Record of Decision (BLM 2010b). This plan has been prepared to allocate resources and provide a comprehensive framework for the BLM's management of 1.5 million acres of public land within Socorro and Catron counties.

Arizona

Phoenix Field Office, Phoenix Resource Management Plan and Final Environmental Impact Statement (BLM 1988a). This plan was developed to guide the BLM in its management of the Phoenix Resource Area, which consists of approximately 911,000 acres of public land within two distinct geographic regions of Arizona, and includes portions of Pima and Pinal counties located within the Project study corridors. This area is now managed by the Tucson Field Office.

Safford District Office, Safford District Resource Management Plan and Environmental Impact Statement (BLM 1991). This plan has been prepared to guide the management of 1.4 million acres of public land in the Safford District (southeastern Arizona) for the next 15 years, including Graham, Greenlee, Cochise, Pinal, Pima, and Gila counties.

Safford Field Office, Environmental Assessment/Gila Box Riparian National Conservation Area Management Plan (BLM 1998a). This plan provides for the appropriate management of the Gila

Box Riparian Area for approximately 15 years (from 1998). It includes portions of Graham and Greenlee counties.

Tucson Field Office, Muleshoe Ecosystem Management Plan and Environmental Assessment (BLM 1998b). This plan was prepared to manage the riparian areas, and associated aquatic, plant, and animal communities.

Tucson Field Office, Las Cienegas Resource Management Plan and Record of Decision (BLM 2003). This plan was prepared to manage the 49,000 acres of public land, resources and uses within the Las Cienegas National Conservation Area and Sonoita Valley Acquisition Planning district.

National Forest

New Mexico

National Forest Service Southwestern Region, Cibola National Forest Land and Resource Management Plan (USFS 1985). This plan defines the direction for managing the Cibola National Forest for the next 10 to 15 years, including management direction for the Kiowa, Rita Blanca, McClellan Creek, and Black Kettle National Grasslands.

National Forest Service Southwestern Region, Lincoln National Forest Land and Resource Management Plan (USFS 1986a, with last amendment in 2009). This plan defines the direction for managing the Lincoln National Forest for the next 10 to 15 years.

Arizona

National Forest Service Southwestern Region, Coronado National Forest Land and Resource Management Plan (USFS 1986b, with last amendment in 2005). This plan defines the direction for managing the CNF for the next 10 to 15 years.

State

New Mexico

New Mexico Certificate of Public Convenience and Necessity. The New Mexico Public Regulation Commission controls all aspects of transmission line siting within the state. Three permits are required to build a transmission line greater than or equal to 230 kV: (1) Certificate of Public Convenience and Necessity; (2) Location Permit; and (3) Right-of-Way Width Determination, which establishes, under New Mexico statute, the requirement for Public Regulation Commission approval on all proposed transmission lines with a right-of-way width greater than 100 feet, regardless of voltage, in cases other than a fee-simple acquisition.

Arizona

Arizona Corporation Commission. In 1971, the Arizona Legislature required that the Arizona Corporation Commission (ACC) establish the Power Plant and Transmission Line Siting Committee, after it found that existing law did "not provide adequate opportunity for individuals,

groups interested in conservation and the protection of the environment, local governments, and other public bodies to participate in timely fashion the decision to locate a specific major facility at a specific site." The Committee provides a single, independent forum responsible for evaluation of applications to build power plants (of 100 MW or more) or transmission projects (of 115 kV or more) in the state.

Utilities with proposed power plants or transmission lines subject to Commission/Committee jurisdiction are required to make an application to the ACC for a Certificate of Environmental Compatibility (CEC). During open public hearings, the Committee considers the matter(s) contained in the application relative to a series of factors specified in Section 40-360.06, ARS. Following deliberations, the Committee makes a recommendation to the ACC regarding approval of the CEC, and may propose conditions and/or restrictions for inclusion in the CEC. Subsequently, the ACC makes a final determination on the CEC application and may accept, reject, or modify the Committee's recommendations.

Arizona State Land Department. ASLD's purpose is to manage State Trust lands and resources to enhance value and optimize economic return for the trust beneficiaries, consistent with sound stewardship, conservation, and business management principles supporting socioeconomic goals for citizens here today and for generations to come (ASLD 2012). Rights-of-way are granted across State Trust Land for a variety of public and private uses, such as access roads, infrastructure, power lines, communication lines, and public roadways. The ASLD has jurisdiction over rights-of-way that would cross State Trust land.

Counties and Cities

New Mexico

New Mexico does not have any state laws requiring comprehensive land use plans. Therefore, the counties of Socorro, Luna, and Hidalgo do not have any future land use designations. City and county plans within the state of New Mexico can be found in Section 3.10.4.

Arizona

Arizona State Law requires that all counties prepare and adopt a comprehensive plan. According to state law, "[t]he purpose of the plan is to bring about coordinated physical development in accordance with the present and future needs of the county. The comprehensive plan shall be developed so as to conserve the natural resources of the county, to ensure efficient expenditure of public funds and to promote the health, safety, convenience and general welfare of the public" (ARS 11-806). City and county plans for the state of Arizona can be found in Section 3.10.4.

Conservation Initiatives and Programs

Middle Rio Grande Conservation Initiative

The Middle Rio Grande Conservation Initiative was created in response to the *America's Great Outdoors* initiative, the goals of which were to enhance conservation, recreation, and education in the Middle Rio Grande.

Middle Rio Grande Bosque Initiative

The primary objective of the Middle Rio Grande Bosque Initiative is "to protect, enhance, and restore biological values by addressing ecological functions." The USFWS received a total of $9.3 million between 1994 and 2009, and this funding accomplished a total of 317 projects, including research, monitoring, habitat enhancement, and education/outreach efforts.

Middle Rio Grande Endangered Species Collaborative Program

The Middle Rio Grande Endangered Species Collaborative Program is a partnership "organized to protect and improve the status of endangered species…along the Middle Rio Grande while simultaneously protecting existing and future regional water uses." Congress appropriated $115.8 million to the BOR between 2001 and 2009 to support the program, along with $12.7 million in non-federal matching funds.

Middle Rio Grande Revitalization Project

The Middle Rio Grande Revitalization Project is focused on ecosystem restoration and recreation enhancement. The USACE has appropriated $20 million in funding for habitat restoration and recreation projects.

Lower San Pedro River Collaborative Conservation Initiative

The Lower San Pedro River Collaborative Conservation Initiative is a voluntary landowner-driven initiative that "would focus on restoring and conserving rural working landscapes while enhancing local economies along the Lower San Pedro River corridor." The USFWS would support the landowners by offering facilitation and conservation grant support for projects, and as funding becomes available, could also offer conservation easement opportunities. The USFWS would also work with willing sellers to purchase lands to be added to a future NWR. This initiative is currently at the initial scoping stage; however, until an EIS has been prepared, the level of impact to initiative measures cannot be determined.

Sonoran Desert Conservation Plan

Pima County, Arizona created the *Sonoran Desert Conservation Plan* to manage rapid urban expansion, while preserving large areas with high conservation value. The elements of the plan identify and provide goals, objectives, and strategies for managing biological corridors and critical habitat, riparian areas, mountain parks, cultural resources, and working ranch lands. The SDCP includes strategies to "focus future growth and associated infrastructure expansion in areas in closest proximity to existing urbanized areas, not in areas of highest biological richness." The SDCP provides guidelines used to classify conservation lands within the CLS in Pima County's Comprehensive Plan. CLS category designations and Conservation guidelines apply to lands under the jurisdiction of Pima County and Pima County Flood Control District. The CLS identifies various conservation categories, including Important Riparian Areas, Biological Core Management Areas, and Multiple Use Management Areas. The SDCP also provides the

framework for a future multiple species conservation plan to support an incidental take permit for 10 species listed under the ESA.

Working Lands for Wildlife Habitat Initiative

The Working Lands for Wildlife Habitat Initiative is sponsored by the partnership between the USDA NRCS and the USFWS. In Arizona, the initiative "will focus on cooperative efforts to assist ranchers and farmers in preserving their heritage and way of life while strengthening rural economies and conserving the federally endangered Southwestern Willow Flycatcher." The initiative is proposed "to use agency technical expertise combined with $33 million in financial assistance from the Wildlife Habitat Incentive Program to combat the decline of seven specific wildlife species whose decline can be reversed and will benefit other species with similar habitat needs," in multiple states.

Natural Resource Conservation Districts

Redington Natural Resource Conservation District

The Redington NRCD encompasses approximately 290,381 acres in the San Pedro River Valley of southeastern Arizona in Cochise, Pima, Pinal, and Graham counties. Approximately 185,286 acres are located within the Project study corridor. The Redington NRCD's *Long Range Natural Resource Conservation Plan, 2010-2016*, includes adopted management recommendations in response to the NRCD's major concerns and objectives. The primary objective of the Redington NRCD "is to provide leadership in promoting the conservation of all natural resources within the district." Major identified concerns addressed in the plan include soil erosion and sedimentation (design and construction practices), upland vegetation (grazing practices), water availability/quantity/quality (BMPs), noxious and invasive plants, wildlife and fish (discourage habitat fragmentation, education), and conservation planning/education. The plan includes management direction to "discourage habitat fragmentation and stream sedimentation created by utility or major transportation corridors."

In 2010, the Redington NRCD formalized this management direction through adoption of a Major Utility/Transportation/Communication Corridors Policy, which states "[i]t is the policy of the Redington Natural Resource Conservation District to oppose the construction of any new major energy, transportation, or communication corridors through the Redington NRCD. In order to minimize impacts of such actions all future construction of such corridors should be along existing corridors of similar capabilities that would only require an upgrade from what currently exists."

Winkelman Natural Resource Conservation District

The Winkelman NRCD encompasses approximately 1,609,464 acres in the San Pedro River Valley of southeastern Arizona in Pinal, Pima, Gila, and Graham counties. Approximately 628,993 acres are located within the project study corridor. The Winkelman NRCD's *Land Management Plan* includes management direction to "provide guidance to rural property owners, farmers and ranchers for the protection, restoration and conservation of land, water and soil

resources of the District and state to include the preservation of water rights and the control and prevention of soil erosion." The management direction also includes assisting "private property owners in conserving natural resources, fish and wildlife and their habitat, rivers and streams and associated riparian habitats, protecting the tax base, [and] protecting public lands…" The plan includes strategies to coordinate with federal agencies through "being involved with the agencies at the earliest date as the agency begins moving forward" on a project, "insuring [*sic*] that all property owners are aware of proposed actions," "coordinating public meetings," "recruiting experts" when appropriate, "insisting on…compliance with NEPA," and "insuring [*sic*] that all actions pertaining to species are good for all species including the human species." The plan also states that all actions should "protect the economic base of the district."

In 2010, the Winkelman NRCD added a policy to formalize management of proposed major corridors, titled Policy 1 – Major Corridors Policy, which states that "[i]t is the policy of the Winkelman Natural Resource Conservation District to oppose the construction of any new major energy, transportation or communication corridors through or across District lands." Further, the policy states that "…all future major new transmission installations should be planned to follow existing rights-of-way," and "…considerations be made for upgrading existing facilities rather than construction of new facilities."

3.10.2 Regional Overview

3.10.2.1 New Mexico

Agriculture, including livestock grazing, is the predominant land use within the study corridors. Irrigated agriculture is commonly found in the Rio Grande Valley, and near other populated areas.

North of the WSMR, land within the study area is mostly open range used for grazing, with ownership a mix of BLM, state, and private. The DOD also owns a small amount of land in this area. LC 94, a cruise missile launch site approximately 14 miles south of US 60 and 22 miles north of US 380, near the extended east/west midpoint of the WSMR, is leased by the WSMR. The Gran Quivira ruins are located south of SR 55, approximately 20 miles southeast of the town of Mountainair.

The town of Socorro, a community of more than 8,800 people, is in the Rio Grande Valley 20 miles northwest of the WSMR and 20 miles south of the Sevilleta NWR. Socorro is the County seat and home to New Mexico Tech University. South of Socorro is the town of San Antonio, whose major land uses include single-family residential, commercial, and agriculture (near the Rio Grande). The Bosque del Apache NWR is located south of San Antonio and contains three separate wilderness areas.

South of the Bosque del Apache NWR is the 358,000-acre Armendaris Ranch, which is bordered to the east by the WSMR and to the west by the Rio Grande. The towns of Truth or Consequences and Elephant Butte are located approximately 15 miles west of the southern portion of the Armendaris Ranch.

Southwest of Truth or Consequences is the city of Deming, one of the larger cities in Luna County, with an estimated population of 14,000 residents. The city of Lordsburg is approximately 60 miles west of Deming, along I-10.

3.10.2.2 Arizona

In Arizona, the study corridor includes various land uses and recreational opportunities. With the exception of the city of Tucson, the study area has a predominantly rural character, with center pivot and flood irrigated farmland and livestock grazing being the primary land uses. Irrigated agriculture is commonly found in the Sulphur Springs Valley, along the San Pedro River; and near the terminus of the Project, near the planned Pinal Central Substation in Pinal County.

Approximately 10 miles east of the Arizona and New Mexico border along I-10 is the town of San Simon, a small agricultural based community surrounded by center pivot and flood irrigated agricultural fields. The Bowie townsite, an agricultural based community similar to San Simon, is approximately 16 miles west of San Simon.

The planned Willow-500 kV Substation would be located approximately 14 miles northwest of the Bowie townsite and in the eastern foothills of the Pinaleño Mountains. Two subroutes surround the Pinaleño Mountains unit of the CNF. Subroute 4A is adjacent to the eastern and northern national forest boundary and parallels a portion of US Route 191, south of the city of Safford. Subroute 4B is south and west of the forest boundary through the Sulphur Springs Valley, bordered on the west by the Galiuro Mountains. Single-family residential properties and center-pivot sprinkler-irrigated agricultural fields are located in portions of the Sulfur Springs Valley north of Willcox.

Part of the CNF, the Galiuro Mountains also contain the Galiuro Wilderness Area and the Muleshoe Ranch CMA, which is cooperatively managed by the BLM, TNC, and USFS. Near the northern edge of the Galiuro Mountains is Aravaipa Canyon; to the north of which is the Aravaipa Canyon Preserve, managed by TNC. West of the Galiuro Mountains is the San Pedro River and San Pedro River valley. Within the study area, the communities of Cascabel, San Manuel, and Mammoth lie along the San Pedro River, surrounded by irrigated farmland. Cascabel is located near the southern end of the study area, and San Manuel and Mammoth near the north. On the west side of the San Pedro River near the town of Cascabel, Pima County owns several parcels of land that, in cooperation with TNC, have been set aside as grazing allotments to preserve the natural state of the land. These parcels of land are bordered by the Rincon Mountains and CNF to the west.

The Rincon and Catalina mountains are also part of the CNF. Situated west of the San Pedro River, the Rincon Mountains contain the Rincon Mountain Wilderness Area and the eastern portion of the Saguaro National Park. To the north of Tucson, the Catalina Mountains contain the Pusch Ridge Wilderness Area, just southeast of Catalina State Park. Oracle State Park is located near the northern end of the Catalina Mountains, close to the town of Oracle.

The city of Tucson is a large population center with multiple land uses, including single- and multi-family residential, commercial, industrial, military, public, and recreation. Tucson

International Airport is located on the south side of Tucson; Davis-Monthan AFB is located north of the airport.

The remainder of Saguaro National Park, which also contains the Saguaro Wilderness Area, is in the Tucson Mountains. Ironwood Forest National Monument is north of the Saguaro National Park, in the town of Marana. The Tortolita Substation is also located in Marana, on the east side of I-10. The terminus of this Project, the planned Pinal Central Substation, is located farther north in Pinal County.

3.10.3 Existing Land Use and Recreation

Land Jurisdiction and Ownership – The study corridors are within the following counties in New Mexico: Hidalgo, Grant, Luna, Sierra, Socorro, Lincoln, and Torrance. In Arizona, the study corridors are within portions of the following counties: Pinal, Pima, Graham, Greenlee, and Cochise. The study corridors include five incorporated cities and towns and at least four unincorporated communities in New Mexico; and nine incorporated cities and towns and at least five unincorporated communities in Arizona (Table 3-45). Federal and state agencies with land ownership or management responsibilities within the study corridors are listed in Table 3-46 and Table 3-47.

Table 3-45. Counties and Towns in the Vicinity of the Study Corridors

County	Towns/Communities
New Mexico	
Hidalgo	Lordsburg
Grant	*The study corridor passes near no towns or unincorporated communities in Grant County*
Luna	Deming
Sierra	Elephant Butte, Truth or Consequences
Socorro	Bingham (unincorporated), Lemitar (unincorporated), Luis Lopez (unincorporated), San Antonio (unincorporated), Socorro
Lincoln	Corona (unincorporated)
Torrance	Mountainair
Arizona	
Cochise	Bowie (unincorporated), Benson, San Simon (unincorporated), Willcox
Graham	Safford, Thatcher
Greenlee	Duncan (unincorporated)
Pima	Avra Valley (unincorporated), Marana, Tucson
Pinal	Eloy, Marana, Oracle, San Manuel (unincorporated)

Table 3-46. Federal Land Management Agencies within the Study Corridors			
Department	Agency	Office/Management Responsibility	
		New Mexico	Arizona
U.S. Department of the Interior	Bureau of Land Management	New Mexico State Office, Roswell, Rio Puerco, and Socorro Field Offices, and Las Cruces District Office	Safford and Tucson Field Offices
	National Park Service	Salinas Pueblo Missions National Monument	Saguaro National Park
	Bureau of Reclamation	—	Central Arizona Project
	U.S. Fish and Wildlife Service	Bosque del Apache NWR and Sevilleta NWR	—
U.S. Department of Agriculture	U.S. Forest Service	Lincoln, Cibola, and Gila National Forests	Coronado National Forest
U.S. Department of Defense	U.S. Department of the Army, Air Force, and National Guard	White Sands Missile Range	Fort Huachuca Buffalo Soldier Electronic Proving Ground, Davis-Monthan AFB, Silverbell Heliport Western Army National Guard Aviation Training Site, and Picacho Auxiliary Army Airfield #1

Table 3-47. State Land Management Agencies within Study Corridor	
Department	Management Responsibility
New Mexico	
New Mexico State Land Office	New Mexico State Lands
New Mexico State Parks	Elephant Butte Lake State Park
Arizona	
Arizona Game and Fish Department	Cluff Ranch Wildlife Area
Arizona State Land Department	Arizona State Trust Lands
Arizona State Parks	Roper Lake State Park and Oracle State Park

3.10.3.1 General Developed Land Uses

The study corridors and subroutes traverse numerous government jurisdictions, with residential, commercial, industrial, recreational, and agricultural land uses. Major transportation routes include three interstate highways, and state and local transportation routes. International airports, military airports, and municipal/community airports are also located within the study area. Existing land uses on federal, state, county, and private lands have been documented within the study corridors and are summarized in the following sections.

3.10.3.2 Agriculture and Range

Land within the Project study corridors is mainly federal and state owned, and largely undeveloped. These lands are leased to ranchers to graze livestock. Smaller-scale private

agricultural operations within the study corridors mainly occur near populated areas. Active dairy farms are also located within the study corridors.

The BLM's objective for grazing lands is to ensure the long-term health and productivity of these lands, and to create multiple environmental benefits that result in healthy watersheds (BLM 2010j). Livestock grazing is managed in accordance with Rangeland Health Standards. The number of authorized Animal Unit Months (AUM) on BLM land can vary depending upon factors such as drought, wildfire, and market conditions. The BLM field and district offices manage grazing allotments within the study area, as indicated below.

New Mexico

- Las Cruces District Office: manages 347 grazing allotments. The allotments are administered by MOU, between the Safford and Las Cruces districts. This MOU also provides for the administration of a portion of one allotment located in Cochise County, Arizona, by the Mimbres Resource Area (BLM 1993).
- Socorro Field Office: manages approximately 252 grazing allotments that are located completely or partially within the field office (BLM 2010c).

Arizona

- Safford Field Office: manages 109 allotments in their field office, and another 118,000 acres of rangeland in New Mexico, in cooperation with the BLM Las Cruces District Office (BLM 1991).
- Tucson Field Office: does not have a specific RMP, and currently uses the Eastern Arizona Grazing EIS (BLM 1987) for management of rangeland. The Tucson Field Office manages 136 grazing allotments.

In addition to BLM-managed grazing allotments, state trust lands in New Mexico and Arizona are leased for grazing within the study area, according to Title 10, Chapter 2, Part 8 of the NMAC, and Section 37-281.01 of the ARS. The acreages below represent the amount of state trust lands per county in New Mexico and Arizona, with the assumption that any state trust lands can be leased for the purpose of livestock grazing.

New Mexico

- Grant/Sierra Counties: 64,097 acres
- Hidalgo County: 486,960 acres
- Lincoln County: 359,081 acres
- Luna County: 713,208 acres
- Socorro County: 649,638 acres
- Torrance County: 449,746acres

Arizona

- Cochise County: 1,327,382 acres
- Graham County: 484,361 acres
- Greenlee County: 169,605 acres
- Pima County: 711,404 acres
- Pinal County: 1,101,467 acres

Irrigation types that occur within the study corridors include center-pivot sprinklers, flood, and row configurations. Irrigated farmlands have been identified because of the potential for transmission towers to conflict with or impede center-pivot sprinkler systems. Center-pivot sprinklers are anchored to one location and swivel up to 360 degrees to irrigate a complete circle, typically 160 acres or larger.

3.10.3.3 Conservation Easements

A recorded conservation easement on a property may define future types of development allowable on the property, or may restrict all types of development, depending on the particular type of easement recorded. A number of existing and proposed conservation easements are known to occur throughout the study area, with particular concentrations along the Rio Grande and the San Pedro River, as well as large areas identified for conservation purposes in Pima County, Arizona. Various agencies and groups fund and/or help manage these conservation easements for a variety of conservation purposes, including reclamation, rehabilitation, riparian protection, habitat and species protection, invasive species removal, among others. These agencies include, but are not limited to, the DOI, USFWS, BOR, USACE, USDA, NRCD, Middle Rio Grande Conservancy District, Rio Grande Agricultural Land Trust, Socorro Soil and Water Conservation District, and NM State Forestry.

It is possible that the Project, when designed, will cross land with a recorded conservation easement. In order to obtain a right-of-way across property with a conservation easement, the Project proponent would be required to review the nature of the easement recorded. If the specific type of right-of-way being sought is not restricted, then the acquisition of the right-of-way would be handled as a negotiation between the property owner and the Project proponent, on a case-by-case basis, similar to an unrestricted property.

3.10.3.4 Parks and Recreation

The study corridors cross a vast majority of rural and undeveloped land, with limited formal recreation opportunities, except in the vicinity of populated areas. The majority of undeveloped areas provide many dispersed recreation opportunities, including hiking, biking, horseback riding, hunting, fishing, and bird watching. Formal recreation opportunities occur near cities and towns, including but not limited to parks, ball fields, golf courses, rodeo arenas, and fairgrounds. Near Truth or Consequences, Elephant Butte and Caballo reservoirs provide ample water-based recreational opportunities such as boating, fishing, and swimming.

Gran Quivira, located north of the WSMR and south of Mountainair, is the only national monument within the SunZia study corridor. However, there are no direct land use impacts to Gran Quivira, as none of the Project alternatives crosses land that is part of the monument.

Arizona State Trust Lands leased for agriculture, mining, commercial, or military purposes are not open to recreational use. Other State Trust Lands may be closed to some or all recreational uses due to hazardous conditions or dust abatement, in coordination with the AZGFD or based on certain state, county, or local laws or ordinances.

3.10.3.5 Transportation and Access

Three major interstate highways lie within the study corridors: I-10, I-25, and I-19. I-25 generally parallels a main railroad line in a north-south direction, along the west side of the WSMR. I-10 crosses a majority of the Project's southern corridor; from the Anthony, New Mexico area on the east, through Tucson, Arizona near the Project's terminus, the planned Pinal Central Substation. I-19 splits off from I-10 in south Tucson, and heads south to Nogales, Arizona.

Multiple railroad lines also lie throughout the study corridors, most of which parallel existing interstates and state highways, including I-10, I-25, and US Route 54.

ADOT's long-range statewide planning process, known as Building a Quality Arizona, involved local/regional leaders in formulating the Statewide Transportation Planning Framework Program that evaluated roadway, public transit, and rail improvements. Through this process, the Regional Framework Study identified three potential transportation improvement scenarios through the year 2050. These include Scenario A: Personal Vehicle Mobility; Scenario B: Transit Mobility; and Scenario C: Focused Growth. Each scenario presented different types of potential transportation improvements between now and 2050, based on different types of development outcomes.

There are numerous municipal and international airports in or near most cities and towns throughout the study area. Table 3-48 lists public and military air facilities within the study corridors.

Table 3-48. Public and Military Air Facilities within the Study Area

New Mexico	Arizona	
• Deming Municipal Airport • Lordsburg Municipal Airport • Picacho Auxiliary Army Airfield • Socorro Municipal Airport • Truth or Consequences Municipal Airport	• Benson Municipal Airport • Cochise County Airport • Davis-Monthan AFB • Eloy Municipal Airport • Marana Airport/Pinal Airpark	• Marana Regional Airport • Safford Municipal Airport • San Manuel Airport • Silverbell Heliport • Tucson International Airport

3.10.3.6 Mining and Minerals

Scattered mining operations occur within approximately 31 mining districts within the Project study corridors; 20 of these districts are located in New Mexico (New Mexico Bureau of Mines

and Mineral Resources/USGS 2009) and the remaining 11 are located in Arizona (AZGS 2011). Generally, land use agencies favor locating new infrastructure elements near disturbed land areas. Different mining techniques can allow for transmission infrastructure to be located near or across the mine (e.g., types of underground mining that can include coal), while other types may not be compatible (e.g., sand and gravel mines). There are numerous different leases occurring within the study corridors that were not observed on aerial imagery, due to the underground nature of the mines. Mines described in the summary of inventory results are visible surface mines within the study corridors that could be considered conflict areas for the Project. Pre-1955 mining claims also were documented and include BLM mining claims, which gave claimants certain surface rights. PL 84-167 required the BLM to publish each township in each state where the United States wished to acquire complete surface management rights; most townships were published between 1955 and 1968. The Master Title Plat for a particular township (and the Historical Index) will show if the township was published, give the date of publication, and list the claimants (by claim name) that responded or were adjudicated surface rights under PL 84-167. To maintain these surface rights under this determination, the chain of title cannot be broken (BLM 2010c). The lists of mining claims and mining districts are provided in Appendix E.

Mineral resources typically are divided into three broad categories: (1) locatable, (2) leasable, and (3) salable. *Locatable* minerals include a broad category of economically important minerals that include precious and base metals, such as gold and copper; fissionable products, such as uranium; industrial minerals; and rocks that bear precious stones. *Leasable* resources typically are extracted for use in energy production and include oil, natural gas, coal, and geothermal deposits. Mining leasable mineral resources on federal land require a lease of set duration with the responsible land management agency. *Salable* mineral resources typically are used for construction and industrial purposes and include sand and gravel. They may be acquired from federally owned or controlled lands via a permit or contract, or through small-scale collection, such as recreational rock collecting. See Section 3.3 for more information on mining.

The New Mexico Tech Energetic Materials Research and Testing Center (EMRTC), located in the mountains adjacent to the New Mexico Tech Campus in Socorro, New Mexico, is a research and training facility, specifically for explosives research and testing. The EMRTC includes a 40-square-mile field laboratory that contains more than 30 test sites and ranges, and has the ability to conduct tests involving more than 20,000 pounds of explosives[1].

3.10.3.7 Military Installations and Airspace

There are multiple military installations and airspace restrictions throughout the Project study corridors; however, none of the major military installations in New Mexico (WSMR, Holloman AFB, Fort Bliss-McGregor Range, and Fort Bliss-Doña Ana Range) falls within the study corridors. Military installations and airspace designations are shown in the Map Volume (Figure M 10-3E and M 10-3W). The Northern Call-up Area is located directly north of the WSMR, covers approximately 1.5 million acres, and includes BLM land, New Mexico state land, and private land. The WSMR conducts missile test firings onto the range from the LC 94

[1] http://www.emrtc.nmt.edu. Accessed March 30, 2012

launch site near Subroute 1A, and the Sulf Site in the northwest portion of WSMR. Missile test firings were conducted 47 times between the two sites in 2009, but can be many more or less per year (WSMR 2009). Pursuant to evacuation agreements, residents and businesses located in this area are required to evacuate their properties for periods of 12 hours, with at least 48 hours between consecutive evacuation periods during these tests. No evacuations can occur during the cattle shipping period (October 15 through November 15) or on a holiday and the preceding day. Evacuations are scheduled at least 30 days in advance of a test event. There are four designated evacuation areas, all of which fall within the study area: FIX, A-350, ABRES 4A, and ABRES 4A Extension. The number of evacuations is limited to 25 per year per evacuation area, with no more than six per month (*ibid*)[1]. WSMR states that there is an average of 15 evacuations per year.

The majority of the airspace units above and near the WSMR, including airspace units R5107C, R5107H, and R5107E, are classified as joint use. These airspace units are designated a Special Use Airspace, in which the controlling agency is the FAA and the using agency is a military installation. With respect to the Special Use Airspace, when in use by the military installation designated as the using agency, air traffic control is provided by Holloman AFB. The military installation may prohibit civilian aircraft or projectiles from traversing the airspace without permission. When not in active use by the DOD, control of the airspace units is returned to the FAA.

These airspace units are scheduled and mainly used for research, development testing and experimentation, military training, and civilian contract program development and testing. In addition, aircraft from Holloman AFB, Kirtland AFB, and Fort Bliss Army Airfield operate within the restricted airspace at various times. Civilian and commercial air traffic may enter the restricted airspace only with permission of WSMR Range Control. The major activities conducted within the WSMR restricted airspace include air-to-air and surface-to-air weapons systems tests. Other activities include the operation of aerial drone targets, towed aerial targets, unmanned air systems, space probes, safety chase, aerial photography, and fixed- and rotary-wing security patrols. Training activities in the WSMR airspace include NASA crew training, aircraft weapons delivery, air-to-air combat maneuvers, and other military exercises. A large amount of the airspace is used as safety buffer zones for missile and rocket firings (*ibid*).

The Electronic Proving Ground is a facility headquartered at Fort Huachuca in Sierra Vista, Arizona that conducts noise tests for electronic combat and electronic warfare equipment. These tests are performed under a variety of circumstances and configurations (Electronic Proving Ground 2010). The current infrastructure within the Electronic Proving Ground study area, such as power lines, cell phone towers, radio stations, and other "emitters," have been measured and taken into account to form a "zero point" for testing purposes.

Davis-Monthan AFB is home to the 355th Fighter Wing, which trains pilots to operate the A-10 Thunderbolt II aircraft. Pinal Air Park is home to the Silver Bell Army Heliport, a U.S. Army

[1]Along with residential and business evacuations, the WSMR has an MOU with the NMDOT to allow closure of selected highways affected during particular missions. The agreement allows for road closures up to an hour, but no longer than 80 minutes in duration on US Route 54 and US 70, and up to 2 hours in duration on US 380. Notice is given by the WSMR to the NMDOT District Engineer at least 48 hours prior to setting up roadblocks.

helicopter training facility. There are multiple military training routes throughout southern Arizona, with many converging near the town of Redington. The Jackal Low Military Operations Area is located near Aravaipa Canyon, with the lowest altitude of operation at 100 feet above ground level. The Army National Guard trains helicopter pilots near the Tortolita Substation and in the vicinity of the Picacho Mountains. The training area includes approximately 3,600 square miles of low-level training areas, including military training flights between 1,000 and 10,000 feet above mean sea level. The Army National Guard uses a site referred to as Square Field, which is located within the study corridor, for emergency training exercises.

3.10.3.8 Energy Facilities, Canals, Designated Utility Corridors, Communication Sites, BLM Right-of-Way Avoidance Areas

Existing linear energy facilities, such as transmission lines and pipelines, can provide opportunities to site new linear energy facilities, as the consolidation of infrastructure within common or parallel corridors can reduce visual and ground disturbance. Energy facilities observed within the Project study corridors included distribution and transmission lines of 115 kV or larger, natural gas/petroleum pipelines with 6-inch diameters or larger, major and minor substations, and power plants.

Existing substations found within the study corridors include the Luna, Hidalgo, Winchester, San Manuel, Vail, Irvington, Tortolita, and Saguaro. The future permitted Pinal Central Substation is also located within the study corridor. Four new substations are proposed as part of the Project: SunZia East, Midpoint, Lordsburg, and Willow-500 kV.

Existing power plants found within the study corridors for the Project alternative routes include the Saguaro (Pinal County), Irvington (Pima County), and Luna (Luna County) natural gas power plants. The Bowie Power Station and associated 345 kV gen-tie transmission line and Willow 345 kV Substation have been permitted. The Bowie Power Station site is located in Cochise County, approximately 4 miles south of Subroute 3B (centerline of Link B150b), and the Willow 345 kV substation site is located west of the proposed SunZia Willow-500 kV Substation in Graham County. The Afton (Doña Ana County) and Apache (Cochise County) power plants are located within the Project study area, but outside the 6-mile-wide study corridors.

Existing transmission lines, pipelines, and electrical facilities within the study area are owned and/or operated by numerous different utilities, including Arizona Public Service Company, BOR, Chevron Pipeline Company, El Paso Electric Company, El Paso Natural Gas Company, Kinder Morgan, Public Service Company of New Mexico, Southwest Transmission Co-op Incorporated, SRP, TransWestern Pipeline Company, TEP, Tri-State G & T Association, and Western Area Power Administration.

In response to increasing interest in the development of renewable energy resources, in 2013 the DOE and DOI finalized a map identifying solar energy zones (SEZ) and variance areas identified in 2013. Some of the SEZs identified in New Mexico are located in the study area near the study corridors, including the Afton SEZ; 29,964 acres, located southwest of the city of Las Cruces, New Mexico; and west of I-10.

In addition to the SEZs, in the Solar Programmatic EIS, variance areas were also established. Variance areas are areas that may be available for a utility-scale solar energy right-of-way, with special stipulations or considerations. These areas are BLM land outside of exclusion areas and SEZs. Variance areas that are established within the study area and/or crossed by the study corridors are within the Las Cruces District Office in New Mexico and Safford and Tucson Field Offices in Arizona.

Using the Legacy Rehost 2000 BLM Search System, pending solar projects were identified within the Project study corridors, including two projects awaiting federal right-of-way decisions. Iberdrola Renewables has a pending right-of-way application for a 24,320-acre solar facility just east of the New Mexico and Arizona border, northwest of the I-70 and I-10 interchange. Link B160a runs east to west, immediately south of the right-of-way area. Solar Reserve, LLC, has a pending right-of-way application for an approximately 5,300-acre solar facility northeast of Lordsburg, New Mexico. Links B111 and B121 both cross the pending right-of-way area, and Link B120b is adjacent to the right-of-way boundary (BLM 2011a). Additional research was completed that identified other potential and proposed solar projects in the study area, discussed in Section 4.17.3.2. Additional research was also completed for wind projects, which identified other potential and proposed wind projects in the study area, discussed in Section 4.17.3.2.

In addition to proposed renewable projects, new transmission facilities are planned near the study corridors. The planned Pinal Central Substation to Tortolita Substation 500 kV transmission line, proposed by TEP, would parallel links C810a, C820, C813, C816, C817, C820, C830, C840, C850, C880, and C880a. This project is currently in the permitting stage. The proposed San Manuel Interconnect Project, a 230 kV transmission line proposed by Southwest Transmission Co-op, would parallel Link C660. There are additional proposed projects in the area that are in the early stages of development, including the Southline Transmission Project located in and to the south of the Project study area. These proposed projects are also discussed in Section 4.15.4.9, Land Use and Recreation Resources.

Utility corridors are designated as such by federal, state, or county agencies, but are usually determined through coordination between multiple agencies to help ensure continuity of the corridors between different jurisdictions or land ownership. Utility corridors are areas where existing utilities are located and provide an opportunity to place new facilities in parallel corridors, which in turn helps to minimize impacts. Some Project subroutes follow existing corridors established by the Las Cruces BLM Field Office and the West-wide Energy Corridors established by the BLM. The DOE West-wide Energy Corridors were created by Section 368 of the EPAct, which directs the secretaries of Agriculture, Commerce, Defense, Energy, and the Interior to designate corridors on federal land in 11 western states, including New Mexico and Arizona. Section 368 corridors allow for oil, gas, and hydrogen pipelines, and electricity transmission and distribution facilities (West-wide Energy Corridor Programmatic EIS Information Center 2011). Existing corridors and their proximity to the subroutes are described in Table E-3 in Appendix E.

Canals for transportation of water for municipal and irrigation purposes are located throughout the study area. The Middle Rio Grande Conservation District and BOR administer canals, including the Rio Grande Conveyance Channel in New Mexico. The Central Arizona Water

Conservation District manages the CAP facilities on federal lands administered by the BOR in Arizona. The San Carlos Irrigation and Drainage District administers the San Carlos Irrigation Project facilities, under BIA jurisdiction, also located in Arizona. San Carlos Irrigation Project canals are located within the Pinal County portion of the study area, north of the Picacho Reservoir, and include the Florence Canal, Casa Grande Canal, and Florence-Casa Grande Canal. The CAP and San Carlos Irrigation Project Canals are shown on Figure M 10-1W (Map Volume).

Communication facilities, including microwave stations, radio towers, and cellular/digital towers, are found scattered throughout the study corridors. Communication cables, typically fiber optic bundles, are used for transmission of voice, data, and utility signals. Fiber optic cables may also be buried or installed on overhead electrical transmission structures. Communication cables are typically installed within utility rights-of-way, or adjacent to them. Major interstate communication cables in the Southwest are located along I-10 and railroads between New Mexico and Arizona.

Right-of-way avoidance areas designated by the BLM have been identified within the study area for each of the alternative subroutes. Where the Project right-of-way would cross an avoidance area, an RMP amendment may be required. If required, one of two alternative plan amendments would be adopted: (1) a utility corridor of 400 feet (to allow for the Project right-of-way) or (2) a utility corridor 2,500 feet wide (utility corridor to be used for the Project as well as other future projects). A third alternative, No Action, would apply where a subroute crosses an avoidance area if it is found that the Project would not conflict with management objectives. The information below details the avoidance areas that are crossed, including where they are generally located and, if the information was available, for what the area is managed.

- Route Group 1 – all subroutes cross avoidance areas that are designated in the Socorro and Mimbres RMPs. Links that cross these areas are:
    - E101b and E133, which cross an avoidance area south of the Sevilleta NWR that is managed by the Socorro RMP to manage VRM Class II
    - E211, which crosses an avoidance area to the west of San Antonio that is displayed on the Socorro RMP Lands and Realty map
    - A80, which crosses an avoidance area to the north of the WSMR that is displayed on the Socorro RMP Lands and Realty map
    - A111 and A112, which cross an avoidance area north of the Bosque del Apache NWR that is managed by the Socorro RMP for VRM Class II, as well as the San Pedro SMA
    - A140, A160, A161, and A161b, which cross an avoidance area to the west of San Antonio that is displayed on the Socorro RMP Lands and Realty map
    - A440, which crosses an avoidance area managed in the Mimbres RMP for the Butterfield Trail northeast of Deming, and another directly south that is managed for VRM Class II (also Link A530)
- Route Group 3 – all subroutes cross avoidance areas designated in the Mimbres RMP. The links that cross these areas include:

- B120b and B110a, which cross avoidance areas to the east of Lordsburg that are displayed on the Right-of-Way Avoidance/Exclusion Area map in the Mimbres RMP
- B112 and B140, which cross avoidance areas to the west of Lordsburg that is managed for VRM Class II

- Route Group 4, Subroute 4C1 – links C331 and C361 cross an avoidance area northeast of the Saguaro National Park (east), managed in the Safford RMP for the Muleshoe Ecosystem Management Area

3.10.4 Planned Land Use

Designated planned and future land uses were identified within the study area, on federal, state, county, and private land; a large majority of the study area is designated as grazing/mixed use/vacant. However, as the subroutes pass through populated areas, a variety of future land use designations occur, including residential, commercial, industrial, and open space. The majority of designated future land use is located in and around populated areas; because these categories are the same as existing land use, they will remain unchanged. The counties of Socorro, Luna, and Hidalgo do not have any future land use plans; therefore, the inventory assumes that existing land use in the area would continue. Data for the planned land use section have been obtained from the following city and county comprehensive land use plans and general plans:

New Mexico

- Doña Ana County Comprehensive Plan (1994)
- Grant County Comprehensive Plan (2004)
- Hidalgo County Comprehensive Plan (2004)
- Lincoln County Comprehensive Plan (2007)
- Sierra County Comprehensive Plan (2006)
- Belen Comprehensive Land Use Plan (2003)
- City of Deming Comprehensive Plan (2003)
- City of Elephant Butte Comprehensive Plan (2003)
- City of Las Cruces Comprehensive Plan (1999)
- City of Lordsburg Comprehensive Plan (2001)
- City of Socorro Comprehensive Plan (2003)
- City of Truth or Consequences Comprehensive Plan (2007)
- Town of Carrizozo Comprehensive Plan (2008)
- Village of Hatch Comprehensive Plan (2007)

Arizona

- Cochise County Comprehensive Plan (2006)
- Graham County Comprehensive Plan (1996)
- Greenlee County Comprehensive Plan(2003)
- Pima County Comprehensive Plan (2007)
- Pinal County Comprehensive Plan(2009)

- City of Casa Grande General Plan (2010)
- City of Tucson General Plan (2001)
- City of Safford General Plan (2004)
- City of Willcox General Plan (2009)
- City of Benson General Development Plan (2002)
- Town of Marana General Plan Update (2007)
- Sonoran Desert Conservation Plan (1999)
- Redington NRCD Long Range Natural Resource Conservation Plan, 2010-2016 (2010)
- Land Management Plan of the Winkelman NRCD (revised 2010)

3.10.5 Summary of Inventory Results

The following section identifies the present land uses within the study corridors and their proximity to each subroute.

3.10.5.1 General Land Use Subroute Summary

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 traverses Torrance, Lincoln, Socorro, Sierra, and Luna counties, and can generally be categorized as rural residential and vacant undeveloped, with widely dispersed residences occurring throughout the study corridor. Residential densities are predominantly rural, with higher densities occurring along the Rio Grande, approximately 3 miles north of Socorro, New Mexico. Although this subroute is in close proximity (less than 0.5 mile) to residences, it crosses no residential structures. Commercial and industrial uses are also widely dispersed throughout this portion of the study corridor. The majority of these uses occur along I-25, near Socorro. Commercial uses in this part of the study corridor include retail businesses, small offices, and hotels/motels. Industrial uses include automotive repair garages, mini-storage facilities, and wreckage/salvage yards. This subroute does not cross commercial or industrial land uses.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 crosses the same counties as Subroute 1A1, and can generally be categorized the same as Subroute 1A1, with rural residential and vacant undeveloped areas and widely dispersed residences occurring throughout the study corridor. Commercial and industrial uses are also widely dispersed throughout this portion of the study corridor. Similar to Subroute 1A1, the majority of these uses occur along I-25, near Socorro and San Antonio, as well as areas near Elephant Butte and Truth or Consequences. Subroute 1A2 does not cross commercial or industrial land uses but, as with Subroute 1A1, does cross agricultural areas near Socorro.

Subroute 1A – North River Crossing

Subroute 1A crosses the same counties as the BLM preferred alternative and Subroute 1A1, except for Torrance County, and can generally be categorized the same as the BLM preferred alternative and Subroute 1A1, with rural residential and vacant undeveloped areas and widely dispersed residences in the study corridors. Commercial and industrial uses are also widely

dispersed throughout this portion of the study corridor. Similar to the BLM preferred alternative and Subroute 1A1, the majority of these uses occur along I-25, near Socorro and San Antonio, as well as areas near Elephant Butte and Truth or Consequences. Subroute 1A does not cross commercial or industrial land uses but, similar to the BLM preferred alternative and Subroute 1A1, does cross agricultural areas near Socorro.

Subroute 1B – San Antonio Crossing

This subroute is similar to the BLM preferred alternative, and primarily crosses rural and undeveloped land. However, where Link A140 crosses the Rio Grande, the subroute is in close proximity (less than 0.3 mile) to approximately six rural residential dwellings.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A and 1B1 (Gran Quivira) primarily cross rural and undeveloped land. However, Link E81 crosses in close proximity (less than 0.3 mile) to approximately one residence.

Local alternative links for 1A, 1B1, 1B2, and 1B3 primarily cross rural and undeveloped land. Links A161b and A260 cross in close proximity (less than 0.3 mile) to approximately three residences and one residence, respectively. Links A361 and A430 cross an area of existing dense agriculture.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 runs primarily through vacant/undeveloped land in Luna, Grant, and Hidalgo counties in New Mexico; and Cochise, Graham, Greenlee, and Cochise counties in Arizona. This subroute is more than 6 miles north of the cities of Deming and Lordsburg, New Mexico, and has two industrial structures within 0.5 mile.

Subroute 3A – North

Subroute 3A is similar the BLM preferred alternative and runs primarily through vacant/undeveloped land, with two industrial structures within 0.5 mile of the subroute centerline.

Subroute 3B – South

Subroute 3B is similar to the BLM preferred alternative, but is located closer to Lordsburg, New Mexico. Although residential, commercial, industrial, and various quasi-public uses occur in Lordsburg, the subroute is approximately 2 miles south of Lordsburg. As it crosses into Arizona along I-10, Subroute 3B is approximately 2 miles north of the rural agricultural community of San Simon.

Crossover Links for Route Group 3

Crossover links 3A and 3B are located in areas that are primarily vacant/undeveloped land.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

4A – North of Mt. Graham

Subroute 4A is located in Graham, Cochise, Pima, and Pinal counties in Arizona. A large majority of this study corridor can be characterized as rural residential, with large areas of vacant land. There are no commercial or industrial uses within this segment of the study corridor for this subroute. As the route approaches the Project terminus at the planned Pinal Central Substation, Link C850 crosses a residential property, and links C880 and C880a pass within 0.5 mile of a rural residence and agriculture areas, but does not directly affect any residential dwellings. (This portion of the study corridor is common to all of the alternatives in Route Group 4.)

Subroute 4B – Sulphur Springs Valley

This subroute is similar to 4A. It primarily crosses vacant undeveloped land, with no direct crossings of residential, commercial, or industrial uses. No residential dwellings are encountered, except for the area near the planned Pinal Central Substation.

Subroute 4C2c – BLM Preferred Alternative

Link C110 crosses two large rural residential properties and continues south, and crosses the San Pedro River with links C261 and C201, avoiding impacts to residential, commercial, and industrial uses. The remainder of the BLM preferred alternative crosses vacant undeveloped land until it approaches the Pinal Central Substation, where the route crosses a residential property, and links C880 and C880a pass within 0.5 mile of a rural residence and agriculture areas; it does not directly affect any residential dwellings.

Subroute 4C1 – East of San Pedro River

This segment of the study corridor is similar to subroutes 4A and 4B. However, Link C110 located north of Willcox crosses two rural residential properties. Link C660 is adjacent to a mine in San Manuel for approximately 2.5 miles. The remainder of the land in this subroute is vacant and undeveloped.

Subroute 4C2 – West of San Pedro River

As stated above, a portion of Link C110 crosses two rural residential properties. However, instead of turning north to San Manuel, the subroute crosses the San Pedro River south of Cascabel. In this area, Link C266 is less than 0.5 mile from approximately 11 rural residential dwellings. The remainder of the subroute passes west of San Manuel and approximately 3.6 miles north of the town of Oracle, which includes low to medium residential densities, as well as limited commercial, industrial, and quasi-public uses (local government buildings, post office, etc.).

Subroute 4C3 – Tucson

Subroute 4C3 crosses a densely populated urban area in and around the city of Tucson, which has a population of approximately 1,020,200 people. Residential uses within the city vary in density from low to high and include single- and multi-family homes, townhouses, apartments, mobile home parks, and subdivisions under construction. Multiple churches and educational facilities, such as daycare and preschools, are located throughout the urban areas. School and quasi-public uses such as local, state, and federal government buildings are located within this study corridor, but are not crossed by subroutes in the Rillito and Santa Cruz River basins. Links F111 and F112 traverse the seasonal Santa Cruz River, crossing approximately 44 residential properties; including a manufactured home park, a medium density residential subdivision that is under construction, and approximately 8 commercial and industrial properties.

Major commercial and industrial parks are located throughout the city, with concentrations near the Tucson International Airport and Davis-Monthan AFB, and along the I-10 corridor. As this subroute proceeds north from the Tortolita Substation, Link C817 is directly adjacent to one single-family residential property.

Local Alternative and Crossover Links for Route Group 4

Local alternative links for 4A, 4B, 4C1, 4C2, and 4C3 are located in areas where agriculture is the primary land use. Link C860 crosses within 0.3 mile of a residence. Link C890 crosses through irrigated agriculture areas for almost the entire link.

Local alternative links for 4C2 cross largely undeveloped land used for ranching and grazing. Link C680 crosses within 0.3 mile of 12 residences; Link C812 parallels approximately 1.3 miles of a canal; and Link C817 passes to the west of a residence within 0.1 mile.

Local alternative links for 4C3, links F81a and F81b, do not directly cross any residential, commercial, industrial, or quasi-public uses; however, multiple high density single-family residential subdivisions, and commercial and industrial land uses occur less than 0.1 mile (500 feet) from the subroute.

3.10.5.2 Agriculture and Range Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

A major portion of this subroute crosses undeveloped land used for ranching and grazing, primarily through grazing leases on federal and state land. These uses occur along links A10, A21, E80d, E101a, and E101b, along the northern portion of the WSMR, also known as the Northern Call-up Area; and along Link E133, bordering the Sevilleta NWR. Link E180 crosses through the Rio Grande Valley, as well as flood and row irrigated farmland.

Subroute 1A2 – BLM Preferred Alternative

As with Subroute 1A1, a major portion of this subroute crosses undeveloped land used for ranching and grazing, primarily through grazing leases on federal and state land. These uses occur along links A10, A21, E86a, E86b, and E101b, along the northern portion of the WSMR; and along Link E133, bordering the Sevilleta NWR. Link E180 crosses through the Rio Grande Valley, as well as flood and row irrigated farmland.

Subroute 1A – North River Crossing

Similar to the BLM preferred alternative and Subroute 1A1, Subroute 1A crosses undeveloped land used for ranching and grazing, primarily through grazing leases on federal and state land, along the same links described above, as well as links A22 and E80c along the northern portion of the WSMR. Link E180 traverses the Rio Grande Valley, and directly crosses flood and row irrigated farmland.

Subroute 1B – San Antonio Crossing

Subroute 1B is similar to 1A, with the addition of links E90 through A80, which cross lands primarily used for ranching and livestock grazing. This land is mostly privately- or BLM-owned, with smaller interspersed portions of state-owned land. Local Alternative Link A260 crosses a large portion of BLM land; Link A140 crosses the Rio Grande and directly crosses flood and row irrigated farmland; and Local Alternative Link A161b crosses a large parcel of private land that is subdivided ranch land, and is in the process of residential development.

Local Alternative and Crossover Links for Route Group 1

A portion of the Midpoint Substation Local Alternative Link A430 crosses flood irrigated agricultural land, and was designed to bypass fields irrigated with center pivots.

<u>Route Group 3: Midpoint Substation to Willow-500 kV Substation</u>

Subroute 3A2 – BLM Preferred Alternative

The majority of Subroute 3A2 crosses BLM and State Trust land used for ranching and grazing. There is very little farmland along this segment, except near Link B90.

Subroute 3A – North

Similar to the BLM preferred alternative, the majority of this subroute crosses BLM and State Trust land used for ranching and grazing. There is very little farmland along this segment, except near the Midpoint Substation and Link B90.

Subroute 3B – South

Subroute 3B is similar to the BLM preferred alternative, with the addition of irrigated farmland near Lordsburg and San Simon. Link B80, just west of the Midpoint Substation, crosses the outer edge of a center pivot irrigated field and two flood irrigated fields.

Crossover Links for Route Group 3

There are no apparent agricultural areas crossed by crossover links associated with Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

The majority of this subroute crosses mountainous terrain, comprising state land used for ranching and grazing. Link C592 at the San Pedro River, and links C880 and C880a, all near the planned Pinal Central Substation, cross irrigated farmland.

Subroute 4B – Sulphur Springs Valley

This subroute is similar to 4A, but includes links C130a and C130b through the Sulphur Springs Valley. Link 130a is adjacent to irrigated farmland near Bonita, but would not conflict with center pivot sprinkler irrigation.

Subroute 4C2c – BLM Preferred Alternative

The majority of Subroute 4C2c crosses undeveloped areas used for ranching and grazing. Links C110, C880, and C880a cross, and Link C850 is adjacent to, irrigated farmland. Link C680 is adjacent to a small agricultural operation.

BLM preferred alternative links C450 and C441 cross State Trust lands leased to Pima County for grazing, as described above for Subroute 4C2.

Subroute 4C1 – East of San Pedro River

The majority of this subroute crosses undeveloped areas used for ranching and grazing. Links C110, C880, and C880a cross, and Link C850 is adjacent to, irrigated farmland.

Subroute 4C2 – West of San Pedro River

This subroute is similar to 4A and 4B, although links C111 and C270 cross undeveloped areas used for ranching and grazing.

Subroute 4C2 crosses State Trust lands leased to Pima County for grazing. Pima County proposes to acquire the Six Bar Ranch (Link C450) and A7 Ranch (links C276 and C441) for preservation in the future.

Subroute 4C3 – Tucson

This subroute encounters the same agricultural areas as 4C1. Links C260 and C261 cross undeveloped areas used for ranching and grazing.

Local Alternative and Crossover Links for Route Group 4

Pinal Central Substation local alternatives cross primarily undeveloped land used for ranching and grazing. Local Alternative Link C890 for 4A, 4B, 4C1, 4C2, and 4C3 crosses flood irrigated farmland.

For Local Alternative 4C2 (Tortolita Substation area), Link C680 passes adjacent to a small agricultural operation, and Link C810 crosses within 0.3 mile of an agricultural area.

Local Alternative Link F40b for 4C3 crosses an area west of the San Pedro River that is used for ranching and grazing. Local Alternative Link C121 (4C1, 4C2, and 4C3) crosses agricultural lands for approximately 5.5 miles, and crosses center pivot sprinkler irrigated farmland near Bonita.

3.10.5.3 Parks and Recreation Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Dispersed recreation opportunities are located throughout the Subroute 1A1 study corridor. Numerous community parks and community, senior, and recreational centers are located within Socorro (City of Socorro 2003). A small community park that offers opportunities for camping, picnicking, fishing, and biking is located approximately 5 miles north of Socorro and is approximately 0.5 mile north of Link E180. A portion of Subroute 1A1 crosses the Johnson (Gordy's) Hill SRMA (links E180 and E133), which is used for OHV recreation. No parks or recreational centers are crossed by this subroute.

Subroute 1A2 – BLM Preferred Alternative

Dispersed and formal recreation opportunities are similar to those described in Subroute 1A1. No parks or recreational centers are crossed by this subroute.

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1, but also has areas of recreation located in Truth or Consequence (City of Socorro 2003; City of Truth or Consequences 2007). Subroute 1A is located approximately 5 miles north of Socorro and crosses a portion of the Johnson (Gordy's) Hill SRMA, as does the BLM preferred alternative and Subroute 1A1.

Subroute 1B – San Antonio Crossing

Subroute 1B is similar to 1A1; however, San Antonio has no community parks or areas for organized recreation. Dispersed recreation opportunities on BLM land near the community include geocaching, camping, hiking, horseback riding, hunting, OHV opportunities, and rock hounding.

Local Alternative and Crossover Links for Route Group 1

This area is largely undeveloped and limited to dispersed recreation on BLM land.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Only dispersed recreation occurs along Subroute 3A2. The majority of the formal recreational facilities are located in and around Deming and Lordsburg, New Mexico, within Luna and Hidalgo counties, respectively. The closest recreational facilities are limited to existing educational facilities, primarily in Greenlee and Luna counties, which are open for the public's use when school is not in session (Greenlee County 2003).

Subroute 3A – North

Subroute 3A has similar recreation opportunities as the BLM preferred alternative.

Subroute 3B – South

This segment of the subroute is similar to Subroute 3A2. However, Lordsburg, New Mexico contains a special events center that also functions as the city's convention center; as well as four parks with playground equipment, picnic areas, and softball fields (City of Lordsburg 2001). Near Lordsburg, but within the jurisdiction of Hidalgo County, are the Hidalgo County fairgrounds and rodeo arena (*ibid*). Located within Deming is the Voires Pit Park, a large amphitheater with a 6,100-square-foot covered pavilion, as well as the Sam Baca Aquatic Center, Hooten Park, and the Rio Mimbres Golf Club. Subroute 3B is approximately 2.3 miles south of Lordsburg and approximately 5 miles north of Deming.

Crossover Links for Route Group 3

This area is largely undeveloped and limited to dispersed recreation on BLM land.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Dispersed recreation on BLM land is the extent of opportunities available in this subroute, such as bird watching and hiking in and around the ephemeral riverbed, as the subroute crosses the seasonal San Pedro River/Wash wildlife corridor (Link C592).

Subroute 4B – Sulphur Springs Valley

This subroute has similar recreational opportunities as Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

There are dispersed recreational opportunities along the San Pedro River, including hiking, bicycling, equestrian, fishing, birding, and other wildlife watching activities. Formal recreational opportunities are located in the Willcox and Benson communities, 7 to 11 miles south of the study corridor. Willcox has a sports park with a rodeo/fairground arena and athletic fields; and two municipal parks, one of which contains a community swimming pool. Both of the parks contain walking paths and picnic areas. The city of Benson has a community pool and three public parks that contain basketball and volleyball courts, horseshoes stakes, a skate park, walking trails, ramadas, grills, and playgrounds (City of Benson 2011).

In the northern portion of the study corridor, the rural communities of San Manuel, Oro Valley, Picacho, and Eloy each contain small community parks allowing for a variety of recreational uses. Pinal County has community parks, including the Pinal County Fairgrounds located adjacent to the proposed Pinal Central Substation (Pinal County 2009). There are dispersed recreational opportunities near the Santa Cruz River on BLM land in south-central Pinal County that include hiking, bicycling, and equestrian activities.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is similar to the BLM preferred alternative Subroute 4C2c.

Subroute 4C2 – West of San Pedro River

This subroute is similar to Subroute 4C1.

Subroute 4C3 – Tucson

This subroute is within the densely populated Tucson urban area. Recreational opportunities abound, including municipal and regional parks, community centers, community pools, trails for hiking, wildlife viewing, mountain biking, camping, river parks, and equestrian access. Link F112 crosses the Silverbell Regional Park, and crosses within 0.2 mile of the Silverbell Golf Course. In addition, the Pines Golf Club at Marana is less than 0.1 mile from Link F510.

The Sweetwater Wetlands Park, less than 0.3 mile from Link F112, is an urban wildlife habitat and park that doubles as a water reclamation facility (City of Tucson 2011). Along I-10, Link F112 is parallel to the Santa Cruz River Park, which offers biking, running, walking paths, and equestrian access in the seasonally dry riverbed. The El Paseo de los Arboles Commemorative Park is also located along the Santa Cruz River Park, adjacent to Link F112. Sam Lena Park, part of the Kino Sports Complex, is located on the north side of Ajo Way and is adjacent to I-10; it offers a number of amenities for public use and is less and 0.2 mile from Link F111 (Natural Resources, Parks and Recreation 2010).

Winchester and Tortolita Substations

The area is largely undeveloped and limited to dispersed recreation on BLM land.

Local Alternative and Crossover Links for Route Group 4

The Pinal County Fairgrounds are located adjacent to the planned Pinal Central Substation. Dispersed recreational opportunities in this area include trails that run through the Santa Cruz River on BLM land in south-central Pinal County.

Rillito River Park is a large recreational facility located in the vicinity of the local alternative links for 4C3, with walking paths along the north and south banks of the seasonally dry riverbed. The existing multi-use trails are parallel to Link F81b, and the historic Rillito Race Track is adjacent to Link F81b. Numerous private and municipal golf courses are located less than 0.5 mile from this subroute. In addition to Link F81b, Link F51 crosses part of the Pima County-managed Cienega Creek Natural Area.

3.10.5.4 Transportation and Access Subroute Summary

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The roadways in this portion of the subroute include I-25, US Routes 54 and 60/85, and SRs 1, 55, 27, and 26. I-25 is a regional transportation route, while the others are alternative routes; all are under the jurisdiction of the NMDOT. The Burlington Northern Santa Fe and Atchison, Topeka, and Santa Fe railroads are generally parallel to I-25. There are no designated scenic highways within this portion of the study area.

Aviation facilities near this subroute include the Socorro Municipal Airport 3 miles south of the town of Socorro and 6 miles south of Link E180. Link A260 is approximately 5 miles north of the Truth or Consequences Municipal Airport, and approximately 7 miles north of Truth or Consequences.

Subroute 1A2 – BLM Preferred Alternative

The transportation routes and aviation facilities near to or crossed by Subroute 1A2 are the same as for Subroute 1A1.

Subroute 1A – North River Crossing

The transportation routes and aviation facilities near to or crossed by Subroute 1A are the same as the BLM preferred alternative and Subroute 1A1, except for the Truth or Consequences Municipal Airport located near Link A260.

Subroute 1B – San Antonio Crossing

Subroutes 1B1, 1B2, and 1B3 are similar to 1A. There are no additional roads or aviation facilities along this subroute.

Midpoint Substation

SR 26 is parallel to links A440 and A530 near the Midpoint Substation.

Local Alternative and Crossover Links for Route Group 1

Link A260 is approximately 5 miles north of the Truth or Consequences Municipal Airport, and approximately 7 miles north of Truth or Consequences. The Hatch Municipal Airport is located approximately 3 miles west of Hatch, New Mexico, and 9 miles east of Link A361.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

The major roadways along Subroute 3A2 include I-10 and US Route 70, which run east and west through the Bowie townsite; San Simon, Arizona; and Lordsburg and Deming, New Mexico. This route is under the jurisdiction of both NMDOT and ADOT, as it crosses the state line. The UPRR parallels I-10 through this segment of the study corridor. There are no designated scenic highways within the study corridor.

There are several private airstrips used for agricultural purposes and to access private land within the study corridor, but no public aviation facilities. Link B90 is approximately 6 miles north of the Deming Municipal Airport.

Subroute 3A – North

The transportation routes and aviation facilities that Subroute 3A crosses or is near are the same as for Subroute 3A2.

Subroute 3B – South

Subroute 3B is similar to Subroute 3A2, except for the presence of two large aviation facilities. The Deming Municipal Airport is approximately 2 miles east of Deming, New Mexico, and 5 miles south of Link B80. Lordsburg Municipal Airport is approximately 0.5 mile southeast of Lordsburg, New Mexico, and less than 1 mile north of Link B112.

Crossover Links for Route Group 3

The crossover and local alternative links for Route Group 3 are not located near or parallel to transportation facilities.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

The major roadways along this subroute include US Route 191 and SRs 77, 79, and 87; all under ADOT jurisdiction. US Route 191 and SRs 77 and 79 are alternate primary routes that run north and south in the study area. Link B153a parallels US Route 191. The Arizona Eastern Railroad, which runs from the Bowie townsite north into Safford, is also located along this subroute.

Link C850 is approximately 5 miles south of the Coolidge Municipal Airport, and Link C880a is approximately 5 miles northeast of the Eloy Municipal Airport.

Subroute 4B – Sulphur Springs Valley

The transportation facilities along Subroute 4B are the same as those described for Subroute 4A, although Subroute 4B would not be adjacent to US Route 191.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c is similar to Subroute 4A for the roads that it is adjacent to or crosses, and the Arizona Eastern Railroad that runs from the Bowie townsite north into Safford, as well as for the Coolidge and Eloy Municipal Airports near links C850 and C880a.

Subroute 4C2c is near the Cochise County and San Manuel Airports, as described above for Subroute 4C1 and 4C2.

Subroute 4C1 – East of San Pedro River

In addition to the major roads mentioned for Subroute 4A, I-10 and I-19 occur along this subroute. I-10 is the main east-west transportation route running from Willcox through Tucson, and is in close proximity to the planned Pinal Central Substation. I-19 is a major north-south route, running from Tucson south to Nogales (outside of the study area). Links C693 and C760 are parallel to SR 79.

The Cochise County Airport is located near this subroute. It is approximately 3 miles west of Willcox and 8 miles southeast of Link C212.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to Subroute 4C1. San Manuel Airport is approximately 3 miles north of San Manuel, 2 miles northeast of Link C660, and less than 1 mile west of Link C450.

Subroute 4C3 – Tucson

In Tucson's metropolitan area, I-10 and I-19 are located along this subroute. I-10 is the main east-west transportation route running from Willcox through Tucson, and is in close proximity to the planned Pinal Central Substation. I-19 is a major north-south route running from Tucson, south to Nogales (outside of the study area). Multiple aviation facilities are located within the

study area, including Davis-Monthan AFB and Tucson International Airport. Davis-Monthan AFB is 2 miles southeast of Tucson, 5 miles west of Link F81a and 2 miles east of Link F111. Tucson International Airport is approximately 6 miles south of Tucson and 2 miles south of Link F111. Benson Municipal Airport is approximately 3 miles northwest of Benson and 5 miles southeast of Link F40A. At the north end of the study area, the Marana Regional Airport is approximately 3 miles west of Marana and 5 miles southwest of Link F540. Marana Airport/Pinal Airpark is approximately 7 miles northwest of Marana and 3 miles southwest of Link C810a. There are numerous private airstrips for agricultural and private use located primarily in the eastern and northern portions of the study corridor.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C790 for 4A, 4B, and 4C1 parallels SR 79.

Local alternative links for 4A, 4B, 4C1, 4C2, and 4C3 include Link C890, which parallels roughly 1.0 mile of SR 287 for approximately 0.5 mile to the east.

I-10 is approximately 0.3 mile west of link C810a, which is associated with the Winchester Substation and Tortolita Substation local alternatives.

Local alternative links for 4C3 include Link F81a, which parallels 0.7 mile to the northeast of I-10 for roughly 3.0 miles. Link F81b follows local roads through the downtown portion of Tucson.

3.10.5.5 Mining and Minerals Subroute Summaries

Mining sites, claims, and prospects are scattered throughout the study corridors for each of the alternatives. The following descriptions include locations of concentrated mine sites.

Route Group 1: SunZia-East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Surface mining sites are adjacent to or crossed by Subroute 1A1 at links E200 and E211. E211 is also adjacent to a gravel pit. There is a surface mining operation adjacent to Link A260. The subroute crosses approximately 5 miles of the EMRTC, but is not anticipated to conflict with current test areas. Moreover, minor site-specific subroute adjustments during the project design, if a right-of-way is granted, are likely to further reduce any potential conflicting uses.

Subroute 1A2 – BLM Preferred Alternative

Surface mining sites adjacent to or crossed by Subroute 1A2 are similar to those described for Subroute 1A1. The subroute crosses approximately 5 miles of the EMRTC, but is located outside the active testing areas.

Subroute 1A – North River Crossing

Surface mining sites are adjacent to or crossed by the subroute at links E200, E211, and A270, which are adjacent to a gravel pit. The subroute crosses approximately 5 miles of the EMRTC, but is located outside the active testing areas.

Subroute 1B – San Antonio Crossing

There is a concentration of mine sites, claims, and prospects along Link A80, and a gravel pit is adjacent to Link A270.

Local Alternative and Crossover Links for Route Group 1

There is a surface mining operation adjacent to Link A260.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

There is a concentration of mine sites, claims, and prospects adjacent to Link B170. This subroute crosses an authorized locatable mineral mine site on Link 160a, northwest of Lordsburg.

Subroute 3A – North

The concentration of mine sites, claims, and prospects for Subroute 3A are the same as for the BLM preferred alternative.

Subroute 3B – South

There is a concentration of mine sites, claims, and prospects adjacent to links B112, B150a, B150b, and B170. Surface mining and material sites are adjacent to or crossed by links B110a, B112, B150a, and B150b.

Crossover Links for Route Group 3

There are no surface mining or gravel pit sites located within crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

There is a concentration of mine sites, claims, prospects, and a surface mining site adjacent to Link C170.

Subroute 4B – Sulphur Springs Valley

There is a concentration of mine sites, claims, and prospects adjacent to links C130b and C170. There are no surface mining and material sites adjacent to or crossed by the subroute.

Subroute 4C2c – BLM Preferred Alternative

There is a concentration of mine sites, claims, and prospects adjacent to links C110, C441, and C680.

Subroute 4C1 – East of San Pedro River

There is a concentration of mine sites, claims, and prospects adjacent to Link C110. Surface mining and material sites adjacent to or crossed by the subroute include Link C660.

Subroute 4C2 – West of San Pedro River

There is a concentration of mine sites, claims, and prospects adjacent to links C110, C441, and C680. There are no surface mining and material sites adjacent to or crossed by the subroute.

Subroute 4C3 – Tucson

There is a concentration of mine sites, claims, and prospects adjacent to Link C110. Surface mining and material sites adjacent to or crossed by the subroute include links F111, F112, and F510.

Local Alternative and Crossover Links for Route Group 4

There is a concentration of mine sites, claims, and prospects adjacent to links C680 and C671. Surface mining and material sites are adjacent to links F81a and F81b.

3.10.5.6 Military Installations and Airspace Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Links E80d, E101a, and E101b cross the Northern Call-up Area north of the WSMR. Pursuant to evacuation agreements, residents and businesses located in this area are required to evacuate their properties during missile tests. Adjacent to the north and west sides of the WSMR in Socorro County, the DOD has delineated and designated four areas as safety evacuation areas (i.e., areas evacuated of residents and nonresidents prior to and during missile firing on the WSMR).

Within the Northern Call-up Area, the DOD controls two areas of airspace known as R5107C and R5107H. These cover the same geographic region, one on top of the other. The lower level R5017C starts at the surface and extends to 9,000 feet above ground level, and is used for low-level flight operations. The upper level R5107H extends from 9,001 feet to 60,000 feet above ground level and is used for high altitude flight operations.

Link E80d is approximately 1 mile east of LC 94, which is used to test-fire missiles onto the WSMR.

The policy of the Air Force regarding training and testing around the Gran Quivira is to avoid the airspace within a 5-nautical-mile radius of the center of the Gran Quivira (links E82, E84, and E85).

Subroute 1A2 – BLM Preferred Alternative

Links E86a, E86b, and E101b cross the Northern Call-up Area north of the WSMR, as described for Subroute 1A1. Subroute 1A2 is along the northern boundary of the R5107C and R5107H airspace.

Link E86b is approximately 5 miles north of LC 94.

Subroute 1A2 crosses within the 5-mile radius of the center of the Gran Quivira (links E82, E84a, E84b, and E86a).

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1, but includes Link E80c, which also crosses the Northern Call-up Area north of the WSMR.

Subroute 1B – San Antonio Crossing

The land uses associated with this subroute are similar to the BLM preferred alternative and Subroute 1A, between the SunZia East Substation and the point where Link E90 diverges to the south. Link E90 is approximately 1 mile west of LC 94. Links A90, A111, A30, A50, A60, A40, A41, and A80 are located within the Northern Call-up Area. Subroute 1B3 (Link A41) crosses a 1-mile segment of DOD land approximately 3 miles north of the WSMR.

Local Alternative and Crossover Links for Route Group 1

The Air Force policy regarding training and testing around the Gran Quivira is to avoid the airspace within a 5-nautical-mile radius of the center of the National Monument.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

There are no military installations or airspace near or crossed by Subroute 3A2.

Subroute 3A – North

Subroute 3A is the same as the BLM preferred alternative.

Subroute 3B – South

Subroute 3B crosses a parcel of land owned by the DOD and used by the Army National Guard as a shooting range. This parcel of land is located approximately 8 miles northwest of Deming on the south side of US Route 80.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Military installations or airspace in Route Group 4 are near Subroute 4C3 and the Pantano-Rillito local alternative subroute. Link F111 is within 3 miles of Davis-Monthan AFB, parallel to the main runway. Link F540 is approximately 3 miles east of the Pinal Air Park, which is home to the Silver Bell Army Heliport. Link C820 is approximately 2 miles east of Square Field, an area used by the U.S. Army during helicopter training exercises. Links C760, C780, C817, C818, C830, C840, C850, and C860 all cross a military training route associated with the Silver Bell Army Heliport.

Subroutes 4C1, 4C2, 4C2a, 4C2b, 4C2c, and 4C3 cross the northern portion of the Buffalo Soldier Electronic Proving Ground. This facility, headquartered at Fort Huachuca, conducts noise tests for electronic combat and electronic warfare equipment (see Section 3.10.3.7).

Local Alternative and Crossover Links for Route Group 4

Local alternative links for 4C3 include links F81a and F81b, which are within 3.0 miles of the Davis-Monthan AFB, parallel to the main runway.

3.10.5.7 Energy Facilities, Utility Corridors, and Communication Sites Subroute Summaries

Each of the subroutes is parallel to existing linear utilities or is located in designated utility corridors. Existing electrical generating facilities and substations are also located within the alternative study corridors. Planned energy facilities are discussed in Section 4.17, Cumulative Impacts (Table 4-36). Further description of the subroutes in relation to the parallel utility corridors and other linear energy features is provided in Appendix E.

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 parallels or crosses pipeline, existing utilities, and designated utility corridors, including the planned SunZia East Substation, which is a beginning point for the Project. Subroute 1A1 parallels existing utilities and designated utility corridors for approximately 140.7 miles, and is within the DOE West-wide Energy Corridor along links E211, A161, and A161a. Link E180 crosses portions of a BLM-designated utility corridor, and Link A260 is parallel to the DOE West-wide Energy Corridor.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 parallels or crosses similar existing utilities and designated utility corridors as Subroute 1A1. The BLM preferred alternative parallels linear energy facilities and designated utility corridors for approximately 140.7 miles, and is within the DOE West-wide Energy Corridor along links E211, A161, and A161a. Link E180 crosses portions of a BLM-designated utility corridor, and Link A260 is parallel to the DOE West-wide Energy Corridor.

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1, except that the total mileage equals 113.5 and does not include Link A260.

Subroute 1B – San Antonio Crossing

These three subroutes parallel existing utilities and designated utility corridors for approximately 88.6 to 98.6 miles, depending on the subroute. Subroute 1B is within the BLM designated utility corridor with Link A140, and within the West-wide Energy Corridor with links A161, A161a, and A260.

Local Alternative and Crossover Links for Route Group 1

Portions of the crossover and local alternative links are parallel to existing utilities and designated utility corridors for approximately 11.2 to 20.7 miles. Link A260 is parallel to the DOE West-wide Energy Corridor.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 is parallel to existing utilities and designated utility corridors for approximately 42.4 miles. The existing Hidalgo and Lordsburg substations are adjacent to Link B121.

Subroute 3A – North

Subroute 3A is parallel to existing utilities and designated utility corridors for approximately 42.4 miles. Subroute 3A is similar to the BLM preferred alternative.

Subroute 3B – South

The subroute parallels existing utilities and designated utility corridors for approximately 76.2 miles. Links B110a, B110b, B112, and B150a are located in the West-wide Energy Corridor. Power plants observed along the subroute include the Evergreen Power Plant, adjacent to Link B112.

Crossover Links for Route Group 3

Crossover Link B111 parallels existing utilities and designated utility corridors for 7.2 miles, and Link B140 is within the West-wide Energy Corridor for 0.3 mile.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

This subroute parallels existing utilities and designated utility corridors for approximately 27.6 miles. No substations or power plants are adjacent to this subroute.

Subroute 4B – Sulphur Springs Valley

This subroute parallels existing utilities and designated utility corridors for approximately 21.6 miles. No substations or power plants are adjacent to this subroute.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c parallels existing utilities and designated utility corridors for approximately 90.4 miles. The Oracle Junction Substation is adjacent to Link C680. Links C260 and C261 are adjacent to the Winchester Substation.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 parallels existing utilities and designated utility corridors for approximately 66.5 miles. This subroute parallels the proposed San Manuel 230 kV transmission line project at Link C660.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 parallels existing utilities and designated utility corridors for approximately 74.8 miles. No power plants are adjacent to this subroute. The Oracle Junction Substation is adjacent to Link C680.

Subroute 4C3 – Tucson

This subroute parallels pipeline, existing utilities, and designated utility corridors for approximately 125.3 miles. The minor substations adjacent to this subroute include: Adonis Substation adjacent to Link F540; Tucson and Rillito substations adjacent to Link F112; Vail Substation adjacent to links F80 and F60b; and Cienega Substation adjacent to links F60b and F82. Irvington Generating Station and Substation is adjacent to Link F111, the North Loop Generating Station and Substation is adjacent to Link F510, and the DeMoss Petrie Generating Station and Substation is adjacent to Link F112.

Local Alternative and Crossover Links for Route Group 4

The crossover and local alternative links for Route Group 4 parallel existing utilities and designated utility corridors for approximately 1.6 to 46.2 miles. Local alternative links for 4C2 (Winchester and Tortolita substations) include links C260 and C261, which are adjacent to the existing Winchester Substation. For local alternative links for 4C2 (Tortolita Substation), Link C810a is adjacent to the existing Tortolita Substation.

Local alternatives links for 4C3 include links F81a and F81b, which are adjacent to the East Loop Substation. The Northeast Substation is adjacent to Link F81b.

Communication facilities such as microwave stations, radio towers, and cellular/digital towers located within the study corridors are identified in Table 3-49.

Table 3-49. Communication Facilities within the Study Corridors	
Subroute	**Communication Facility Link Locations**
Group 1	
1A1 – North River Crossing	A161a, A330b, E82, A260
1A2 – BLM Preferred Alternative	A161a, A330b, E82, A260
1A – North River Crossing	A161a, E80c, A330b, A270
1B – San Antonio Crossing	A140, A161a, A41, A270, E80c, A330b, A270
Local Alternative and Crossover Links for Route Group 1	E81, E82, A260
Group 3	
3A2 – BLM Preferred Alternative	B120a
3A – North	B120a
3B – South	B112, B150b
Crossover Links for Route Group 3	None
Group 4	
4A – North of Mt. Graham	B153b, C170
4B – Sulphur Springs Valley	None
4C2c – BLM Preferred Alternative	C450,C441, C260
4C1 – East of San Pedro River	None
4C2 – West of San Pedro River	C450, C441
4C3 – Tucson	F112, F510
Local Alternative and Crossover Links for Route Group 4	C260, F81b, F40b

3.10.5.8 Planned Land Use Subroute Summaries

Summaries of planned land uses for each of the alternative subroutes are described below. Descriptions of BLM RMP right-of-way avoidance areas are provided in Chapter 2, Section 2.6.

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Similar to the existing land uses, planned land use along the majority of Subroute 1A1 is vacant/mixed use/grazing. In Socorro County, no planned land uses have been identified and existing uses are expected to continue. For approximately 13.0 miles, Link A161 crosses a planned residential development that is adjacent to the Bosque del Apache NWR. Pending projects crossed by this alternative include the New Mexico Copper Corporation mining lease area (Link A330b), located adjacent to Highway 152, and the AT&T Corporation communication facility lease area (Link E211). These leases are not addressed in Section 4.10 of Chapter 4, Land Use and Recreation Impacts, due to the preliminary status of the leases, but are addressed as reasonably foreseeable future activities in Section 4.17 of Chapter 4, Cumulative Effects.

Subroute 1A2 – BLM Preferred Alternative

Planned land use for Subroute 1A2 is similar to Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1.

Subroute 1B – San Antonio Crossing

Similar to 1A, the planned land use along this subroute is expected to be a continuation of the existing grazing and agricultural land uses. Link A161 passes directly through the approved Willow Springs Ranch residential development.

Local Alternative and Crossover Links for Route Group 1

The area is largely undeveloped; existing uses of grazing/mixed use/vacant are expected to continue. Local alternative links for 1A, 1B1, 1B2, and 1B3 include Link A161b, which runs adjacent to the west side of the Willow Springs Ranches, a plat-approved residential development approximately 26 miles south of Socorro, New Mexico, and 2 miles west of I-25.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Existing land uses, primarily for grazing and agriculture, are expected to continue; particularly since no long-range comprehensive plans exist for much of Luna and Hidalgo counties. Aven Associates, LLC mine lease area (Link B160a) is a pending mining lease, located approximately 3.5 miles west of Highway 70[1].

Subroute 3A – North

Subroute 3A is similar to the BLM preferred alternative.

Subroute 3B – South

Subroute 3B is similar to the BLM preferred alternative, with existing mixed/vacant/grazing land uses expected to continue. Link B150b crosses through low residential future land use for Cochise County. Entrée Gold Inc. mine lease area crossed by Link B112, south of City of Lordsburg[1].

Crossover Links for Route Group 3

Link B111 crosses a proposed solar farm (see Section 3.10.3.8), with existing mixed/vacant/grazing land uses expected to continue.

[1] This lease is pending and is not addressed in Section 4.10 of Chapter 4, Land Use and Recreation Impacts, due to its preliminary status, but is addressed as a reasonably foreseeable future activity in Section 4.17 of Chapter 4, Cumulative Effects.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

The primary existing land uses along this subroute are grazing/mixed use/vacant; these and other existing uses are expected to continue into the future. A conceptual new roadway between Safford and Pima is proposed under the ADOT Regional Framework Study 2050 Scenario A, which would be in a similar corridor to portions of Link B153b (ADOT 2011). Land along Link C620 is designated for residential and park uses (Pinal County 2009); Link 760 is near a small area of land designated for residential uses; links C850 and C880 are in a study corridor for a planned future freeway, identified in the ADOT Regional Framework Study 2050 Scenario A, that would connect US Route 60 (outside of the study area) and I-10 near Picacho State Park (ADOT 2011); and Link C880a crosses over land designated for commercial and residential uses, where it then crosses SR 87 and terminates at the planned Pinal Central Substation adjacent to planned/existing residential areas (Pinal County 2009).

Subroute 4B – Sulphur Springs Valley

The planned land use for this segment of the route is similar to the planned land use for Subroute 4A. There are no specific development plans for the portion of the subroute crossing Graham and Cochise counties.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c passes through and near multiple areas designated for residential uses. Link C670 crosses land designated for residential uses north of Oracle, Arizona; as does Link C450 approximately 2 miles southwest of San Manuel (Pinal County 2009). West of the San Pedro River, Link C441 is less than 0.5 mile east of land designated for future residential development. Between SR 79 and the town of Oracle, Arizona, Link C680 crosses land planned for residential development with an existing golf course, and passes less than 1 mile north of land designated for residential development (*ibid*). Existing homes in this area are widely dispersed.

Subroute 4C1 – East of San Pedro River

The San Pedro Valley subroutes cross areas with the most active of the future planned land uses. Link C660 is near an existing mine; surrounding land is planned for continued industrial uses as the mine expands its operating area (Pinal County 2009). Link C670 crosses land designated for residential uses north of Oracle, Arizona; land along Link C691 is designated for residential and park uses (*ibid*); and Link C691 crosses directly through the plat-approved Willow Springs Ranch residential development. The remainder of this subroute is similar in planned land use to Subroute 4A.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to the BLM preferred alternative.

Subroute 4C3 – Tucson

Subroute 4C3 is different from other subroutes in Route Group 4 that traverse developed and densely populated areas. Link F40a, approximately 9 miles north of Benson, Arizona, passes northwest of land with existing agriculture and residential uses that are expected to continue (Cochise County 2006).

Through the Santa Cruz River, this subroute is nearly identical to the Pantano Rillito local alternative. Link F510 passes through approximately 2.3 miles of land designated for parks/preservation; however, there are currently no plans or pending approvals for parks in this area (Pima County 2010b). Near the Tortolita Substation, sporadic parcels of land are designated for residential development; however, the majority of land between Tucson and the Tortolita Substation is managed by the BLM and planned for grazing/mixed use/vacant. North of the Tortolita Substation, Link C816 passes through land designated for residential development. The planned Pinal Central Substation to the Tortolita Substation 500 kV transmission line owned by TEP parallels the following links: C810a, C813, C816, C817, C820, C830, C840, C850, C880, and C880a. This project is currently in the environmental permitting process, with an approximate construction date of 2013. Links C850, C880, and C880a cross land designated for agriculture, commercial, parks and preservation, and low density residential. With the exception of the commercial designation, these land uses will continue.

Local Alternative and Crossover Links for Route Group 4

This area is largely undeveloped; existing uses of grazing/mixed use/vacant are expected to continue.

Local Alternative Link C790 crosses through an area designated for low density residential.

Local alternative links C680 and C816 cross through an area designated for low density residential, and C810a crosses a planned commercial area.

Local Alternative Link F40b passes through undeveloped and developed land designated for residential uses (Pima County 2010b), and within 0.5 mile of existing and planned residential development. Prior to crossing into the Rillito River, Link F81a passes approximately 0.1 mile to the east of a planned medium-density residential subdivision that has not reached full build-out. The remainder of Link F81a passes through the Rillito River, an existing recreation area designated for parks and preservation (City of Tucson 2011).

The local alternative links in the vicinity of Tucson include C860, C870, and C890. They cross a mix of planned land uses within the urban area of the Tucson Valley that are a continuation of existing uses, including urban residential, office, commercial, mixed, and industrial (*ibid*).

3.11 SPECIAL DESIGNATIONS

3.11.1 Introduction

This section identifies special designations within the study area for the proposed Project alternatives. Special designations are identified in BLM land use planning documents and are

either administratively or congressionally designated. Congressionally designated areas may include wilderness areas, WSAs, wild and scenic rivers, national conservation areas, and national scenic or historic trails. Administrative designations may include ACECs and SRMAs. Special designations protect values and land uses unique to an area, which typically require a more intensive management emphasis than is applied to surrounding public land. Specific management prescriptions are identified for these areas, including the avoidance or exclusion of some activities or uses (i.e., right-of-way leases or grants). Wilderness areas, WSAs, and lands with wilderness characteristics are described in Section 3.12.

3.11.2 Areas of Critical Environmental Concern

According to the FLPMA, ACEC are "…areas within the public land where special management attention is required (where such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values; fish and wildlife resources, or other natural systems or processes; or to protect life/provide safety from natural hazards."

The following ACEC are located within the 6-mile-wide study corridor for each of the alternative subroutes:

- The Ladron Mountain/Devil's Backbone Complex ACEC is located in New Mexico and is managed to maintain viable populations of Desert Bighorn Sheep through activities such as habitat improvements and coordination with the NMDGF on Desert Bighorn Sheep transplants and reintroductions. It is also managed to maintain and/or implement closure to domestic sheep and goats within 10 miles of bighorn habitat and to exclude grazing on land that has not been allotted.
- The Mockingbird Gap Proprietary ACEC is located in New Mexico and is managed to research, study, and protect cultural resource sites.
- The Uvas Valley ACEC is located in New Mexico and is managed to protect biological values.
- The Bear Springs Badlands ACEC is located in Arizona and is managed to protect paleontological and scenic resources.
- The Swamp Springs-Hot Springs Watershed ACEC is located in Arizona and is co-managed by the BLM, USFS, and AZGFD to protect riparian areas, threatened and endangered species, bighorn sheep, native fish, and cultural resources.
- The Aravaipa Watershed ACEC is located in Arizona and is managed to maintain or restore the natural ecological processes, biological communities, and cultural resources.
- The Muleshoe Ranch CMA, ACEC is located in Arizona and is co-managed by the BLM, USFS, and AZGFD to protect riparian areas, threatened and endangered species, bighorn sheep, native fish, and cultural resources.
- The South Rim ACEC is located in Arizona and is co-managed by the BLM, USFS, and AZGFD to protect riparian areas, threatened and endangered species, bighorn sheep, native fish, and cultural resources.

- The Table Mountain RNA, ACEC is located in Arizona and is managed to protect the Alligator Juniper savanna vegetation system that is of extremely restricted range.
- The Turkey Creek ACEC is located in Arizona and is managed to protect two riparian woodlands.
- The Desert Grasslands RNA ACEC is located in Arizona and is managed to protect vegetation (desert grasslands).

3.11.3 BLM National Back Country Byways

BLM national backcountry byways are designated under the BLM's Byways Program, established in 1989 as a component of the National Scenic Byways Program (BLM 2009e). In the New Mexico portion of the study corridors, the Quebradas Backcountry Byway is an unpaved county road traversing approximately 24 miles of rugged, colorful landscape east of Socorro (*ibid*). There are no backcountry byways located in the Arizona portion of the study corridors.

3.11.4 Research Natural Areas

RNAs are established and maintained for the primary purpose of research and education, because the land is: (1) a typical representation of a common plant or animal association; (2) an unusual plant or animal association; (3) a threatened or endangered plant or animal species; (4) a typical representation of common geological, soil, or water features; or (5) outstanding or unusual geological, soil, or water features (BLM 1993).

The Lordsburg Playa RNA, located in the New Mexico portion of the study corridors, is approximately 4,500 acres of land managed to protect biological and research values. It provides an important stop-off or wintering site for migrating shorebirds and waterfowl in some wet years (*ibid*).

The Desert Grasslands RNA, ACEC, located in the Arizona portion of the study corridors, is being managed to protect desert grasslands that provide critical habitat for 13 state-listed wildlife species and are important for watershed stabilization (BLM 1991).

The Table Mountain RNA, ACEC, also located in the Arizona portion of the study corridors, is approximately 1,220 acres of land managed to protect two important plant communities: the alligator juniper savanna and a white oak woodland containing Mexican blue oak (*ibid*)

3.11.5 Special Management Areas

SMAs are areas that have been identified by the BLM for the management of a specific resource(s). A total of three SMAs are located in the New Mexico portion of the study corridors: San Pedro (proprietary), located east of San Antonio; Stallion, located approximately 11 miles northeast of San Antonio; and Penjeacu, located south of Socorro. The San Pedro SMA includes 1,201 acres of public land (BLM 2010b) and is managed to protect Fugate's Blue Star, a special-status species. The Stallion SMA includes 10,883 acres of public land and is designated for the

management of watershed resources (*ibid*). The Penjeacu SMA includes 11 acres designated for the protection and management of cultural resources (*ibid*).

3.11.6 Wild Horse Management Areas

Wild horse management areas are designated in 10 western states to protect and preserve the herds of wild horses and burros roaming public lands. Herd areas include those where wild horses and burros were located when the Wild Free-Roaming Horses and Burros Act of 1971 was signed. Herd management areas (HMA) are areas where populations of wild horses and burros are being managed. The Bordo Atravesado HMA is located on approximately 19,605 acres of federal, state, and private lands roughly 15 miles northeast of Socorro, New Mexico. The HMA is being managed for approximately 50 wild horses and burros and is located in the Project study area (BLM 2010k).

3.11.7 Special Recreation Management Areas

An SRMA is "a public lands unit identified in land use plans to direct recreation funding and personnel to fulfill commitments made to provide specific, structured recreation opportunities (i.e., activity, experience, and benefit opportunities). The BLM recognizes three distinct types of SRMAs: community-based, intensive, and undeveloped big open" (BLM 2010c).

The SRMAs listed below are located in the New Mexico portion of the study corridors and are managed by the BLM Socorro Field Office.

- *The Box* – managed to enhance the area's unique recreational values, primarily rock climbing and bouldering; maintain scenic quality; and ensure protection for cultural sites, Desert Bighorn Sheep, and bats and their habitat.
- *Johnson (Gordy's) Hill* – managed for recreation uses that include OHV races and group events.
- *Quebradas Back Country Byway* – managed for a variety of recreation opportunities and experiences, including driving for pleasure, high scenic quality, geological sightseeing, interpretation and environmental education, mountain biking, and access to hiking areas such as the Presilla and Sierra de Las Canas WSAs.
- *Socorro Nature Area* – managed for recreational use and to provide environmental education and interpretation opportunities. Experiences will be primarily picnicking, hiking, sightseeing in Bosque Habitat, access to the Rio Grande, camping, and mountain biking (*ibid*).

3.11.8 National Monuments

National monuments are designated under the Antiquities Act of 1906 and are managed mainly by the NPS; however, some are managed by the BLM USFWS and other federal, state, and local agencies. The only national monument located within the SunZia study corridors is the Gran

Quivira in New Mexico[1]. Originally designated as a national monument by President William Taft, it now protects 1,100 acres of land that contains the ruins of four mission churches and pueblos that date back to early contact between the Pueblo Indians and Spanish Colonials[2]. None of the Project alternative routes crosses within the boundaries of any national monument within the study area.

3.11.9 National Trails

National trails are designated under the National Trails System Act of 1968. According to the NPS, this system comprises:

- National recreation trails that provide a variety of outdoor recreation uses in or accessible to urban areas
- National scenic trails that are designated to (1) allow outdoor recreation opportunities; (2) protect nationally significant scenic, historic, natural, or cultural qualities of areas; and (3) represent desert, marsh, grassland, mountain, canyon, river, forest, and other areas, as well as landforms that are characteristic of a region
- National historic trails that follow as closely as possible and practicable to the original trails or routes of national historic significance

There are also connecting and side trails designated to provide additional points of public access to, or connections between, national recreation, scenic, or historic trails (NPS 2010c).

The following trails would cross or be located parallel to alternative subroutes within study corridors:

- Juan Bautista de Anza NHT – a trail comprising the overland route traveled by Captain Juan Bautista de Anza of Spain during the years 1775 and 1776, from Sonora, Mexico, to the vicinity of San Francisco, California (BLM 2011b)
- El Camino Real de Tierra Adentro NHT – designated in 2000 for its cultural significance, the trail is the primary route between the colonial Spanish capital of Mexico City and the Spanish provincial capitals (present-day Mexico and New Mexico), between the sixteenth and nineteenth centuries (*ibid*)
- Arizona National Scenic Trail – a non-motorized trail extending 820 miles across the state of Arizona from the United States–Mexico international border to the Arizona–Utah border. The trail is intended to be a primitive, long distance trail that highlights the state's topographical, biological, historical, and cultural diversity (BLM 2011b)
- Continental Divide National Scenic Trail – part of the National Scenic Trail System, a 50-mile-wide corridor on either side of the actual continental divide, established by Congress to protect significant scenic values (BLM 2011b)

The inventory and assessment of National Historic and Scenic Trails is included in Appendix L.

[1]http://www.cr.nps.gov/history/hisnps/npshistory/monuments.htm
[2]http://www.nps.gov/sapu/index.htm

3.11.10 National Wildlife Refuges

The USFWS is the principal agency for the conservation, protection, and enhancement of fish and wildlife and their habitats. Within the USFWS, the NWR System administers a network of lands and waters for the conservation, management, and (where appropriate) restoration of fish, wildlife, and plant resources and their habitats within the United States, for the benefit of present and future generations of America. The NWR System provides compatible wildlife-dependent recreational uses; including hunting, fishing, wildlife observation, photography, interpretation, and education (USFWS 2010b).

Two NWRs are located in the New Mexico portion of the study corridors; the Sevilleta and Bosque del Apache. The approximately 230,000-acre Sevilleta NWR is managed to maintain natural processes of flood, fire, and succession that sustain its diverse ecosystem. It is home to more than 1,200 species of plants, 89 species of mammals, 225 species of birds, 58 species of reptiles, and 15 species of amphibians (USFWS 2011d). The Bosque del Apache NWR is approximately 57,000 acres and includes three wilderness areas and five RNAs. It provides habitat for tens of thousands of birds, including Sandhill Cranes, geese, and ducks that migrate there in the autumn to make the NWR their winter home (USFWS 2011e).

3.11.11 Summary of Inventory Results

The following summary describes the special designations that are located within the study corridors for alternative subroutes.

3.11.11.1 Areas of Critical Environmental Concern Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Link E200 is directly south of the Ladron Mountain/Devil's Backbone Complex ACEC, which comprises several noncontiguous parcels of land.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the same as Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

There are no ACECs within or near the links in Subroute 1B.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 include links A430 and A481, which are approximately 2.75 miles east and southeast of the Uvas Valley ACEC, northeast of Deming, New Mexico. Local Alternative Link A161b borders the eastern edge of the Ladron Mountain/Devil's Backbone Complex ACEC, near the Willow Springs Ranch Subdivision.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no ACECs within or near the subroutes or the crossover and local alternative links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Link B153b is less than 1 mile south of the Bear Springs Badlands ACEC, west of the city of Safford, Arizona. Link C170 is approximately 3 miles south of the Turkey Creek ACEC, and less than 2 miles south of the Table Mountain RNA, ACEC, near Aravaipa Canyon.

Subroute 4B – Sulphur Springs Valley

This subroute is similar to Subroute 4A, but does not include the Bear Springs Badlands ACEC near Safford, Arizona.

Subroute 4C2c – BLM Preferred Alternative

There are no ACECs within or near Subroute 4C2c.

Subroute 4C – San Pedro Valley and Tucson

Link C331 crosses the southwest corner of the Muleshoe Ranch CMA, ACEC, and the Swamp Springs-Hot Springs Watershed ACEC, near the Muleshoe Ranch area north of Benson, Arizona.

Local Alternative and Crossover Links for Route Group 4

Crossover links for 4A, 4B, and 4C1 include Link C500, which is approximately 2.25 miles from the Desert Grasslands RNA, ACEC, near Mammoth, Arizona.

3.11.11.2 National Back Country Byways Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 is less than 0.5 mile (Link E180) from the Quebradas Back Country Byway.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the same as Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

Links A90 and A111 are approximately 2 miles from the southern portion of the Quebradas Back Country Byway.

Local Alternative and Crossover Links for Route Group 1

There are no Back Country Byways in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no Back Country Byways in or near the subroutes or the crossover and local alternative links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no Back Country Byways in or near the subroutes or the crossover and local alternative links in Route Group 4.

3.11.11.3 Research Natural Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

There are no RNAs located near Subroute 1A1.

Subroute 1A2 – BLM Preferred Alternative

There are no RNAs located near Subroute 1A2.

Subroute 1A – North River Crossing

There are no RNAs located near Subroute 1A.

Subroute 1B – San Antonio Crossing

There are five RNAs in Subroute 1B, all within the Bosque del Apache NWR: Apache Camp, Chupadera, Jornada del Muerto, Rio Grande Marsh, and San Pasqual. The RNAs are within 3 miles of links A160 and A111.

Local Alternative and Crossover Links for Route Group 1

There are no RNAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

The Lordsburg Playa RNA, approximately 1.0 mile from Link B150a, parallels Link B150a for approximately 2.0 miles.

Subroute 3A – North

There are no RNAs in or near Subroute 3A.

Subroute 3B – South

Subroute 3B includes the parallel Lordsburg Playa RNA.

Local Alternative and Crossover Links for Route Group 3

There are no RNAs in or near the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Link C170 is located to the south, within 2 miles of Table Mountain RNA, ACEC, and approximately 3 miles from Turkey Creek ACEC.

Subroute 4B – Sulphur Springs Valley

Subroute 4B would affect the same special designations as Subroute 4A.

Subroute 4C – San Pedro Valley and Tucson

There are no RNAs in or near any of the 4C subroute groups, including the BLM preferred alternative.

Local Alternative and Crossover Links for Route Group 4

Crossover links for 4A, 4B, and 4C1 include Link C500, which is located to the southwest, within 3 miles of the Desert Grasslands RNA, ACEC.

3.11.11.4 Special Management Areas

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

There are no SMAs located near Subroute 1A1.

Subroute 1A2 – BLM Preferred Alternative

There are no SMAs located near Subroute 1A2.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

Link A111 borders the northern edge of the San Pedro SMA, and Link A90 is within 1 mile of the Stallion SMA.

Local Alternative and Crossover Links for Route Group 1

There are no SMAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no SMAs located near Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no SMAs located near Route Group 4.

3.11.11.5 Wild Horse Management Areas

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The Bordo Atravesado HMA is located within approximately 3.0 miles of Link E101b.

Subroute 1A2 – BLM Preferred Alternative

The Bordo Atravesado HMA is located within approximately 3.0 miles of Link E101b.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

There are no herd areas or HMAs located near Subroute 1B.

Local Alternative and Crossover Links for Route Group 1

There are no herd areas or HMAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no herd areas or HMAs located near Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no herd areas or HMAs located near Route Group 4.

3.11.11.6 Special Recreation Management Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The Johnson (Gordy's) Hill SRMA is crossed by links E180 and E133, and the Quebradas Back Country Byway SRMA is located approximately 1.0 mile from links E180 and E133. The Socorro Nature Area is located approximately 2.0 miles north of Link E180; and The Box SRMA, located approximately 2.0 miles west of Link E211, parallels Link E211 for approximately 2.0 miles.

Subroute 1A2 – BLM Preferred Alternative

This subroute uses the same alignment as Subroute 1A1 in the affected parts of these SRMAs.

Subroute 1A – North River Crossing

This subroute uses the same alignment as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative, in the affected parts of these SRMAs.

Subroute 1B – San Antonio Crossing

The Quebradas Back Country Byway SRMA is located approximately 1.0 mile from Link A90 and approximately 2 miles south of Link A111 for subroutes 1B1 and 1B2. Link A111 is approximately 2 miles north of Subroute 1B3.

Local Alternative and Crossover Links for Route Group 1

There are no SRMAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no SRMAs in or near the subroutes or the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no SRMAs in or near the subroutes or the local alternative and crossover links for Route Group 4.

3.11.11.7 National Monuments

Route Group 1: SunZia East Substation to Midpoint Substation

There are no national monuments near Route Group 1 subroutes.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A and 1B1 (Gran Quivira area) include links E81 and E83, which are located within 2 miles of the Salinas Pueblo Missions National Monument.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no national monuments near the subroutes or the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no national monuments near the subroutes or the local alternative and crossover links for Route Group 4.

3.11.11.8 National and Historic Trails Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The historic El Camino Real de Tierra Adentro National Trail is directly crossed by Link E180 of Subroute 1A1. Link A440 crosses the Butterfield historic trails.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the same as Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A2, the BLM preferred alternative, and Subroute 1A1.

Subroute 1B – San Antonio Crossing

The historic El Camino Real de Tierra Adentro National Trail is directly crossed by Link A140 of this subroute. Link A400 is adjacent to General Cooke's Wagon Road Trail, and Link A440 crosses the historic Butterfield Trail.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A, 1B1, 1B2, and 1B3 include Link A431, which crosses the historic Butterfield Trail.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 crosses two national trails. Link B120b crosses the CDNST and the historic Butterfield Trail, and Link B140 crosses the historic Butterfield Trail.

Subroute 3A – North

Subroute 3A crosses two national trails. Link B120b crosses the CDNST and the historic Butterfield Trail.

Subroute 3B – South

Subroute 3B crosses two national trails. Link B112 crosses the CDNST, and Link B150a crosses the historic Butterfield Trail.

Local Alternative and Crossover Links for Route Group 3

Links B111 and B140 cross the historic Butterfield Trail.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A crosses the Arizona National Scenic Trail at Link C620. Link C880a crosses the historic Butterfield Trail at the planned Pinal Central Substation.

Subroute 4B – Sulphur Springs Valley

Subroute 4B is the same as Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c is similar to Subroute 4A, except that 4C2c crosses the Arizona National Scenic Trail at Link C670. This trail is within 3.0 miles of links C661 and C450. Link C880a crosses the historic Butterfield Trail and is adjacent to the Juan Bautista de Anza NHT.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is the same as Subroute 4C2c, except that the Arizona National Scenic Trail is also within 3.0 miles of Link C661.

Subroute 4C2 – West of San Pedro River

Link C450 is located within 3.0 miles of the Arizona National Scenic Trail.

Subroute 4C3 – Tucson

This subroute crosses the Arizona National Scenic Trail at Link F600. The historic Butterfield Trail is paralleled for approximately 13.0 miles with Link F540, 4.0 miles with Link F510, and 3.0 miles with Link F112; crossed by links F600, F112, F510, and C880a; and is within 3.0 miles of Link C810a. The subroute also parallels the Juan Bautista de Anza NHT for approximately 13.0 miles with links F112 and F510, and crosses the trail at links F510 and F112.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C890 is located within 3.0 miles of the historic Butterfield Trail, and local alternative links F40b, F81a, and F81b are parallel to the Trail for approximately 4 to 7 miles, eventually crossing it. Link F51 crosses the Arizona National Scenic Trail.

3.11.11.9 National Wildlife Refuge Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The Sevilleta NWR is within 3.0 miles of links E101b and E133.

Subroute 1A2 – BLM Preferred Alternative

Similar to Subroute 1A1, the Sevilleta NWR is within 3.0 miles of links E86b, E101b, and E133.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1.

Subroute 1B – San Antonio Crossing

The Bosque del Apache NWR is within 3.0 miles of links A160 and A111.

Local Alternative and Crossover Links for Route Group 1

There are no NWRs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no NWRs located in or near the subroutes or local alternative and crossover links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no NWRs located in or near the subroutes or local alternative and crossover links in Route Group 4.

3.12 WILDERNESS, WILDERNESS STUDY AREAS, AND LANDS WITH WILDERNESS CHARACTERISTICS

3.12.1 Introduction

This section identifies wilderness areas and WSAs within the Project study area and identifies lands with wilderness characteristics that are crossed by the proposed Project alternatives. Wilderness areas and WSAs are specially designated. Special designations protect values and land uses unique to an area that typically require a more intensive management emphasis than is applied to surrounding public land. Lands with wilderness characteristics are not administratively or congressionally designated, but are BLM lands that have been identified to contain wilderness characteristics. The BLM conducts and maintains inventories regarding the presence or absence

of wilderness characteristics. According to Section 201 of the FLPMA, the preparation and maintenance of the inventories does not change or prevent change of the management or use of the lands. BLM lands identified as having wilderness characteristics are considered when analyzing projects under the NEPA.

3.12.2 Wilderness Areas

Designated by Congress to be included in the National Wilderness Preservation System, wilderness areas are managed either independently or cooperatively by the BLM, NPS, USFWS, and USFS. Wilderness areas protect the habitat, serve as a sanctuary from modern day conflicts for diverse species of plants and animals, and provide a source of clean water for numerous plant and wildlife species. They are also used for science and education by providing sites for field trips and study areas for student research. Wilderness areas may also provide recreational opportunities such as hiking and camping in a primitive setting (BLM 2011c). Section 2(a) of the 1964 Wilderness Act states that wilderness areas "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character."

Wilderness areas located within the study corridors include the Bosque del Apache and White Mountains in New Mexico; and the Peloncillo Mountains, Santa Teresa Mountains, Aravaipa Canyon, Galiuro Mountains, Redfield Canyon, Rincon Mountains, Saguaro, and Pusch Ridge wilderness areas in Arizona.

3.12.3 Wilderness Study Areas

BLM WSAs are identified through the FLPMA, which directed the BLM to inventory and study its roadless areas for wilderness characteristics. Until Congress makes a final determination on a WSA, they are managed so as not to impair the suitability of such areas for preservation as wilderness. A WSA must have the following:

- Size – roadless areas of at least 5,000 contiguous acres of public land or of manageable size
- Naturalness – generally appear to have been affected primarily by the forces of nature (unaffected by man-made influences)
- Solitude – provide outstanding opportunities for solitude or primitive and unconfined types of recreation

In addition, WSAs often have special qualities such as ecological, geological, educational, historical, scientific, and scenic values (BLM 1978g).

WSAs within the New Mexico portion of the study corridors include Stallion, Veranito, Presilla, Devil's Backbone, Cooke's Range, Sierra de las Canas, Antelope, Jornada del Muerto, and Sierra de las Uvas. There are no WSAs in the Arizona portion of the study corridors.

3.12.4 Lands with Wilderness Characteristics

Section 201 of the FLPMA requires the BLM to maintain on a continuing basis an inventory of all public lands and their resources and other values, including information regarding wilderness characteristics.

BLM Manual 6310 "Conducting Wilderness Characteristics Inventory of BLM Lands" and Manual 6320 "Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process" direct BLM offices to continue to conduct and maintain inventories regarding the presence or absence of wilderness characteristics, and to consider identified lands with wilderness characteristics in land use plans and when analyzing projects under NEPA. BLM Manual 6310 provides the BLM with guidance and general procedures for doing so under Section 201 of the FLPMA. The BLM has determined that updated inventories were necessary for the evaluation of the Project in conjunction with NEPA analysis.

For the purpose of this study, the inventories for each BLM district and field office were conducted in accordance with the BLM manuals. In order to be classified as lands with wilderness characteristics, the inventory unit must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation, and may possess supplemental values. Specifically, the inventory evaluates wilderness characteristics as defined in Section 2(c) of the Wilderness Act of 1964 (see Section 3.12.3).

In September 2011, BLM field and district offices completed a wilderness characteristics inventory update for the portions of the proposed Project where route segments crossed BLM lands. Citizens' Wilderness Inventory Units have been reviewed as part of the inventory of Lands with Wilderness Characteristics on BLM land. The status of inventories of lands with wilderness characteristics for each of the BLM districts or field offices crossed by the proposed Project is summarized below.

Safford Field Office: The current inventory represents an update of previous wilderness characteristics inventories conducted in 1979 and 1980. Link C361 of Subroute 4C1 crosses Inventory Unit 4-90 (Muleshoe), which was found to have characteristics meeting each of the three criteria noted in Section 3.12.3. No other inventory units that would be crossed by the proposed Project were found to have wilderness characteristics, due to fragmentation by roads and land ownership and/or not meeting the size or naturalness criteria.

Tucson Field Office: The Bogard Wash and Suizo Wash inventory units, crossed by Link C820, were found to have wilderness characteristics in the initial inventory conducted in 1979. However, based upon the updated inventory, these units were found to no longer contain wilderness characteristics due to not meeting the naturalness and/or size criteria. No other inventory units that would be crossed by the proposed Project were found to have wilderness characteristics, due to fragmentation by roads and land ownership and/or not meeting the size criteria.

Socorro Field Office: According to inventory conducted in September 2011, there is a pending land with wilderness characteristics unit adjacent to the Stallion WSA..

Las Cruces District Office: According to the district offices current inventory, the Nutt Grassland inventory unit, crossed by Link A361, was found to have wilderness characteristics. No other inventory units that would be crossed by the proposed Project were found to have wilderness characteristics.

3.12.4.1 Wilderness Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 –North River Crossing

Link 161 is approximately 3.5 miles west of the Indian Well and Chupadera portions of the Bosque del Apache Wilderness Area.

Subroute 1A2 – BLM Preferred Alternative

The BLM preferred alternative is similar to Subroute 1A1.

Subroute 1A – North River Crossing

This subroute is similar to the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

Links A111 and A160 are approximately 2 to 3 miles north of the Little San Pascual and Indian Well portions of the Bosque del Apache Wilderness Area.

Local Alternative and Crossover Links for Route Group 1

There are no wilderness areas in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Link B160a is just over 3 miles north of the Peloncillo Mountains Wilderness Area, just west of the New Mexico-Arizona border.

Subroute 3A – North

Link B160a is just over 3 miles north of the Peloncillo Mountains Wilderness Area, just west of the New Mexico-Arizona border.

Subroute 3B – South

Link B150a is approximately 0.5 mile south of the Peloncillo Mountains Wilderness Area, just west of the New Mexico-Arizona border.

Local Alternative and Crossover Links for Route Group 3

There are no wilderness areas in or near the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Links B153b and C170 are approximately 3 miles south of the Santa Teresa Wilderness Area, 4.75 miles south of the North Santa Teresa Wilderness Area, and 3.75 miles south of the Aravaipa Canyon Wilderness Area.

Subroute 4B – Sulphur Springs Valley

This subroute is similar to Subroute 4A, in terms of Link C170.

Subroute 4C2c – BLM Preferred Alternative

Links C441 and C201 are approximately 2 to 3 miles east of the Rincon Mountain Wilderness Area in the CNF.

Subroute 4C – San Pedro Valley and Tucson

Link C470 is approximately 3 miles west of and parallel to the Galiuro Wilderness Area; and is approximately 1.5 miles west of the Redfield Canyon Wilderness Area, which is north of the Muleshoe Ranch. Link C441 is approximately 2 miles east of the Rincon Mountain Wilderness Area, in the CNF; while Link F40a borders the southern boundary of the Rincon Mountain Wilderness Area. Link F510 is approximately 3 miles west of the West Saguaro Wilderness Area, near the northwest portion of Tucson.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C201 is approximately 3 miles east of the Rincon Mountain Wilderness Area in the CNF.

Local alternative links for 4C3 include Link F40b, which follows the southern boundary of the Rincon Mountain Wilderness Area. Link F81a is approximately 1.25 miles west of the East Saguaro Wilderness Area, near the east side of Tucson. Link F81b is approximately 4.75 miles south of the Pusch Ridge Wilderness Area, near the north side of Tucson in the CNF.

3.12.4.2 Wilderness Study Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Link E101b is less than 0.5 mile north of the Stallion WSA; Link E133 borders the southern edge of the Veranito WSA; Link E180 is approximately 3 miles north of the Presilla WSA, northeast of the town of Socorro; and Link A440 is approximately 5.25 miles southeast of the Cooke's Range WSA, north of the Midpoint Substation site.

Subroute 1A2 – BLM Preferred Alternative

This subroute is similar to Subroute 1A1.

Subroute 1A – North River Crossing

This subroute is similar the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

This subroute is similar to Subroute 1A1, except that links E90 and A90 are approximately 1 mile east and 1.75 miles south of the Stallion WSA, respectively; links A90 and A111 are approximately 3.25 miles east of the Sierra de las Canas WSA; and Link A111 is approximately 2.5 miles north of the Antelope WSA, which is near the northeast corner of the WSMR.

Local Alternative and Crossover Links for Route Group 1

Local Alternative Link A161b is approximately 2 miles east of the Devil's Backbone WSA and approximately 5 miles east of the Devil's Reach WSA, southwest of San Antonio. Link A430 is approximately 5.25 miles west of the Sierra de Las Uvas WSA, near Hatch.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 – Links B60 and B90 are approximately 4.5 miles south of the Cooke's Range WSA. Link B160a is approximately 3 miles north of the Peloncillo Mountains WSA, which borders the east side of the New Mexico-Arizona border.

Subroute 3A – North

Links B60 and B90 are approximately 4.5 miles south of the Cooke's Range WSA.

Subroute 3B – South

Link B150a is approximately 2.5 miles south of the Peloncillo Mountains WSA, which borders the east side of the New Mexico-Arizona border.

Local Alternative and Crossover Links for Route Group 3

There are no WSAs within the study corridors for the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no WSAs within the study corridors for the subroutes, or for the local alternatives and crossover links in Route Group 4.

3.12.4.3 Lands with Wilderness Characteristics Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Route Group 1 crosses a pending land with wilderness characteristics unit adjacent to Stallion WSA.. The centerline of Link A400 is approximately 350 feet west of the Nutt Grassland inventory unit.

The centerline of links A160 and A140 are located approximately 2 miles northwest and 3 miles north, respectively, from the Chupadera #2 inventory unit.

Local Alternative and Crossover Links for Route Group 1

Link A361 crosses approximately 0.15 mile of the northeast corner of the Nutt Grassland inventory unit.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no lands with wilderness characteristics crossed by the subroutes, or by the local alternative and crossover links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

There are no lands with wilderness characteristics crossed by Subroute 4A.

Subroute 4B – Sulphur Springs Valley

There are no lands with wilderness characteristics crossed by Subroute 4B.

Subroute 4C2c – BLM Preferred Alternative

There are no lands with wilderness characteristics crossed by the BLM preferred alternative.

Subroute 4C1 – East of San Pedro River

Links C331 and C361 cross approximately 1.3 miles of the southwestern portion of Inventory Unit 4-90 (Muleshoe).

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is the same as the BLM preferred alternative.

Subroute 4C3 – Tucson

Subroute 4C3 is the same as the BLM preferred alternative.

Local Alternatives for Route Group 4

There are no lands with wilderness characteristics crossed by the local alternatives.

3.13 SOCIAL AND ECONOMIC CONDITIONS

3.13.1 Introduction

This section describes the existing social and economic conditions within the study area of the proposed Project, as well as the broader host region that includes portions of counties throughout the states of New Mexico and Arizona.

The baseline conditions and existing environment focus on demographics and social trends that comprise the study area (see Figure 1-1).

The FLPMA requires the BLM to integrate physical, biological, economic, and other sciences in land use planning, and to analyze social, economic, and institutional information. The NEPA requires federal agencies to integrate "the natural and social sciences in planning and decision making" (42 USC 4332[2][A]).

The study area was developed with an overall consideration of areas within New Mexico and Arizona that would most likely be directly impacted by Project construction. Social and economic conditions vary across the study area, and are assessed with county-level data where data sources are consistent across the Project study area. Data for cities and towns were used to bring clarification to local socioeconomic conditions. The following subsections address population demographics, housing, and employment and the economy within the route groups. Table 3-50 represents the route group distribution by county.

Where possible, New Mexico and Arizona are discussed separately, in order to compare data most effectively and maintain consistent methodology. Adopted planning documents and sources

such as the U.S. Census Bureau (2000, 2010), U.S. Census Bureau American Community Survey[1] (2005-2009), Arizona Department of Commerce, New Mexico State University (NMSU), and U.S. Bureau of Labor Statistics provided data and background information. Though no alternative corridors are located within Doña Ana County, it is included in the socioeconomic analysis because the Project could influence socioeconomic aspects of the County in various ways (e.g., job creation, need for housing, and material supplies); in addition, Doña Ana County is expected to house the operations activities for the Project.

Table 3-50. Route Groups Breakdown by County

Location	Route Group 1	Route Group 3	Route Group 4
New Mexico			
Luna County	●	●	
Sierra County	●		
Socorro County	●		
Lincoln County	●		
Doña Ana County	●	●	
Grant County		●	
Hidalgo County		●	
Torrance County	●		
Arizona			
Cochise County		●	●
Graham County		●	●
Greenlee County		●	
Pima County			●
Pinal County			●

3.13.2 Regional Overview

The following sections describe the counties within New Mexico and Arizona that would be affected by the Project. When combined, these sections present a regional overview of the geographic characteristics and historic settings in the study area.

3.13.2.1 New Mexico

The Project study corridors cross seven New Mexico counties, beginning in the central portion of the state at the proposed SunZia East Substation in Lincoln County, continuing west and south (crossing through Torrance, Socorro, and Sierra counties toward Doña Ana) and due west (crossing through Luna, Grant, and Hidalgo counties), where it crosses into southeastern Arizona. According to the 2005-2009 American Community Survey, the population density in New Mexico was 16.2 persons per square mile (Table 3-51). Overall, New Mexico population

[1]The U.S. Census American Community Survey estimates are based on data collected over a 5-year time period. The estimates represent the average characteristics of population and housing between January 2005 and December 2009 and January 2006 and December 2010 and do not represent a single point in time.

densities are much lower than the United States average of 85.2 persons per square mile; however, New Mexico population density is representative of lower density development across many states in the Southwest (U.S. Census 2000a).

Table 3-51. Geographic Characteristics of Study Corridors: New Mexico

Location	Land Area (millions of acres)	Land Area (square miles)	Persons per square mile (2009)
United States	**2,264**	**3,537,438**	**85.2**
State			
New Mexico	77.67	121,356	16.2
Counties			
Doña Ana County	2.44	3,807	52.0
Grant County	2.54	3,966	7.5
Hidalgo County	2.21	3,447	1.5
Lincoln County	3.09	4,831	4.3
Luna County	1.90	2,965	9.0
Sierra County	2.68	4,180	3.0
Socorro County	4.25	6,646	2.7
Torrance County	2.14	3,345	5.0

Source: New Mexico State University 2008; 2009 American Community Survey

New Mexico County Summaries

Doña Ana County was created in 1852, 6 years after New Mexico became part of the United States (Doña Ana County Historical Society 2001). Historically, communities within the County were agriculturally based. Over time, industries such as health care and social assistance; professional, scientific, and technical services; and growth-related industries (including construction and retail trade) have emerged. Doña Ana has been characterized as one of the fastest-growing counties in the United States over the past decade. Las Cruces, the county seat, is the largest community in Doña Ana. Other communities include Sunland Park, Anthony, and Mesilla; unincorporated communities include Hatch, Chaparral, and Mesquite.

Grant County was established by an act of Territorial Legislature in 1868; created from a portion of land that was formerly part of Doña Ana County (Bennet 2011). Historically, Grant County's economy was based on mining, ranching, and agricultural activities. Silver City, the county seat, is the largest municipality and is home to a majority of the County's residents. Economic activities include retail trade, government, health care and social assistance, accommodations, and food services. Other municipalities located in Grant County include Bayard and Hurley, with Santa Clara, Cliff, and Gila representing some of its unincorporated communities.

Hidalgo County was formed from Grant County in 1919 (Hidalgo County 2010); Lordsburg is the county seat. Following the Gadsden Purchase of 1853, the Butterfield Stagecoach Company route passed through what is now Hidalgo County. Historically, the County's economy revolved around mining, ranching, and farming. Recent major economic activities have grown to include tourism and construction, associated with the development of retirement communities. Lincoln County is home to the town of Carrizozo and numerous unincorporated towns (Town of Carrizozo 2008). The county seat was previously located in the town of Lincoln, but was moved

to Carrizozo in 1909. Much of Lincoln County's early economy was based on the presence of the El Paso and Northeast Railroad; today, the Lincoln County government is among its employers. Unincorporated communities include Ruidoso, Ruidoso Downs, Lincoln, and White Oaks.

Luna County was created by an act of the New Mexico Legislature adopted on March 16, 1901 (Luna County 2011); Deming is the county seat. Luna County was created from the eastern portion of Grant County and the western portion of Doña Ana County. Known as a railroad transportation hub, it was the site of the historic completion of the second transcontinental railroad. Farming, ranching, and copper mining and refining were common forms of economic activity across the County during the twentieth century. Unincorporated communities located in Luna County include Columbus and Gage.

Sierra County was formed in 1884 from portions of Socorro, Grant, and Doña Ana counties. Sierra County has two incorporated communities; county seat Truth or Consequences and Elephant Butte. Historically the County's economy was based on agriculture, mining, and tourism to the hot springs. Since the 1960s, the economy has become dependent on retirement communities and recreation around Elephant Butte and Caballo Lakes. Unincorporated communities include Williamsburg, Arrey, Hermosa, and Hillsboro.

Socorro County was created by Territorial Legislation in 1852; at one point, it had the greatest land area of any county in New Mexico (Socorro County Chamber of Commerce 2011). With respect to population, its largest city is the county seat Socorro. The first Spanish settlement took place in Socorro in the late 1500s, because explorers found that the area offered fertile soil to grow corn. In later years, the County was further established for military and mining purposes. Unincorporated communities in Socorro County include Alamo, Bingham, Lemitar, Luis Lopez, and San Antonio.

Torrance County was created from the eastern part of Valencia County in 1903; Estancia is the county seat. Named after Francis J. Torrance, one of the promoters of the building of the New Mexico Central Railroad, the County is recognized for its high level of agricultural productivity (Torrance County 2010). Crops such as pinto beans, corn, alfalfa, and pumpkins are harvested year round. Torrance County is home to the Manzo Mountains, Salinas Pueblo National Monument, and a vast and undisturbed rangeland. Mountainair is the nearest incorporated town in proximity to the alternative routes in Torrance County.

3.13.2.2 Arizona

The Project study corridors cross five Arizona counties, beginning in the southeastern portion of the state (crossing Cochise, Greenlee, and Graham counties) and heading west (through Pima and Pinal counties) until it reaches the planned Pinal Central Substation in Pinal County. According to the 2009 U.S. Census, population densities within the study area were highest in Pima County, with nearly 108 persons per square mile; much higher than the state's estimate of 55.7 persons per square mile (Table 3-52). Overall, Arizona densities are much lower than the United States average of 85.2 persons per square mile. While population density in Arizona is low relative to the country's average, it is representative of lower density development across many states in the Southwest. Additional population data for Arizona counties are discussed in this section.

Table 3-52. Geographic Characteristics of Study Corridors: Arizona			
Location	**Land Area (millions of acres)**	**Land Area (square miles)**	**Persons per square mile (2009)**
United States	**2,264**	**3,537,438**	**85.2**
State			
Arizona	72.73	113,635	55.7
Counties			
Cochise County	3.98	6,219	20.5
Graham County	2.96	4,630	7.5
Greenlee County	1.18	1,837	4.2
Pima County	5.88	9,184	107.8
Pinal County	3.44	5,374	55.1
Sources: Arizona Department of Commerce 2009; 2009 U.S. Census			

Arizona County Summaries

Cochise County was established in 1881, by the 11th Territorial Legislature, prior to Arizona becoming a state. Historically, the County's economic activity included mining operations in the towns of Tombstone and Bisbee, the county seat. Government, trade, transportation, utilities, professional and business services, mining, and educational and health services make up a majority of the County's economy; agriculture is both a historic and current contributor to its economy. The largest employers in Cochise are Fort Huachuca, Sierra Vista School District, and the Cochise County government (Arizona Department of Commerce 2009). Communities include Benson, Sierra Vista, Willcox, Douglas, and Huachuca City.

Graham County was also established in 1881, by the 11th Territorial Legislature, prior to Arizona becoming a state; Safford is the county seat. Graham County was split from portions of Apache and Pima counties, and was named after Mount Graham, the highest peak in the area (10,516 feet). Early visitors to the area were primarily explorers; however, farming communities began to develop along the Gila River in the 1870s. Primary employment industries include private services, trade, transportation, public utilities, and government. The largest employers in Graham County are the Arizona State Prison in Safford, Eurofresh Bonita (a hydroponic tomato nursery), the City of Safford, Freeport McMoRan (a mining company formerly owned by Phelps Dodge Corporation), and Eastern Arizona College in Thatcher (*ibid*). Thatcher, Safford, and Pima are major communities in the County.

Greenlee County was created in 1909, by an act of the 25th Territorial Assembly. Formed from a portion of Graham County, Greenlee is largely government-owned. The discovery of copper ore in Clifton, the county seat, contributed to growth in the area. Today, Freeport McMoRan is a major employer in the County. Clifton Elementary and Clifton High School, Duncan Public Schools, Fairbanks School, and the Greenlee County government are the County's primary employers. Other notable industries include government, private services, trade, transportation, and utilities (*ibid*).

Pima County was created in 1864, and is the second largest of Arizona's four original counties. Spanish settlement in Pima County dates back to 1690, when the Spaniards encountered tribes living in the area. Early Euro-American settlers discovered gold and silver in the mid-eighteenth

century, opening the door to mining and ranching across the County. Major communities in Pima County include county seat Tucson, Marana, Oro Valley, and Sahuarita. Primary industries include government, education and health services, trade, transportation, utilities, and professional and business services. The UA, Amphitheater Unified School District, Pima Community College, Raytheon Missile Systems, and Davis-Monthan AFB are among Pima County's major employers (*ibid*).

Pinal County was formed in 1875 from portions of Maricopa and Pima counties; Florence is the county seat. Larger than the state of Connecticut, Pinal County is characterized by two distinct regions; a mountainous eastern region and low desert valleys in the west. Its mountainous regions resulted in development of Mammoth, Oracle, San Manuel, and Kearny, where copper mining, smelting, milling, and refining industries are still active. Desert and lower elevation landscapes shaped the agricultural communities of Arizona City, Apache Junction, Maricopa, Picacho, Eloy, Red Rock, and Stanfield. In recent years, Apache Junction, Arizona City, Coolidge, Eloy, and Casa Grande have diversified their local economies from mining activities to include manufacturing, trade, and services. Government, trade, transportation and utilities, leisure and hospitality, and education and health services make up Pinal County's major industries. Some of the County's major employers include the Arizona State Prison in Florence, Evergreen Air Center in Marana, Frito-Lay in Casa Grande, and numerous school districts and government operations in Florence, Eloy, Casa Grande, and Apache Junction (*ibid*).

3.13.3 Jurisdiction and Ownership

The following section identifies land ownership across all counties crossed by the Project. Ownership percentages are not limited to the study area. The proposed Project would cross BLM, BOR, state, and private lands.

3.13.3.1 New Mexico

Table 3-53 represents land ownership across the eight counties previously described.

Table 3-53. Land Ownership in New Mexico Counties within the Study Area (Percent of Total County Acreage[1])

Location	BLM	BOR	USDA	USFS	DOD	USFWS	Indian Res.	NPS	State	Private	Local or State Parks
Doña Ana County	45.7	—[3]	4.5	—	20.2	2.3	—	2.2	9.2	15.9	—[3]
Grant County	13.4	—	—	34.2	0.1	—	—	—	13.9	38.4	—
Hidalgo County	38.7	—	—	3.5	0.0	—	—	—	17.1	40.8	—
Lincoln County	16.8	—	—	12.8	5.9	—	—	—	9.7	54.9	—
Luna County	40.0	—	—	0.0	0.1	—	—[3]	—	28.8	31.1	—[3]
Sierra County	28.3	—[3]	—	14.0	19.1	—	—	—	11.0	25.3	2.3
Socorro County[2]	21.6	0.0	0.0	14.4	10.4	6.7	3.6	—[3]	12.5	30.5	0.4
Torrance County	0.8	—	—	7.2	—	—	0.8	—[3]	14.7	76.5	—

[1] Percentages are rounded and therefore may not total 100 percent.
[2] Socorro County is the only county with New Mexico Game and Fish land, consisting of 95 acres.
[3] Land is present, but is less than 0.01 percent.
Source: BLM 2009f

3.13.3.2 Arizona

Table 3-54 represents land ownership across the five counties previously described.

Table 3-54. Land Ownership in Arizona Counties within the Study Area (Percent of Total County Acreage[1])

Location	BLM	BOR	USFS	DOD	USFWS	Indian Reservation	NPS	County	State	Private	Local or State Parks	AZGFD
Cochise County	10.0	—	12.3	2.71	0.1	—	0.4	—	34.5	39.9	—[2]	0.1
Graham County	24.2	—	12.8	—[2]	—	36.3	—	—	16.7	10.0	—[2]	—[2]
Greenlee County	13.3	—	63.7	—	—	—	—	—	14.7	8.4	—	—
Pima County	6.4	0.1	5.7	1.2	8.7	42.1	7.0	—[2]	14.7	13.7	0.3	—[2]
Pinal County	11.2	1.1	6.4	0.2	—	20.3	0.1	—[2]	35.0	25.6	0.1	—[2]

[1] Percentages are rounded and therefore may not total 100 percent.
[2] Land is present, but is less than 0.01 percent.
Source: ALRIS 2009
Note: Land ownership designated as 'Other' is not represented in this table, Cochise and Pima counties have 61 and 192 acres of land that falls into this category, respectively.

3.13.4 Population and Demographics

The following section describes population and demographic data for New Mexico and Arizona. Population estimates and projections for counties within each route group are meant to give a general overview of counties, cities, towns, and unincorporated communities, and do not differentiate individual subroutes.

3.13.4.1 Past, Current, and Projected Population

New Mexico

Table 3-55 represents population estimates and growth rates for those portions of New Mexico that fall within the study area. The largest city in New Mexico's portion of the study area was Las Cruces, located in Doña Ana County. Overall, a large majority of New Mexico routes cross areas that can be characterized as rural areas, with low population densities.

Table 3-55. Population Estimates and Growth: New Mexico				
Location	**2000**	**2010**	**Percent Change (2000 to 2010)**	**Percent Annualized Growth**
State				
New Mexico	1,819,046	1,964,860	8.0	0.8
Counties				
Doña Ana County	174,682	209,233	13.2	2.0
Grant County	31,002	29,514	-4.8	-0.5
Hidalgo County	5,932	4,894	-17.4	-1.7
Lincoln County	19,411	20,497	5.6	0.6
Luna County	25,016	25,095	0.0	0.0
Sierra County	13,270	11,988	-9.7	-0.1
Socorro County	18,078	17,866	-1.2	-0.1
Torrance County	16,911	16,383	-3.1	-0.3
Total Population	**304,302**	**335,470**	**10.2**	**1.0**
Cities and Towns				
Anthony (Doña Ana County)	7,904	9,360	18.4	1.8
Carrizozo (Lincoln County)	1,036	996	-3.9	-0.4
Corona (unincorporated; Lincoln County)	165	172	4.2	0.4
Deming (Luna County)	14,116	14,855	5.2	0.5
Elephant Butte (Sierra County)	1,390		2.9	0.3
Hatch (unincorporated; Doña Ana County)	1,673	1,648	-1.5	-0.1
Las Cruces (Doña Ana County)	74,267	97,618	31.4	3.1
Lordsburg (Hidalgo County)	3,379	2,797	-17.2	-1.7
Socorro (Socorro County)	8,877	9,051	2.0	0.2
Truth or Consequences (Sierra County)	7,289	6,475	-11.2	-1.1
Sources: U.S. Census 2000; U.S. Census 2010				

Based on 2005 estimates, New Mexico counties within the Project study area are expected to grow to approximately 441,223 by 2025, an increase of 30 percent from the 2005 population estimate (Table 3-56). Most of this growth is expected in Doña Ana, Grant, Luna, and Hidalgo counties. Because these estimates were based on data gathered through 2005, it is important to note that projections for 2015 and 2025 could be overestimated. Still, the potential for further growth across the state should be recognized; New Mexico grew by 8 percent between 2000 and 2010 (see Table 3-52).

Table 3-56. Population Projections: New Mexico Counties[1]				
Location	**2005**	**2015**	**2025**	**Percentage of Expected Growth (2005 to 2025)**
Doña Ana County	192,474	237,241	274,661	42.7
Grant County	31,511	35,748	39,589	25.6
Hidalgo County	5,966	6,667	7,420	24.4

Table 3-56. Population Projections: New Mexico Counties[1]				
Location	2005	2015	2025	Percentage of Expected Growth (2005 to 2025)
Lincoln County	21,898	23,574	24,518	12.0
Luna County	26,394	29,755	32,919	24.7
Sierra County	13,657	13,793	13,959	2.2
Socorro County	18,513	20,012	21,167	14.3
Torrance County	18,282	22,184	26,990	47.6
Total Projected Population	**328,695**	**388,974**	**441,223**	**30.0**

[1] Projections based on 2005 baseline data.
Sources: Bureau of Business and Economic Research, University of New Mexico 2008

Arizona

Table 3-57 represents population estimates and growth rates for those portions of Arizona that fall within the study area. The most densely populated areas crossed by Arizona routes are found in the Tucson metropolitan area.

Table 3-57 Population Estimates and Growth: Arizona				
Location	2000	2010	Percent Change (2000 to 2010)	Percent Annualized Growth
State				
Arizona	5,130,632	6,392,017	24.6	2.5
Counties				
Cochise County	117,755	131,346	11.5	1.2
Graham County	33,489	37,220	11.1	1.1
Greenlee County	8,547	8,437	-1.3	-0.1
Pima County	843,746	980,263	16.2	1.6
Pinal County	179,727	375,770	109.1	10.9
Total Population	**1,183,264**	**1,533,036**	**29.6**	**3.0**
Cities and Towns				
Benson (Cochise County)	4,711	5,105	8.4	0.8
Casa Grande (Pinal County)	25,224	48,571	92.6	9.3
Duncan (Greenlee County)	812	696	-14.3	-1.4
Eloy (Pinal County)	10,375	16,631	60.3	6.0
Marana (Pima and Pinal counties)	13,556	34,961	157.9	15.8
Oracle (Pinal County)	3,563	3,686	3.5	0.3
Safford (Graham County)	9,232	9,566	3.6	0.4
Thatcher (Graham County)	4,022	4,865	21.0	2.1
Tucson (Pima County)	486,699	520,116	6.9	0.7
Willcox (Cochise County)	3,733	3,757	0.6	0.1

Sources: U.S. Census 2000, U.S. Census 2010

Arizona counties within the Project area are expected to grow by nearly 900,000 by 2025; an increase of 24.3 percent from the 2006 population estimate (Table 3-58). Most of this growth is

expected in Pinal and Pima counties. Similar to the data presented for New Mexico, these projections are based on older data and therefore could be overestimated, based on the rapid pace of growth that took place in Arizona through 2006. Unlike New Mexico, Arizona grew by nearly 25 percent between 2000 and 2010. Though growth is not likely to increase at the same rate as it did between 2000 and 2010, significant growth can be expected over the coming years.

Table 3-58. Population Projections: Arizona Counties [1]

Location	2006	2015	2025	Percentage of Expected Growth (2006 to 2025)
Cochise County	134,789	158,650	179,317	33
Graham County	35,873	39,307	42,848	19.4
Greenlee County	8,281	8,188	8,205	-0.9
Pima County	980,977	1,175,967	1,360,157	38.7
Pinal County	269,892	486,363	732,282	171.3
Total Projected Population	**1,429,812**	**1,868,475**	**2,322,809**	**24.3**

[1] Projections based on 2006 baseline data
Sources: Arizona Department of Economic Security 2006

3.13.4.2 Age Distribution

The age distribution of a population is important to determine the number of eligible working residents. It can also be a key indicator in the types of services a community will need to provide to its population. Common services for any community include hospitals, schools, grocery stores, and utilities. The following section briefly discusses the median age of populations within the study area.

New Mexico

Age characteristics within the New Mexico portion of the study area vary greatly between communities and counties, from older populations to younger. The estimated median age[1] across the state of New Mexico was 40.2 in 2009. Counties with the youngest population are Doña Ana and Socorro, with estimated median ages of 31 and 34.9, respectively (U.S. Census, American Community Survey 2009). Within these counties, the youngest populations can be found in the cities of Anthony, Hatch, Socorro, and Las Cruces, with estimated median ages of 24.5, 25.8, 27.4, and 30.8, respectively. Sierra County is home to the oldest population in the New Mexico portion of the study area, representing a median age of 51.5 years. Lincoln and Grant counties are also home to older populations, 47.3 and 44.6 years, respectively.

[1] Median age denotes the age of population at the midpoint of the total distribution across the entire population. In other words, 50% of the population is above or below this age. Median age is often a better indicator than average age because average numbers can be skewed by a large number or high or low ages across the population.

Arizona

Estimated median ages in Arizona counties in the study area do not vary greatly from one to another, ranging between 32.0 and 40.4 years. The estimated median age across the state was 36.2 in 2009 (U.S. Census, American Community Survey 2009). The counties with the youngest population include Graham and Pinal, with estimated median ages of 32.0 and 35.3, respectively. Within these counties, the youngest populations can be found in the cities of Thatcher, Eloy, and Casa Grande, with estimated median ages of 28.6, 30.4, and 32.9, respectively. Tucson is also home to a young population, estimated at 32.0 years of age. Cochise County is home to the oldest population in the Arizona portion of the study area, representing a median age of 40.4 years.

3.13.4.3 Race and Ethnic Characteristics

The following section presents a breakdown of all race and Hispanic or Latino ethnic groups for counties, cities, and towns that fall within or near the Project study area. In accordance with the U.S. Office of Management and Budget's 1997 *Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity*, Hispanic or Latino populations are considered an ethnicity and not a race; therefore, it is possible for one who was surveyed to select any race (i.e., White alone or African American) and also to have chosen Hispanic or Latino as their ethnicity. These data must be analyzed separately from racial data.

New Mexico

Table 3-59 illustrates that a large white population—approximately 84 percent—resides across the New Mexico portion of the study area. Native American Indians or Alaska Natives make up 1.8 percent of the population, while African Americans make up 1.4 percent, and people identifying themselves as "some other race, or two or more races" make up 11.8 percent of the population. The greatest proportion of American Indian or Alaska Natives is located in Socorro County, totaling nearly 13 percent of the population. Asians and Native Hawaiians and Pacific Islanders made up the smallest percentage of the population, each representing less than 0.1 percent of the total population across study area counties. Approximately 56 percent of the population considers themselves Hispanic or Latino.

Arizona

Table 3-60 illustrates a somewhat more diverse population in terms of race in the Arizona counties within the study area than in the New Mexico counties. Pima and Pinal counties represent more diverse populations relative to the other Arizona counties throughout the study area; larger cities typically have populations that are more diverse.

Native American Indians or Alaska Natives make up 5.6 percent of the population, while African Americans, Asians, and Native Hawaiians and Pacific Islanders make up 3.3 percent, 2.1 percent, and 0.2 percent of the population, respectively. People identifying themselves as "some other race, or two or more races" make up 15.2 percent of the population. The greatest percentage of American Indian or Alaska Natives is located in Graham County, totaling nearly 28.8 percent of the total population. The Hispanic/Latino population across all counties was

estimated to be 31.0 percent in 2009. A majority of these populations is located in the southern portions of the Tucson metropolitan area; but communities such as Oracle, Mammoth, and San Manuel in Pinal County have large percentages of Hispanic or Latino residents as well (42.8 percent, 76.2 percent, and 56.7 percent, respectively) (U.S. Census, American Community Survey 2005–2009).

3.13.5 Housing

Housing unit and occupancy data provide the information necessary to evaluate an area's ability to withstand temporary or permanent growth. Table 3-59 and Table 3-60 illustrate the number of total housing units, rental costs, and the number of vacant housing units estimated in 2010. Together, these data describe housing options for counties, cities, and towns across the study area.

3.13.5.1 New Mexico

Table 3-61 presents housing vacancy and rent data across the New Mexico portion of the study area. In 2010, the greatest number of vacant residences could be found in Lincoln and Doña Ana counties. The median gross rent across each New Mexico county was between approximately $400 and $700 per month, with the lowest rents in Hidalgo, Sierra, and Grant counties.

3.13.5.2 Arizona

Table 3-62 presents housing vacancy and rent data across the Arizona portion of the study area. In 2010, the greatest number of vacant residences could be found in Pima and Pinal counties. The median gross rent across each Arizona county was between approximately $400 and $850 per month, with the lowest rents in Greenlee and Graham counties.

3.13.6 Employment and the Economy

New Mexico employed approximately 1.1 million people across the state in 2008. Doña Ana County had the largest total employment in the study area, employing approximately 91,977. In Arizona, more than 3 million people were employed in 2008. Pima County represents the greatest number of employment across the Arizona portion of the study area, with approximately 466,000 employed.

Across all of New Mexico, the average annual wage was just over $34,000, with finance and insurance listed as the highest paying industry, at approximately $57,000 annually. In Arizona, the average annual wage was slightly higher, approximately $38,000 in 2008. The highest paid sector in the state was management of companies and enterprises, at approximately $67,000.

Table 3-59. New Mexico: Resident Population by Race [1]															
Location	Total Population	White Alone	% Total Population	Black or African American Alone	% Total Population	American Indian and Alaska Native Alone	% Total Population	Asian Alone	% Total Population	Native Hawaiian and Other Pacific Islander Alone	% Total Population	Some Other Race, or two or more races	% Total Population	Hispanic or Latino [2]	% Total Population
State															
New Mexico	1,964,860	1,381,186	70.3	43,332	2.2	183,098	9.3	26,774	1.4	971	0.0	329,499	16.8	879,480	44.5
Counties															
Doña Ana	197,819	171,780	86.8	3,760	1.9	2,268	1.1	1,898	1.0	52	0.0	18,061	9.1	128,258	63.8
Grant	29,723	20,805	70.0	171	0.6	525	1.8	196	0.0	0	0.0	8,026	0.3	14,270	46.8
Hidalgo	5,001	3,600	72.0	69	1.4	35	0.7	0	0.0	0	0.0	1,297	0.3	2,764	53.9
Lincoln	20,888	17,987	86.1	74	0.4	126	0.6	33	0.0	0	0.0	2,668	0.1	6,122	27.6
Luna	26,724	23,784	89.0	191	0.7	254	1.0	86	0.0	0	0.0	2,409	0.1	16,108	58.7
Sierra	12,645	11,370	89.9	40	0.3	81	0.6	0	0.0	0	0.0	1,154	0.1	3,763	28.6
Socorro	18,163	13,664	75.2	188	1.0	1,934	10.6	410	0.0	30	0.2	1,937	0.1	8,634	45.8
Torrance	16,566	12,394	74.8	83	0.5	628	3.8	152	0.0	14	0.1	3,295	0.2	6,342	38.3
Totals	**327,529**	**275,384**	**84.1**	**4,576**	**1.4**	**5,851**	**1.8**	**2,775**	**0.0**	**96**	**0.0**	**38,847**	**11.8**	**186,261**	**56.1**
Cities and Towns															
Anthony (Doña Ana)	**9,270**	8,207	88.5	37	0.4	58	0.6	0	0	0	0	968	10.4	8,367	9.3
Carrizozo (Lincoln)	**1,418**	996	70.2	35	2.5	213	15	0	0	1	0.1	173	12.2	728	5.3
Corona (unincorporated; Lincoln)	**146**	125	85.6	0	0	3	2.1	0	0	0	0	18	12.3	39	2.7
Deming (Luna)	**15,668**	13,782	88	327	2.1	294	1.9	65	0.4	0	0	1,200	7.7	10,509	6.1
Elephant Butte (Sierra)	**1057**	990	93.7	0	0	4	0.4	0	0	0	0	63	6.4	127	12.0
Hatch (unincorporated; Doña Ana)	**1,187**	1,149	96.8	0	0	3	0.3	0	0	0	0	35	2.9	1,067	89.9
Las Cruces (Doña Ana)	**90,586**	77,197	85.2	2,542	2.8	2,134	2.4	1,633	1.8	18	0	7,062	7.8	49,536	54.7
Lordsburg (Hidalgo)	**2,791**	1,776	63.6	85	3	33	1.2	0	0	0	0	897	32.1	2,062	73.9
Socorro (Socorro)	9,379	7,096	75.7	109	1.2	576	6.1	360	3.8	60	0.6	1,178	12.6	4,934	52.6
Truth or Consequences (Sierra)	7,513	6,186	82.3	248	3.3	324	4.3	131	1.7	0	0	624	8.3	2,047	27.2

Sources: U.S. Census 2009: 2005-2009 ACS

[1] Percentages for races are rounded and may not total 100 percent

[2] Hispanic or Latino populations are considered an ethnicity and therefore are not included in the race data.

Table 3-60. Arizona: Resident Population by Race [1]															
Location	Total Population	White Alone	% Total Population	Black or African American Alone	% Total Population	American Indian and Alaska Native Alone	% Total Population	Asian Alone	% Total Population	Native Hawaiian and Other Pacific Islander Alone	% Total Population	Some Other Race, or two or more races	% Total Population	Hispanic or Latino [2]	% Total Population
State															
Arizona	6,324,865	4,906,936	77.6	227,282	3.6	284,265	4.5	153,301	2.4	11,045	0.2	742,036	11.7	1,881,878	29.8
Counties															
Cochise	127,613	105,718	82.8	5,372	4.2	1,368	1.1	2,341	1.8	401	0.3	12,413	9.7	40,211	30.2
Graham	127,312	77,420	60.8	1,497	1.2	36,719	28.8	1,583	1.2	225	0.2	9,868	7.8	9,646	27.2
Greenlee	7,723	6,617	85.7	38	0.5	185	2.4	36	0.5	10	0.1	837	10.8	3,544	44.8
Pima	990,213	731,847	73.9	33,194	3.4	32,920	3.3	24,612	2.5	1,054	0.1	166,586	16.8	324,836	31.8
Pinal	296,113	217,795	73.6	10,339	3.5	16,173	5.5	4,106	1.4	1,370	0.5	46,330	15.6	88,387	28.8
Totals	1,548,974	1,139,397	73.6	50,440	3.3	87,365	5.6	32,678	2.1	3,060	0.2	236,034	15.2	**466,624**	**31.0**
Cities and Towns															
Benson (Cochise)	5,086	4,574	89.9	123	2.4	65	1.3	11	0.2	86	1.7	227	4.5	846	16.6
Casa Grande (Pinal)	40,064	28,057	70	1,889	4.7	2,161	5.4	1,000	2.5	170	0.4	6,787	16.9	15,250	38.1
Duncan (Greenlee)	719	630	87.6	0	0	80	11.1	0	0	0	0	9	1.3	172	23.9
Eloy (Pinal)	12,807	6,505	50.8	746	5.8	622	4.9	132	1	28	0.2	4,774	37.3	9,300	72.6
Marana (Pima and Pinal)	32,705	26,191	80.1	1,260	3.9	272	0.8	1,373	4.2	21	0.1	3,588	11	7,060	21.6
Oracle (Pinal)	2,860	2,172	75.9	0	0	0	0	0	0	0	0	688	24.1	1,182	41.3
Safford (Graham)	9,438	7,552	80	433	4.6	221	2.3	14	0.1	0	0	1,218	12.9	3,356	35.6
Thatcher (Graham)	4,582	4,152	90.6	22	0.5	182	4	56	1.2	7	0.2	163	3.6	1,267	27.7
Tucson (Pima)	554,022	386,946	69.8	28,897	5.2	22,707	4.1	18,146	3.3	1,158	0.2	96,168	17.4	213,609	38.6
Willcox (Cochise)	4,007	3,583	89.4	16	0.4	0	0	204	5.1	0	0	204	5.1	1,374	34.3

Sources: U.S. Census; 2005-2009 ACS

[1] Percentages for races are rounded and may not total 100 percent

[2] Hispanic or Latino populations are considered an ethnicity and therefore are not included in the race data.

Table 3-61. New Mexico: Housing and Occupancy Costs (2010)						
Location	Total Housing Units	Total Occupied Units	Total Vacant Units	% Occupied Units	% Vacant Units	Median Gross Rent[1]
State						
New Mexico	901,388	791,395	109,993	87.8	12.2	683
Counties						
Doña Ana	81,492	75,532	5,960	92.7	7.3	631
Grant	14,693	12,586	2,107	85.7	14.3	541
Hidalgo	2,393	1,936	457	80.9	19.1	393
Lincoln	17,519	9,219	8,300	52.6	47.4	701
Luna	10,999	9,593	1,406	87.2	12.8	487
Sierra	8,356	5,917	2,439	70.8	29.2	513
Socorro	8,059	7,014	1,045	87.0	13.0	562
Torrance	7,798	6,264	1,534	80.3	19.7	589
Totals	151,309	128,061	23,248	84.6	15.4	–
Cities and Towns						
Anthony (Doña Ana)	2,809	2,635	174	93.8	6.2	481
Carrizozo (Lincoln)	558	430	128	77.1	22.9	438
Corona (unincorporated; Lincoln)	120	83	37	69.2	30.8	473
Deming (Luna)	6,226	5,582	644	89.7	10.3	538
Elephant Butte (Sierra)	1,316	772	544	58.7	41.3	373
Hatch (unincorporated; Doña Ana	555	500	55	90.1	9.9	674
Las Cruces (Doña Ana)	42,370	39,433	2,937	93.1	6.9	395
Lordsburg (Hidalgo)	1,269	1,070	199	84.3	15.7	552
Socorro (Socorro)	4,066	3,649	417	89.7	10.3	500
Truth or Consequences (Sierra)	4,226	3,247	979	76.8	23.2	–

[1] Median gross rent represents the midpoint rent of the total distribution across all renter-occupied housing units. In other words, 50% of the population pays either above or below this rent value. Median rent is often a better indicator than average rent because average numbers can be skewed by a large number or high or low rents across the paid by the population in a given area." This data is based on a 5-year average of median gross rent values between 2006 and 2010.

Sources: U.S. Census 2010

Table 3-62. Arizona: Housing and Occupancy Costs (2010)						
Location	Total Housing Units	Total Occupied Units	Total Vacant Units	% Occupied Units	% Vacant Units	Median Gross Rent
State						
Arizona	2,844,526	2,380,990	463,536	83.7	16.3	856
Counties						
Cochise	59,041	50,865	8,176	86.2	13.8	713
Graham	12,980	11,120	1,860	85.7	14.3	604
Greenlee	4,372	3,188	1,184	72.9	27.1	385
Pima	440,909	388,660	52,249	88.1	11.9	737
Pinal	159,222	125,590	33,632	78.9	21.1	848
Totals	676,524	579,423	97,101	85.6	14.4	–
Cities and Towns						
Benson (Cochise)	2,941	2,369	572	80.6	19.4	638
Casa Grande (Pinal)	22,400	17,651	4,749	78.8	21.2	801
Duncan (Greenlee)	398	289	109	72.6	27.4	538
Eloy (Pinal)	3,691	2,984	707	80.8	19.2	523
Marana (Pima and Pinal)	14,726	13,073	1,653	88.8	11.2	1,143
Oracle (Pinal)	1,772	1,515	257	85.5	14.5	499
Safford (Graham)	3,908	3,385	523	86.6	13.4	591
Thatcher (Graham)	1,840	1,606	234	87.3	12.7	610
Tucson (Pima)	229,762	205,390	24,372	89.4	10.6	690
Willcox (Cochise)	1,659	1,421	238	85.7	14.3	366

[1] Median gross rent represents the midpoint rent of the total distribution across all renter-occupied housing units. In other words, 50% of the population pays either above or below this rent value. Median rent is often a better indicator than average rent because average numbers can be skewed by a large number or high or low rents across the paid by the population in a given area." This data is based on a 5-year average of median gross rent values between 2006 and 2010.

Sources: U.S. Census 2010

3.13.6.1 Basic and Nonbasic Industry Sectors within the Project Study Area

Basic industry sectors are those industries or businesses that are considered the economic drivers of the study area. Typically, basic industries export their product out of the local area, and therefore do not rely on local business conditions to sustain operations; whereas nonbasic industry sectors are those that supply the local area with goods and services, and therefore do rely on local business conditions to sustain operations. In addition, nonbasic industries provide services that help support the basic industry sectors.

Basic Industry Sectors within the Project Study Area

The following descriptions were adapted from the Economic Impact Assessment (EIA) (see Appendix G) to describe the businesses and industries that comprise the basic industry sectors within the Project study area.

Agriculture and Related Industries

Farm proprietor's employment and farm employment are important sectors in all the potentially affected counties, with the exception of Pima County. Although Pima County has substantial agricultural activities, it has become urbanized to the extent that its agricultural sector has been outgrown by other industries, and is no longer identified as an export-base industry. Other agrarian-based industries (e.g., forestry, fishing, and related activities) are identified as basic in four counties; Doña Ana and Lincoln counties in New Mexico, and Cochise and Pinal counties in Arizona.

Tourism

Tourism is an important industry in both New Mexico and Arizona and supports local businesses for accommodation, food services, and retail. Both New Mexico and Arizona are tourist-destination locations, and almost all counties within the study area have National Forests, National and State Parks, recreational and wilderness areas, or other natural attractions within their borders, or are in close proximity to these attractions. In New Mexico, domestic and international travelers spent a total of $5.4 billion in 2009; generating a total payroll of $1.1 billion and approximately $800 million in revenues for federal, state, and local government services (U.S. Travel Association 2010). In Arizona, domestic and international travelers spent a total of $13.4 billion in 2009; generating a total payroll of $4.1 billion and approximately $2.1 billion in revenues for federal, state, and local government services (*ibid*). In 2009, total tourism related employment across New Mexico and Arizona was 55,900 and 146,800, respectively (*ibid*).

Tourism is frequently high in counties that have specific areas of interest, such as Grant County (Gila National Forest and Gila Cliff Dwellings National Monument); Graham County (CNF, Tombstone); Pima County (Saguaro National Monuments, CNF, and destination resorts); and Lincoln County (ski resorts). Some of the affected counties have major interstate traffic (Hidalgo in New Mexico, and Cochise and Pinal in Arizona), and others are close to (or are part of) major urban tourism destinations (Pinal, which is in close proximity to Phoenix). Other counties such as Luna in New Mexico, and Cochise and Pima in Arizona, attract numerous visitors from Mexico because of their proximity to the border and for shopping availability.

Mining

Mining is an important industry in some counties within the Project study area, particularly in Grant County in New Mexico, and Graham and Greenlee counties in Arizona. Mining, which typically creates relatively high paying jobs in rural areas, was also identified as a basic industry in Lincoln County New Mexico and in Pinal County Arizona.

Utilities

Both New Mexico and Arizona are net exporters of utilities, which represent a broad category of services, including water, sewer, electricity, and natural gas. Typically, water and sewer provision provide services to a local population, and export-base utilities are likely to represent electricity generation. Doña Ana, Grant, and Lincoln counties in New Mexico, and Cochise, Greenlee, Pima, and Pinal counties in Arizona have utilities identified as export-base industries.

Health Care and Social Assistance

Health care and social assistance was identified as a basic industry for Doña Ana and Pima counties within the Project study area. Doña Ana is home to the Memorial Medical Center, Mesilla Valley Hospital, and the UNM Cancer Center. Pima County is home to the Tucson Medical Center, Northwest Medical Center, Carondelet St. Mary's Hospital, Carondelet St. Joseph's Hospital, University Medical Center (a teaching and research hospital), and Arizona Cancer Center. These medical facilities serve patients from a much broader region than just the county in which they are located, and several of them conduct major research, attracting research money from outside the area.

Military and Federal Civilian

Military is identified as basic industry in two counties: Cochise (Fort Huachuca, an Army installation) and Pima (Davis Monthan AFB). Federal civilian employment was also identified as an export industry in these two counties. Military bases hire substantial numbers of federal civilians for various types of support positions, both technical and nontechnical.

Although many of the analyzed counties are relatively close to some type of military installation, some are also identified exporters of forestry, fishing, and related activities. Since park rangers and other BLM officials are federal employees, counties with substantial outdoor recreational activities and federal forest lands have relatively high levels of federal civilian employees (Doña Ana, Hidalgo, and Luna counties in New Mexico; and Graham County in Arizona).

Relatively high levels of federal civilian employees also occur in larger urban areas, where federal facilities such as the justice department and federal courts are concentrated (Doña Ana in New Mexico; and Pima in Arizona). It should be noted that professional, scientific, and technical services were identified as basic sectors in two of the analyzed counties: Socorro and Cochise. Highly skilled professional employees in the professional, scientific, and technical service industries are supporting the military bases in each county.

State Government

State government typically services the population of the state and therefore is nonbasic. The exception to this is where educational facilities serve populations from outside the counties in which they are located; including major universities that draw students worldwide and engage in major research projects that bring substantial research dollars into the county (e.g., NMSU in Doña Ana County and UA in Pima County). Another exception of state government representing a basic industry is with the presence of substantial state correctional facilities (e.g., Arizona State Prison Complex located in Pinal County).

Nonbasic Industry Sectors within the Project Study Area

The following descriptions were adapted from the EIA (see Appendix G) to describe the businesses and industries that comprise the nonbasic industry sectors Project study area.

Construction and Construction-related Sectors

As shown previously, New Mexico and Arizona grew considerably between 2000 and 2010 (approximately 8 and 25 percent, respectively). Construction is usually considered a nonbasic industry, because it responds to population growth.

Local Government

Local government employment reflects local voter preferences and the political environment of the local area. However, state government can be basic, particularly in education, if the region exports education services to out-of-state students or if the education institutions attract out-of-state funding for research.

Retail Industries

Retail businesses are typically aimed at serving local populations. If there is substantial tourism to an area, retail can represent an export-base industry. For the purpose of identifying economic base industries, a strong tourism sector will be identified through the accommodation and food services category of employment rather than the retail category.

Health Care

Health care and related industries are usually not an export-base industry, because they also depend greatly on an existing population. The exception is when there are major health centers in the region that conduct research projects and/or provide state-of-the art services that cannot be found in nearby states. These are usually found in larger counties, such as Pima (Tucson) and Doña Ana (Las Cruces).

Social Services and Social Assistance

Social services and social assistance are typically nonbasic local services, such as housing and welfare assistance, that provide specialized services to local residents throughout the Project study area.

Industries with Relatively Few Employees

Small businesses typically provide services to the local residents, and were not identified as export-base industries. A very small industry, even if its share of employment is higher than the United States' share, cannot be a significant factor in the local economy.

Summary of Basic and Nonbasic Industry Sectors

Most of the counties through which the Project crosses rely on export base industries that are related either to land endowments (agriculture; forestry, fishing, and related activities; mining; tourism) or are related to federal military/defense installations (military; federal civilian; professional, scientific, and technical employment). For some of the counties, utilities (electricity) represent an export base sector. The state government provides export base activities

in a few counties that have education centers or corrections facilities. Health and social assistance represent an export industry in the two largest counties included in this study.

3.13.6.2 Unemployment

New Mexico

Table 3-63 displays unemployment rates for 2000, 2005, and 2010 for the United States and the state of New Mexico, as well as for the counties that fall within the New Mexico portion of the study area.

Table 3-63. Unemployment Rates: New Mexico (percentage)

Location	2000	2005	2010[1]	Rate Change (2005 to 2010)
United States	3.9	4.9	9.4	4.5
State				
New Mexico	4.9	4.7	8.4	3.7
Counties				
Doña Ana	6.1	5.7	8.3	2.6
Grant	5.8	6.0	11.3	5.3
Hidalgo	6.8	4.8	7.5	2.7
Lincoln	4.2	4.5	6.8	2.3
Luna	15.5	12.8	19.0	6.2
Sierra	4.4	5.4	6.7	1.3
Socorro	5.1	4.5	6.1	1.6
Torrance	5.0	5.5	10.3	4.8

[1] Annual percentage based on 11 months of data (January to November)
Source: U.S. Bureau of Labor Statistics 2010

Arizona

Table 3-64 displays unemployment rates for 2000, 2005, and 2010 for the United States and the state of Arizona, as well as for the counties that fall within the Arizona portion of the study area.

Table 3-64. Unemployment Rates: Arizona (percentage)

Location	2000	2005	2010[1]	Rate Change (2005 to 2010)
United States	3.9	4.9	9.4	4.5
State				
Arizona	4.0	4.5	9.5	5.0
Counties				
Cochise County	4.5	4.8	8.1	3.3
Graham County	5.5	6.0	13.7	7.7
Greenlee County	4.3	4.8	11.1	6.3
Pima County	3.7	4.5	8.7	4.2
Pinal County	4.6	5.6	11.7	6.1

[1] Annual percentage based on 11 months of data (January to November)
Source: U.S. Bureau of Labor Statistics 2010

3.13.7 Fiscal Conditions: Tax Rates and Revenues

Taxes are collected in New Mexico and Arizona, resulting in state and local tax revenues that are then used to provide public services to populations. Sales and income tax collected by the state of Arizona is shared with counties and incorporated towns, regardless of where the taxes are collected. New Mexico does not have a state-shared tax revenue program, therefore tax revenue benefits would remain within closer proximity to the Project. The tax revenue estimates for subroutes in New Mexico include those generated by sales tax, income tax, and corporate income tax. In Arizona, tax revenue estimates are based on sales tax (Transaction Privilege Tax), personal income tax, corporate income tax, and property taxes.

The average tax rates and revenues for each state, including counties crossed by the study corridor are included in Table 3-65 and Table 3-66.

Table 3-65. New Mexico: Revenue and Income Summary (2009)

	Gross Receipts and Selective Sales Taxes	Personal Income Taxes[1]	Net Corporate Income Taxes
Average Effective Tax Rates	4.8%	2.2%	0.5%
Total Revenues	**$2,493,029,000**	**$932,442,000**	**$203,584,000**

[1] Personal income taxes are based on an adjusted total personal income for New Mexico. Adjusted personal income is defined to be equal to total personal income minus most transfer payments and minus two components of dividends, interest and rent (see Appendix D of the EIA).
Source: SunZia Southwest Transmission Project Economic Impact Assessment-Revised 2012

Table 3-66. Arizona: Revenue and Income Summary (2010)

	Gross Transaction Privilege Tax (Sales Taxes) Collections	Net Personal Income Taxes	Net Corporate Income Taxes
Average Effective Tax Rates	3.3%	2.5%	0.5%
Total Revenues	**$5,981,605,185**	**2,423,214,707**	**$413,280,938**

Source: SunZia Southwest Transmission Project Economic Impact Assessment-Revised 2012; Arizona Department of Revenue 2011 Annual Report

3.13.8 Emergency Services

The following sections provide information for fire and medical emergency services by county throughout the New Mexico and Arizona portions of the Project study area. While it is important that law enforcement agencies throughout the study area are notified of construction locations and schedule prior to work beginning, the likelihood that law enforcement services would be in considerable demand is minimal, due to the distribution of relatively small construction crews across a linear, 500-mile corridor.

3.13.8.1 Fire Services

New Mexico

There are 18 fire stations that serve areas within the Project corridors, in addition to fire management units of the BLM, USFWS, and New Mexico State Forestry. Due to the remoteness and low population density of some portions of the Project corridor, some areas are underserved relative to others. These areas will be described in Section 4.13.

Fire services across the New Mexico portion of the Project study area are presented in Table 3-67.

Table 3-67. Fire Services: New Mexico

Location	Fire Station	Location
Doña Ana County	BLM Las Cruces District Office	1800 Marquess St., Las Cruces, NM 88005 (575) 525-4300
	Hatch Volunteer Fire Department	207 Franklin, Hatch, NM 87937
Grant County [1]	—	—
Hidalgo County	Hidalgo County Fire Department District [1]	300 S Shakespeare St., Lordsburg, NM 88045 (505) 542-8212
	Lordsburg Fire Department	404 Wabash St., Lordsburg, NM 88045 (505) 542-9261
Lincoln County	White Oaks Volunteer Fire Department	Hwy 349, Carrizozo, NM 88301
	Carrizozo Fire Department	400 8th Ave., Carrizozo, NM 88301
Luna County	Cooks Peak Fire District 403	2470 Tulip Dr. NE, Deming, NM 88030 (505) 544-8729
	Deming Fire Department	309 S Gold Ave., Deming, NM 88031 (505) 546-8848
Sierra County	Arrey-Derry Fire Department	1021 Percha Dam Rd., Arrey, NM 87930 (505) 740-2527
	Caballo Fire and Rescue	Highway 187 mi. 26, Caballo, NM 87931 (505) 743-3488
	Lakeshore Fire Department	301 S Lost Canyon, Elephant Butte, NM 87935 (505) 744-4172
	Hillsboro Fire/Rescue Department	State Rd., 27 RT, Hillsboro, NM 88042 (505) 895-5368
	Monticello-Placita Volunteer Fire Department	PO Box 22, Monticello, NM 87939 (505) 743-2146
	Truth or Consequences Volunteer Fire Department	300 E 9th Ave., Truth or Consequences, NM 87901 (505) 894-2132
	Las Palomas Volunteer Fire Department	101 W. Las Palomas Rd., Williamsburg, NM 87942 (505) 894-3742
Socorro County	BLM Socorro Field Office	901 S. Highway 85, Socorro, NM 87801 (575) 835-0412
	BLM Rio Puerco Field Office	435 Montano Rd., NE Albuquerque, NM 87107
	San Antonio Fire Department	1770 ST RD 1,San Antonio, NM 87801 (505) 835-2114
	New Mexico State Forestry Division (Socorro Division)	1701 Enterprise Socorro, NM 87801 (575) 835-9359

Table 3-67. Fire Services: New Mexico		
Location	**Fire Station**	**Location**
	Socorro Fire Department	200 Fisher Street, Socorro, NM 87801 (575) 835-3969
	Midway Fire Department	13 Chambon Rd., Lemitar, NM 87823 (575) 835-0985
	U.S. Fish and Wildlife Service, Bosque del Apache NWR	NM HWY 1, San Antonio, NM 87832 (575) 835-1828
Torrance County	Mountainair Volunteer Fire Department	304 N Summit, Mountainair, NM 87036 (505) 847-0147
[1] Given the distance of Silver City (30+ miles) and other Grant County communities, it is unlikely that fire services would come from Grant County. Services to portions of Grant County would likely come from Lordsburg in Hidalgo County. Sources: www.firedepartmentdirectory.com 2011		

Arizona

Twenty-seven fire stations are located within proximity to the Project corridor, most of which are located in Pima County in the Tucson metropolitan area. Services are also provided by the BLM and other land management agencies. Fire services across the Arizona portion of the Project corridor are represented in Table 3-68.

Table 3-68. Fire Services: Arizona		
Location	**Fire Station**	**Location**
Cochise County	Bowie Volunteer Fire District	118 West Kinchilla Street, Bowie, AZ 85605 (520) 847-2553
	Mescal Volunteer Fire Department	448 N Warren Rd., Benson, AZ 85602 (520) 586-7007
	Willcox Rural Fire Department	522 N Haskell Ave., Willcox, AZ 85643 (520) 384-3271
Graham County	Pima Rural Fire Department	86 S 200 W, Pima, AZ 85543 (928-485-2402)
	Thatcher Fire Department	1150 N College Ave., Thatcher, AZ 85552 (928) 428-1200
	BLM Safford Field Office	711 S 14th Ave., Safford, AZ 85546 (928) 348-4400
Greenlee County[1]	—	Cochise and Graham Counties
Pima County	BLM Tucson Field Office	3201 E. Universal Way, Tucson, AZ 85756 (520) 258-7200
	BLM Lower Sonoran Field Office	21605 N 7th Ave., Phoenix, AZ 85027 (623) 580-5500
	Avra Valley Fire District	15790 W Silverbell Rd., Marana, AZ 85653 (520) 682-3255
	Mountain Vista Fire District	2292 W Magee Rd., #190, Tucson, AZ 85742 (520) 575-4087
	Golder Ranch Fire District	3885 E Golder Ranch Dr., Tucson, AZ 85739 (520) 825-9001
	Tucson Fire Department	300 S Fire Central Pl., Tucson, AZ 85701 (520) 791-4502
	Rincon Valley Fire Department	14550 E Sands Ranch Road, Vail, AZ 85641 (520) 647-3760
	Northwest (NW) Fire District Station #39	12095 Thornydale Rd., Marana, AZ 85653

Table 3-68. Fire Services: Arizona		
Location	**Fire Station**	**Location**
	NW Fire District #38	8475 Stargrass Dr., Marana, AZ 85742
	NW Fire District #37	13001 N Tortolita Rd., Marana, AZ 85653
	NW Fire District #36	13475 Marana Main St., Marana, AZ 85653
	NW Fire District #35	3220 N Camino de Oeste, Marana, AZ 85745
	NW Fire District #34	8165 N Wade Rd., Marana, AZ 85743
	NW Fire District #32	4151 W El Camino del Cerro, Tucson, AZ 85745
	NW Fire District #31	4701 N La Cholla Blvd., Tucson, AZ 85705
	NW Fire District #30	1520 W Orange Grove, Tucson, AZ 85704
Pinal County	Casa Grande Fire Department	101 E 5th St., Casa Grande, AZ 85222 (520) 421-8777
	Eloy Fire District	4010 N Toltec Rd., Eloy, AZ 85231 (520) 466-3544
	Fire Station #586 (Regional Fire and Rescue Department, Inc.)	7951 W McCartney Rd., Casa Grande, AZ 85294 (520) 723-4680
	Mammoth Volunteer Fire District	114 Copper St., Mammoth, AZ 85618 (520) 487-2050
	Florence Fire Department	72 E First St., Florence, AZ 85232 (520) 868-7609
	San Manuel Fire Department Association	565 S Redington Rd., San Manuel, AZ 85631 (520) 385-9231
	Oracle Volunteer Fire Department	1475 W American Ave., Oracle, AZ 85623 (520) 896-2980

[1] Fire services to Greenlee County will likely come from Cochise and Graham counties.
Sources: www.firedepartmentdirectory.com 2011; www.northwestfire.org 2011

3.13.8.2 Medical Services

New Mexico

With the exception of Hidalgo and Torrance counties, 24-hour emergency services can be found in all New Mexico counties within the Project corridor. Residents and visitors in need of emergency services in Hidalgo and Torrance counties are taken to Silver City and Albuquerque, respectively. Hospitals in Las Cruces and Albuquerque can accommodate helicopter transportation, should an emergency situation call for these measures.

Table 3-69 lists the emergency medical services that are located throughout the New Mexico portion of the Project corridor.

Table 3-69. Emergency Medical Services: New Mexico			
Location	**Hospital**	**Address**	**Capabilities Summary**
Bernalillo County	University of New Mexico Hospital	2211 Lomas Blvd. NE, Albuquerque, NM 87106 (505) 272-2111	Level 1 Trauma Center
Doña Ana County	Mountain View Regional Medical Center	4311 E Lohman Ave., Las Cruces, NM 88011 (575) 556-7600	15,000 square-foot facility, 168 beds, 24-hour emergency services and intensive care unit, 625 employees.

Table 3-69. Emergency Medical Services: New Mexico			
Location	**Hospital**	**Address**	**Capabilities Summary**
	Memorial Medical Center	2450 S Telshor Blvd., Las Cruces, NM 88011 (575) 522-8641	24-hour emergency services and intensive care unit. Helicopter transportation for emergency situations.
Grant County	Gila Regional Medical Center	1313 E 32nd Street, Silver City, NM 88061 (575) 538-4000	40 physicians and dentists, 24-hour physician staffed emergency room
Hidalgo County[1]	—	—	—
Lincoln County	Lincoln County Medical Center	211 Sudderth, Ruidoso, NM 88345 (575) 257-8200	24-hour emergency services with intensive care unit
Luna County	Mimbres Memorial Hospital	900 W Ash Street, Deming, NM 88030 (575) 546-5800	24-hour emergency services with 7,500 square-foot emergency room with 9 beds and a triage area. 6-bed intensive care unit and 66 skilled nursing long-term beds. 25 active physicians and a total of 325 employees.
Sierra County	Sierra Vista Hospital	800 E 9th Ave., Truth or Consequences, NM 87901 (575) 894-2111	24-hour emergency services. 25-bed hospital with ambulance, surgery, and anesthesiology services.
Socorro County	Socorro General Hospital	1202 Highway 60 West (PO Box 1009) Socorro, NM 87801 (575) 835-1140	General and acute care hospital and 24 hour emergency room. Hospital provides 15 staffed inpatient beds. The staff consists of five family practice physicians (including three who offer obstetric services), one surgeon, one internist, two pediatricians, and a certified nurse midwife.
Torrance County	Mountainair Family Health Center	105 E Piñon St., Mountainair, NM 87036 (505) 847-2271	The Mountainair Health Center offers helicopter service to hospitals in Albuquerque, because it is unable to handle emergency services.

[1] Hidalgo County does not have a facility capable of accommodating medical emergencies. Those needing medical emergency services are taken north to Silver City.

Sources: The Agape Center 2011, Mountain View Regional Medical Center 2010, Socorro General Hospital 2011, Gila Regional Medical Center 2006, Mimbres Memorial Hospital 2009, Memorial Medical Center 2011, Gerald Champion Regional Medical Center 2011, Lincoln County Medical Center 2011, Sierra Vista Regional Health Center 2011. Personal Communication Patricia Autrey 2011.

Arizona

With the exception of Greenlee County, 24-hour emergency services can be found in all Arizona counties within the study area. In the event that a helicopter is needed to transport an injured worker, it is likely that one of three hospitals in Tucson would be able to provide medical services. Similar to fire services, routes in uninhabited portions of Graham and Pinal counties will have the least access to medical services.

Table 3-70 displays emergency medical services that are located within proximity to the Arizona portion of the study area.

Table 3-70. Emergency Medical Services: Arizona			
Location	**Hospital**	**Address**	**Capabilities Summary**
Cochise County	Benson Hospital	450 S Ocotillo Rd., Benson, AZ 85602 (520) 586-2261	24-hour emergency services, 8-bed specialized unit, 6 local physicians.
	Northern Cochise Community Hospital	901 Rex Allen Dr., Willcox, AZ 85643 (520) 384-3541	24-hour emergency service, level-four trauma center.
Graham County	Mt. Graham Regional Medical Center	1600 20th Ave., Safford, AZ 85546 (928) 348-4000	24-hour emergency services, 17 treatment bays and triage center (nationwide compliant)
Greenlee County[1]	—	—	—
Pima County	University of Arizona Medical Center	1501 N Campbell Ave., Tucson, AZ 85724 (520) 694-0111	24-hour emergency services, level-one trauma center, helicopter transportation, 41,000 square-foot, 61-bed facility.
	Tucson Medical Center	5301 E Grant Rd., Tucson, AZ 85712 (520) 327-5461	24-hour emergency services, 40 treatment rooms (10 critical care rooms), triage services, helicopter transportation.
	Northwest Medical Center	6200 N La Cholla Blvd., Tucson, AZ 85741 (520) 742-9000	24-hour emergency services, helicopter transportation.
	St. Joseph's Hospital	350 N Wilmot Rd., Tucson, AZ 85711 (520) 873-3000	24-hour emergency services, helicopter transportation, emergency rehabilitation services, 460 active and provisional physicians.
	Kino Community Hospital	2800 E Ajo Way, Tucson, AZ 85713 (520) 874-2000	24-hour emergency services and helicopter transportation.
	Oro Valley Hospital	1551 East Tangerine Road Oro Valley, AZ 85755 (520) 901-3500	24-hour emergency services
Pinal County	Casa Grande Regional Medical Center	1800 E Florence Blvd., Casa Grande, AZ 85122 (520) 381-6300	24-hour medical services, trauma services, 20 physicians on staff.

[1] Greenlee County does not have a medical facility within close proximity to the Project Area. Therefore, medical emergencies would likely be accommodated in Cochise or Graham counties.

Sources: Arizona Department of Commerce 2009, Benson Hospital 2010, Mt. Graham Regional Medical Center 2010, University of Arizona Medical Center 2011, Tucson Medical Center 2011, Carondelet St. Joseph's Hospital 2011, Casa Grande Regional Medical Center 2011, Northern Cochise Community 2011, Kino University Physicians Hospital 2006, Northwest Hospital 2010

3.13.9 Summary of Inventory Results

This section summarizes the social and economic situation in New Mexico and Arizona, identifying key similarities and differences between various subroutes across the study area. Overall, populations across New Mexico can be characterized as rural, low-density communities. With the exception of the subroutes in the Tucson region, a majority of the routes within Arizona cross rural, low-density communities. Social and economic conditions for local alternative and crossover links are consistent with those of the subroutes, and are not discussed separately in the following summaries.

3.13.9.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 and Subroute 1A2, the BLM preferred alternative, pass through unincorporated portions of Lincoln and Torrance counties, and near to the cities of Socorro (Socorro County) and Truth or Consequences (Sierra County). Subroute 1A is similar to Subroute 1A1 and 1A2, except there are no portions of Subroute 1A that cross Torrance County. Subroute 1B traverses smaller communities, including San Antonio. Social and economic conditions throughout each of the subroutes are relatively consistent, characterized by small employment centers with nonbasic industries, including retail, accommodation and food services, and health care. The presence of small communities limits the amount of housing and lodging available in an area.

3.13.9.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Social and economic conditions in the New Mexico portion of Route Group 3 (which includes Subroute 3A2, the BLM preferred alternative, and subroutes 3A and 3B) in the study area are similar to Route Group 1. The route passes through Luna, Grant, and Hidalgo counties. Economically, the small communities along these routes (including Deming in Luna County and Lordsburg in Hidalgo County) depend largely on nonbasic employment based on retail, accommodation and food services, and health care. A majority of population and available housing in the region is located north of the subroutes within Grant County near Silver City and its surrounding communities. The Arizona portion of Route Group 3 passes through Cochise, Graham, and Greenlee counties. Communities in this area depend mostly on nonbasic employment seen in other rural communities, but also have a high concentration of professional scientific/technical basic sector jobs. A majority of these jobs is found in Cochise County. Cochise and Graham counties have a large amount of available housing, as compared to Greenlee County.

3.13.9.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroutes 4A and 4B cross in proximity to the same Graham County and Pinal County communities; and pass near Safford and Mammoth before rejoining all other subroutes east of Casa Grande in Pinal County. Both subroutes are characterized by similar social and economic conditions. The economy in Safford serves as the primary provider of retail, accommodation and food services, and health care for Graham County. In Pinal County, Mammoth is similar to Safford in that the community relies on retail and accommodation and food services for its populations and nearby communities. A majority of employment can be found near Casa Grande and Safford. Housing vacancies are highest in Casa Grande, with a small number of vacant units located in Safford and Thatcher.

Subroute 4C2c, the BLM preferred alternative, Subroute 4C1, and Subroute 4C2 come within proximity of the small communities of San Manuel, Mammoth, and Oracle in Pinal County. These communities have traditionally depended on mining, and still have active operations today. Subroute 4C3 in the Tucson metropolitan area of Pima County represents the most densely populated and economically diverse portion of the entire study area and of Route Group 4. The economy in this region is based heavily on tourism-related industries (such as food service and lodging), health care, professional/technical, and manufacturing jobs. Much of

Cochise County within Route Group 4 is sparsely populated. A majority of available housing is located in Pima County near Tucson and in Pinal County near Casa Grande.

3.14 ENVIRONMENTAL JUSTICE CONDITIONS

3.14.1 Introduction

This section describes the existing environmental justice conditions within closest proximity to the Project study area, including portions of counties throughout the states of New Mexico and Arizona.

EO 12898 (U.S. Department of Housing and Urban Development 1994) requires federal agencies to address high and disproportionate environmental impacts on minority and low-income populations. Should potentially significant and adverse impacts attributable to the proposed Project fall disproportionately on these populations, environmental justice impacts would result. The required analysis involves screening the proposed Project study area to determine if environmental justice populations exist, and to assess the degree to which those populations might be expanding within the area. The analysis further involves determining whether the proposed Project impacts would be significant, and if they would disproportionately affect any environmental justice populations.

The race, ethnic, and poverty data reported in this section were acquired from the U.S. Census Bureau's American Community Survey[1], and represent estimates based on data collected between 2005 and 2009 (presented on the census tract level). Census 2010 information was used to update American Community Survey data where applicable (U.S. Census 2011a, and Census 2011b). Census tracts vary in spatial size, typically contain between 2,500 and 8,000 people, and do not cross county boundaries. In 2009, the average total census tract population across the seven New Mexico counties and five Arizona counties within the study corridors were 3,503 and 5,538, respectively.

CEQ guidance suggests that an environmental justice population may be identified if "the minority population percentage of the affected area exceeds 50 percent, or if the minority population percentage of the affected area is meaningfully greater than the minority population in the general population or other appropriate unit of geographic analysis" (CEQ 1997a). Minority populations are defined as "individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic Origin; or Hispanic" (*ibid*). In order to set a conservative threshold for identifying potential environmental justice populations, those who were American Indian or Alaskan Native, Asian, Black, other race, or two or more races were aggregated and divided by the total population for each census tract to determine which areas were greater than 50 percent minority. It is important to note that the "other race" U.S. Census category consists of all single race populations other than White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander race categories. This category comprises write-in entries, and

[1] The U.S. Census American Community Survey estimates are based on data collected over a 5-year time period. The estimates in this section represent the average characteristics of population and housing between January 2005 and December 2009 and do not represent a single point in time.

could include Hispanic or Latino populations if the respondent considered this to be their race. Given the demographics in New Mexico and Arizona, it is expected that many people in the "other race" category are Hispanic or Latino. Hispanic or Latino populations were only counted as an ethnicity in the U.S. Census' American Community Survey 2005-2009 estimates; therefore, this number is divided by the total population separately from other minority population groups. Census tracts with greater than 50 percent Hispanic or Latino populations were also considered to be potential environmental justice populations.

The CEQ defines low-income populations based on an annual statistical poverty threshold. In identifying low-income populations, poverty thresholds do not vary geographically and are identical across the United States (Census 2011c). In 2009, the poverty threshold for an individual living alone was $10,956. For a family of four (two adults and two children), the poverty threshold was $21,576. If the income for a family of four was below $21,576, each person in the household was considered to be below the poverty level. For the purposes of identifying low-income populations within 3 miles of each Project subroute, all census tracts with an equal or greater percentage of population below the poverty level for New Mexico and Arizona was considered a potential environmental justice population. In 2009, the percentage of New Mexico and Arizona individuals that were below the poverty level was 18.1 percent and 14.7 percent, respectively. Special note for census tracts with low densities, such as those in rural areas, will be made throughout the inventory section.

3.14.2 Study Area Overview

Table 3-71 includes race, ethnicity, and poverty percentages statewide for New Mexico and Arizona, and for the counties within the Project study area. Arizona and New Mexico populations are primarily white and Hispanic or Latino. Overall, neither of these states is home to a diverse population; much of these populations are identified as either White or Hispanic.

Table 3-71. Race, Ethnicity, and Poverty: New Mexico and Arizona (Percent of total population)

	White Alone and Non-Hispanic	Hispanic or Latino	Other Racial and Ethnic Minorities	Total Racial and Ethnic Minorities	Variation in Percentage to Statewide Average[1].	Total population below poverty level
Arizona	57.3	30.3	12.5	42.7	–	15.3
Cochise	58.0	32.8	9.2	42.0	0.7	15.7
Graham	51.8	31.2	17.0	48.2	-5.5	20.0
Greenlee	47.0	49.0	4.0	53.0	-10.3	13.5
Pima	54.7	35.2	10.1	45.3	-2.6	16.4
Pinal	57.8	29.4	12.8	42.2	0.6	13.5
New Mexico	40.1	46.9	13.0	59.9	–	18.4
Grant	48.2	48.7	3.1	51.8	8.1	14.8
Hidalgo	41.4	56.6	2.0	58.6	1.2	22.6
Lincoln	65.6	30.5	3.9	34.4	25.4	12.9
Luna	35.6	61.7	2.8	64.4	-4.6	32.8
Sierra	67.5	28.8	3.7	32.5	27.4	22.5

Table 3-71. Race, Ethnicity, and Poverty: New Mexico and Arizona (Percent of total population)						
	White Alone and Non-Hispanic	Hispanic or Latino	Other Racial and Ethnic Minorities	Total Racial and Ethnic Minorities	Variation in Percentage to Statewide Average[1].	Total population below poverty level
Socorro	37.4	48.8	13.7	62.6	-2.7	26.8
Torrance	55.0	40.1	4.9	45.0	14.8	19.4

[1] Variation of county to state non-minority populations
Source: U.S. Census Bureau 2011a and 2011b.
Note: Census respondents may choose one or more races, and therefore census tallies may overlap.

3.14.3 Summary of Inventory Results

Potential environmental justice populations are identified for each route group in this section[1].

3.14.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A – North River Crossing

Subroutes 1A, 1A1, and 1A2 (BLM preferred alternative) are in proximity to or cross seven census tracts with potential environmental justice populations. These tracts include the western portion of census tract 9602 in Lincoln County, the southern portion of census tract 96730 in Torrance County, the northern portions of census tracts 9781, 9783.01, 9783.02, and 9783.03 (including part of the city of Socorro) in Socorro County, and census tract 5 in Luna County (located north of Deming). Census Tract 9781, which covers a majority of Socorro County, has a greater percentage of population below the poverty level than the state average and is characterized by a low population density (1.6 people per square mile). Approximately 1,031 individuals (or 21.7 percent) were below the poverty level in 2009. Census tract 9783.01 contains a large percentage of low-income individuals, estimated at approximately 40 percent of the tract's total population. Located 1.5 miles south of Subroute 1A2, tract 9783.02 contains 801 individuals, or 28.7 percent of individuals of low-income status. Tract 9783.03 contains a large number of Hispanic or Latino individuals, approximately 64 percent or 2,170 people; only a small portion of this tract is crossed by Subroute 1A2 (approximately 0.9 mile). In 2009, overall population densities for census tracts 9783.01, 9783.02, and 9783.03 were 43.3, 2,089.6, and 179.1 people per square mile, respectively. Tract 5 comprises a high percentage of low-income populations, approximately 33 percent or 1,450 individuals. However, the population density in this census tract was low; just 2.6 people per square mile. Subroute 1A2 does not pass near any communities within Luna County and ends approximately 7.5 miles northeast of Deming.

[1] Text has been updated where environmental justice conditions changed from American Community Survey 2005 to 2009 to Census 2010.

Subroute 1B – San Antonio Crossing

With the exception of census tract 9783.01, Subroute 1B1 includes similar potential environmental justice populations as Subroute 1A. Subroute 1B1 crosses through the southern portion of census tract 9783.03 that is not crossed by Subroute 1A, which crosses through the northern portion of the tract near the city of Socorro. Subroute 1B1 is located approximately 8 miles south of the city of Socorro, near the unincorporated community of San Antonio.

Overall, potential environmental justice populations located in proximity to subroutes 1B2 and 1B3 are similar to those found in Subroute 1B1. Subroute 1B3 passes near the community of Bingham, while Subroute 1B2 does not pass near any communities.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A1 and 1B1 cross two potential environmental justice census tracts in Torrance County. Census tract 9634 is crossed by local alternative links E83 and E84, which begin at SR 14 as it parallels the Torrance-Socorro County boundary. Despite having a large Hispanic population, approximately 65 percent or 229 individuals, this portion of the tract is largely uninhabited. The population density of the entire census tract (which spans 1,727 square miles) is just 0.4 people per square mile. Census tract 9635 to the west of tract 9634 (crossed by alternative links E83, E84, and E85) contains a high percentage of low-income residents, 28.8 percent, or 392 individuals. Similar to census tract 9634, this area is characterized by a sparsely populated landscape of just 3.7 people per square mile.

3.14.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A – North and Subroute 3A2 – BLM Preferred Alternative

In New Mexico, subroutes 3A and 3A2 cross three potential environmental justice census tracts: tract 5 in Luna County (see discussion in Subroute 1A2), tract 9648 in Grant County, and tract 9700 in Hidalgo County. The highest population densities are located far from the subroute, in the northern portions of the census tract near Silver City; estimated to be 1.9 people per square mile in 2009. Census tract 9700 in Hidalgo County comprises a high percentage of low-income individuals (28.1 percent) who are spread across the county. However, the density and total population of this tract is low; just 0.7 people per square mile, or 2,195 individuals.

In Arizona, subroutes 3A and 3A2 cross approximately 9 miles of a potential environmental justice census tract in Greenlee County (tract 9603), and approximately 26 miles of census tract 9616 in Graham County. The tracts are characterized by low population densities that range from 5.4 to 6.6 people per square mile.

Subroute 3B – South

Subroute 3B crosses potential environmental justice populations in two locations that are not crossed by Subroute 3A2. In New Mexico, Subroute 3B crosses census tract 9882 surrounding Lordsburg, which has a relatively high population density (614.7 people per square mile) and is home to a large percentage of Hispanic and low-income individuals; 77.4 percent and 36.2

percent, respectively. In Arizona, Subroute 3B crosses census tract 1 in Cochise County, which is home to a high percentage of low-income individuals, representing 22.7 percent of the population (8 percent higher than the state average).

3.14.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A crosses the southern portion of census tract 9912 in Graham County, which has a slightly higher percentage of low-income individuals than the state of Arizona (representing 15.7 percent compared to Arizona's 14.7 percent). Tract 9912 also contains the Town of Thatcher; however, the center of the town is approximately 6 miles northeast of the route.

Subroute 4A crosses or comes within proximity to three potential environmental justice census tracts in Pinal County: tracts 6.01, 12, and 20. Census tract 6.01 passes approximately 2 miles north of the unincorporated community of Mammoth, and is considered a potential environmental justice population because of a high low-income population (26.3 percent or 1,966 individuals) and a large Hispanic or Latino population (56 percent or 4,221 individuals). Population density in census tract 6.01 is low relative to other areas throughout the study corridors; 11.2 people per square mile. Near the planned Pinal Central Substation, Subroute 4A crosses census tract 12, where approximately 26.1 percent of the residents are low-income. Encompassing a portion of Toltec, census tract 20 is characterized by low-income and a high percentage of Hispanic residents; 27 and 77 percent, respectively.

Subroute 4B – Sulphur Springs Valley

Subroute 4B crosses the same potential environmental justice populations as Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Located north of the unincorporated community of San Manuel, census tract 7 has a population of 4,375 and contains high percentages of both Hispanic (57 percent) and low-income individuals (24.3 percent). This route would affect the same environmental justice populations as subroutes 4A and 4B, including two census tracts in Pinal County.

Subroute 4C1 – East of Sand Pedro River and Subroute 4C2 – West of San Pedro River

Subroutes 4C1 and 4C2 would affect the same environmental justice populations as Subroute 4C2c.

Subroute 4C3 – Tucson

Subroute 4C3, which begins at the Willow-500 kV substation in census tract 2 of Cochise County, passes through the greatest number of potential environmental justice tracts. These are among the most densely populated areas within the Project study area and run through the Tucson metropolitan area. Due to the large number of census tracts, Subroute 4C3 environmental

justice populations are summarized as those that are located within 1 mile of Subroute 4C3, and those that are located between 1 and 3 miles of Subroute 4C3 (Table 3-72 and Table 3-73). The majority of potential environmental justice populations in these census tracts comprise low-income and Hispanic or Latino populations.

Local Alternative Links for Route Group 4

The Pantano-Rillito local alternative links (F81a and F81b) within Subroute 4C3 traverse the northern portions of Tucson. These links would affect much fewer potential environmental justice populations than the southern Tucson route. The majority of the census tracts just north of this route is characterized by higher income levels and lower numbers of minority populations. The population just south of links F81a and F81b is characterized by lower income populations similar to the southern routes. Fourteen census tracts within 1 mile south of these links have higher percentages of low-income residents as compared to the state of Arizona. Unlike the southern Tucson routes, no census tract within 1 mile of F81a and F81b has a minority population greater than 50 percent of the total tract population. Outside of 1 mile, both low-income and minority populations can be found. Some potential environmental justice populations identified within Subroute 4C3, particularly those along Link F111 in southern Tucson, are located within proximity to F81a and F81b. However, the alternative links that run through the northern portions of Tucson are in proximity to fewer potential environmental justice populations.

Table 3-72. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (within 1 mile of the Proposed Route)

		Type of Environmental Justice Population		
County	**Census Tract**	**Low-Income**	**Hispanic or Latino**	**Other Minority**
Pinal	12	●		
Pima	1	●		
	2	●	●	
	3	●		
	4	●		
	9	●		
	10	●	●	●
	11	●	●	●
	12	●	●	●
	13.02	●	●	
	21	●	●	●
	22	●	●	●
	23	●	●	
	24	●	●	●
	25.01	●	●	
	25.03	●	●	

Table 3-72. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (within 1 mile of the Proposed Route)

		Type of Environmental Justice Population		
County	**Census Tract**	**Low-Income**	**Hispanic or Latino**	**Other Minority**
	41.04	●	●	●
	41.10	●	●	●
	41.11	●	●	●
	41.12	●	●	●
	44.07	●	●	●
	44.12	●		
	44.14		●	
	44.15		●	
	44.18	●		
	45.04	●	●	
	45.06	●		
	45.09	●		

Source: U.S. Census 2009: 2005-2009 ACS

Table 3-73. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (between 1 and 3 miles of the Proposed Route)

		Types of Environmental Justice Population		
County	**Census Tract**	**Low-Income**	**Hispanic or Latino**	**Other Minority**
Pinal	21	●		
Pima	5	●		
	6	●		
	7	●		
	8	●	●	
	13.01	●	●	
	14	●		
	14.14		●	
	15	●		
	16	●		
	20	●	●	
	25.04	●	●	
	26.01	●	●	
	26.02	●		

Table 3-73. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (between 1 and 3 miles of the Proposed Route)				
		Types of Environmental Justice Population		
County	Census Tract	Low-Income	Hispanic or Latino	Other Minority
	27.01	●		
	35.01	●	●	
	37.01	●	●	
	37.02	●	●	●
	37.04	●	●	●
	38.01	●	●	
	38.02	●	●	
	39.01	●	●	
	39.02	●	●	
	41.06	●	●	
	43.10		●	●
	44.11	●		
	44.19	●		
	44.20	●		
	45.07	●		
	45.08	●		
	46.26	●		
Source: U.S. Census 2009: 2005-2009 ACS				

3.15 HEALTH AND SAFETY/HAZARDOUS MATERIALS

3.15.1 Introduction, Methods, and Regulatory Framework

3.15.1.1 Introduction

The Health and Safety/Hazardous Materials section includes documentation and discussion of EMF, and environmental contaminants occurring in the 0.2-mile-wide study corridors (0.1 mile on either side of the reference centerline).

3.15.1.2 Methods

Publicly available databases were reviewed to obtain information regarding Superfund sites[1] and leaking underground storage tanks (LUST). The Comprehensive Environmental Response,

[1]A Superfund site is an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people.

Compensation, and Liability Information System (CERCLIS) contains data on potentially hazardous waste sites that have been reported to the EPA and on sites listed on the National Priorities List (NPL). The ADEQ, NMED, and EPA were queried regarding available data; these data were used to assess proximity and location of sites in relation to the proposed corridors.

3.15.1.3 Regulatory Framework

Federal Laws

Environmental Protection Agency

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. CERCLA (USC 42 Chapter 103) provides the broad federal authority to respond directly to the release or the threatened release of hazardous substances that may endanger public health or the environment. It establishes requirements concerning closed and abandoned hazardous waste sites; provides for liability of persons responsible for the release of hazardous waste; and establishes a trust fund to provide for cleanup when no responsible party can be identified. It also enables the revision of the National Contingency Plan (Title 40 CFR Part 300), which provides the guidelines and procedures needed to respond to the release or the threatened release of hazardous substances, pollutants, and/or contaminants. The National Contingency Plan also established the NPL. CERCLA was amended by the Superfund Amendments and Reauthorization Act on October 17, 1986.

The Resource Conservation and Recovery Act of 1976 (RCRA) (USC 42 Chapter 82) established a program administered by the EPA for the regulation of the generation, treatment, storage, and disposal of hazardous waste. The RCRA was amended in 1984 by the Hazardous and Solid Waste Amendments, which affirmed and extended the "cradle to grave" system of regulating hazardous wastes. The "cradle to grave" management system ensures that hazardous waste is managed safely through its life-cycle ensuring safe transportation, treatment, storage, and disposal.

As part of the CWA, the EPA oversees and enforces the Oil Pollution Prevention regulation contained in Title 40 of the CFR, Part 112; often referred to as the "SPCC rule," because the regulations describe the requirements for facilities to prepare, amend, and implement Spill Prevention, Control, and Countermeasure Plans. A project is subject to these regulations if there is a reasonable expectation that there may be discharge of oil into or upon Navigable Waters of the United States.

Occupational Safety and Health Administration

The OSHA's mission is to ensure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health. OSHA staff establishes and enforces protective standards, and reaches out to employers and employees through technical assistance and consultation programs. OSHA standards are listed in Title 29 CFR Part 1910.

Bureau of Land Management

The BLM engages in hazardous material emergency response actions, site evaluations, and prioritization of cleanups in accordance with laws and regulations. This involves working with the EPA, state environmental quality departments, counties, and responsible parties (both public and private) to fund and expedite the cleanup of hazardous sites within their jurisdictions. Sites that are an imminent threat to public health and safety, or that are under a consent order—a voluntary agreement between a state or federal agency and a responsible party to settle a dispute—and therefore able to generate penalties and fines, are a BLM priority.

State Laws

New Mexico

Within the NMED, the Occupational Health and Safety Bureau has the responsibility of enforcing the Occupational Health and Safety Regulation within New Mexico. As applicable to the Project, New Mexico has adopted federal OSHA regulations.

The Hazardous Waste Bureau, also part of the NMED, is tasked with providing regulatory oversight and technical guidance to New Mexico hazardous waste generators and treatment, storage, and disposal facilities as required by the New Mexico Hazardous Waste Act (Chapter 74 Article 4 NMSA 1978) and regulations promulgated under the Act. Under the New Mexico Hazardous Waste Act, all underground storage tanks (UST) are required to be registered with the state. Additionally, the Hazardous Waste Bureau monitors hazardous waste and Superfund sites, coordinating the latter with the EPA.

Arizona

Within the ADEQ, the Waste Programs Division has been tasked with protecting and enhancing public health and the environment by reducing the risks associated with waste management, contaminated sites, and regulated substances. The Division ensures the proper handling, storage, treatment and disposal of wastes, and proper operation and maintenance of USTs. The division also investigates complaints and violations regarding hazardous waste and USTs. Arizona state laws regarding the standards and inspection requirements for USTs are stipulated in ARS Title 49 Chapter 6, Electric and Magnetic Fields.

3.15.2 Electric and Magnetic Fields

There are currently no laws regulating levels of EMFs; however, there is public concern regarding possible health hazards from the delivery and use of electric power. EMFs are phenomena that occur both naturally and as a result of human activity. Naturally occurring EMFs are caused by the weather and Earth's geomagnetic field. Magnetic fields associated with transmission lines are created when current flows through power lines. The strength of the fields is determined mainly by line current, line height, and distance.

Electrical transmission and distribution systems are not the only sources of magnetic fields. Local sources include homes and workplaces, and their respective electric wiring and appliances. Typical magnetic levels from common household appliances are provided in Table 3-74.

Table 3-74. Typical 60 Hz Magnetic Levels of Common Household Products

Product	Magnetic Field 6 Inches from Product (mG)	Magnetic Field 2 Feet from Product (mG)
Electric Shaver	100	–
Vacuum Cleaner	300	10
Electric Oven	9	–
Dishwasher	20	4
Microwave Oven	200	10
Hair Dryer	300	–
Computers	14	2
Fluorescent Lights	40	2
Fax Machine	6	–
Copy Machines	90	7
Garbage Disposals	80	2

Source: Western Area Power Administration 2005
mG – milliGauss
Hz – hertz

The electrical effects of transmission lines are those related to electric fields, magnetic fields, and corona. Electric fields from power lines are directly dependent on the line voltage (i.e., field strength is reduced as the distance from the source increases). EMFs can also interfere with computer monitors, cardiac pacemakers, and defibrillators. Table 3-75 lists typical EMF levels associated with 115 kV, 230 kV, and 500 kV transmission lines.

Table 3-75. Typical 60 Hz EMF Levels from Overhead Power Lines

Line Voltage	Centerline	Approximate Edge of Right-of-Way	100 feet	200 feet	300 feet
115 kV					
Electric Field (kV/m)	1.0	0.5	0.07	0.01	0.003
Magnetic Field (mG)	30	6.5	1.7	0.4	0.2
230 kV					
Electric Field (kV/m)	2.0	1.5	0.3	0.05	0.01
Magnetic Field (mG)	57.5	19.5	7.1	1.8	0.8
500 kV					
Electric Field (kV/m)	7.0	3.0	1.0	0.3	0.1
Magnetic Field (mG)	86.7	29.4	12.6	3.2	1.4

Source: Western Area Power Administration 2005
kV/m – kilovolts per meter

3.15.3 Audible Noise

At the surface of high-voltage power line conductors, the electric field may become concentrated on surface irregularities and cause an electrical breakdown of the insulating properties of the air, resulting in power loss at the site of breakdown (i.e., corona). Corona can result in audible noise, particularly when the surrounding air contains numerous water droplets or snowflakes. If there is sufficient corona activity, audible noise can be noticeable within a few hundred feet of the transmission line. The intensity is most pronounced directly beneath line conductors, and decreases with increased distance from the transmission line.

Corona activity depends on a number of factors: altitude, line voltage, conductor size, conductor geometry, and weather conditions. Corona activity is most likely to occur near transmission lines at higher altitudes and is most pronounced during foul weather. The breakdown strength of air is 30 kV per centimeter at sea level, and decreases with increasing altitude. A transmission line is designed so that at a particular altitude, conductor size, and line voltage, the electric field at the conductor surface does not exceed the breakdown potential. Nevertheless, any irregularities on the conductor surface (e.g., nicks, water droplets, or debris) will create points where the electric field is intensified sufficiently to produce corona.

When corona occurs on 500 kV transmission line conductors, it is accompanied by an audible snapping sound. If there is enough corona activity on the line, many small snaps from corona sources along a conductor may be sufficient to produce discernible audible noise (sizzling or crackle) at the edge of the right-of-way.

Sound level is measured in decibels (dB) referenced to 20 micropascals, which is approximately the pressure threshold of human hearing at 1 kilohertz (kHz). The range of audible frequencies for the human ear is approximately 20 Hz to 20 kHz, with peak sensitivity near 1 kHz. Sound at 20 Hz or 20 kHz, where the ear is less sensitive, is given much less weight than at frequencies near 1 kHz, where the ear is most sensitive. The weighting of sound over the frequency spectrum to account for the sensitivity of the human ear is called the A-weighted sound level.

When the A-weighting scale is applied to a sound-pressure measurement, the level is often reported as dBA (A-weighted decibel), referenced to the audible pressure threshold. The sound level of typical human speech is approximately 60 dBA, and background levels of noise in rural and urban environments are approximately 30 to 40 dBA. Specific identifiable noises such as birdcalls, neighborhood activity, and traffic can produce audible noise levels of 50 to 60 dBA. Table 3-76 lists the sound intensities of common acoustic sources.

Table 3-76. Commonly Encountered Acoustic and Audible Noise Levels

Source	A-Weighted Sound Level (dBA)
Automobile horn	110
Inside subway	95
Traffic	75
Conversation	65
Office	55
Living Room	45

Table 3-76. Commonly Encountered Acoustic and Audible Noise Levels	
Source	**A-Weighted Sound Level (dBA)**
Library	35
Bedroom	24

Corona-generated audible noise varies at different times to account for fluctuating sound levels; statistical descriptors are used to describe environmental noise. Exceedance levels (L levels) refer to the A-weighted sound level that is exceeded for a specified percentage of the time. Thus, L_5 refers to a noise level that is exceeded only 5 percent of the time, L_{50} refers to a sound level exceeded 50 percent of the time, etc. Sound-level measurements are expressed in the L_{50} level (median level) in fair and foul (steady rain) conditions.

3.15.4 Summary of Inventory Results

Existing and past land uses are indicators of hazardous materials storage or use. A limited review of environmental databases was conducted to identify known hazardous waste sites within the study corridors.

3.15.4.1 CERCLIS Sites

A search of publicly available databases was used to determine if there were any NPL sites or Superfund sites within the study corridors. No sites were located within the study corridors in New Mexico (NMED 2011; EPA 2011g). A total of three sites were identified in Arizona within the study corridor in the Tucson metropolitan area, using the CERCLIS database and data provided by the ADEQ (Table 3-77). None of the sites identified is on the NPL.

Table 3-77. CERCLIS Sites within the Study Corridors in Arizona			
Route	**CERCLIS ID**	**Site Name**	**Location**
Pantano-Rillito Subroute (Link F81a)	AZD983471418	Broadway Landfill – South	South of intersection of E Broadway Blvd and S Prudence Rd.
Pantano-Rillito Subroute (Link F81a and F81b)	AZD983471426	Broadway Landfill – North	North of intersection of E Broadway Blvd and S Prudence Rd.
Pantano-Rillito Subroute (Link F81b)	AZD980813216	El Camino del Cerro Landfill	0.25 mile west of I-10 and El Camino Blvd.
Source: ADEQ 2009; EPA 2011g			

3.15.4.2 Underground Storage Tanks

According to the NMED, there are currently 16 USTs located within 1 mile of the proposed routes within New Mexico (NMED 2011). All are located underneath gas stations that may or may not still be operational, and none of these is located within 600 feet of the Project centerline.

According to the ADEQ, there are currently 886 USTs located within 1 mile of the proposed routes within Arizona. Of these, 35 are located within 600 feet of the Project centerline; 30 along Subroute 4C3, on links F111 and F112 (Table 3-78); and 5 within 600 feet of the Pantano-Rillito Local Alternative Subroute centerline along Link F81b (ADEQ 2009).

Table 3-78. Underground Storage Tanks within 600 Feet of the Project Centerline				
Route	**Non-Leaking**	**Leaking**	**Priority-Leaking**	**Total**
Pantano-Rillito Subroute (Link F81b)	1	4	0	**5**
Subroute 4C3 – Willow-500 kV Substation to Pinal Central Substation (Link F111)	6	12	0	**18**
Subroute 4C3 – Willow-500 kV Substation to Pinal Central Substation (Link F112)	1	6	5	**12**
Source: ADEQ 2009				

Five USTs are designated priority leaking sites. All five are located at a single gas station at the intersection of West St. Mary's Road and I-10, on the west side of Tucson.

CHAPTER 4 – ENVIRONMENTAL IMPACTS

4.1 INTRODUCTION

This chapter describes the effects or impacts, including the potential cumulative effects of the Project, on the environment that potentially could result from the action alternatives described in Chapter 2; specifically the construction, operation, and decommissioning of the 500 kV transmission lines, substations, and associated facilities. Also described are the effects of not building the proposed Project (No Action alternative).

The information regarding the existing condition of the environment in Chapter 3 is the baseline that was used to measure and identify potential impacts resulting from the Project. The EIS considered and incorporated mitigation, where appropriate, before arriving at the impacts described in this chapter.

An impact, or effect, is a modification to the environment brought about by an outside action. Impacts vary in significance from no change, or only slightly discernible change, to a full modification or elimination of the environmental condition. Impacts can be short-term, long-term, or permanent. According to the BLM NEPA Handbook, section 6.8.1.1 "…effects analysis predicts the degree to which the resource would be affected upon implementation of an action. Effects can be ecological, aesthetic, historic, cultural, economic, social, or health. Effects may also include those resulting from actions that may have both beneficial and detrimental effects" (BLM 2008).

Short-term or temporary impacts typically are associated with construction activities, where the environment generally would revert to preconstruction conditions at or within a few years of the end of construction. For the Project, short-term or temporary impacts are those that would occur from the time that ground-disturbing activities begin, through reclamation (anticipated to be approximately 5 years), when vegetation has been re-established in construction areas such as temporary access roads, staging areas, batch plants, wire pulling and tensioning sites, etc. Long-term or permanent impacts are those that would occur through the life of the Project or beyond. The life of the Project is estimated to be a minimum of 50 years.

An action can have direct or indirect effects, and can contribute to cumulative effects. Direct effects occur at the same time and place that an action is being performed. Indirect effects occur later in time or farther from the initial action, but are still reasonably foreseeable. Cumulative effects result from a proposed action's incremental impacts, when these impacts are added to the impacts of other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes them (federal or nonfederal).

4.1.1 Methods

The method of environmental impact analysis included the assessment of initial impacts, mitigation planning, and assessment of residual impacts, and is described as follows.

4.1.1.1 Assessment of Initial Impacts

Based on the Project description and resource data reflecting the affected environment, each resource specialist identified the types and amounts of impacts that could occur (i.e., initial impacts). The potential vulnerability of each resource as affected by the Project was considered both qualitatively and quantitatively in predicting the intensity of initial impacts, and was evaluated against the following:

- *Resource significance* – a measure of formal concern for a resource through legal protection or by designation of special status
- *Resource sensitivity* – the probable response of a particular resource to Project-related activities
- *Resource quality* – a measure of rarity, intrinsic worth, or distinctiveness, including the local value and importance of a resource
- *Resource quantity* – a measure of resource abundance and the amount of the resource potentially affected

Some resources are more conducive to quantification than others. For example, impacts on vegetation can be characterized partly by measuring the area of potential ground disturbance, and air quality can be measured against air quality standards. Where other resources are difficult to quantify, levels of impact were based on best available information and professional judgment. For the purposes of analysis for this Project, the intensity of impacts was described using the following levels:

- *High* – impacts that could cause substantial change or stress to an environmental resource or use (severe adverse or exceptional beneficial effects); or significant impacts
- *Moderate* – impacts that could potentially cause some change or stress to an environmental resource or use (readily apparent effects)
- *Low* – impacts that could be detectable, but slight; or no identifiable impacts

The definitions of a low, moderate, or high impact are specific to each resource, and impact levels may be more specifically defined to include moderate-high and low-moderate categories. Resource-specific impact-level criteria are described in the respective sections in this chapter, and detailed results are included in Appendix H, Resource Impact Analysis Data.

The impact assessment is based on the Project's effects to resources within the study corridors for each of the alternatives (see Section 3.1). The assessment identified the likely impacts that would result from full implementation of the Project utilizing either Option A or Option B. Where applicable, the individual resource sections identified how impacts would differ between these two options. To facilitate the analysis, the study corridors are centered on the "reference centerline," the precise location of which would be determined through engineering surveys of the selected route prior to construction. The assessment also addressed short- and long-term impacts that would result from construction and operation of access roads, substations, converter stations, fiber optic equipment and regeneration stations, and ancillary facilities located within the study corridor. The description of these Project facilities, based on preliminary design

concepts, is provided in Chapter 2 and the Draft POD. Site-specific Project details and mitigation measures, based on final engineering design and surveys, would be developed in conjunction with the Final POD.

The assessment of initial impacts included an estimate of the types and amount of ground disturbance that could occur based on the design and typical specifications of the proposed facilities, construction techniques and equipment used, extent and duration of the construction, and requirements for operation of the transmission line and associated facilities. Other factors for assessment included activities associated with routine maintenance and decommissioning.

Potential impacts primarily would result from the following construction activities:

- Upgrading existing roads or constructing new roads for access where needed
- Preparing structure sites, staging areas, regeneration station site, substation sites, electrode facility, and batch plant site
- Assembling and erecting structures
- Stringing conductors (e.g., wire pulling and splicing sites)

In addition, impacts on some resources would occur following construction, resulting from the presence of the transmission lines and access roads, and from periodic maintenance activities.

The amount of ground surface that could be disturbed as the result of implementation of the Project was estimated based on the typical design characteristics of the 500 kV transmission Project (see Section 2.4, Description of Proposed Action and Plan of Development), including structure sites, staging areas, and batch plant site. The estimated ground disturbance also includes substations and ancillary facilities (areas of disturbance for substations are included in Table 2-6). The estimated ground disturbance associated with using existing access roads, or upgrading or constructing access roads (see Table 2-7) was also considered. Estimates were based on assigned access levels that considered slope, miles of new or existing roads required, and potential spur roads required (see Section 2.4.10.1, Access Roads).

Table 4-1 summarizes the anticipated ground disturbance in acres associated with the construction of each alternative subroute. Temporary ground disturbance during construction would be associated with structure work areas, wire-splicing sites, wire pulling sites, wire tensioning sites, construction yards, and a concrete batch plant. Permanent ground disturbance is estimated to include transmission line structure base areas, substations, ancillary facilities, and permanent access roads.

Table 4-1. Ground Disturbance

Subroute	Length of Subroute (miles)	Ground Disturbance			
		Temporary Disturbance		Permanent Disturbance	
		acres	acres/mile	acres	acres/mile
1A1	228.8	1,813	7.9	1,238	5.4
1A2	230.3	1,819	7.9	1,270	5.5
1A	219.5	1,739	7.9	1,196	5.4

Table 4-1. Ground Disturbance					
Subroute	Length of Subroute (miles)	Ground Disturbance			
		Temporary Disturbance		Permanent Disturbance	
		acres	acres/mile	acres	acres/mile
1B1	223.6	1,772	7.9	1,189	5.3
1B2	209.2	1,657	7.9	1,121	5.4
1B3	206.3	1,635	7.9	1,106	5.4
3A2	123.9	979	7.9	673	5.4
3A	123.4	978	7.9	665	5.4
3B	128.6	1,019	7.9	638	5.0
4A	132.9	1,053	7.9	778	5.9
4B	133.0	1,054	7.9	793	6.0
4C2c	161.2	1,277	7.9	928	5.8
4C1	139.0	1,101	7.9	802	5.8
4C2	151.8	1,203	7.9	870	5.7
4C3	172.9	1,370	7.9	892	5.2

Impacts associated with ancillary facilities—including, but not limited to, substations, regeneration stations, and access roads—are assumed to be located and taken into account within the study corridor analyzed for the transmission line. Site-specific details are not available at this time; site-specific location and mitigation will be developed in conjunction within the Final POD.

4.1.1.2 Mitigation Planning

Mitigation includes specific means, measures, or practices that would reduce or eliminate effects of a proposed action or alternatives, and may be used to reduce or avoid adverse impacts to environmental resources, whether or not they are significant in nature. Standard mitigation measures were incorporated in the assessment of initial impacts for all alternatives considered in the detailed analysis. These measures typically address specific environmental policies, BMPs, planning guidelines, or regulatory requirements. Standard mitigation measures are listed in Table 2-10 (Chapter 2).

After the identification of initial impacts for each resource, selective mitigation measures to reduce or minimize impacts were considered in the analysis of residual impacts. Selective mitigation measures were developed in collaboration with the BLM and cooperating agencies, including measures or techniques recommended or required after initial impacts were assessed. Selective mitigation measures provide a planning tool for minimizing potential adverse impacts and, in most cases, would be considered for moderate to high impacts. Where warranted, selective mitigation measures were recommended to reduce potential impacts in specific locations. A list of these selective mitigation measures is provided in Table 2-11 (Chapter 2).

For each alternative subroute, mitigation measures were identified that would reduce the potential impact of the Project on a particular resource. While selective mitigation measures were identified with respect to the occurrence of resource impacts, the specific locations and

sequencing of such measures would be determined in the Final POD. Prior to construction, the Applicant would coordinate with the BLM and other land-management agencies or landowners, as appropriate, to refine the implementation of mitigation at specific locations or areas. For example, if a road closure were recommended, the Applicant would work with the land-management agency or landowner to determine the specific method of road closure most appropriate for the site or area (e.g., barricading with a locking gate, obstructing access on the road). Detailed mitigation will be incorporated into the POD prior to Project construction.

4.1.1.3 Assessment of Residual Impacts

Residual impacts are the environmental effects that remain after selective mitigation measures are applied. The level of residual impact is determined by how effective the mitigation is in reducing or avoiding the initial impact. Locations and intensities of potential residual impacts anticipated to occur from construction and operation of the transmission line along the reference centerline were assessed for each alternative route and described for each resource in this chapter. The results of the impact analyses are included in tables (Appendix H) and displayed as color-coded centerlines on each resource map (Map Volume). Figure M 1-1, Jurisdiction and Ownership, shows the locations of all alternative link centerlines, land ownership, and jurisdictional boundaries within the study area. Several of the alternative routes considered in this EIS share common links and would result in similar environmental effects. Rather than repeating information, descriptions of alternative routes have been abbreviated, as appropriate, to focus on the effects unique to an alternative.

4.1.1.4 Impacts of Decommissioning

The term of the BLM right-of-way grant to allow use of federal land would be limited to 50 years, although the useful life of the Project facilities is projected to be at least 50 years and up to 75 years. Should the right-of-way and facilities no longer be needed, the transmission lines and associated facilities would be decommissioned. Subsequently, conductors, insulators, concrete pads, and hardware would be dismantled and removed from the right-of-way. All areas of permanent disturbance would be restored in accordance with a Termination and Reclamation Plan to be developed by the right-of-way grant holder, and approved by the BLM Authorized Officer.

Impacts resulting from the decommissioning process would be similar in scope to the impacts that occur during construction of the Project. The amount of ground disturbance for access to the Project facilities would be within the amount of land disturbed during construction. Although impacts associated with decommissioning are anticipated to be similar to the impacts during construction, potential impacts and the timeframe of decommissioning are considered speculative and, therefore, cannot be meaningfully analyzed within each resource section. As described in the Draft POD, procedures would be implemented under the direction of the land management agencies or owners, in compliance with applicable regulations and guidelines.

4.2 CLIMATE AND AIR QUALITY

4.2.1 Introduction

Emissions of air pollutants would occur during construction of the transmission lines and substations and, to a lesser extent, during the Project operations phase. This section provides the estimated amounts of criteria pollutant emissions that would occur during construction of the proposed Project for each of the subroutes under consideration. Where feasible, potential GHG emissions have also been quantified and reported in this section (the potential impact of GHG emissions on climate is discussed in Section 4.17.4.2). Emissions from construction activities would be confined to daytime hours and would occur only during active construction periods. In addition, emissions would be transient as construction progresses, so emissions would not occur in one area for a long duration, thereby limiting their impact. Ambient pollutant concentrations resulting from specific construction activities have been quantified and compared with applicable ambient standards.

In general, emissions have not been quantified for the operation of the transmission lines and substations, with the exception of GHG emissions from circuit breakers. During the operations phase, emissions would be limited primarily to vehicular use for routine maintenance and emergency repair activities. The sources would be similar to those from construction, but pollutants would be emitted in much smaller amounts on an annual basis; therefore, the majority of emissions and impacts would be associated with construction.

Only the No Action alternative would result in no Project-related emissions or impacts. Where emissions and ambient concentrations are below EPA- or state-defined *de minimis* levels, the impacts would be considered low. More substantial emissions and impacts that do not result in potential ambient standard exceedances would be considered moderate. Potential exceedances of ambient standards would represent high impact levels.

The following categories of emission sources have been considered:

- Fugitive dust from earth moving activities associated with construction or expansion of the transmission lines, substations, and concrete batch plants
- Paved and unpaved road dust associated with construction or expansion of the transmission lines, substations, and concrete batch plants, as well as operation of the concrete batch plants
- Traffic (tailpipe) emissions from on-road vehicles associated with construction or expansion of the transmission lines, substations, and concrete batch plants, as well as operation of the concrete batch plants
- Exhaust emissions from nonroad engines (i.e., construction equipment) associated with construction or expansion of the transmission lines, substations, and concrete batch plants
- Helicopter emissions associated with construction of the transmission lines
- Emissions from concrete batching operations
- Emissions of GHGs from circuit breakers at the substations

Reasonable and feasible mitigation measures have been incorporated into the emission estimates. Best available control measures are often defined and, in some jurisdictions, required for use in controlling fugitive dust from construction operations, as well as from both paved and unpaved roads. The EPA has defined requirements for diesel nonroad engine emissions by model year (Tier standards). The use of Tier 3 engines is assumed as the default for quantification of diesel equipment emissions, except where no Tier 3 standard is available for a given engine size range (e.g., Tier 2 was used for equipment < 50 horsepower). The on-road emission factors used in this analysis include the effects of vehicle fleet turnover in reducing tailpipe emissions over time.

4.2.2 Impact Assessment Methodology

This section describes the methods used to calculate emissions and to estimate ambient impacts for the transmission lines, substations, and concrete batch plants. Regulatory requirements potentially applicable to Project components are discussed, and the analysis of general conformity is described. Emissions, impacts, regulatory requirements, and the results of the conformity analysis are presented in Section 4.2.3.

4.2.2.1 Significant Impacts

With respect to air quality, effects have been analyzed by calculating emissions of the major regulated pollutants from construction and operation of the transmission lines and substations. Emissions from construction and maintenance sources such as traffic, construction equipment, fugitive dust from earthmoving, etc., are generally not subject to federal or state limitations; but in some cases do require mitigation (such as watering of disturbed areas) or are indirectly regulated through limitations imposed on the subject equipment itself (e.g., motor vehicle tailpipe standards or diesel engine performance standards). Due to the lack of any direct limitations with which to compare them, significant impacts on air quality are not determined based on project emissions in and of themselves.

However, in addition to tallying Project emissions, a screening-level impact analysis was performed using a dispersion model to predict ambient concentrations of pollutants due to Project activities that have the most potential to exceed standards. Ambient levels of several pollutants are limited by national and/or state ambient air quality standards, which regulate concentrations of pollutants in the atmosphere due to all sources of emissions. A significant impact on air quality would occur if ambient concentrations resulting from mitigated Project emissions, when added to representative background concentrations of the subject pollutants due to all other sources, would exceed any national or state ambient air quality standard.

4.2.2.2 Emission Calculation Methods

During construction, sources of PM_{10} and $PM_{2.5}$ would include grading and earthmoving associated with the development of access roads and work pad and substation areas, digging and drilling to prepare for the structure foundations, constructing and operating the concrete batch plants, and vehicular traffic. Particulate matter emissions from traffic include both tailpipe emissions from fuel burning, and fugitive dust from traffic on paved and unpaved roads.

On-road vehicles and nonroad engines (i.e., construction equipment) would release nitrogen oxides (NO_x); CO; SO_2; hydrocarbons, including volatile organic compounds (VOC); and GHGs, including CO_2, methane (CH_4), and nitrous oxide (N_2O). Fuel combustion in helicopters would release the same pollutants.

The primary emission sources associated with the operations phase of the transmission lines would include windblown dust from ground disturbance, road dust, and vehicle emissions during periodic maintenance or emergency repair activities. In addition, the circuit breakers at each of the substations would be filled with SF_6, a GHG. There would be a small amount of ongoing leakage of SF_6 over time, resulting in emissions of this pollutant.

As noted above, because operations emissions and impacts would be much lower than construction phase emissions and impacts, they have not been quantified; with the exception of SF_6 from the circuit breakers.

Fugitive Dust from Transmission Line, Substation, and Batch Plant Construction

Fugitive dust was estimated from construction of the transmission lines and substations. In addition, fugitive dust emissions were quantified for construction of concrete batch plants, located approximately every 30 miles along the right-of-way.

Uncontrolled fugitive dust emission factors of 0.42 ton PM_{10} per acre per month and 0.042 ton $PM_{2.5}$ per acre per month were used for access road construction; while uncontrolled fugitive dust emission factors of 0.11 ton PM_{10} per acre per month and 0.011 ton $PM_{2.5}$ per acre per month were used for other construction activities, including construction of the substations and batch plants used (Countess Environmental 2006; Midwest Research Institute 2005; EPA 2001). For the transmission lines, the earthmoving and grading activities were assumed to be half for access roads and half for other activities, and average emission factors of 0.27 ton PM_{10} per acre per month and 0.027 ton $PM_{2.5}$ per acre per month were used (Countess Environmental 2006).

A control efficiency of 61 percent for watering, as needed, and application of dust suppressant, if warranted (i.e., if watering is insufficient to prevent visible emissions > 20 percent opacity, or other opacity or dust control specifications), was applied to uncontrolled emissions, based on work sponsored by the WRAP (*ibid*).

Dust from paved and unpaved roads was estimated using vehicle counts supplied by Project engineers for each transmission line option and substation; roads were assumed to be 60 percent unpaved and 40 percent paved. Vehicle counts were converted to total vehicle miles travelled (VMT), assuming average speeds of 45 mph on paved roads and 20 mph on unpaved roads (limitation of speed on unpaved roads is also a mitigation measure), as well as the hours per day each vehicle was expected to be used, as estimated by Project engineers.

Paved and unpaved road emissions for construction of the batch plants were scaled from calculations performed for one of the substations based on the ratio of acreage disturbed for the substation and the batch plants. Additional paved and unpaved road emissions were estimated for batch plant operation, based on the expected number of loads of raw materials delivered to the

plants. The number of raw material loads needed is a function of the expected cubic yards of concrete required for transmission lines and substation construction.

Emissions were calculated using spreadsheet models developed by WRAP (2009). In addition to speed control, mitigation measures would include dust suppressant application on unpaved roads, if warranted (i.e., when dust generation is observed despite imposition of other mitigation measures); frequent watering of unpaved roads (twice daily assumed); and prompt removal of dirt tracked onto paved roads. Construction traffic associated with the Pinal Central Substation was assumed to use only paved roads, based on the character of the existing roads in the vicinity of the substation.

Both earthmoving/grading fugitive dust and dust from paved and unpaved roads for transmission lines and substation construction were apportioned over the Project duration for options A and B, based on relative month-by-month schedules for each activity supplied by Project engineers. Emissions from construction-related fugitive dust were assumed to occur, based on the expected timing of road or pad construction and foundation installation for each option. Emissions from paved and unpaved roads were assumed to occur based on the fraction of total activity occurring in each month, since all activity has associated vehicle traffic, not just road/pad and foundation activities. The monthly emissions thus obtained were summed to provide total emissions during each year of Project activity. Total batch plant construction and paved and unpaved road emissions were calculated, but not apportioned to months.

Traffic Emissions

A number of support vehicles would be used during Project construction, including a fleet of pickup trucks, flatbed trucks, and other vehicles such as concrete and boom trucks. As each of these vehicles would emit regulated pollutants, the emissions of these pollutants were calculated using the EPA's Mobile6 emission model (EPA 2003). Mobile6 calculates emission factors for various vehicle types based on grams of pollutant emitted per vehicle-mile basis. Emission factors obtained from Mobile6 included those for NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, VOC, and CO_2. Emission factors for CH_4 and N_2O for various types of vehicles were taken from *Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from Mobile Combustion Sources* (EPA 2008).

Mobile6 inputs included use of low-altitude mode and conventional Western gasoline composition. Total pound per day emissions were based on the Mobile6 emission factors and the number of VMT for each vehicle type, as estimated in the paved and unpaved road dust task described above. These emission factors were applied to the various vehicle classes based on size and fuel used. For diesel fueled equipment, 15 ppm sulfur content was assumed (as required after June 2010; see 40 CFR 80, Subpart I).

As with fugitive dust, emissions for the transmission lines and for each of the substations were apportioned over the Project schedule for both of the options. In this case, the relative fractions of total Project activities occurring in each month were used to apportion emissions, rather than just road/pad and foundation activities, since vehicle traffic is associated with all activities involved in transmission line and substation construction.

Emissions from traffic associated with batch plant construction were scaled from one of the substations, based on relative disturbed areas.

Construction Equipment Emissions

Nonroad engine exhaust emissions for the Project were estimated on a monthly basis, using the equipment information and schedules provided for each transmission line and substation option. Nonroad engine emission factors were selected based on the type and size of engine. Emission factors for criteria pollutant emissions from diesel engines were taken from federal emission standards applicable to nonroad engines (EPA 2010b), with the exception of SO_2 emission factors. Engines were assumed to be Tier 3.

The SO_2 emission factor for diesel engines was estimated based on an equation given in EPA document NR-009A (*Exhaust Emission Factors for Nonroad Engine Modeling — Compression-Ignition*) (EPA 1998) and the federal diesel fuel sulfur content limitation of 15 ppm. Emission factors for gasoline engines were taken from EPA document 420R-05-019 (*Exhaust Emission Factors for Nonroad Engine Modeling — Spark-Ignition*) (EPA 2005a). The SO_2 emission factor for gasoline engines was estimated based on an equation presented in EPA document NR-0010b (*Exhaust Emission Factors for Nonroad Engine Modeling — Spark Ignition*) (EPA 1999).

Assumptions made in emission factor selection and emission calculations are listed as follows:

- PM emission factors were used to conservatively estimate emissions for PM_{10} and $PM_{2.5}$.
- Where available, nonmethane hydrocarbon (NMHC) emission factors were used to estimate VOC emissions. Where only HC emission factors were available, these emissions were conservatively used to estimate VOC emissions.
- The Tier 3 diesel VOC emission factor for equipment 50-750 hp was assumed to be 0.2 gram per brake horsepower-hour, based on page 7 of EPA document NR-009A.
- The Tier 3 diesel NO_x emission factor was estimated from the difference of the NMHC and NO_x emission standard, and the assumed 0.2 gram per brake horsepower-hour emission factor for VOC.
- Brake-specific fuel consumption for diesel engines 50-100 hp was assumed to be 0.408 pound per horsepower-hour, based on Table B-2 of EPA document NR-009A[1].
- Brake-specific fuel consumption for diesel engines >100 hp was assumed to be 0.367 pound per horsepower-hour, based on Table B-2 of EPA document NR-009A[2].
- Gasoline-fueled air compressors were assumed to have phase 2, 4-stroke engines.

Helicopter emissions were estimated based on hours of operation and fuel usage of the MD600 (Hughes 500) helicopter that would be used. Emission information for helicopters was obtained from the Swiss Federal Office of Civil Aviation's document *Guidance on the Determination of Helicopter Emissions*, Edition 1, March 2009 (Federal Office of Civil Aviation 2009).

[1] http://www.epa.gov/oms/models/nonrdmdl/nr-009a.pdf
[2] *ibid*

CO_2 emission factors for gas engines were estimated based on an equation given in the EPA document *Exhaust Emission Factors for Nonroad Engine Modeling — Spark-Ignition* (EPA 2005a). For diesel engines, the CO_2 emission factors were calculated based on an equation in EPA document NR-009d (*Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling — Compression-Ignition*) (EPA 2010b). CH_4 and N_2O emission factors for gas and diesel engines, and CO_2, CH_4, and N_2O emission factors for helicopters were obtained from *Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance — Direct Emissions from Mobile Combustion Sources* (EPA 2008). Global warming potentials for calculating CO_2 equivalent (CO_2e) emissions from 40 CFR 98, Table A-1[1] were used.

Emissions for each of the transmission lines and for each of the substations were apportioned over the Project schedule for each of the options. Month-by-month schedules for each activity were used to apportion the equipment emissions associated with that activity over time.

Concrete Batch Plant Operation Emissions

Concrete batch plants would be constructed and operated to supply concrete for the Project approximately every 30 miles along the right-of-way. Emissions generated in the construction of the batch plants were discussed in previous subsections.

Operation emissions were based on emission factors in the EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) (EPA 2005b) for concrete batching operation (Section 11.12-1). Emissions were based on a total output from all the batch plants of 20,000 cubic yards of concrete for the transmission lines and 2,000 cubic yards for each substation. The concrete was assumed to be truck-mixed. Emissions resulting from traffic involved in bringing raw materials to each batch plant were based on the estimated raw material loads needed to meet the concrete requirements, which were estimated for each transmission line and substation by Project engineers. Trucks transporting raw material to each concrete batch plant were assumed to have an average weight of 20 tons and to travel 100 miles round trip. Batch plant traffic emissions were not apportioned to months.

Substation Operation Emissions

The substations would include circuit breakers containing SF_6, a highly effective dielectric used for interrupting arcs. A potent GHG, SF_6 emissions from the substations would occur as a result of circuit breaker equipment leaks. A leak rate lower than 0.1 percent is obtainable for circuit breakers, even after many years of service (McDonald 2007). SF_6 emissions for each substation have been calculated based on the total SF_6 content of the breakers and application of a 0.1 percent leak rate. CO_2e emissions have been calculated using the SF_6 global warming potential from Table A-1 of 40 CFR 98.

[1]http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&sid=b974f92ac0ea0bb6bf5f94eceeb7dbe0&rgn=div9&view=text&node=40:21.0.1.1.3.1.1.10.11&idno=40

4.2.2.3 Impact Analysis Methods

Construction activities associated with the Project would release regulated pollutants into the atmosphere for subsequent transport. Some of these pollutants may be transported from the immediate area into the surrounding air. A dispersion modeling analysis was conducted to assess probable Project impacts on ambient air quality[1].

The EPA has recently promulgated a new screening-level dispersion model, AERSCREEN, which is a screening version of the EPA's recommended model for near field dispersion analyses, AERMOD. AERSCREEN was used to simulate emissions and transport from transmission line and substation construction for those pollutants for which state or federal ambient standards have been defined. Construction of concrete batch plants was not modeled because the activities are similar to those employed in substation construction (grading, structure erection, etc.), but with much smaller emissions. Similarly, operation emissions from the batch plants were not modeled because they would be negligible (less than 1 ton of particulate matter emissions for all concrete batch plants associated with each potential transmission line).

For the transmission line segments, maximum fugitive dust emissions would occur during access road construction. For the other pollutants, maximum emissions from construction equipment would occur during installation of the transmission line structures. Emissions from helicopter operations, traffic, and paved and unpaved road traffic were not modeled because they would occur over a large area, resulting in negligible impacts at any given location.

Because AERSCREEN can only simulate emissions from a single source for a 1-hour time period, both fugitive dust and construction equipment emissions were modeled as being emitted from an area representing a work site, rather than from individual pieces of equipment, with the size of the site based on expected activities and the width of the transmission line right-of-way. The release height was set to 10 meters, in accordance with procedures recommended by the Colorado Department of Public Health and Environment (CDPHE), Air Pollution Control Division for fugitive sources with substantial turbulence (e.g., equipment activity) (CDPHE 2005). Although CDPHE guidance was developed for a previous screening model, SCREEN3, the recommendation can be reasonably applied to the newer AERSCREEN model as well.

Maximum 1-hour impacts were conservatively assumed to apply to other short-term averaging periods (i.e., 3-hour, 8-hour, and 24-hour). Annual impacts were not estimated because the equipment and other emitting activities would not stay in one location, but would move along the right-of-way as the transmission lines are constructed. The calculated impacts would apply to the construction of the first transmission line in either option. Based on the projected construction schedules, impacts from construction of multiple transmission lines would not overlap in time and space and are therefore not additive.

AERSCREEN requires information about the surface characteristics that may influence dispersion, including representative albedo, Bowen ratio, and surface roughness length.

[1] The impact analysis of Option B, assumed construction of the AC line first and the DC line second. However, such conclusions would be expected to be the same if the sequencing of construction were reversed such that a DC line was constructed first, followed by an AC line.

Maximum and minimum expected temperatures are also entered. Two data sets were used to simulate the conditions that the various route groups would traverse. Annual average albedo, Bowen ratio, and surface roughness for grasslands and for desert shrublands were calculated from seasonal values given in the AERMET[1] User's Guide, tables 4-1, 4-2a, and 4-3 (EPA 2004b). Route groups 1 and 2 used the grasslands data for modeling, along with average maximum and minimum temperature data for Socorro, New Mexico. The remainder of the route groups used the desert shrubland data, along with average maximum and minimum temperature data for Safford, Arizona. Because the daily or hourly emissions from a single work site were modeled, impacts would apply equally to any route group segment or transmission line within the same modeled vegetation community.

VOCs were not modeled because they are regulated as precursors to other pollutants (O_3, PM_{10}), and are generally modeled only as part of regional applications. GHG emissions were also not modeled because there are no ambient standards for GHGs, and they contribute to climate change on a global, rather than local or regional, scale.

For substation construction, maximum emissions of fugitive dust would occur when each site is graded. Maximum emissions of other pollutants would occur during structure work. As with the transmission lines, these activities were simulated as area sources representing a daily work site. One of the larger substations was used to conservatively represent impacts from any of the substations. Modeling for the SunZia East and Midpoint substations used grasslands/Socorro data, while the rest of the substation modeling used desert shrubland/Safford data.

AERSCREEN calculates conservative impacts that are likely to overestimate actual impacts for several reasons. As noted above, 1-hour impacts are applied to all averaging periods. In reality, wind direction varies with time so that over longer averaging periods, the emissions plume becomes more diffuse, with lower impacts at any given location. In addition, AERSCREEN calculates maximum impacts based on worst-case meteorological conditions. The conditions simulated include those characteristic of both daytime and nighttime, even though construction operations will only occur during the day. Nighttime conditions often lead to the highest impacts, because the atmosphere is often more stable at night; thus the emissions plume does not disperse as readily as during the day. Finally, many of the ambient standards that the impact analysis results are compared to have complicated forms that involve averaging submaximum concentrations over several years. For example, the 1-hour NO_2 standard is based on a 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour concentrations. AERSCREEN only calculates maximum, rather than submaximum, concentrations and it is unlikely that worst-case impacts would occur in the same location over multiple construction years.

The EPA has established significant impact levels (SIL) for various pollutants and averaging periods. If modeled concentrations for a given pollutant and averaging period are below the SILs, the emissions are not expected to cause or contribute to an exceedance of the NAAQS. Predicted impacts were first compared with the SILs. If the predicted impacts were above the SIL level for a given pollutant and averaging period, the impact was added to a representative background

[1] AERMET is the meteorological processor for the EPA's AERMOD model.

concentration and compared with applicable ambient standards. Resulting impacts are shown in Appendix F and summarized in Section 4.2.3.

4.2.2.4 Regulatory Requirements

Federal, state, and local air quality requirements regulate emissions of a large number of pollutants from various sources. Many of the regulations are aimed at stationary sources, which would include the concrete batch plants and substations, but not the construction emissions. Emissions of regulated pollutants from construction operations are primarily focused on control of fugitive dust, as outlined below. Tailpipe emissions from on-road traffic and from the nonroad engines used in construction equipment (such as cranes, bulldozers, etc.) are regulated at the federal level, through specified performance requirements for various types of engines. The burden of meeting the performance requirements is placed on manufacturers of such equipment.

GHGs have recently become regulated pollutants at the federal level. Federal requirements now impose reporting obligations on owners of certain types of sources. In addition, the EPA has recently begun requiring GHG emission inventories and control technology analyses for new or modified large sources of pollutants. None of the activities involved in the proposed Project would be subject to federal GHG requirements.

States have also taken steps to address GHG emissions. New Mexico, for example, has several regulations limiting GHG emissions from certain large source types. At present, however, it appears that few if any state requirements would apply to GHG emissions from construction of the proposed Project. Operation of the substations may trigger a notification and reporting requirement in New Mexico (see below).

The regulatory requirements that would apply to activities associated with construction and operation of the transmission lines, substations, and concrete batch plants are outlined below.

Transmission Line, Substation, and Concrete Batch Plant Construction

- The City of Deming, New Mexico, has a local ordinance that requires a permit and an approved dust control plan for land disturbance greater than or equal to 3,500 square feet (Ordinance 11-5-4).
- Luna County, New Mexico, Building Code requires a dust control plan approved by the County for land clearing activities (Ordinance 75).
- There are no existing air quality requirements for construction sources in the state of New Mexico, except as administered by specific counties and cities as outlined above. However, New Mexico is considering the need for a statewide dust control regulation. If such a regulation is passed, it could apply to various activities associated with construction of transmission lines, substations, and batch plants.
- On-road diesel vehicles and nonroad diesel vehicles operating in urban areas will be limited to 30 to 40 percent opacity, depending on elevation (NMAC 20.2.61).

- Several requirements in Title 18, Chapter 2, Article 6 (*Emissions from Existing and New Nonpoint Sources*) of the AAC pertain to dust emissions and may apply to various activities associated with transmission line construction.
    - AACR18-2-604 requires dust control measures to limit emissions from open areas, dry washes, and riverbeds
    - AACR18-2-605 requires dust mitigation for roads
    - AACR18-2-606 requires dust mitigation for material handling operations
    - AAC R18-2-607 requires dust mitigation for storage piles
    - AACR18-2-614 limits opacity of emissions from nonpoint sources to 40 percent
    - These requirements would apply in the areas traversed by the various route groups outside of Pinal and Pima counties, which have their own requirements.
- The AAC also contains requirements that would apply to some of the construction equipment used in transmission line construction. AAC R18-2-801 and AAC R18-2-802 limit opacity from certain off-highway mobile sources and off-road machinery to 40 percent.
- AAC section 18-2-804 limits opacity from road and site cleaning machinery and requires dust control for road or site cleaning activities.
- Pima County, Arizona, requires an activity permit for earthmoving, blasting, road construction, trenching, and land stripping above certain thresholds (Pima County Code of Ordinances, Title 17, Chapter 17.12, Article IV, 17.12.470).
- Pima County Code of Ordinances, Chapter 17.16 contains several potentially applicable requirements.
    - 17.16.050 contains opacity requirements for nonpoint sources, limitations on off-site transport of visible emissions, and dust mitigation requirements
    - 17.16.060 contains additional requirements for mitigation and reclamation of fugitive dust producing activities
    - 17.16.070 contains fugitive dust emissions standards for motor vehicle operation
    - 17.16.080 requires dust control measures to limit emissions from open areas, dry washes, and riverbeds
    - 17.16.090 requires dust mitigation for roads
    - 17.16.100 contains requirements for mitigation of material handling, construction, and material transport particulate matter emissions
    - 17.16.110 contains requirements for dust mitigation from storage piles
    - 17.16.450 limits the opacity of emissions from off-road machinery
    - 17.16.470 limits opacity from road and site cleaning machinery and requires dust control for road or site cleaning activities

Pinal County, Arizona, has similar requirements to those in Pima County and in other areas of Arizona with regard to dust mitigation, as codified in the Pinal County Air Quality Control District (PCAQCD) Code of Regulations Chapter 4, Article 2. In addition, PCAQCD Chapter 2, Article 8 limits the opacity of emissions. PCAQCD Chapter 4, Article 3 requires a fugitive dust registration for any area of disturbance greater than 0.1 acre. The registered activity is required to follow Universal Performance Standards to limit dust generation, as spelled out in the regulations. Dust-generating activities within the West Pinal County PM_{10} nonattainment area are subject to further restrictions, including application of specified mitigation measures, and will also likely require a permit from the county.

Concrete Batch Plant and Transmission Line Operation

The concrete batch plants would be considered stationary or portable stationary sources in most air quality jurisdictions. It is assumed that the batch plants would not include any fuel burning equipment or stationary internal combustion (IC) engines, such as generators. If fuel-burning or IC engines are needed, additional requirements may apply. The following requirements are potentially applicable:

- New Mexico requires a construction permit for stationary sources emitting more than 10 pounds per hour or 25 tons per year (tpy) of any federal or New Mexico criteria pollutants, including temporary or portable sources. The individual concrete batch plants are unlikely to emit greater than 25 tpy, but should be evaluated against the 10-pound per hour threshold prior to construction (NMAC 20.2.72.200).
- An NOI is required for new or modified stationary sources in New Mexico emitting greater than 10 tpy of any regulated pollutant. The individual batch plants would probably not exceed this threshold. Portable sources subject to this requirement or to permit requirements must submit relocation notices (NMAC 20.2.73.200).
- Opacity from the batch plant will be limited to 20 percent in New Mexico. On-road diesel vehicles and nonroad diesel vehicles operating in urban areas will be limited to 30 to 40 percent opacity, depending on elevation (NMAC 20.2.61).
- If a permit or NOI is required in New Mexico, the batch plants would be subject to emission inventory requirements (NMAC 20.2.73.300).
- Arizona generally limits the opacity of emissions to 20 percent (AAC R18-2-702); however, certain requirements may specify different limitations.
- Arizona may require a construction permit for the batch plants (AAC R18-2-302). If so, the batch plant(s) may qualify for coverage under the Concrete Batch Plant General Permit. Portable sources that would operate under more than one jurisdiction would apply to ADEQ, while any batch plant that would operate only in Pima or Pinal counties would apply for a county, rather than a state, permit. The appropriate permitting authority (ADEQ, PCAQCD, or the Pima County Department of Environmental Quality) should be consulted prior to batch plant construction (AAC R18-2-302).
- If a permit is required and the batch plants are considered portable sources, a relocation notice is required to be submitted to the permitting authority (AAC R18-2-324).

- If any of the batch plants are considered existing sources in Arizona, there are fugitive dust requirements (AAC R18-2-723).
- The concrete batch plants may be subject to general emission limitations, odor limitations, VOC/solvent handling and storage requirements, and other specific limitations under the AAC (AAC R18-2-730). The appropriate permitting authority should be consulted prior to batch plant construction.
- Pima County has opacity limitations for point sources that apply within the county (Pima County Code of Ordinances, 17.16.040).

It is expected that few air quality requirements would apply to the operation phase of the transmission line; however, dust control permits may be required for certain maintenance activities. The appropriate permitting authority should be consulted regarding permit or other dust control requirements for specific maintenance activities that would result in particulate matter emissions, such as earthmoving activities.

Substation Operation

The substations would be considered stationary sources in most air quality jurisdictions; however, provided the substations have no fuel burning equipment or stationary IC engines, there would be few, if any, regulated emissions. The exception may be the SF_6 leakage from circuit breakers. As a federally regulated pollutant, the SF_6 emission may be subject to an NOI and reporting requirements in New Mexico for annual emissions exceeding specified thresholds (see NMAC 20.2.73.200, NMAC 20.2.73.200).

4.2.2.5 Mitigation Measures

Mitigation measures would be used to limit particulate matter emissions during both the construction and operational phases of the Project. As noted in the previous section, dust control plans or permits would be required in specific areas of New Mexico, subject to NEAPs, and in some Arizona jurisdictions. Such permits or plans would detail specific mitigation measures to be applied and would be adhered to (see ST 20). In Arizona, even where plans or permits are not required, the Project would still be subject to fugitive dust control measures mandated by the applicable regulations. Following construction, disturbed areas would be reclaimed using stabilization methods such as native vegetation, groundcover of non-erodible elements, or approved soil stabilization palliatives as prescribed by the land-management agency, which would limit ongoing fugitive dust emissions.

The following dust control measures have been specifically applied to the Project emission estimates:

- Watering at least twice daily in all disturbed areas undergoing active construction or disturbance
- Watering all unpaved roads at least twice daily in areas of active use

- Application of dust suppressants, if warranted, to unpaved roads and other disturbed areas (i.e., when generation of dust is observed despite application of other control measures, such as speed control and watering)
- Limitation of speeds on unpaved roads to 20 mph in most areas
- Sweeping up tracked-out dirt where unpaved roads or disturbed areas meet paved roads every 14 days, using PM_{10} efficient street sweepers, in areas of active construction or use
- Concrete batch plants will be restricted to areas outside of the West Pinal County and Rillito PM_{10} nonattainment areas

Additional mitigation measures may be applied in accordance with dust control plans or permits issued or approved by the various air quality control jurisdictions.

With respect to other sources and pollutants, nonroad engine emissions would be limited by using diesel equipment with Tier 3 engines. Traffic emissions explicitly incorporate the effects of ongoing federal emissions reduction requirements. Where stationary source permits or notifications are required, the Project would comply with all limitations or requirements imposed by the permitting authority.

Leak detection monitoring that would alert when a circuit breaker loses 10 percent of its SF_6 is proposed to mitigate GHG emissions from the substations. In addition, the Project proponent may participate in EPA's SF_6 Emission Reduction Partnership for Electric Power Systems, the objective of which is to reduce SF_6 emissions via cost-effective technologies and practices. Partners agree to annually estimate SF_6 emissions, establish a strategy for replacing older, leakier pieces of equipment, implement SF_6 recycling, ensure that only knowledgeable personnel handle SF_6, and submit annual progress reports. In turn, the EPA acts as a clearinghouse for technical information on successful strategies to reduce SF_6 emissions, provides partners with recognition for their achievements, and serves as a repository for data on a partner's emission reduction achievements.

General Conformity

In 1993, the EPA promulgated a rule requiring federal actions to conform to State Implementation Plans (SIP). Conformity means that a federal action will not interfere with strategies to attain the NAAQS. New Mexico's conformity regulations are codified at NMAC 20.2.98. Arizona has incorporated the federal conformity requirements in 40 CFR 93, by reference in AAC R18-2-1438.

Federal actions responsible for air pollutant emissions within a nonattainment or maintenance area must undergo a conformity applicability analysis to determine whether a conformity determination is necessary. None of the Project route groups would traverse any nonattainment or maintenance areas in New Mexico; therefore, the New Mexico portions of the proposed Project are exempted from conformity analysis. In Arizona, various proposed route groups would cross the Rillito PM_{10} nonattainment area, the West Pinal County PM_{10} nonattainment area, the San Manual SO_2 maintenance area, and the Tucson/Pima County CO maintenance area. Conformity analyses are required for these four areas.

The Pinal Central Substation will be located in the West Pinal County PM_{10} nonattainment area; none of the other substations would be located in any nonattainment or maintenance area. Concrete batch plants may be located in one or more of the maintenance areas, but it has been assumed that no batch plant would be located within either of the PM_{10} nonattainment areas.

To perform a conformity analysis, the total of Project-related direct and indirect emissions (such as emissions from associated traffic) is tested against *de minimis* emission levels. The total of direct and indirect emissions should include regulated precursor substances. Neither SO_2 nor CO has precursors. The definition of precursors to PM_{10} contained in 40 CFR 93 refers to "those pollutants described in the PM_{10} nonattainment area applicable SIP as significant contributors to the PM_{10} levels." The most recent SIP submittal for the Rillito area (*Final Arizona State Implementation Plan, Rillito PM_{10} Nonattainment Area*; ADEQ 2008b) does not list any substance other than directly emitted PM_{10}; therefore, only directly emitted PM_{10} was included in the total of direct and indirect emissions for the Rillito nonattainment area. There is as yet no SIP for the recently designated West Pinal County PM_{10} nonattainment area; however, the *Technical Support Document, Pinal County, Arizona, Area Redesignation for the 1987 24-hour PM_{10} NAAQS* (EPA 2010c) indicates: "Emissions of SO_2, NO_x, VOCs (volatile organic compounds) and NH_3 (ammonia), which are precursors of secondary PM_{10}, are included for informational purposes in Appendix A but were not considered because the PM_{10} problem in Pinal County is primarily a fugitive dust problem." Therefore, only directly emitted PM_{10} was included in the total of direct and indirect emissions for the West Pinal County PM_{10} nonattainment area.

Conformity determinations are required for any federal action where the total of direct and indirect emissions exceeds the annual *de minimis* thresholds.

To calculate emissions within each of the four areas, pollutant emissions for construction of the transmission line route groups that would traverse the nonattainment or maintenance areas were converted to a ton per mile of transmission line basis, and then multiplied by the number of miles in the longest route that crosses a given nonattainment or maintenance area. The maximum 12-month emissions at any point during the Project schedule were used in these calculations to provide a conservative estimate of total emissions. It was assumed that only one transmission line would be built within each nonattainment or maintenance area in a 12-month period (i.e., construction of the first line and the second line would not overlap in *both* time and space). This assumption is reasonable, considering that the maximum length of any transmission line through any of the nonattainment or maintenance areas is less than 30 miles; a small fraction of the total expected transmission line lengths (minimum length of approximately 460 miles).

Emissions from the construction of batch plants were added to the transmission line construction emissions to provide total estimated emissions within each nonattainment or maintenance area. Only 15 miles of the transmission line route would traverse the Rillito PM_{10} nonattainment area, and approximately 6 miles would traverse the West Pinal County PM_{10} nonattainment area; therefore, since batch plants are expected to be constructed every 30 miles along the right-of-way, it was assumed that a concrete batch plant would not be built/operated within either of the nonattainment areas. For the San Manuel SO_2 maintenance area, a single batch plant was included, based on the length of the longest transmission line route to cross the area. For the Tucson/Pima County CO maintenance area, two batch plants were included in the calculations.

4.2.3 Impact Analysis Results

This section discusses the results of the emissions estimation and impact analyses performed for the proposed Project.

4.2.3.1 No Action Alternative

The No Action alternative would mean that air pollutant emissions from construction equipment, Project-related traffic, earthmoving activities, construction and operation of several concrete batch plants, and leakage of GHGs from substation circuit breakers would not occur. Under the No Action alternative, air quality emissions may continue at current levels and trends, although it is uncertain whether other changes may occur that affect emissions..

4.2.3.2 Impacts Common to All Alternatives

This section addresses transmission line construction emissions, ambient air impacts from construction of either of the transmission line options, emissions and impacts from construction and operation of the concrete batch plants, and the results of the general conformity analysis. No significant impacts to air quality (see Section 4.2.2.1) would result from the construction or operation of the transmission lines, including construction and operation of concrete batch plants.

Transmission Line Construction Emissions and Impacts

While the length of the transmission lines would vary somewhat depending on which alternative routes are selected and permitted, the level of effort required to build a transmission line from the SunZia East Substation to the Pinal Central Substation was assumed to be approximately equivalent for any of the alternatives under consideration. Fugitive dust emissions from earthmoving would be somewhat higher for the first transmission line than for the second line that would be constructed, because some of the roads and portions of the right-of-way would not have to be reworked for the second line.

Appendix F presents the criteria pollutant emissions summary for the transmission line construction options by year and source category (fugitive dust from earthmoving, paved and unpaved roads emissions, nonroad engines/construction equipment, and on-road traffic). The emissions are also presented in tons per mile of transmission line, and GHG emissions are summarized in Appendix F. Note that the CO_2 emissions shown in Appendix F are a summation of the emissions of individual GHGs, including CO_2, CH_4, and N_2O, expressed as an equivalent mass of CO_2.

The results of the air pollutant dispersion modeling conducted for transmission line construction are also shown in Appendix F. Fugitive dust emissions are expected to be higher for the first transmission line than for the second line that would be constructed for Option A or Option B, because the main access roads would be initially constructed where needed for the first transmission line, and for the most part followed by smaller spur roads for the second transmission line. Because construction of the first and second transmission lines (in Option A or B) would not overlap in time and space, the modeling performed can be conservatively assumed

to represent short-term impacts from either of the options. The results of the impact analysis vary slightly by alternative route group, because the background air pollutant concentrations vary in different areas, and because different surface characteristics were used for the various route groups.

Project-related impacts were first compared to SILs defined by the EPA for various pollutants and averaging periods. An air quality modeling SIL should not be confused with the similar sounding term significant adverse effect, or significant impact, in the NEPA sense. Instead, SILs are used to define impacts that are considered to be negligible or *de minimis*. If Project-related impacts are predicted to be below the applicable SIL, the impact would not cause or contribute to an exceedance of the NAAQS. In general, the states would also consider impacts below the federal SILs as *de minimis*.

For the impacts summarized in Appendix F, if the dispersion modeling projected that the SIL would be exceeded or if there was no EPA-defined SIL, the Project impact was added to a representative background concentration and the total compared with the applicable ambient standards (federal or state). The background concentrations used were recent measured values from nearby monitoring sites and represent ambient concentrations of pollutants contributed by sources other than the Project. As shown in Appendix F, most impacts were predicted to be within regulatory limits (below the applicable National, Arizona, and/or New Mexico Ambient Air Quality Standards). Because of high background concentrations of PM_{10} within the West Pinal County PM_{10} nonattainment area, maximum total 24-hour PM_{10} impacts (Project + background) from transmission line and Pinal Central Substation construction were projected to potentially exceed the numerical value of the PM_{10} standards. It should be noted that the form of the standard is "not to be exceeded more than once per year, on average over three years." The modeled concentrations used in this comparison were maximum impacts (rather than second high impacts, as would fit the form of the standard) due to the screening nature of the dispersion model used. In addition, maximum Project emissions within the nonattainment area are unlikely to persist over 3 years, due to the short segment of transmission line (approximately 6 miles) within the nonattainment area.

Concrete Batch Plant Emissions and Impacts

Appendix F summarizes construction and operation emissions for the concrete batch plants. Approximately 16 or 17 concrete batch plants would be constructed and operated for each transmission line and associated substation construction. Batch plants would be located approximately every 30 miles along the transmission line right-of-way. It is expected that two to three batch plants would be operational at any given time. GHGs expressed as CO_2e include CO_2, CH_4, and N_2O.

General Conformity Analysis

The total of Project direct and indirect emissions calculated, as described in Section 4.2.2.5, was compared with conformity determination thresholds (*de minimis* levels) for each nonattainment and maintenance area to determine whether additional analysis was required. The estimated emissions in each area are shown in Table 4-2. Estimated emission totals were below the *de*

minimis levels (100 tons per year of the pollutant for which the area is nonattainment or maintenance) for all three nonattainment and maintenance areas; therefore, a conformity determination is not required.

Table 4-2. Conformity Analysis Results

Nonattainment or Maintenance Area/Pollutant	Total of Direct and Indirect Emissions (tons per year)	Conformity de Minimis Levels (tons per year)
One 500 kV Single-Circuit, AC Facility (First Line)		
Rillito Nonattainment Area/PM_{10}	97.6	100
Tucson/Pima County Maintenance Area/CO	59.2	100
San Manuel Maintenance Area/SO_2	0.09	100
West Pinal County Nonattainment Area/PM_{10}	47.65	100
Option A: Two 500 kV Single-Circuit, AC Facilities		
Rillito Nonattainment Area/PM_{10}	93.2	100
Tucson/Pima County Maintenance Area/CO	58.7	100
San Manuel Maintenance Area/SO_2	0.09	100
West Pinal County Nonattainment Area/PM_{10}	47.65	100
Option B: One 500 kV Single-Circuit AC Facility and One 500 kV Single-Circuit DC Facility		
Rillito Nonattainment Area/PM_{10}	95.2	100
Tucson/Pima County Maintenance Area/CO	62.9	100
San Manuel Maintenance Area/SO_2	0.09	100
West Pinal County Nonattainment Area/PM_{10}	50.96	100

4.2.3.3 Route Group 1: SunZia East Substation to Midpoint Substation

Criteria pollutant emissions associated with construction and expansion of the SunZia East Substation are summarized in Appendix F. GHG emissions associated with construction and operation of the substation are also shown in Appendix F. GHGs expressed as CO_2 from substation construction include CO_2, CH_4, and N_2O, while GHGs emitted during substation operation include only SF_6.

The results of the air pollutant dispersion modeling conducted for construction of the SunZia East Substation are also shown in Appendix F. Emissions from nonroad engines (construction equipment) are slightly higher for the SunZia East Substation than for some of the smaller substations; therefore, the dispersion modeling analysis for the SunZia East Substation construction was used to represent the local ambient impacts from all substations because these impacts are expected to be as high or higher than those from all other substations. For fugitive dust emissions, construction of the Midpoint Substation was modeled instead of the SunZia East Substation because a larger area would be disturbed, thereby increasing emissions. Once again, the most conservative modeling results were used to represent the minor differences in expected impacts between the substations. The results also vary slightly by substation, because the background air pollutant concentrations vary in different areas and because different surface characteristics were used for different substations. Representative background air quality concentrations and surface characteristics were applied to each substation location in estimating impacts. All impacts are predicted to be within regulatory limits (below the applicable National

and/or New Mexico Ambient Air Quality Standards). No significant impacts to air quality (see Section 4.2.2.1) would result from the construction or operation of the substations.

4.2.3.4 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Criteria pollutant emissions associated with construction and expansion of the Midpoint and Lordsburg substations; GHG emissions associated with construction and operation of the two substations; and impacts associated with the construction of the two substations are summarized in Appendix F.

All impacts are predicted to be within regulatory limits (below the applicable National and/or New Mexico Ambient Air Quality Standards). No significant impacts to air quality (see Section 4.2.2.1) would result from the construction or operation of the substations.

4.2.3.5 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Criteria pollutant emissions associated with construction and expansion of the Willow-500 kV and Pinal Central substations; GHG emissions associated with construction and operation of the two substations; and impacts associated with the construction of the two substations are shown in Appendix F.

With the exception of 24-hour PM_{10}, impacts are predicted to be within regulatory limits (below the applicable National and/or Arizona Ambient Air Quality Standards). Because of high background concentrations of PM_{10} within the West Pinal County PM_{10} nonattainment area, maximum total 24-hour PM_{10} impacts (Project + background) from transmission line and Pinal Central Substation construction were projected to potentially exceed the numerical value of the PM_{10} standards. It should be noted that the form of the standard is "not to be exceeded more than once per year, on average over three years." The modeled concentrations used in this comparison were maximum impacts (rather than second high impacts, as would fit the form of the standard) due to the screening nature of the dispersion model used. In addition, maximum project emissions within the nonattainment area are unlikely to persist over 3 years, due to the short segment of transmission line (approximately 6 miles) within the nonattainment area. As a result, an actual exceedance of the standard due to Project activities is unlikely but cannot be ruled out. Therefore, a potential significant impact (see Section 4.2.2.1) could result from Project construction activities[1].

[1] The AERSCREEN model assumes a worst-case scenario, and does not fully account for the use of mitigation measures. Prior to and during construction activities, the Project owners or contractors would be responsible for complying with NAAQS. More site-specific modeling and mitigation would be utilized and implemented such that construction and operation of the Project would not likely indicate an exceedance of any NAAQS.

4.3 EARTH RESOURCES

4.3.1 Introduction

This chapter describes the impacts associated with geological hazards and with Earth resources, such as minerals and soils, that could result from the construction, operation, and decommissioning of the Project.

Potential impacts resulting from geological hazards include ground rupture from Quaternary faults, destabilization of the land surface by fissures, and flooding. Potential impacts to mineral resources associated with the Project includes the restriction of access to locatable, leasable, and salable mineral resources; while potential impacts to soil resources include accelerated rates of erosion by water or wind, and the irreversible conversion of designated Prime or Unique Farmland soils to nonagricultural uses.

Mitigation planning provides a way by which impacts associated with the Project may be reduced to acceptable levels, thereby minimizing the effect that the Project would have on the environment. The mitigation planning process includes: (1) an inventory of Earth resources within the Project area; (2) the assignment of sensitivity levels to the inventoried data; (3) the application of the access model and standard mitigation measures to the resource sensitivities, to produce the initial impact levels; and (4) the application of selective mitigation measures to the initial impact levels, to arrive at the residual impact levels. Initial and residual impacts were assessed on a five-tiered scale, 1 to 5; with 5 being High and 1 being Low.

4.3.2 Impact Assessment Methodology

4.3.2.1 Geological Hazards

Methods for assessing potential impacts resulting from geological hazards include: (1) identifying the types of potential impacts; (2) developing criteria for assessing the intensity of potential impacts to the Project (Table 4-3); (3) classifying the relative sensitivity (high, moderate, or low) of areas to the likelihood of a geological hazard occurring in the future; (4) estimating the initial impacts to the Project based on the resource sensitivity and the access model; (5) identifying the appropriate selective mitigation measures for minimizing potential adverse effects; (6) determining specific areas where selective mitigation should be applied; and (7) estimating the potential residual impacts to the Project.

Table 4-3. Criteria for Assessing Intensity of Impacts Resulting from Geological Hazards

High	Areas where Quaternary faults are present Areas where fissures (and, therefore, subsidence) are present Areas where floodplains are present
Low	Areas where Quaternary faults are not present Areas where fissures are not present

Types of Potential Impacts

Geological hazards could directly and indirectly impact the construction and operation of the Project. The Project would not have any direct or indirect impact on geological hazards.

Potential direct effects resulting from geological hazards include:

- Loss of equipment or injury as a result of earthquakes or flooding

Potential indirect impacts resulting from geological hazards include:

- Loss of transmission service as a result of earthquakes, fault-related ground rupture, or land-surface destabilization by fissures

Criteria for Assessing Intensity of Impacts

Criteria were developed to assess the intensity of potential impacts to the Project resulting from geological hazards. Areas where Quaternary faults are present were assigned a high level of impact intensity, because the faults are considered active and capable of generating strong earthquakes (USGS 2006). Areas where surface fissures are present were also assigned a high level of impact intensity, because the fissures may be actively expanding, and thus capable of destabilizing the land surface in the near future.

Mitigation of Impacts

Initial sensitivity classifications and the impact model are the basis for assessing initial potential impacts of geological hazards on the Project. These classifications, presented in Table 4-4, were assigned using the criteria presented in Table 4-5. Standard mitigation measures would be implemented to mitigate impacts that could occur throughout the Project area. These measures include restricting vehicle access to limit disturbance of the ground surface and vegetation, requiring new access roads to follow the natural land contours as closely as possible, and attempting to use pre-existing access roads to the greatest degree possible; all of which help to prevent land-surface destabilization. Due to their universal application, standard mitigation measures were considered in the assessment of initial impact levels.

In addition to the standard mitigation measures and BMPs included as part of the Project descriptions in Chapter 2 (see Table 2-10), a selective mitigation measure was developed to mitigate potential impacts resulting from areas identified as having fissures (see SE 8, Table 2-11).

Residual Impacts

Table 4-4 summarizes the initial sensitivity classification that provided the basis for assessing initial impacts of geological hazards on the Project, the selective measure applied to mitigate these potentially adverse effects, and residual impacts.

Table 4-4. Summary of Sensitivity Level Impacts by Geological Hazards				
Geological Hazard	**Resource Sensitivity Level**	**Initial impacts**	**Mitigation Measure Applied**	**Residual Impact**
Quaternary Faults	High	Moderate	—	Moderate
Fissures	High	High	SE 8	Moderate
100-year Floodplain	High	High	SE 8	Moderate

4.3.2.2 Mineral Resources

The methods for assessing potential impacts on mineral resources resulting from construction of the Project include: (1) identifying the types of potential impacts; (2) classifying the sensitivity of the mineral resources; (3) developing criteria for assessing the intensity of a potential effect to a mineral resource; (4) estimating the initial impacts to mineral resources; (5) identifying the appropriate selective mitigation measure(s) to mitigate impacts; and (6) estimating the potential residual impacts to mineral resources.

Types of Potential Impacts

Locatable and salable mineral resources can be exposed at the surface, lie just below the surface, or be located several hundred feet below the surface. Active mines and mining operations exist throughout the Project study area. Where mining operations or mineral resources cannot be avoided, the construction and operation of the Project could limit development and extraction of mineral resources, where Project facilities might interfere with mining activities. Blasting done during the construction phase could also impact mineral development. The use of standard and selective mitigation measures would minimize impacts to mineral development. Access constructed for the Project could provide improved access for mining activities in remote areas.

Criteria for Assessing Intensity of Impacts

Criteria were developed to assess the intensity of potential impacts to mineral resources associated with implementation of the Project (Table 4-5). These criteria were based on the type of mineral resource and any activities associated with it, such as mining, drilling, testing, etc.

Table 4-5. Criteria for Assessing Intensity of Impacts to Mineral Resources	
High	Areas with known active mines or mining claims with commercial value Areas with known oil or gas wells with commercial value Areas with known mineral resources with commercial value Areas with known producing geothermal wells with commercial value
Moderate	Areas with geothermal resources or leases Oil and gas leases, coal leases, mineral leases

Table 4-5. Criteria for Assessing Intensity of Impacts to Mineral Resources	
Low	Areas with no known active mines or mining claims Areas with no known oil or gas wells Areas with no known geothermal resources Areas with no known coal or other mineral leases Areas with no known mineral resources

Mitigation of Impacts

Initial resource sensitivity classifications are the basis for assessing initial potential impacts to mineral resources associated with the construction and implementation of the Project. These classifications were assigned using the criteria presented in Table 4-5. Standard mitigation measures would be implemented to mitigate impacts that could occur throughout the Project area, and applied at all points within it. These measures include restricting vehicle access to limit disturbance of the ground surface and vegetation, requiring new access roads to follow the natural land contours as closely as possible, and attempting to use pre-existing access roads to the greatest extent possible. Due to their universal application, standard mitigation measures were considered in the assessment of the initial impact levels.

In addition to the BMPs included as part of the Project description in Chapter 2, a selective mitigation measure was developed to mitigate potential high and moderate impacts to mineral resources. This measure includes the avoidance or spanning of active mines or claims, geothermal leases, or producing wells, where feasible (see SE 8, Table 2-11). Site specific design of roads and structures using standard and selective mitigation measures would minimize restrictions to mineral development.

Residual Impacts

Table 4-6 summarizes the initial resource sensitivity classifications that provided the basis for assessing initial impacts on mineral resources, the mitigation measures applied to mitigate potentially high and moderate adverse effects on those resources, and residual impacts. A determination would be made regarding the presence of pre-1955 mining claims during the survey process. If such claims are located and refuted, the BLM would need to receive authorization from the claimant prior to grant of right-of-way.

Table 4-6. Summary of Sensitivity Level and Residual Impacts on Mineral Resources			
Mineral Resource	**Resource Sensitivity Level**	**Mitigation Measure Applied**	**Residual Impacts**
Active mines, active claims, producing wells	High	SE 8	Low to Moderate
Geothermal agreements and leases	Moderate	SE 8	Low to Moderate
Oil and Gas Leases	Moderate	SE 8	Low to Moderate
Potential Mines	Moderate	SE 8	Low to Moderate

4.3.2.3 Soil Resources

The methods for assessing potential impacts on soil resources resulting from construction of the Project include: (1) identifying the types of potential impacts; (2) developing criteria for assessing the intensity of potential impacts to soil resources; (3) classifying the relative sensitivity (high, moderate, low) of areas to accelerated erosion by water or wind, and the conversion of designated Prime or Unique Farmland soils to nonagricultural uses; (4) assessing initial impacts; (5) identifying the appropriate selective mitigation measure(s) to mitigate impacts; (6) determining specific areas where selective mitigation should be applied; and (7) estimating the potential residual impacts on soil resources.

Types of Potential Impacts

The construction of the Project would result in both direct and indirect adverse impacts to soil resources. Direct impacts associated with construction activities could include:

- Accelerated soil erosion in areas where construction-related activities have disturbed or altered the land surface by exposing soils (temporary)
- Accelerated soil erosion in areas where construction-related activities have altered the contours of the land surface (temporary)
- Loss of designated Prime or Unique Farmland soils (i.e., conversion to nonagricultural uses) (permanent)

There would be minimal direct impacts associated with the operation of the facilities, presence of the transmission line, or maintenance activities associated with the Project; however, indirect impacts would occur.

Indirect impacts associated with both the construction and operation of the Project could include the following:

- Construction of permanent access roads, which could be used by the general public to access currently inaccessible areas, potentially resulting in accelerated rates of erosion by water or wind (permanent)
- Degradation of the land surface and loss of soils resulting from accelerated soil erosion (temporary to permanent)
- Loss of soil productivity and negative impacts on water quality, if sediment is washed into nearby streams and lakes (temporary), see Section 4.5

Biological Soil Crusts and Desert Pavements

Potential Project-related impacts to biological soil crusts are associated with the direct impacts of surface-disturbing activities (e.g., blading of new access roads) and the indirect impacts of increased public recreational use (e.g., access of OHVs). Based on the rarity of ideal biological crust supporting soil types (Section 3.3.5.3) within the Project area, it is unlikely that the Project would encounter and impact these unique resources. However, if biological soil crusts were

identified during Project activities, existing standard and selective mitigation measures would be implemented in order to limit impacts, including restricting access to mapped and designated roadways, and spanning and avoiding sensitive areas.

Desert pavements may occur within the Project area on low slope surfaces that have been undisturbed by previous ground-disturbing activities such as grazing or construction. Potential Project-related impacts to desert pavements are associated with the blading of new access roads on these undisturbed surfaces, which would break up the surface and decrease its stability, in turn increasing the potential for both water and wind erosion. Standard and selective mitigation measures, such as restricting construction access to defined travelways, would limit potential direct impacts; and closing or limiting the use of access roads that are not necessary for the operation and maintenance of the Project would limit indirect impacts from increased public recreation access.

Criteria for Assessing Intensity of Impacts

Criteria were developed to assess the intensity of a potential impact on soil resources associated with implementation of the Project (Table 4-7). These criteria were based on susceptibility of soils to water and wind erosion, and potential impacts on designated Prime or Unique Farmland soils.

Soil susceptibilities to water and wind erosion were assessed based on standards from the NRCS. SSURGO-level soil mapping units assigned a K_w value of 0.40 or higher have a high susceptibility to water erosion; soil mapping units assigned a K_w value between 0.20 and less than 0.40 have a moderate susceptibility to water erosion; and soil mapping units assigned a K_w value less than 0.20 have a low susceptibility to water erosion. The susceptibility of a soil mapping unit to wind erosion is based on its assignment to a Wind Erodibility Group or WEG. Soil mapping units assigned to WEG 1 or 2 are highly susceptible to wind erosion; soil mapping units assigned to WEG 3, 4, or 4L have a moderate susceptibility to wind erosion; soil mapping units assigned to WEG 5, 6, or 7 have a low susceptibility to wind erosion; and soil mapping units assigned to WEG 8 are not susceptible to wind erosion.

Table 4-7. Criteria for Assessing Intensity of Impacts to Soil Resources

High	Designated Prime or Unique Farmland soils Soils highly susceptible to water erosion (Kw ≥ 0.40) Soils highly susceptible to wind erosion (WEG = 1 or 2)
Moderate	Soils moderately susceptible to water erosion (0.2 ≥ Kw < 0.40) Soils moderately susceptible to wind erosion (WEG = 3, 4, or 4L)
Low	Soils weakly susceptible to water erosion (Kw < 0.20) Soils weakly or not susceptible to wind erosion (WEG = 5, 6, 7, or 8) Soils that have never been and will never be designated Prime or Unique Farmland

Mitigation of Impacts

Initial resource sensitivity classifications were the basis for assessing initial potential impacts to soil resources associated with the construction and implementation of the Project. These classifications were assigned using the criteria presented in Table 4-7. Standard mitigation

measures are implemented to mitigate impacts that could occur throughout the Project study area, and were applied at all points within it. These measures include restricting vehicle access to limit disturbance of the ground surface and vegetation, requiring new access roads to follow the natural land contours as closely as possible, and attempting to use pre-existing access roads to the greatest degree possible. Due to their universal application, standard mitigation measures were considered in the assessment of the initial impact levels.

In addition to BMPs included as part of the Project description in Chapter 2, selective mitigation measures were developed to mitigate potential high and moderate (initial) impacts to soil resources. Selective mitigation measures applied to reduce these impacts are summarized in Table 4-8.

Based upon site-specific travel planning and NEPA analysis, the respective agency would determine which roads on public lands would remain open, restricted, or closed to the public (SE 4) or gated (SE 6), using the most effective and least environmentally damaging methods appropriate, where feasible. These mutually exclusive measures would minimize traffic across minimally or previously undisturbed landscapes, which would limit the exposure of soils susceptible to water or wind erosion.

A detailed Project reclamation plan would be developed to mitigate site-specific resource impacts (SE 5), which would aid in returning the land surface to a state close to its original condition; thereby limiting the exposure of soils susceptible to water or wind erosion, and the irreversible conversion of designated Prime or Unique Farmland soils to nonagricultural uses.

Structures would span designated Prime or Unique Farmland soils (SE 8) to minimize irreversible conversion of agricultural lands to nonagricultural uses, by limiting the number of structure sites located on designated Prime or Unique Farmland soils.

Residual Impacts

Table 4-8 summarizes the initial resource sensitivity classifications that provided the basis for assessing initial impacts to soil resources, the mitigation measures applied to mitigate potentially adverse impacts on those resources, and residual impacts.

Table 4-8. Summary of Sensitivity Level and Residual Impacts on Soil Resources

Soil Resource	Resource Sensitivity Level	Mitigation Measure(s) Applied (Table 2-11)	Residual Impacts
Soils with a high susceptibility to water or wind erosion	High	SE 5 (4 or 6, but not both)	Moderate to Low-Moderate
Soils designated Prime or Unique Farmland	High	SE 5, 8 (4 or 6, but not both)	Moderate to Low-Moderate
Soils with a moderate susceptibility to water or wind erosion	Moderate	SE 5 (4 or 6, but not both)	Low
Soils with a low susceptibility to water or wind erosion	Low	None	Low
Soils not designated Prime or Unique Farmland	Low	None	Low

4.3.2.4 Significant Impacts

For the purposes of this analysis, a significant impact on earth resources, including geological hazards, mineral resources, and soil resources, could result if any of the following were to occur from construction or operation of the proposed action:

- Loss of equipment or injury as a result of earthquakes or flooding
- Loss of transmission service as a result of earthquakes, fault-related ground rupture, or land-surface destabilization by fissures caused by subsidence
- Loss of availability of a known mineral resource that would be of value
- Limited development and extraction of mineral resources, resulting from the presence of permanent facilities or fences and gates
- Substantial soil erosion and loss of soil material and productivity
- Permanent conversion of designated Prime or Unique Farmland soils to nonagricultural uses

4.3.3 Impact Analysis Results

A summary of baseline resource inventory and results of the impact analysis are presented in Table 4-9 and described in this section.

4.3.3.1 No Action Alternative

Under the No Action alternative, the environment would remain as it presently exists.

4.3.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the proposed SunZia East Substation, travelling across Chupadera Mesa to the Rio Grande crossing, then travelling south through the Rio Grande Valley to the proposed Midpoint Substation. The total length of the subroute is 228.8 miles. Potentially significant issues discussed in this section include geological hazards, disruption of mineral resource production, and loss of soil resources through accelerated erosion.

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 1A1 would be from Quaternary faults and 100-year floodplains. Following the implementation of SE 8 along Subroute 1A1, less than 1 percent of the subroute would have moderate residual impacts, less than 2 percent would have moderate-low residual impacts, and 98 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults along links E200, A161a, and A260. Available data shows there

are only low and low-moderate residual impacts associated with 100-year floodplains in Luna County, along links A440 and A400.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 1A1 would be associated with restricting access to mineral resources, specifically those in the Socorro Peak mining district, west of Socorro, and in an area west of Caballo Reservoir. There are no moderate residual impacts to mineral resources along Subroute 1A1. Following the implementation of SE 8 along Subroute 1A1, 32 percent would have moderate-low residual impacts, and 68 percent would have low residual impacts to mineral resources.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 1A1 would be to soils that are susceptible to erosion, mainly those in the mountainous areas northeast of Socorro, New Mexico. Soils designated as Prime or Unique Farmland occur along 4 miles of this subroute. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 1A1, 29 percent (rounded to the nearest whole number) would have moderate-low impacts, and 71 percent would have low impacts on soil resources.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is identical to Subroute 1A1, except for the more northerly route it takes with Link E86.

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 1A2 would be from Quaternary faults and 100-year floodplains. Following implementation of SE 8 along Subroute 1A2, less than 1 percent of the subroute would have moderate residual impacts, less than 2 percent would have moderate-low impacts, and 98 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults along links E200, A161a, and A260.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 1A2 is the restriction of access to mineral resources, specifically those in the Socorro Peak mining district west of Socorro, and in an area west of the Caballo Reservoir. Following implementation of SE 8 along Subroute 1A2, 36 percent would have moderate-low impacts, and 64 percent would have low impacts on mineral resources.

Table 4-9. Alternative Route Comparison: Earth Resource Inventory Data and Residual Impacts

Subroute	Total Miles	Inventory														Impact Assessment											
		Geological Hazards (miles)			Mineral Resources (miles)			Soil Resources (miles)								Miles of Residual Impacts (miles)											
								Water Erosion			Wind Erosion			Farmland		Geological Hazards			Mineral Resources					Soil Resources		
		Faults	Fissures	100-Year Floodplains	No mining	Leases	Active mining	Low	Moderate	High	Low	Moderate	High	Low	High	Low	Low-Moderate	Moderate	Low	Low-Moderate	Moderate	Moderate-High	High	Low	Low-Moderate	Moderate
1A1	229	2.3	0	2.2	215	12	2	129	89	11	139	85	5	225	4	224	4	1	155	74	0	0	0	162	67	0.2
1A2	230	2.3	0	2.2	216	12	2	127	87	16	146	81	3	226	4	225	4	0.8	147	83	0	0	0	156	72	2
1A	220	2	0	2	205	12	2	127	83	9	126	86	8	219	0.6	215	4	0.5	124	95	0.6	0	0	154	66	0
1B1	224	2	0	2	216	5	3	118	95	11	106	96	22	224	0	219	3	1	128	93	2	0	0	149	74	0.1
1B2	209	2	0	2	194	12	3	113	80	17	107	82	20	209	0	205	3	1	122	83	5	0	0	140	69	0.1
1B3	206	2	0	2	188	16	3	118	75	14	112	75	19	206	0	202	3	1	119	81	7	0	0	142	64	0.1
3A2	124	0.5	0	6	116	4	4	61	58	5	49	54	21	110	14	117	4	3	55	69	0	0	0	60	64	0
3A	123	0.5	0	10	116	4	4	65	64	5	49	55	20	110	14	116	4	4	55	69	0	0	0	57	67	0
3B	129	0	0	6	124	2	3	35	94	0.2	54	59	17	101	28	124	2	3	82	46	1	0	0	59	70	0
4A	133	1	0.3	6	113	0.2	20	66	66	0.2	76	57	0.4	125	8	128	4	0.8	55	70	8	0	0	94	39	0.1
4B	133	0.1	0.3	7	113	0.2	20	56	73	4	64	69	0.4	106	27	129	2	2	45	81	8	0	0	76	54	3
4C2c	161	0	0.3	8.8	144	0	17	83	75	3	83	76	2	148	13	152	9	0.4	87	74	0	0	0	110	50	1
4C1	139	0.1	0.3	8	129	0.1	10	66	70	3	75	64	0.2	126	13	134	5	0.4	57	81	1	0	0	92	46	2
4C2	152	0	0.3	9	135	0	17	73	76	3	73	77	2	139	13	144	7	0.4	69	82	1	0	0	99	52	1
4C3	173	0	0.3	29	159	0.1	14	76	95	2	93	73	7	131	40	150	23	0.4	105	68	0.4	0	0	105	67	0.5

Total miles rounded to the nearest whole number.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 1A2 would be to soils that are susceptible to water erosion, mostly those in the mountainous areas northeast of Socorro, New Mexico, and northwest of the Gran Quivira. Soils designated as Prime or Unique Farmland occur along 4 miles of this subroute. Following implementation of SE 4 or 6, 5, and 8 along Subroute 1A2, less than 1 percent of this subroute would have moderate impacts, 31 percent would have moderate-low impacts, and 68 percent would have low impacts on soil resources. Moderate impacts are associated with soils that are highly susceptible to water erosion along Link E86.

Subroute 1A – North River Crossing

Subroute 1A is identical to Subroute 1A1, except for the segment that crosses Chupadera Mesa (Link A22-E80c).

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 1A would be from Quaternary faults and 100-year floodplains. Following the implementation of SE 8 along Subroute 1A, less than 1 percent of the subroute would have moderate residual impacts, less than 2 percent would have moderate-low residual impacts, and 98 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults along links E200, A161a, and A270.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 1A would be associated with restricting access to mineral resources, specifically those in the Socorro Peak mining district, west of Socorro, and in an area west of Caballo Reservoir. Following the implementation of SE 8 along Subroute 1A, less than 1 percent of the total miles would have moderate residual impacts, 43 percent would have moderate-low residual impacts, and 56 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines or leases along Link 161a, and moderate-low residual impacts are associated with the presence of active mines or leases along links A330a and A330b.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 1A would be to soils that are susceptible to water erosion, mainly those in the mountainous areas northeast of Socorro, New Mexico. Soils designated as Prime or Unique Farmland occur along 0.6 mile of this subroute. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 1A, less than 1 percent of this subroute would have moderate impacts, 30 percent would have moderate-low

impacts, and 70 percent would have low impacts on soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along Link E80d.

Subroute 1B – San Antonio Crossing

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 1B1 would be from Quaternary faults. Following the implementation of SE 8 along Subroute 1B1, less than 1 percent of the subroute would have moderate residual impacts, less than 1 percent would have moderate-low impacts, and 99 percent would have low impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults along links A111, A112, A140, A161a, and A270. The impacts from floodplains are the same as for Subroute 1A.

The primary impact of concern associated with the implementation of Subroute 1B2 would be from Quaternary faults. Following the implementation of SE 8 along Subroute 1B2, less than 1 percent of the subroute would have moderate residual impacts, less than 1 percent would have moderate-low residual impacts, and 99 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults along links A111, A112, A140, A161a, and A270.

The primary impact of concern associated with the implementation of Subroute 1B3 would be from Quaternary faults. Following the implementation of SE 8 along Subroute 1B3, less than 1 percent of the subroute would have moderate residual impacts, less than 1 percent would have moderate-low residual impacts, and 99 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults along links A111, A112, A140, A161a, and A270.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 1B1 would be associated with restricting access to mineral resources, specifically those in the Carthage coalfield, the Socorro Peak mining district west of Socorro, the Louis Lopez mining district southwest of San Antonio, and in an area west of Caballo Reservoir. Following the implementation of SE 8 along Subroute 1B1, less than 1 percent would have moderate residual impacts, 42 percent would have moderate-low residual impacts, and 57 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along links A160 and A161a; and moderate-low impacts are associated with the presence of coal leases and active mines along links A90 and A111.

The primary impact of concern associated with the implementation of Subroute 1B2 would be associated with restricting access to mineral resources, specifically those in the oil and gas leases west of SunZia East, the Carthage coalfield, the Louis Lopez mining district southwest of San Antonio, and in an area west of Caballo Reservoir. Following the implementation of SE 8 along Subroute 1B2, 2 percent would have moderate residual impacts, 39 percent would have

moderate-low residual impacts, and 58 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along links A160 and A161a; and moderate-low impacts are associated with the presence of coal leases along links A30, A50, A90, and A111, and with the presence of active mines and leases along links A330a and A330b.

The primary impact of concern associated with the implementation of Subroute 1B3 would be associated with restricting access to mineral resources, specifically those in oil and gas leases west of SunZia East, the Carthage coalfield, the Louis Lopez mining district southwest of San Antonio, and in an area west of Caballo Reservoir. Following the implementation of SE 8 along Subroute 1B3, 3 percent would have moderate residual impacts, 39 percent would have moderate-low residual impacts, and 57 would have low residual impacts to mineral resources.

Moderate residual impacts are associated with the presence of active mines and leases along Link A160; and moderate-low impacts are associated with the presence of active mines and coal leases along links A30, A40, A80, and A111, and with the presence of active mines and leases along links A330a and A330b.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 1B1 would be to soils that are susceptible to wind erosion, mainly those in the Jornada del Muerto. No soils designated Prime or Unique Farmland occur along this subroute. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 1B1, less than 1 percent of the subroute would have moderate impacts, 33 percent would have moderate-low impacts, and 67 percent would have low residual impacts on soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along links E80d and A111. The primary impact of concern associated with the implementation of Subroute 1B2 would be to soils that are susceptible to wind erosion, mainly those in the Jornada del Muerto. No soils designated Prime or Unique Farmland occur along this subroute. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 1B2, less than 1 percent of the subroute would have moderate impacts, 33 percent would have moderate-low residual impacts, and 67 percent would have low residual impacts on soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along Link A111.

The primary impact of concern associated with the implementation of Subroute 1B3 would be to soils that are susceptible to wind erosion, mainly those in the Jornada del Muerto. Soils designated as Prime or Unique Farmland occur along this subroute. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 1B3, less than 1 percent of the subroute would have moderate impacts, 31 percent would have moderate-low residual impacts, and 69 percent would have low residual impacts on soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along Link A111.

Local Alternative Links

Geological Hazards

The primary impacts of concern associated with implementation of local alternative links A260, A430, and A481 are from Quaternary faults and from flooding. Following implementation of SE 8, 2 percent of these links have moderate residual impacts, 2 percent have low-moderate residual impacts, and 96 percent have low residual impacts from geological hazards. The other local alternative links have only low residual impacts from geological hazards.

Mineral Resources

Local alternative links for 1A and 1B1 (Gran Quivira area) do not cross any known mineral resources or mines and, therefore, only have low residual impacts. Local alternative links for 1A, 1B1, 1B2, and 1B3 (A161b, A260, A361-A430-A481) do not cross any known mineral resources or mines and, therefore, only have low residual impacts.

Soil Resources

The primary impact of concern associated with the implementation of local alternative links E81, E83, E82-E84-E85 would be to soils that are susceptible to water erosion, mainly those in the Gran Quivira area. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along this local alternative, less than 1 percent of the links would have moderate residual impacts, 66 percent would have moderate-low residual impacts, and 34 percent would have low residual impacts on soil resources.

The primary impact of concern associated with the implementation of local alternative links A161b, A260, A361-A430-A481 would be to soils that are susceptible to water erosion, mainly those in the Uvas Valley. No soils designated Prime or Unique Farmland occur along this subroute. Following the implementation of SE 4 or 6, 5, and 8 along this local alternative, 37 percent would have moderate-low residual impacts and 63 percent would have low residual impacts on soil resources.

Crossover Links

Geological Hazards

Crossover Link A70 has low residual impacts from geological hazards, such as subsidence or flooding.

Mineral Resources

Crossover Link A70 does not cross any known mineral resources or mines.

Soil Resources

The primary impact of concern associated with the implementation of Crossover Link A70 would be to soils that are susceptible to water erosion, mainly those in the vicinity of Yellow Dog Canyon. No soils designated Prime or Unique Farmland occur along this subroute. Following the implementation of SE 4 or 6, 5, or 8 along Crossover Link A70, 75 percent would have moderate-low residual impacts and 25 percent would have low residual impacts on soils.

4.3.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 begins at the proposed Midpoint Substation, and travels west to the proposed Willow-500 kV Substation. The length of this subroute is 123.9 miles. Potentially significant issues discussed in this section include geological hazards, disruption of mineral resource production, and loss of soil resources through accelerated erosion.

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 3A2 would be from flooding on 100-year floodplains. Following implementation of SE 8 along Subroute 3A2, 2 percent of the subroute would have moderate residual impacts and 98 percent would have low residual impacts. Moderate residual impacts are associated with flooding on 100-year floodplains along links B90, B120a, B160d, and B170.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 3A2 would be associated with the restriction of access to mineral resources, specifically those in mining districts near Deming and Lordsburg. Following the implementation of SE 8 along Subroute 3A2, 56 percent would have moderate-low residual impacts and 44 percent would have low residual impacts.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 3A2 would be to soils susceptible to wind erosion, mainly those in the Animas Valley. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 3A2, 52 percent of the subroute would have moderate-low residual impacts and 48 percent would have low residual impacts to soil resources.

Subroute 3A – North

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 3A would be from flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 3A, 3 percent of the subroute would have moderate residual impacts, 3 percent would have moderate-low residual impacts, and 94 percent would have low residual impacts resulting from geological hazards.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 3A would be associated with restricting access to mineral resources, specifically those in mining districts near Deming and Lordsburg, the Big Burro Mountains northeast of Lordsburg and an oil and gas lease northwest of Lordsburg. Following the implementation of SE 8 along Subroute 3A, 56 percent would have moderate-low residual impacts and 44 percent would have low residual impacts to mineral resources. Moderate-low residual impacts are associated with the presence of active mines and leases along links B120B, B121, and B160a.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 3A would be to soils susceptible to wind erosion, mainly those in the Animas Valley. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 3A, 54 percent of the subroute would have moderate-low residual impacts and 46 percent would have low residual impacts to soil resources.

Subroute 3B – South

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 3B would be from flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 3B, 2 percent of the subroute would have moderate residual impacts, 1 percent would have moderate-residual impacts, and 97 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with flooding on 100-year floodplains along links B80, B110a, and B170.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 3B would be associated with restricting access to mineral resources, specifically those in the Lordsburg and Deming mining districts. Following the implementation of SE 8 along Subroute 3B, less than 1 percent would have moderate residual impacts, 36 percent would have moderate-low residual

impacts, and 64 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along Link B150a, and moderate-low residual impacts are associated with the presence of active mines and leases along Link B112.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 3B would be to soils susceptible to wind erosion, mainly those in the Animas Valley. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 3B, 54 percent of the subroute would have moderate-low residual impacts and 46 percent would have low residual impacts to soil resources.

Crossover Links

Geological Hazards

Crossover links B111 and B140 have only low residual impacts resulting from geological hazards, such as flooding.

Mineral Resources

Crossover links B111 and B140 have only low and moderate-low residual impacts to mineral resources.

Soil Resources

The primary impact of concern associated with the implementation of crossover links B111 and B140 for Route Group 3 would be to soils that are susceptible to water and wind erosion; mainly those in the Animas Valley. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along the Route Group 3 crossover links, 53 percent would have moderate-low residual impacts and 47 percent would have low residual impacts to soil resources.

4.3.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 4A would be from flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 4A, less than 1 percent of the subroute would have moderate impacts, 3 percent would have moderate-low residual impacts, and 97 percent would have low residual impacts from geological

hazards. Moderate residual impacts are associated with the presence of Quaternary faults and flooding on 100-year floodplains along links B153a and C173.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 4A would be associated with restricting access to mineral resources, specifically mines west and north of the Galiuro Mountains, and active claims northwest of Oracle. Following the implementation of SE 8 along Subroute 4A, 6 percent would have moderate residual impacts, 53 percent would have moderate-low residual impacts, and 41 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along links C170, C173, C592, and C620; and moderate-low residual impacts are associated with the presence of active mines and leases along links C178, C620, and C760.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 4A would be to soils susceptible to water erosion, mainly those in the northern Galiuro Mountains. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 4A, less than 1 percent of the subroute would have moderate impacts to soil resources, 30 percent of the subroute would have moderate-low residual impacts, and 70 percent would have low residual impacts to soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion or capable of supporting Prime Farmland under appropriate conditions along Link B153a.

Subroute 4B – Sulphur Springs Valley

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 4B would be from flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 4B, 1.5 percent of the subroute would have moderate residual impacts, 1.5 percent would have moderate-low residual impacts, and 97 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with the presence of Quaternary faults and flooding on 100-year floodplains along links C90, C130a, and C173.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 4B would be associated with restricting access to mineral resources, specifically mines west and north of the Galiuro Mountains, and active claims northwest of Oracle. Following the implementation of SE 8 along Subroute 4B, 6 percent would have moderate residual impacts, 61 percent would have moderate-low residual impacts, and 33 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases

along links C170, C173, C592, and C620; and moderate-low residual impacts are associated with the presence of active mines and leases along links C178, C620, and C760.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 4B would be to soils susceptible to water erosion, mainly those in the northern Galiuro Mountains and Aravaipa Canyon. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 4B, 3 percent of the subroute would have moderate residual impacts, 40 percent would have moderate-low residual impacts, and 57 percent would have low residual impacts to soil resources. Moderate residual impacts are associated with soils that are highly susceptible to water erosion or capable of supporting Prime or Unique Farmland under the appropriate conditions along Link C130b.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c begins at the proposed Willow Substation, travelling west to the proposed Pinal Central Substation. The length of this subroute is 161.2 miles. The BLM preferred alternative runs southwest from the Willow Substation across the Sulphur Springs Valley, crosses the San Pedro River, and continues northwest along the San Pedro River Valley, turning northwest towards the Pinal Central Substation. Potentially significant issues discussed in this section include geological hazards, disruption of mineral resource production, and loss of soil resources through accelerated erosion.

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 4C2c would be flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 4C2c, less than 1 percent of this subroute would have moderate residual impacts, 6 percent would have moderate-low residual impacts, and 94 percent would have low impacts. Moderate residual impacts include flooding on 100-year floodplains along Link C110.

Mineral Resources

The primary impact associated with the construction and operation of Subroute 4C2c would be potential restriction of access to mineral resources, specifically access to mines in the San Pedro River Valley near San Manuel, and active claims northwest of Oracle. Following the implementation of SE 8 along Subroute 4C2c, 46 percent of the length of the route would have moderate-low residual impacts and 54 percent would have low residual impacts to mineral resources.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 4C2c would be to soils susceptible to both water and wind erosion, mainly those in the San Pedro River Valley.

Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 4C2c, 1 percent of the subroute would have moderate residual impacts, 31 percent would have moderate-low residual impacts, and 68 percent would have low residual impacts to soils resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along links C201 and C441.

Subroute 4C1 – East of San Pedro River

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 4C1 would be flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 4C1, less than 1 percent of this subroute would have moderate residual impacts, 4 percent would have moderate-low residual impacts, and 96 percent would have low residual impacts from geological hazards.

Mineral Resources

The primary impact of concern with the implementation of Subroute 4C1 would be associated with restricting access to mineral resources. Following the implementation of SE 8 along Subroute 4C1, 1 percent would have moderate residual impacts, 58 percent would have moderate-low residual impacts, and 41 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along links C510 and C660, and moderate-low residual impacts are associated with the presence of active mines and leases along links C660, C693, and C760.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 4C1 would be to soils susceptible to water erosion, mainly those in the San Pedro River Valley. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 4C1, 1 percent of the subroute would have moderate residual impacts, 33 percent would have moderate-low residual impacts, and 66 percent would have low residual impacts to soil resources. Moderate residual impacts are associated with soils that are highly susceptible to water or wind erosion along links C470, C331, and C660.

Subroute 4C2 – West of San Pedro River

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 4C2 would be flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 4C2, less than 1 percent would have moderate residual impacts, 5 percent would have moderate-low

residual impacts, and 95 percent would have low residual impacts from geological hazards. Moderate residual impacts include flooding on 100-year floodplains along Link C110.

Mineral Resources

The potential impacts for Subroute 4C2 would be comparable to those associated with Subroute 4C2c. Following the implementation of SE 8 along Subroute 4C2, 1 percent would have moderate residual impacts, 54 percent would have moderate-low residual impacts, and 45 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along Link C510, and moderate-low residual impacts are associated with the presence of active mines and leases along links C680, C818, and C820.

Soil Resources

Impacts to soils along Subroute 4C2 are nearly identical to those identified along Subroute 4C2c. The primary impact of concern associated with the implementation of Subroute 4C2 would be to soils susceptible to both water and wind erosion, mainly those in the San Pedro River Valley. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 4C2, 1 percent of the subroute would have moderate residual impacts, 34 percent would have moderate-low residual impacts, and 65 percent would have low residual impacts to soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along links C266, C276, and C441.

Subroute 4C3 – Tucson

Geological Hazards

The primary impact of concern associated with the implementation of Subroute 4C3 would be flooding on 100-year floodplains. Following the implementation of SE 8 along Subroute 4C3, less than 1 percent of this subroute would have moderate residual impacts, 13 percent would have moderate-low residual impacts, and 87 percent would have low residual impacts from geological hazards. Moderate residual impacts include flooding on 100-year floodplains along Link C110.

Mineral Resources

The primary impact of concern associated with the implementation of Subroute 4C3 would be associated with restricting access to mineral resources, specifically mines in the Tucson area. Following the implementation of SE 8 along Subroute 4C3, less than 1 percent of the subroute would have moderate residual impacts, 39 percent would have moderate-low residual impacts, and 60 percent would have low residual impacts to mineral resources. Moderate residual impacts are associated with the presence of active mines and leases along Link C820, and moderate-low residual impacts are associated with the presence of active mines and leases along links C817 and C820.

Soil Resources

The primary impact of concern associated with the implementation of Subroute 4C3 would be to soils susceptible to water erosion, mainly those in the Little Rincon Mountains. Soils designated as Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following the implementation of SE 4 or 6, 5, and 8 along Subroute 4C3, less than 1 percent of the subroute would have moderate residual impacts to soil resources, 39 percent (rounded to the nearest whole number) would have moderate-low residual impacts to soil resources, and 61 percent would have low residual impacts to soil resources. Moderate residual impacts are associated with soils that are highly susceptible to wind erosion along links C261 and F40a.

Local Alternative Links

Geological Hazards

The primary impact of concern associated with implementation of Local Alternative Link C790 for subroutes 4A and 4B is from flooding. Following implementation of SE 8, 8 percent of these links have low-moderate residual impacts and 92 percent have low residual impacts from geological hazards.

The primary impact of concern associated with the implementation of local alternative links C860, C870, and C890 for the planned Pinal Central Substation is flooding and fissures. Following implementation of SE 8, 4 percent of these links would have moderate residual impacts, 5 percent would have moderate-low residual impacts, and 91 percent would have low residual impacts from geological hazards. Moderate residual impacts are associated with floodplains.

The primary impact of concern associated with the implementation of Local Alternative Link C692 for Subroute 4C1 is flooding. Following implementation of SE 8 along Local Alternative Link C692, 100 percent of this link would have low residual impacts from geological hazards.

The primary impact of concern associated with the implementation of the Winchester and Tortolita substations local alternative links is flooding. Following implementation of SE 8 at these substations, 1 percent of the links would have moderate-low residual impacts and 99 percent would have low residual impacts from geological hazards.

The primary impact of concern associated with the implementation of the Pantano-Rillito local alternative links is flooding. Following implementation of SE 8 along the Pantano-Rillito alternative route, 56 percent of the links would have moderate-low residual impacts and 44 percent would have low residual impacts from geological hazards.

The primary impact of concern associated with the implementation of local alternative links C72, C90, C121, and C211 for subroutes 4C1, 4C2, and 4C3 is flooding. Following implementation of SE 8 along subroutes 4C1, 4C2, and 4C3, 3 percent of these links would have moderate residual impacts, 24 percent of the links would have moderate-low residual impacts, and 73 percent would have low residual impacts. Moderate residual impacts are associated with floodplains from geological hazards.

Mineral Resources

The primary impact of concern associated with the implementation of local alternative links C692, C790, C860, C870, and C890 is to active mining claims. The local alternative links for the Winchester and Tortolita substations have several mines within 1 mile of their centerline. These links have 50 percent of their total mileage with moderate-low residual impacts. The local alternative links for 4C3 (F40b-F51-F60a, F81a-F81b, C812) have numerous mines within 1 mile of the centerline; but with the implementation of SE 8, only 16 percent of their length have moderate-low residual impacts and 84 percent have low residual impacts. Local alternative links for 4C1, 4C2, and 4C3 (C72-C90-C121-C211) have fewer mines within 1 mile of the centerline. This results in 32 percent of moderate-low residual impacts for their total length, and 68 percent of low residual impacts.

Soil Resources

The primary impact of concern associated with the implementation of Local Alternative Link C790 for subroutes 4A and 4B would be approximately equal between soils that are susceptible to water and wind erosion, mainly those in the vicinity of Brady Wash. No soils designated Prime or Unique Farmland occur along this subroute. Following the implementation of SE 4 or 6, and 5 along Link C790, 33 percent of this link would have moderate-low residual impacts and 67 percent would have low residual impacts.

The primary impact of concern associated with the implementation of local alternative links C860, C870, and C890 for the planned Pinal Central Substation would be approximately equal between soils that are susceptible to water and wind erosion. Soils designated Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following implementation of SE 4 or 6, 5, and 8, 80 percent of these links would have moderate-low residual impacts and 20 percent would have low residual impacts.

The primary impact of concern associated with the implementation of Local Alternative Link C692 for Subroute 4C1 would be to soils that are susceptible to wind erosion. No soils designated Prime or Unique Farmland occur along this subroute. Following implementation of SE 4 or 6, and 5 along Local Alternative Link C692, 20 percent of the link would have moderate-low residual impacts and 80 percent would have low residual impacts.

The primary impact of concern associated with the implementation of the Winchester and Tortolita substations would be to soils that are susceptible to water erosion. Soils designated Prime or Unique Farmland occur along this subroute, but impacts to them would be mitigated. Following implementation of SE 4 or 6, 5, and 8 at the Winchester and Tortolita substations, 21 percent would have moderate-low residual impacts, and 79 percent would have low residual impacts. Moderate residual impacts are associated with soils that are designated Prime or Unique Farmland.

The primary impact of concern associated with the implementation of local alternative links F40b, F51, F60a, F81a, F81b, and C812 would be to soils that are susceptible to water erosion. Soils designated Prime or Unique Farmland occur along this subroute, but impacts to them

would be mitigated. Following implementation of SE 4 or 6, 5, and 8, 22 percent of the links would have moderate-low residual impacts and 78 percent would have low residual impacts.

The primary impact of concern associated with the implementation of local alternative links C72, C90, C121, and C211 would be to soils that are designated Prime or Unique Farmland. Soils that are highly susceptible to water or wind erosion do not occur along these links. Following implementation of SE 4 or 6, 5, and 8, 52 percent of the links would have moderate-low residual impacts and 48 percent would have low residual impacts.

Crossover Links

Geological Hazards

The primary impact of concern associated with the implementation of crossover links C500, C501, C502, and C174 for subroutes 4A, 4B, and 4C1 is flooding. Following implementation of SE 8 along these subroutes, 1 percent of the links would have moderate residual impact, 1 percent would have moderate-low residual impacts, and 98 percent would have low residual impacts. Moderate residual impacts are associated with floodplains.

The primary impact of concern associated with the implementation of Crossover Link C671 for subroutes 4A, 4B, 4C1, and 4C2 is flooding. Following implementation of SE 8 along these four subroutes, 1 percent of the link would have moderate-low residual impacts and 99 percent would have low residual impacts.

Mineral Resources

Crossover links C500, C501, C502, and C174 have 4 percent moderate residual impacts for their total length, as a result of their close proximity to mines and claims. Crossover Link C671 does not cross any mines, but is within 1 mile of mines and active claims, resulting in 32 percent low-moderate residual impacts and 68 percent low residual impacts.

Soil Resources

The primary impact of concern associated with the implementation of crossover links C500, C501, C502, and C174 would be to soils that are susceptible to water erosion. No designated Prime or Unique Farmland soils occur along this subroute. Following implementation of SE 4 or 6, 5, and 8 along these subroutes, none of the links would have moderate residual impacts, 47 percent would have moderate-low residual impactions, and 53 percent would have low residual impacts. Moderate residual impacts are associated with soils that are susceptible to water erosion.

The primary impact of concern associated with the implementation of Crossover Link C671 would be to soils that are susceptible to water erosion. No designated Prime or Unique Farmland soils occur along this subroute. Following implementation of SE 4, 5, and 6 along subroutes 4A, 4B, 4C1, and 4C2, 37 percent of the link would have moderate-low residual impacts and 63 percent would have low residual impacts.

4.3.3.5 Summary of BLM Preferred Alternative

Based on results of the preceding analysis, the following potentially significant impacts from geological hazards and to mineral and soil resources may occur with construction and operation of the BLM preferred alternative:

- Transmission lines may be impacted by earthquakes occurring along Quaternary faults (subroutes 1A2 and 3A2)
- Transmission lines may be impacted by destabilization of the ground surface by earth fissures in the vicinity of the Pinal Central Substation (Subroute 4C2c)
- Transmission lines may be impacted by flooding along 100-year floodplains associated with various rivers, streams, and washes crossed by the Project (subroutes 1A2, 3A2, and 4C2c)
- Accelerated erosion rates may result in loss of soil material and productivity (subroutes 1A2 and 4C2c)

4.4 PALEONTOLOGICAL RESOURCES

4.4.1 Introduction

The primary concern regarding impacts to paleontological resources is the loss of scientifically significant fossils and their contextual data. The degree of impact to these resources depends upon the amount of ground disturbance within areas having moderate to high sensitivity for fossils, based on the BLM's PFYC predictive model[1]. Mitigation of impacts to paleontological resources includes preconstruction surveys, personnel education, monitoring ground disturbance for fossils, preparation and curation of any discovered fossils, and deposition of collected fossils in a paleontological repository. Specific mitigation measures are discussed more fully in the PRTP that will be part of the POD. Sensitivity level is used instead of impact level for paleontological resources, because the future discovery of buried fossils cannot be quantified.

4.4.2 Sensitivity Assessment Methodology

The methods for assessing the sensitivity of areas with paleontological resources include: (1) identifying the types of potential effects on paleontological resources that could result from the construction and operation of the proposed Project and its associated facilities; (2) classifying the sensitivity of geological formations based on PFYC and paleontological density; and (3) developing a PRTP to mitigate impacts to paleontological resources found as a result of implementing the Project.

[1] Based on a system 1 to 5, with 1 being Very Low and 5 being Very High.

4.4.2.1 Types of Potential Environmental Impacts

The construction and operation of the Project may result in both direct and indirect adverse impacts to paleontological resources. Direct impacts associated with construction activities include the loss of paleontological resources as a result of blasting, excavation and construction of facilities, staging areas, structures, and roads. There would be no direct impacts associated with the operation of the facilities and the presence of the transmission lines. Indirect impacts associated with the construction and operation of the Project include:

- Loss of paleontological resources as a result of increased public access to sensitive geological formations, as the construction of permanent access roads may lead to an increase in unauthorized collection or vandalism
- Loss of paleontological resources as a result of increased erosion from construction activities

4.4.2.2 Sensitivity Assessment Criteria

Sensitivity levels are based on the PFYC of each geological formation. Paleontological density is estimated from known fossil localities, as identified during the data inventory of existing literature, institutional records, and geological maps (see Section 3.4, Paleontological Resources); it represents concentrations of fossil localities and acts as a secondary measure of sensitivity. High paleontological density is often associated with geological formations having high PFYC, and can be useful in predicting patterns of fossil localities within a certain geological formation. However, paleontological density also helps to identify areas of fossil concentrations in areas with low PFYC. Sensitivity levels of high, moderate/undetermined, or low were assigned to portions of the study corridors (within 1 mile of the centerline of the proposed transmission lines), as defined below and included in Table 4-10.

- *High Sensitivity Level* – Areas identified as having a PFYC of 4 or 5. In these cases, the geological unit contains a high density of recorded fossil localities, has produced fossil remains in or near the vicinity of the Project, or is very likely to yield additional fossil remains during construction.
- *Moderate/Undetermined Sensitivity Level* – Areas identified as having a PFYC of 3. The undetermined rating in this category refers to a geological unit that has limited exposure in the Project study area, is poorly studied, or contains no recorded paleontological localities. However, in other areas, the same or similar geological unit may contain sufficient paleontological localities to suggest exposures of the unit in the Project study area would have at least a moderate sensitivity level.
- *Low Sensitivity Level* – Areas identified as having a PFYC of 1 or 2. In these cases, the geological unit contains very low or no density of recorded fossil localities, or has produced little or no fossil remains in the vicinity of the Project, or is unlikely to yield any fossil remains. Nevertheless, geological units with few or no prior recorded fossil localities could prove fossiliferous during construction.

Significant Impacts

For the purposes of this analysis, a significant impact on paleontological resources could result if any of the following were to occur from construction or operation of the Proposed Action:

- Direct destruction of a unique paleontological resource or site
- Indirect destruction of a unique paleontological resource or site by increased erosion or increased visibility leading to unauthorized collection

4.4.2.3 Mitigation of Impacts

The primary potential adverse effect to paleontological resources would be loss of these resources due to construction and ground-disturbing activities. However, the implementation of ST 24 (Table 2-10, Chapter 2) would reduce any potential adverse impacts to paleontological resources to a low level. Mitigation would be applied based on sensitivity level and site-specific conditions, as explained in the PRTP. Specific mitigation measures include paleontological surveys, personnel education, monitoring ground disturbance related to the Project, preparation and curation of fossils, and deposition of fossils in a paleontological repository. If unmitigated, impacts to paleontological resources could remain high along portions of the route that cross those formations with high PFYC, as these areas could contain significant vertebrate fossils and other scientifically important paleontological resources.

4.4.3 Sensitivity Analysis Results

4.4.3.1 No Action Alternative

Under the No Action alternative, there would be no impacts to paleontological resources.

4.4.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the proposed SunZia East Substation, traveling west through the Gran Quivira area and into Torrance County. From there, the subroute continues south to an area just north of the Jornada del Muerto, heads west across the Rio Grande, then continues south to the proposed Midpoint Substation. Subroute 1A1 (see Table 4-10), has the second highest sensitivity for paleontological resources in Route Group 1. Areas of high and moderate sensitivity are primarily associated with the Upper Santa Fe Group adjacent to the Rio Grande, Quaternary piedmont alluvial deposits located west of I-25, Baca Formation, Tres Hermanos Formation, undivided Cretaceous rocks, Chinle Group, Abo Formation, and Madera Group in the San Andres Mountains. The Upper Santa Fe Group has the greatest number of miles of high sensitivity. Subroute 1A1 crosses both high and moderate paleontological density areas along links E130, E151, and E180 near Carthage, northeast of Socorro.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2, the BLM preferred alternative, has similar impacts to 1A1 and 1A because they share numerous links; however, Subroute 1A2 has slightly more moderate sensitivity to paleontological resources as a result of its utilization of Link E86.

Table 4-10. Paleontological Sensitivity Levels based on PFYC and Paleontology Density

Subroute	Total Miles	Paleontology (miles)					
		PFYC			Paleontological Density		
		High Sensitivity	Moderate Sensitivity	Low Sensitivity	High Sensitivity	Moderate Sensitivity	Low Sensitivity
Route Group 1: SunZia East Substation to Midpoint Substation							
1A1	228.8	111.2	10.1	107.5	2	4	222
1A2	230.3	111.2	10.5	108.6	2	4	224
1A	219.5	106	10	103	2	5	213
1B1	223.6	98	3	122	2	3	219
1B2	209.2	98	3	108	2	3	205
1B3	206.3	95	1	110	2	3	202
Route Group 3: Midpoint Substation to Willow-500 kV Substation							
3A2	123.9	30	25	69	0	0	124
3A	123.4	27	25	72	0	0	123
3B	128.6	9	37	82	0	0	129
Route Group 4: Willow-500 kV Substation to Pinal Central Substation							
4A	132.9	26	73	35	0	0	133
4B	133.0	35	65	33	0	0	133
4C2c	161.2	45.6	87.6	28	0	0	161.2
4C1	139.0	52	66	22	0	0	139
4C2	151.8	49	77	26	0	0	152
4C3	172.9	15	106	52	0	0	173

Subroute 1A – North River Crossing

Subroute 1A has similar impacts to 1A1, because they share numerous links. However, Subroute 1A has slightly more sensitivity to paleontological resources than 1A1 as a result of its utilization of Link A270 rather than A260 in the Elephant Butte Reservoir area, and several different links west of the SunZia East Substation.

Subroute 1B – San Antonio Crossing

Subroutes 1B1, 1B2, and 1B3 have common links throughout part of their routes, including Link A111, which crosses moderate to high sensitive Mesozoic formations containing numerous fossil localities. Subroutes 1B1, 1B2, and 1B3 vary only slightly in their sensitivity to paleontological resources, but have less sensitivity to paleontological resources than 1A1.

4.4.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Areas of high and moderate sensitivity in Route Group 3 are primarily associated with the Upper Santa Fe and Gila groups located between Deming and Lordsburg in New Mexico, and the Gila Group and older Quaternary deposits located in the San Simon Valley of Arizona.

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2, the BLM preferred alternative, crosses 30 miles of high sensitivity to paleontological resources, 25 miles of moderate sensitivity, and 69 miles of low sensitivity. This results in 44 percent of this route having high and moderate sensitivity, the greatest of the Route Group 3 subroutes.

Subroute 3A – North

Subroute 3A has 3 fewer miles of high sensitivity to paleontological resources than 3A2, but the same distance of moderate sensitivity. This results in 42 percent of this route having high and moderate sensitivity, which is slightly lower than 3A2.

Subroute 3B – South

Subroute 3B has 21 fewer miles of high sensitivity than Subroute 3A2 (see Table 4-10). This is primarily because there are fewer miles of Gila Group deposits crossed by Subroute 3B in New Mexico. Subroute 3B is also the least paleontologically sensitive Route Group 3 subroute, as only 36 percent of this subroute exhibits high and moderate sensitivity, compared to 44 percent for Subroute 3A2.

Route Group 3 has the fewest miles of high and moderate sensitivity as compared to the other route groups. This lack of high or moderate sensitivity is associated with the shorter length of the subroutes in this group and the comparative rarity of fossiliferous geological units along their length. None of the Route Group 3 subroutes includes any areas with a high or moderate paleontological density.

4.4.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Areas of high and moderate sensitivity in Route Group 4 are primarily associated with older Quaternary deposits and Tertiary sedimentary deposits that include the Gila Group, Quiburis Formation, and the St. David Formation in the San Simon, Sulphur Springs, and San Pedro valleys of Arizona.

Subroute 4A – North of Mt. Graham

Subroute proceeds north from the Willow Substation, east of the Pinaleño Mountains and then turns west towards Pinal Central Substation. This subroute avoids the Quiburis and St. David formations, but does come within close proximity to the 111 Ranch Beds, and does cross the Gila Group in the San Simon Valley. As a result, Subroute 4A is the second least paleontologically sensitive subroute, with only 74 percent of the subroute exhibiting high to moderate sensitivity.

Subroute 4B – Sulphur Springs Valley

Subroute 4B proceeds north from the Willow Substation, west of the Pinaleño Mountains before turning west to the Pinal Central Substation. This subroute avoids the Quiburis and St. David formations, but does cross the Gila Group. Subroute 4B is the third least paleontologically sensitive subroute in Route Group 4, with only 75 percent exhibiting high to moderate sensitivity.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c is the second longest subroute in Group 4 and has 45.6 miles of high sensitivity and 87.6 miles of moderate sensitivity. This results in 83 percent of its route with high or moderate sensitivity to paleontological resources, which is the second highest in Route Group 4. The high sensitivity results from crossing the highly sensitive Quiburis and St. David Formation.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is the most paleontological sensitive subroute within Route Group 4. Subroute 4C2c crosses 6 more miles of high sensitive to paleontological resources, but 21 fewer miles for moderate sensitive. This results in 85 percent of its route having high and moderate sensitivity to paleontological resources.

Subroute 4C2 – West of San Pedro River

The sensitivity to paleontological resources for Subroute 4C2 is similar to 4C2c. Subroute 4C2 has slightly more mileage of high sensitive than 4C2c, but less moderate sensitivity. This results in 83 percent of its route with high or moderate sensitivity to paleontological resources, which is the same as 4C2c.

Subroute 4C3 – Tucson

Subroute 4C3 is the least paleontologically sensitive subroute, with only 70 percent of the subroute exhibiting high to moderate sensitivity. This subroute crosses very little of the St. David Formation and does not cross the Quiburis Formation.

Route Group 4 subroutes contain very few known fossil localities, due to the limited amount of paleontological research in these areas.

4.4.3.5 Summary of BLM Preferred Alternative

Generally, Route Group 1 has significantly greater mileage of high sensitivity than route groups 3 and 4. This greater amount of sensitivity is associated with the large regions of the highly sensitive Upper Santa Fe Group, piedmont alluvial deposits located on either side of the Rio Grande, and several fossiliferous Mesozoic formations that are crossed by the alternative routes. Subroutes 1A and 1A1 are the most paleontologically sensitive subroute in Route Group 1, with 53 percent of their route crossing high to moderate areas of sensitivity; and have numerous fossil localities within the Sierra Ladrones and Palomas formations, which have a high PFYC. Route

Group 3 has the least sensitivity to paleontological resources since it crosses the fewest miles of formations with high or moderate PFYC.

Based on the preceding analyses, the following potential impacts to paleontological resources were identified:

- Route Group 1
  - The BLM preferred alternative (1A2) has 18 fossil localities within 1 mile of the centerline. Two Permian localities in Abo Formation along Link E101b (Subroutes 1A2, 1A, and 1A1), 2 localities are in the Blancan Sierra Ladrones Formation along link E180 (Subroutes 1A2, 1A, and 1A1), and 14 localities are in the Blancan Palomas Formation along Link E180. Subroute 1A2 has the highest sensitivity for paleontological resources in Route Group 1.
- Route Group 3
  - The BLM preferred alternative (3A2) crosses the fossiliferous 111 Ranch Beds along Links B160a and B160d and crosses several areas containing the Gila Group. Subroute 3A2 is the most paleontologically sensitive subroute in Route Group 3.
- Route Group 4
  - Subroute 4C2c crosses the Quiburis and St. David formations. Subroute 4C2c and 4C2 are the second highest paleontologically sensitive subroutes in Route Group 4.

If unmitigated, impacts to paleontological resources could be high along these routes, as many areas contain scientifically significant fossils, such as land mammals, dinosaurs, and other vertebrates. However, areas with high or moderate/undetermined sensitivity would have ST 24 applied before and during construction, which would reduce these impacts to a low level. Specific mitigation measures, which will be discussed in the PRTP as part of the POD, include paleontological surveys, personnel education, monitoring ground disturbance related to the Project, preparation and curation of fossils, and deposition of fossils in a paleontological repository.

4.5 WATER RESOURCES

4.5.1 Introduction

This section describes and analyzes the impacts to water resources that could result from the construction of the proposed Project.

4.5.1.1 Impacts to Surface Water

Impacts to surface water could result from placement of structures, blasting, construction of access roads, or temporary work areas. Direct impacts to perennial and intermittent surface water features could include sedimentation from Project-related disturbance, fugitive dust deposition, temporary and permanent fill associated with development of access routes, removal of riparian vegetation, bank alteration, accidental contamination associated with spills of environmentally

harmful material, damage to wetlands, or the introduction of herbaceous and aquatic invasive species. Direct impacts to intermittent surface water features are similar to those for perennial water features, although intermittent streams typically have less associated riparian vegetation and, subsequently, are more prone to erosion. Indirect impacts may result from increased soil erosion due to removal of vegetation.

Construction of access roads would likely require crossing several surface-water resources. These crossings could require the placement of temporary or permanent fill into a stream channel, as well as structures that support the crossing and protect water resources (e.g., bridge pilings, culverts, wing walls, etc.).

Temporary impacts would result from temporary crossings or fill used to cross water resources with little to no stream flow or on temporary access roads. Types of temporary stream crossings would include: (1) dry crossings with no bank or channel improvement; (2) mechanically grading banks to a slope sufficient to drive equipment and building materials across the channel (bank recontouring and revegetation would follow the work at the temporary crossing); (3) placement of fill that would be removed following the completion of work at the site; or (4) span structures. While temporary, these crossings would have the potential to impact stream morphology and ecological function. Modification of stream banks could result in removal of vegetation that could take many years to recover. Sedimentation potential may increase, depending upon the extent of disturbance and recontouring needed. Stormwater discharge and quantity of sedimentation to surface-water resources are often correlated to project-related disturbance.

Permanent impacts would result from permanent crossings, into which structures were placed in the streambed, potentially causing an irreversible loss of riparian vegetation on either side of the crossing. All crossings, temporary and permanent, would be constructed with the minimum footprint required to safely transfer building materials and construction equipment.

Work performed below the ordinary high-water mark in streams determined to be Waters of the United States will require a Section 404 CWA permit, issued by the USACE. The CWA requires that impacts resulting from these crossings are avoided or minimized to the extent possible; any unavoidable impacts must be mitigated. Depending on the type of crossing method used, it may also be necessary to obtain a stream alteration permit from the state and/or a Section 404 permit from the USACE.

4.5.1.2 Impacts to Groundwater

Groundwater located within the Project study area is used for both municipal and agricultural water supply. Subsurface water or groundwater resources are less susceptible than surface water to impacts associated with the proposed action. However, if negatively impacted, remedial action would be more problematic and complicated for groundwater than for surface water. The Project has the potential to impact groundwater resources in areas of shallow groundwater (groundwater that is near the surface), where placement of structures could come in contact with the water table. Potential impacts to groundwater resources include accidental contamination during structure placement or accidental spills of environmentally harmful liquids that have the potential of percolating into shallow groundwater. Implementation of the Project would not require placement of hazardous material below ground, and shallow groundwater would be identified

prior to work occurring in those areas. Impacts to groundwater would be highly unlikely, due to appropriate avoidance and mitigation measures (to be identified in the POD). For example, watering facilities such as developed springs or wells would be avoided; but if damaged, would be repaired or replaced. In addition, spill containment facilities and spill prevention procedures are in place, as part of the POD. As proposed, the Project would not impede the flow or depth of groundwater.

Wells providing groundwater for municipal and agricultural uses are located within the Project study area. Wells also provide connectivity between surface water and aquifers through which contamination could travel. Impacts to wells could include accidental physical damage to well structures during construction, or accidental contamination of groundwater resources; although these are highly unlikely. For the purpose of this assessment, it is assumed that impacts to groundwater resources could occur to wells located less than 600 feet from the Project. Impacts to springs are similar to those described for perennial surface water features.

4.5.2 Impact Assessment Methods

The methods for assessing potential impacts to water resources associated with implementing the Project include: (1) identifying the sensitivity of each water feature in the Project study area; (2) identifying the types of potential effects to water resources; (3) the use of USACE and EPA-approved parameters to identify the functions and values of water resources to classify potential environmental effects; (4) developing criteria for assessing the level of a potential impact to water resources; (5) assessing the initial impacts to water resources; (6) identifying appropriate selective mitigation measures for minimizing potential adverse effects; (7) determining areas where mitigation should be applied; and (8) estimating potential residual impacts to water resources. The residual impacts are a result of the initial impacts identified, the amount of disturbance predicted (based on construction and access roads), and the general and selective mitigation measures applied.

Criteria were developed to assess the level of impact to a water resource associated with the implementation of the Project (Table 4-11). These criteria focused on: (1) the abundance of a particular water resource feature; (2) the time in which, if affected, those resources would regenerate; (3) the potential for permanent loss of water resources and/or associated vegetation; (4) federal and state statutes surrounding particular water resources; and (5) the varying degree of importance a particular resource has on the greater ecosystem.

Table 4-11. Impact Levels for Water Resources

High	Permanent loss of Palustrine (marsh) Forest Overstory Wetlands Permanent loss of wetlands that support federally endangered, threatened, or candidate species Construction and operation-related activities that lead to deposition of material into state-listed impaired waters Construction and operation-related activities that impact wells or springs Placement of structure foundations in areas of shallow groundwater, wetlands, or aquifers Degradation of an Outstanding Water
Moderate	Permanent loss of Palustrine (marsh) Scrub/Shrub Wetlands Permanent fill in Waters of the United States Construction and operation activities that result in permanent increase of sedimentation to nearby surface-water resources Further degradation of an Impaired Water

Table 4-11. Impact Levels for Water Resources	
Low	Temporary loss of Palustrine (marsh) Scrub/Shrub Wetlands Temporary fill in Waters of the United States Construction and operation activities that result in temporary increases in sedimentation to nearby surface water resources

Significant Impacts

For the purposes of this analysis, a significant impact on water resources could result if any of the following were to occur from construction or operation of the proposed action:

- Loss of Palustrine (Marsh) Forest Overstory Wetlands
- Loss of wetlands that support federally endangered, threatened, or candidate species
- Deposition of material into state-listed impaired waters or Waters of the United States
- Impairment or restriction of access to wells or springs
- Placement of structure foundations in areas of shallow groundwater, wetlands, or aquifers

4.5.2.1 Mitigation of Impacts

Initial impacts to water resources were assessed based on the sensitivity of known attributes of each water resource to types of effects that could result from implementation of the Project. Water resources identified by this analysis were differentiated into subcategories, to better represent potential impacts. Surface water was broken into three categories: (1) major rivers, such as the Rio Grande and San Pedro; (2) perennial and intermittent streams; and (3) water bodies (ponds, tanks, wetlands, etc.). Wells and springs were analyzed separately during the inventory.

Removal of unique riparian habitat, increased sedimentation, and reduced water quality are among the primary adverse environmental effects on surface water resources that could be associated with the proposed Project. The primary adverse environmental effect to groundwater resources would be potential degradation caused by construction and operation activities and the presence of permanent facilities.

In addition to standard mitigation measures (see Table 2-10), SE 2 and 8 were developed to reduce high to moderate initial impacts in areas where necessary and feasible. SE 2 would minimize potential impacts to surface water resources by minimizing the construction of new access roads at perennial streams and other surface waters. Access roads would be designed to avoid placement of permanent fill in perennial and intermittent streams, as well as avoiding designs that would lead to the removal of riparian or wetland vegetation. Where construction vehicles and equipment would need to access areas within 328 feet (100 meters) of a riparian area, potential impacts would be avoided in the design stage and anticipated impacts would be adequately mitigated. In addition, an erosion control plan would be implemented to minimize the potential for sedimentation. Spill prevention and containment measures would be implemented, and vehicle refueling and maintenance activities would be limited to designated work areas at least 328 feet from all streams. The Project would comply with the requirements of EO

No. 11988 (Floodplain Management), EO No. 11990 (Wetland Protection), and Sections 401 and 404 of the CWA (in Construction, Operation, and Maintenance Plan).

SE 8 would minimize potential impacts to surface water resources by locating structures to avoid or span sensitive features, such as wetlands, riparian areas, perennial rivers, and streams. The avoidance of sensitive water resources through spanning, selective structure placement, or realignment of access routes was applied to all major rivers, perennial streams, springs, wells, and water bodies, where feasible. Spanning or avoiding sensitive features would also be applied as mitigation to those areas where springs or wells are present to reduce impacts to groundwater resources.

4.5.3 Impact Analysis Results

4.5.3.1 No Action Alternative

Under the No Action alternative, there would be no construction or operations activities associated with the Project. Impacts to water resources associated with the implementation of the Project would not occur.

4.5.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 proceeds west from the SunZia East Substation along the route with links E82, E84, and E85. From there it continues west, eventually crossing the Rio Grande at Link E180. Subroute 1A1 continues south along links A161, A161a, A260, A330a, A330b, and A400 until it reaches the Midpoint Substation. Following implementation of SE 2 and 8, there are no identifiable moderate-high or moderate residual impacts (Table 4-12).

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the northern-most subroute, but its impacts to water resources are similar to those of 1A1. This is a result of the large number of common links between the two subroutes. Subroute 1A2 continues west from Link E84 along Link E86 before connecting to E101. Subroute 1A2 is slightly longer than Subroute 1A1, and has slightly more miles of low residual impacts to water resources than 1A1. Following implementation of SE 2 and 8, there are no identifiable moderate-high or moderate residual impacts for subroute 1A2.

Subroute 1A – North River Crossing

Subroutes 1A, 1B1, 1B2, and 1B3 share a common route after Link A161. Therefore, differences in total mileage of residual impacts for those routes are attributed to differences in impacts before Link A161. Subroute 1A is similar to 1A1 except it proceeds west from SunZia East Substation along a slightly more southern route along Link E80C. Subroute 1A also utilizes Link A270 instead of A260, in the area of Elephant Butte Reservoir.

Subroute 1B – San Antonio Crossing

Subroutes 1B1, 1B2, and 1B3 are common throughout most of their route except where the links vary as the route proceeds west of the SunZia East Substation. Subroutes 1B1, 1B2, and 1B3 have less than 1 percent of low-moderate residual impacts after mitigation. Subroutes 1B1, 1B2, and 1B3 would have similar potential effects to water resources as Subroute 1A. Following the implementation of SE 2 and 8 along these subroutes, the residual impacts to water resources would have no identifiable high or moderate impacts (Table 4-12).

Table 4-12. Route Group 1
Water Resource Inventory Data and Residual Impacts

Subroute	Total Miles	Water (miles or numbers)							Residual Impacts (miles)			
		Perennial Rivers	Intermittent Streams	Impaired Waters	Number of Springs	Number of Wells	Water Bodies	Wetlands	Low	Low-Moderate	Moderate	Moderate-High
1A	219.5	0	12.25	0.2	0	3	0.1	0.2	219.4	0.1	0	0
1A1	228.8	0	14.07	0.2	0	1	0.1	0.2	228.7	0.1	0	0
1A2 (BLM Preferred Alternative)	230.3	0	14.34	0.2	0	1	0.1	0.2	230.2	0.1	0	0
1B1	223.6	0	11.6	0.2	1	5	0.1	0.2	223.5	0.1	0	0
1B2	209.2	0	11.77	0.2	1	5	0.1	0.2	209.1	0.1	0	0
1B3	206.3	0	11.77	0.2	0	2	0.1	0.2	206.2	0.1	0	0
Local Alternative Links for 1A and 1B1 (Gran Quivira area)	62.4	0.3	4.9	—	0	0	0	0	62.4	0	0	0
Crossover Links 1B2, 1B3	7.7	0	1	—	0	0	0	0	7.7	0	0	0

The local alternative links for 1A and 1B1 (Gran Quivira area) have no moderate or high impacts. The low-moderate residual impacts, for both groups of crossover links, result from the crossing of perennial and intermittent streams. One crossover link is available for links 1B2 and 1B3 (A70); it crosses 1 mile of intermittent streams.

4.5.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Impacts to water resources would be similar among the three subroutes in Route Group 3. All three subroutes for Route Group 3 have similar potential impacts to water resources, and all three cross the Mimbres River and Walnut Creek, which are considered perennial throughout some of their reaches. The longest of the subroutes in Route Group 3, Subroute 3B has the highest mileage of residual impacts to water resources. Following implementation of SE 2 and 8 along subroutes 3A2, 3A, and 3B, residual impacts to water resources would include no identifiable high or moderate impacts (Table 4-13).

Two crossover links are available for Route Group 3 (B111 and B140). These crossover links have no residual impacts after mitigation.

Table 4-13. Route Group 3 Water Resource Inventory Data and Residual Impacts											
		Water (miles or numbers)						Residual Impacts (miles)			
Subroute	Total Miles	Perennial Rivers	Intermittent Streams	Number of Springs	Number of Wells	Water Bodies	Wetlands	Low	Low-Moderate	Moderate	Moderate-High
3A2 (BLM preferred Alternative)	123.9	0	3.5	0		0	0	124	0	0	0
3A	123.4	0	3.7	0	3	0	0	120.7	2.7	0	0
3B	128.6	0	4.2	0	8	3	0	124.4	4.2	0	0
Crossover Links 3A, 3B	15.2	0.4	3.6	0	0	0	0	15.2	0	0	0

4.5.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A proceeds north from the Willow Substation, east of the Pinaleño Mountains. Subroute 4A crosses Aravaipa Creek and the San Pedro River. Link C170 crosses an intermittent reach of Aravaipa Creek, approximately 3.4 miles south of the southern boundary to Aravaipa Wilderness. Subroute 4A has very few wells within 1 mile of its centerline, and crosses 21 miles of a sole-source aquifer. The shortest of the subroutes in Route Group 4, Subroute 4A is the least sensitive subroute for water resources. Following implementation of SE 2 and 8 along Subroute 4A, residual impacts to water resources would include no identifiable high, moderate-high, or moderate impacts to water resources, and less than 1 percent of low-moderate impacts.

Subroute 4B – Sulphur Springs Valley

Subroute 4B would have the same potential impacts to water resources as would Subroute 4A. Following the implementation of SE 2 and 8 along Subroute 4B, the residual impacts to water resources would include no identifiable moderate-high or moderate impacts, and less than 1 percent of low-moderate impacts.

Table 4-14. Route Group 4 Water Resource Inventory Data and Residual Impacts													
		Water (miles or numbers)								Residual Impacts (miles)			
Subroute	Total Miles	Perennial Rivers	Intermittent Streams	Outstanding Waters	Number of Springs	Number of Wells	Water Bodies	Wetlands	Sole Source Aquifer	Low	Low-Moderate	Moderate	Moderate-High
4A	132.9	0.06	3.4	—	2	17	0	0.2	21	132.79	0.11	0	0
4B	133.0	0.01	3.6	—	3	17	0	0.2	21	132.89	0.11	0	0
4C1	139.0	0	2.8	—	0	28	0	0	25	139	0	0	0
4C2	151.8	0.02	2.5	—	0	25	0	0.1	42	151.68	0.12	0	0

Table 4-14. Route Group 4 Water Resource Inventory Data and Residual Impacts													
		Water (miles or numbers)								Residual Impacts (miles)			
Subroute	Total Miles	Perennial Rivers	Intermittent Streams	Outstanding Waters	Number of Springs	Number of Wells	Water Bodies	Wetlands	Sole Source Aquifer	Low	Low-Moderate	Moderate	Moderate-High
4C2c (BLM Preferred Alternative)	161.2	0.02	3.3	0	0	11	0	0	42	161.18	0.02	0	0
4C3	172.9	0	5.6	0.1	0	169	0.2	1	88	172.9	0	0	0
Local Alternative Link for 4A, 4B, 4C1	8.8	0	0.1	—	0	0	0	0	3.3	8.8	0	0	0
Local Alternative Links for 4A, 4B, 4C1, 4C2, 4C3	9.9	0.2	0.1	—	0	2	0	0	0	9.9	0	0	0
Local Alternative Links for C1	4.8	0.1	0.1	—	0	0	0	0	4.8	0	4.8	0	0
Local Alternative Links for 4C2 Winchester and Tortolita Substations	68.3	0	1.4	—	0	9	0.1	0	33.4	68.30	0	0	0
Local Alternative Links for 4C3	465	0	0.8	0.1	5.5	53	0	0	42.6	46.4	0.1	0	0
Local Alternative Links for 4C1, 4C2, 4C3	24.4	0	0.7	—	0	6	0.1	0	0	24.4	0	0	0
Crossover Links for 4A, 4B, 4C1	16.5	0	0.3	—	0	0	0	0	0	16.5	0	0	0
Crossover Links for 4A, 4B, 4B, 4C1, 4C2	7.9	0	0.1	—	0	0	0	0.1	0	7.9	0	0	0

4C2c – BLM Preferred Alternative

Subroute 4C2c proceeds west from the Willow-500 kV Substation, through Sulphur Springs Valley, and continues southwest eventually crossing the San Pedro River. From there it heads north, west of the San Pedro River to San Manuel, and then proceeds west to Pinal Central Substation. Subroute 4C2c crosses more mileage of perennial and intermittent streams than the other subroutes, except for 4C3. Following implementation of SE 2 and 8 along Subroute 4C2c, residual impacts to water resources would include no identifiable high, moderate-high, or moderate impacts to water resources, and less than 1 percent of low-moderate impacts.

4C1 – East of San Pedro River

Subroute 4C1 proceeds west from the Willow-500 kV Substation, through Sulphur Springs Valley, and continues north, east of the San Pedro River and crosses the San Pedro River at a point just northeast of San Manuel. Subroute 4C1 crosses fewer miles of perennial streams and a sole source aquifer than 4C2c.

4C2 – West of San Pedro River

Subroute 4C2 has similar sensitivity to water resources as 4C2c.

4C3 – Tucson

Subroute 4C3 is the longest of all subroutes in Route Group 4 and crosses both the San Pedro and Santa Cruz rivers. Subroute 4C3 also crosses the largest mileage of perennial and intermittent streams, a sole source aquifer, and has the largest amount of wells within 1 mile of its centerline. This results in having the highest sensitivity for water resources before mitigation. Subroute 4C3 is also the longest subroute of Route Group 4.

Local Alternatives and Crossover Links for Route Group 4

Several local alternative links are available for Route Group 4. Local alternative links C790, C860, C870, and C890 have only low residual impacts to water resources. Local Alternative Link C692 has low-moderate residual impacts for 100 percent of its total mileage, as a result of crossing a sole source aquifer. Local alternative links for 4C2 have low and low-moderate residual impacts. These are a result of the links crossing a large portion of a sole source aquifer, and several perennial and intermittent streams.

Local alternative links for 4C3 cross a large portion of a sole source aquifer, as well as a greater number of miles for perennial and intermittent streams, and have a large number of wells within 600 feet of their centerline. Local Alternative Link F51 crosses the Outstanding Water Cienega Creek. However, following the implementation of SE 2 and 8, there are only low and low-moderate residual impacts. After the implementation of SE 2 and 8, local alternative links for 4C1, 4C2, and 4C3 have no moderate, moderate-high, or high residual impacts.

Crossover links C500, C501, C502, C174, and C671 have no moderate, moderate-high, or high residual impacts.

4.5.3.5 Summary of BLM Preferred Alternative

Current drought conditions in the Southwest, along with the historical overuse of water for potable and agricultural purposes, make any impact to water resources a concern. Implementation of the Project would be likely to impact water resources located within the Project study area. The construction of access roads, staging areas, work areas, and stream crossings could affect perennial and intermittent streams, water bodies, wetlands, wells, and springs. Impacts to water resources vary between alternative routes. Within Route Group 1, the

impacts to water resources are similar, with 1A1 and 1A2 having slightly more impacts due to their longer routes. Within Route Group 3, Subroute 3A2 has the fewest impacts to water resources, before mitigation. Within Route Group 4, Subroute 4B has the least amount of impacts to water resources, and Subroute 4C3 has the most. Route Group 4 is the only one to contain a sole source aquifer.

Based on results of the preceding analysis, the following potential impacts to water resources were identified for the BLM preferred alternatives:

- Route Group 1
  - Subroutes 1A2 and 1A1 have similar impacts to water resources prior to mitigation, but 1A2 crosses streams that are more intermittent.
  - Subroute 1B3 has the least amount of impacts to water resources.
- Route Group 3
  - Subroute 3A2 crosses the Mimbres River.
  - All of the subroutes in Route Group 3 have similar overall impacts to water resources, with slight variances. Subroute 3A2 crosses the smallest number of streams and does not cross any wells.
- Route Group 4
  - Subroute 4C3 is the most sensitive subroute in Route Group 4, before mitigation, and subroutes 4A and 4B have the least sensitivity.
  - Once mitigation is applied, all of the subroutes have similar residual impacts as 4C2.

4.6 BIOLOGICAL RESOURCES

4.6.1 Introduction

This section addresses the nature, extent, and significance of potential impacts to wildlife, vegetation, and special-status species that could result from Project development. The discussion provides detail on the methods used in the analysis of impacts for biological resources, as well as the development and effectiveness of mitigation measures for the Project, and compares residual impacts that may remain for each subroute after both standard and selective mitigation measures have been applied. A Biological Protection Plan (BPP), which will contain site-specific details on the application of biological mitigation measures during development, construction, and operation of the Project, will be developed as an appendix to the Project POD.

4.6.2 Overview of Potential Impacts

4.6.2.1 Vegetation

Direct impacts to vegetation include removal of plants during construction of new or modified access and spur roads, and at structure and substation sites. Vegetation removal for structure foundations and at substation sites would be permanent. Indirect impacts associated with

vegetation removal may include erosion, reduction of soil water retention, invasive plant colonization, loss of wildlife habitat, habitat fragmentation, and edge effects.

Edge effects can be caused by the creation of an artificial break in a contiguous block of habitat, potentially resulting in increased competition among plants through higher light levels in the understory as the canopy is broken, and water stress caused by decreased humidity in open areas. Riparian woodlands are the only vegetation community within the study corridor that regularly form a closed canopy, and that would be susceptible to substantial edge effects involving changes in humidity and light availability. Other communities may experience edge effects to a lesser degree.

Biological soil crusts are often an important component of aridlands vegetation communities, with an important role in soil stabilization, nutrient cycling, and water retention. These crusts may be composed of lichens, cyanobacteria, fungi, nonvascular plants, and other organisms. Loss of these crusts through ground disturbance can increase susceptibility to wind and water erosion, lower water availability for other plants, and delay vegetation recovery during reclamation. Additional information on biological soil crusts is presented in Section 4.3.2.3.

Special-Status Plants

Special-status plants could be affected by vegetation clearing and construction traffic. Vegetation clearing could potentially impact the seed bank where special-status plants occur, and ground-disturbing activities could allow colonization by invasive plant species. These invasive plant species could compete for resources with special-status plants and other native vegetation, possibly altering the local plant community and fire regime.

4.6.2.2 Wildlife

Linear features such as access roads could fragment wildlife habitat, adversely affecting species that are reluctant to cross areas of open ground due to threat of predation. New access roads may be used by OHVs or other recreational traffic, potentially causing ongoing disturbance to wildlife. Related to this are edge effects created by linear features, which could affect species dependent on large blocks of contiguous habitat. Edge effects may reduce the effective size of habitat blocks for those species, limiting connectivity and dispersal between blocks. Increases in edge habitat may favor some generalist species over others with narrow habitat preferences. Open areas such as access roads may be beneficial to some predators such as raptors and carnivores, due to increased prey visibility. Overall, however, impacts of linear features on wildlife are mostly negative and may be difficult to mitigate onsite.

Large Mammals

Impacts to large mammals could include effects to habitat, forage, and minor loss of prey associated with vegetation removal. Traffic presents a risk to animals crossing roadways during construction, and human presence and construction noise in the construction area may disturb large mammals. These impacts could affect animal movements, breeding, and access to resources. Construction debris and trash may be attractive to wildlife and present a hazard to

them, and often attracts generalist predators such as Coyotes and Common Ravens. Development of new access roads required for the Project may have indirect impacts resulting from increased recreational access in these areas.

Small Mammals

In addition to impacts specified for large mammals, many small mammals are less capable of escaping from ground-disturbing activities. Animals such as rodents take shelter from disturbance in burrows or among vegetation, making them more susceptible to crushing by equipment and vehicular traffic. Vegetation removal for Project access roads may affect movement of small mammals such as mice and ground squirrels that are reluctant to cross open areas due to threat of predation. Animals with larger home ranges or that are relatively mobile, such as skunks and Bobcats (*Lynx rufus*), would be affected less by fragmentation and prey base reduction. Transmission line structures may provide nesting and hunting perch sites for raptors that prey on small mammals.

Aquatic, Shore, and Large Wading Birds

Project development near riparian or other aquatic habitats may affect vegetation that provides nesting habitat, cover, and forage for aquatic, shore, and large wading bird species. Development of stream crossings on access roads and ground-disturbing activities associated with placement of structures in proximity to aquatic habitats may result in erosion that could affect water quality, which could affect aquatic birds directly where increased turbidity reduces foraging success, or indirectly by affecting populations of prey species. Groundwires, conductors, and structures present collision hazards for birds, particularly large-bodied species such as cranes and geese, which cannot make abrupt course corrections when obstacles are encountered in their flight path.

Raptors

Impacts to raptors could potentially include disturbance of breeding and nesting behavior, nest failure, and loss of prey resulting from vegetation clearing. Groundwires, conductors, and structures present collision hazards for raptors, particularly during aerial pursuit of prey. Improperly designed structures, particularly lower-voltage distribution lines, may present electrocution hazards for raptors. Engineering requirements of 500 kV structures must place energy sources far enough from a potential path to ground so as to be beyond the wingspan of even the largest birds, effectively eliminating risk of electrocution from the line itself. “Streamers” (liquid bird waste) directed from a perched bird can also present a conductive path for electricity. This risk can be reduced with design measures that prevent birds from perching on structures at locations where energized lines occur with a short, near-vertical path to grounded components. Substations for 500 kV lines are engineered with spacing similar to transmission lines, with similarly low electrocution risk. Substations that step down to lower-voltage distribution lines may present an electrocution risk if not designed for avian safety. When the risk of electrocution is minimized, beneficial effects for raptors include introduction of perches and nesting sites on structures and the clearing of vegetation that could improve their ability to see prey.

Passerines and Other Upland Birds

Impacts to passerines and other birds could include disturbance to mating and nesting behavior, nest failure, and loss of eggs or young in nests during vegetation clearing. Vegetation clearing would remove cover, nest sites, forage, and invertebrate prey used by passerines; and may allow colonization by invasive plant species that could compete with native vegetation, potentially altering the native plant community and local fire regime. Groundwires, conductors, and structures present collision hazards for passerines, particularly for flocking birds, at night or during other low-visibility conditions. Nocturnally migrating birds typically fly at heights well above transmission line structures, but may be at risk when flying lower, such as in poor weather conditions or where structures are placed on elevated terrain. Transmission line structures are occasionally used by passerines for nesting.

Amphibians

Impacts to amphibians could result from the effects of Project-induced erosion, which could degrade water quality and affect their health and food base. Ephemeral water sources such as stock tanks, often used as breeding sites by amphibians, could be modified or removed during construction. Temporary watering facilities would be provided for wildlife and livestock until permanent repair or replacement is complete, although these temporary replacements may lack established sources of algae, diatoms, and other food sources for larval amphibians. Reproductive success of amphibians using newly constructed ponds could be decreased, although inoculation of newly constructed ponds with sediments from existing ponds may reduce this effect. Amphibian adults, eggs, and larvae could be killed by construction traffic at stream crossings. Many desert amphibians spend the majority of the year underground, and may be crushed during ground-disturbing activities.

Reptiles

Reptiles could be killed by construction traffic or during ground-disturbing vegetation clearing. Invasive plants may alter the native plant community, affecting the invertebrate and small mammal prey base of many reptiles. In addition, many humans have an aversion to snakes in general, and will often kill them without provocation whether encountered in nature or near areas of human activity, including construction sites.

Fish

Potential impacts to fish are primarily associated with the effects of erosion caused by ground-disturbing activities. Introduction of sediment into streams may clog or abrade fish gills, and can alter food webs by decreasing production of algae and reducing invertebrate populations. Severe sedimentation, such as may occur following heavy flooding, can substantially alter stream substrate, filling in gravel or cobble stream beds that may be important spawning sites, and may even fill entire pools and result in the loss of that habitat.

Invertebrates

Eggs, larvae, and adult terrestrial invertebrates could be killed during vegetation clearing and ground-disturbing activities. Changes in the vegetation community would affect local invertebrate populations by reducing their food source, or by reducing cover and making invertebrates more susceptible to predation. Aquatic invertebrates could be affected by reduced water quality, should erosion result from Project development.

4.6.3 Impact Assessment Methods

The potential for occurrence of biological resources was initially assessed with a general search of regional lists of special-status species drafted by land and wildlife management agencies, vegetation maps, and peer-reviewed or other publications providing distribution information for resources (Chapter 3). Using a 4-mile buffer to form the Project study corridor, this approach was intended to account for uncertainty in the distribution of species and their habitat. However, the presence of a resource within the study corridor would not necessarily result in any impacts. Impact potential was assessed based on distributional and ecological information acquired during the search of existing data. Vegetation communities were assumed to be affected if crossed by the centerline of the Project. Special-status species were assumed to be affected if the centerline of the Project was located within their known or reasonably expected range, or if the Project had the potential to alter features of the environment used by that species, including downstream effects on aquatic habitat.

A map of potential occurrence along the Project centerline was created for those ESA-listed, proposed, and candidate species that may be affected by the Project, and was used to estimate the extent of those impacts. This estimated distribution is presented by link in Appendix B3.

Species with a near absence of distribution information within the United States, such as the Jaguar and Ocelot, were not mapped and the extent of effects was not quantified because no mitigation specific to them can be determined to be necessary at a given location. Potential impacts to species that are not known to occur in the study corridor, such as the Todsen's pennyroyal, Kuenzler's cactus, Mexican Gray Wolf, New Mexico Meadow Jumping Mouse, and others, were not assessed quantitatively. However, potential effects are discussed qualitatively below for all species.

Species dependent on a particular vegetation type were mapped as occurring where that vegetation type comprises 50 percent or more of pixels mapped by ReGAP or LANDFIRE, within the overall distribution of the species. Effects to aquatic species were mapped as potentially occurring where the Project centerline would cross major drainages, create substantial new access and ground disturbance, or cross areas of steep slope within watersheds where those species occur. Effects on small-scale, highly sensitive resources, such as riparian woodlands or springs, were generally mapped as occurring within a 1-mile buffer around such locations.

The area of anticipated effects was estimated using the Project slope and access model (see Table 2-7 in Chapter 2). As slope increases or existing access decreases, ground disturbance and effects to terrestrial or aquatic species often increases. Certain bird species were not considered to be affected by changes in slope or access if not dependent on terrestrial resources at a given

location, but the susceptibility of large birds to collision with human structures indicated that the presence of the line itself is a potential effect. The results of the impact analysis for vegetation are presented in Appendix H, Table H-6; and the results for special-status species are presented in Table H-7.

4.6.3.1 Significant Impacts

For the purposes of this analysis, a significant impact on biological resources could result if any of the following were to occur from construction or operation of the proposed action:

- "Take" of a listed, proposed, or candidate species under the ESA or BGEPA, as defined by those acts
- Permanent or long-term loss of suitable critical habitat, or effects that would prevent future recovery of critical habitat
- Mortality rates that result in population-level effects for sensitive and other unlisted species
- Permanent displacement of individuals from biologically important habitats
- Permanent loss of habitat that would result in species-wide or population-wide effects
- Fragmentation resulting from the addition of barriers to wildlife movement, including physical barriers, open spaces avoided by some species, and disturbance or mortality associated with roads, to large, currently intact blocks of habitat

This analysis presents an estimate of the potential for effects to ESA-listed or other species to occur. Consultation with the USFWS under Section 7 of the ESA has been initiated, and includes the development of additional site-specific required or recommended mitigation measures. Preconstruction surveys will further refine these mitigation measures, which will be included as stipulations in the final POD. The NEPA process does not provide a substitute for any requirements under the ESA.

4.6.4 Impact Assessment

4.6.4.1 Mitigation Planning

Mitigation development included a review of biological resources known to occur or potentially occurring within the study corridor. Sources used included land management agency special-status species lists and natural heritage data, Internet resources including GAP vegetation data for New Mexico and Arizona, review of pertinent primary literature, and consultation with specialists regarding certain species. Coordination and cooperation with the USFWS, BLM, AZGFD, and NMDGF, and information from public comments were all integral parts of the resource analysis process, Project alternatives development, analysis of potential impacts, and development of mitigation measures.

Information gathered from these sources was incorporated into a biological resources impact analysis by merging impact levels, topographic gradients, and the degree of existing access to produce an estimate of impacts for the biological resources occurring along each link. Standard

and selective mitigation measures subsequently developed from this information are addressed below and will be incorporated into the BPP, Appendix B1 of the POD.

Standard mitigation measures (see Table 2-10) include those that mitigate general effects to biological resources and the effects of erosion and increased human access. Standard mitigation measures also include preconstruction surveys for special-status species and noxious weeds. These measures would be applied throughout the Project study corridor, as appropriate. Additional species-specific or site-specific potential impacts not sufficiently reduced by standard mitigation measures are addressed with selective mitigation measures (see Table 2-11), and are addressed in the individual resource discussions in this chapter.

For each species or land area discussed below, standard mitigation is assumed but the appropriate selective mitigation measures are listed. In general, if impacts are high-moderate or moderate (see definitions below), application of selective mitigation reduces the impacts to moderate or low-moderate. In most cases, the impacts before implementing selective mitigation were already moderate to low; in such cases, depending on which alternative is chosen and the specifics of design, there may be some lessening of but not a complete reduction in residual impacts.

Five levels of potential impacts are described below for vegetation, and separately for special-status species. Appropriate mitigation measures are listed for each type of impact to the respective resources. ESA-listed, proposed, and candidate species are discussed individually, with descriptions of where they may occur within the study corridor. Impacts to wildlife other than special-status species are not quantified, but in most cases would be closely correlated with total ground disturbance presented in Table 3-31 by vegetation type, and in Appendix H by impact level. However, some areas of high sensitivity to wildlife may not be captured adequately in the vegetation impact analysis. These areas are discussed qualitatively in the discussion of conservation areas and other identified areas of concern (Sections 4.6.4.6 and 4.6.4.7), or in the discussion of individual subroutes and local alternatives (Section 4.6.5).

Table 4-15. Estimated Ground Disturbance by Each Subroute and Vegetation Type														
Subroute	**Miles (acres below)**	**Arizona Upland Sonoran Desertscrub**	**Chihuahuan Desertscrub**	**Closed Basin Scrub**	**Great Basin Conifer Woodland**	**Interior Chaparral**	**Juniper Savanna (ecotone)**	**Colorado River Valley Sonoran**	**Pine-Oak Woodland**	**Plains-Mesa Grassland**	**Plains-Mesa Sand Scrub**	**Semidesert Grassland**	**Urban/ Agriculture**	**Floodplain**
1A	219.5 (2936.6)	-	89.5 (1195.9)	-	-	-	43.2 (600.7)	-	6.2 (86.9)	13.7 (180.0)		63.1 (822.6)	2.6 (35.1)	1.2 (15.4)
1A1	228.8 (3051.6)	-	93.1 (1234.1)	-	-	-	55.7 (766.0)	-	6.2 (86.9)	6.9 (91.6)	-	63.1 (822.6)	2.6 (35.1)	1.2 (15.4)
1A2	230.3 (3089.6)	-	93.1 (1234.1)	-	-	-	57.2 (804.0)	-	6.2 (86.9)	6.9 (91.6)	-	63.1 (822.6)	2.6 (35.1)	1.2 (15.4)
1B1	223.6 (2961.1)	-	94.6 (1270.7)	-	-	-	31.2 (420.5)	-	6.2 (86.9)	13.7 (180.0)	28.9 (365.8)	45.0 (583.3)	1.9 (27.5)	2.1 (26.4)
1B2	209.2 (2777.5)	-	94.6 (1270.7)	-	-	-	30.4 (402.2)	-	-	12.4 (163.7)	22.8 (303.7)	45.0 (583.3)	1.9 (27.5)	2.1 (26.4)
1B2a	212.8 (2815.7)	-	98.2 (1308.9)	-	-	-	30.4 (402.2)	-	-	12.4 (163.7)	22.8 (303.7)	45.0 (583.3)	1.9 (27.5)	2.1 (26.4)
1B3	206.3 (2740.6)	-	94.6 (1270.7)	2.3 (31.1)	-	-	33.3 (446.7)	-	-	12.4 (163.7)	17.8 (232.9)	41.9 (541.7)	1.9 (27.5)	2.1 (26.4)
3A	123.4 (1642.5)	-	19.8 (261.2)	2.2 (29.6)	-	-		-	-	-	-	101.4 (1351.7)	-	-
3B	128.6 (1657.1)	-	39.4 (518.5)	12.0 (158.2)	-	-	-	-	-	-	-	77.2 (980.4)	-	-
3A2	123.9 (1651.6)	-	20.2 (270.3)	2.2 (29.6)	-	-	-	-	-	-	-	101.5 (1351.7)	-	-
4A	132.9 (1830.5)	41.6 (549.9)	-	-	1.0 (17.0)	7.2 (104.3)	-	6.0 (78.8)	2.1 (35.7)	-	-	67.4 (951.2)	5.6 (67.5)	2.0 (26.1)
4B	133.0 (1846.8)	41.6 (549.9)	-	-	1.0 (17.0)	9.2 (135.3)	-	6.0 (78.8)	2.1 (35.7)	-	-	65.5 (936.6)	5.6 (67.5)	2.0 (26.1)
4C1	139.0 (1903.3)	55.6 (741.2)	2.5 (37.6)	-	-	-	-	6.0 (78.8)	8.5 (129.3)	-	-	59.9 (837.5)	5.6 (67.5)	0.9 (11.4)
4C2	151.8 (2072.2)	51.2 (675.7)	5.5 (82.4)	-	-	-	-	6.0 (78.8)	8.5 (129.3)	-	-	74.6 (1033.0)	5.6 (67.5)	0.4 (11.4)
4C2c	161.2 (2205.2)	51.2 (675.7)	7.5 (108.9)	-	-	-	-	6.0 (78.8)	6.5 (101.9)	-	-	84.2 (1169.8)	5.6 (67.5)	0.2 (2.7)
4C3	172.9 (2261.0)	60.6 (761.3)	12.5 (172.6)	-	-	-	-	11.9 (154.8)	6.5 (101.9)	-	-	59.6 (808.8)	21.3 (255.2)	0.5 (6.5)

4.6.4.2 Impacts and Mitigation Measures for Vegetation

Description of Impact Levels for Vegetation

The following definitions of level of impacts were applied in the analysis of potential Project impacts to vegetation. The sensitivity to disturbance and the regional extent of each vegetation community was considered when analyzing impacts. Any impact to vegetation would also affect wildlife that may be present, but impacts to wildlife would be highest in regionally uncommon or highly productive vegetation communities. Uncommon plant communities such as riparian woodlands can be much more susceptible to the types of impacts created by the Project than are many of the relatively open upland plant communities, and so were assigned higher impact levels. Table H-6 (Appendix H) provides the impacts to vegetation that would occur under each Project alternative.

- *Low Impacts* – typically result in small areas of disturbance that do not significantly affect native plant community continuity, or are limited to disturbance of altered, degraded, or non-native plant communities.
- *Low-Moderate Impacts* – typically involve removal of larger, relatively undisturbed areas of vegetation, and may result in localized changes in local plant communities that affect plant community structure and density on a small scale. Such effects would not normally be anticipated to permanently alter local plant communities, and temporarily disturbed areas would be recolonized from adjacent undisturbed habitat over time. Plant communities affected at this level may be regionally widespread or resilient to the indirect, off-site effects of ground disturbance.
- *Moderate Impacts* – typically affect vegetation over larger areas or in steeper terrain where mitigation for erosion is less effective. Acreage of impact to any vegetation type may be measurable on a local scale, but is unlikely to significantly reduce the amount of the vegetation type regionally. Community structure and species composition of some areas may be permanently altered, but not on a large scale. Formerly intact areas may become partially fragmented, and modified ecotonal vegetation assemblages may permanently develop in localized areas.
- *Moderate-High Impacts* – typically involve loss of mature vegetation over acreages that visibly affect the overall appearance and function of habitats on a small to moderate scale. Changes to plant communities are considered permanent. Long-term plant composition in areas of moderate-high impact would take many years to return to predisturbance conditions, and may never do so.
- *High Impacts* – may include substantial, permanent fragmentation and loss of function, and may involve substantial loss of acreage of the community type in the region. This level of loss would affect not only the vegetation, but may significantly and disproportionately impact the wildlife that is dependent on the plant community for sustenance, habitat, or as part of a movement corridor.

Vegetation Mitigation Measures

The degree of loss or direct disturbance of vegetation at any given point in the Project is determined by the availability of existing access roads and by ground slope, with road construction on steeper slopes resulting in increased ground disturbance (Table 2-7). Within the area of ground disturbance, loss of vegetation would be minimized by (1) reducing this area to the extent practicable (SE 1), (2) plant salvage and revegetation in areas of temporary disturbance (SE 5), and (3) closure and restoration of any access roads not required for Project maintenance or access (SE 4). Temporary "drive and crush" impacts to vegetation would occur at small areas during construction, including conductor pulling and tensioning sites, turnarounds, temporary concrete batch plants, and temporary equipment storage yards (SE 3). Closure of temporary access roads and the limiting of access through gating or other means (SE 4 and 6) would minimize indirect impacts to vegetation caused by recreational travel, including off-road vehicle travel beyond the Project right-of-way. All of these measures to minimize ground disturbance and aid reclamation would also minimize effects to biological soil crusts.

Nearly all vegetation communities affected by the Project are dominated by plants of relatively low stature, and a cleared or brushed right-of-way for conductor clearance and fire safety would not be required. Exceptions include riparian woodland and pine-oak woodland, and some individual trees or large shrubs in juniper savanna and xeroriparian scrubland that may require cutting. Tree cutting would be conducted to meet the NESC and an appropriate level of safety, but would be minimized to the extent possible (SE 14). Under most conditions, vegetation would be allowed to attain a height of no more than 12 feet. However, site-specific conditions may allow taller vegetation to remain, such as where an opportunity exists to place structures on elevated terrain at a stream or wash crossing. A Noxious Weed Management Plan, included as Appendix B2 of the POD, addresses survey needs and mitigation for noxious weeds.

Although some degree of habitat fragmentation would occur due to the construction of new access roads, the effects of fragmentation are generally more evident on wildlife species than on arid-adapted vegetation communities. However, closed-canopy riparian woodland may be affected by fragmentation, as openings created by vegetation trimming or removal allow increased light availability and increased competition among plants; decreased humidity; increased success of seedlings; and the invasion of low-stature shrubs, grasses, and disturbance-adapted invasive plants. These effects may extend some distance from the area of cleared vegetation, and would represent a permanent disturbance for the Project lifespan, but would be minimized where possible through selective tree-cutting, spanning riparian woodlands, and noxious weed and invasive plant management (SE 1, 2, 8, and 14).

Special-Status Plants

Selective mitigation measures that address direct vegetation impacts, vegetation preservation and restoration, and noxious weed control would minimize impacts to special-status plant species (SE 3, 5, and 14). The restriction of construction equipment and vehicle traffic to approved routes would minimize impacts to plants outside of these areas.

4.6.4.3 Noxious and Invasive Weeds

Noxious and invasive weeds are identified as major threats to native ecosystems and multiple-use public land resources. Noxious weeds are typically effective competitors with native plants for resources and may permanently change the plant community, often becoming monocultures that may alter the local fire regime by increasing the fire fuel load. Non-native grasses in particular can provide a fuel source for intense fires, for which some native vegetation communities are not adapted. This may result in direct mortality of animals during the fire (Esque et al. 2003), mortality due to a post-fire reduction in food resources, and/or the threat of long-term habitat change due to the increased abundance of fire-adapted non-native plants that often occurs after such fires. Such changes usually preclude re-establishment of the native plant community in disturbed areas, and represent a permanent change in the local ecology. Several noxious or invasive weed species likely already occur within the Project study corridor, and a Noxious Weed Management Plan is included as Appendix B2 of the POD to describe how this issue will be addressed.

Preconstruction noxious weed surveys would be conducted as a part of Project weed management efforts. Early detection, containment, and control of noxious weeds during and following Project construction would minimize the potential for these invasive species colonizing the Project area, and would contain the spread of pre-existing infestations within the Project limits of disturbance. The Noxious Weed Management Plan provides methods to control the potential occurrence or infestation of noxious weeds during and following construction of the Project.

4.6.4.4 Mitigation Measures for Wildlife

This section describes how selective mitigation measures would be applied to minimize direct impacts to wildlife, and indirect impacts through modification or loss of habitat. Although specified in further detail in Section 4.6.4.2, these measures would also benefit any special-status species that may be present.

Large Mammals

Selective mitigation measures addressing the reduction of ground disturbance and restoration of vegetation would help reduce effects to habitat for large mammals (SE 3, 5, and 14). A posted reasonable construction speed limit could minimize potential collision risk to wildlife in road areas, and construction activities may be constrained during certain seasons to address needs of special-status species at specified locations (SE 12). Debris and trash would be properly contained and regularly removed from the Project to an appropriate landfill site. Construction excavations would be fenced or covered to preclude injury or trapping of wildlife or livestock. Postconstruction access may be controlled by various means (SE 4 and 6).

Small Mammals

Resource awareness training for construction personnel would help mitigate impacts to small mammals, and a reasonable posted construction speed limit could minimize potential impacts

to wildlife occurring in the vicinity of roads. Mitigation measures that address vegetation preservation, restoration, and noxious weed and erosion control would contribute to habitat maintenance and recovery for small mammals (SE 3, 4, 5, and 14). Excavations would be addressed as mentioned above (see *Large Mammals*).

Aquatic, Large Wading, and Shore Birds

Large flocks of wintering waterfowl, including Sandhill Cranes, white geese (Snow Goose and Ross's Goose), and other waterfowl disperse daily from Bosque del Apache NWR and the Ladd S. Gordon Waterfowl Area to forage on agricultural lands along the river. The Rio Grande crossing avian impact assessment study showed that white geese regularly flew at heights well above the proposed transmission line at all surveyed crossing sites during both migratory and foraging flights (Appendix B2). Sandhill Cranes and waterfowl, however, were quite variable in flight heights at different crossing points, some being within the collision danger zone. For many bird species, although long-distance flights often take place well above the height of a transmission line, collision risk can increase when taking off or landing and during low-elevation daily flights near feeding areas.

Bird surveys totaled approximately 1,150 hours, were restricted to peak activity near dawn and dusk, and multiple observers were present during each survey occasion. During the study, Sandhill Cranes were commonly observed flying in close proximity to electrical lines, with no collisions or near-misses documented. Two fatal and two apparently non-fatal collisions of ducks were observed, as well as one apparently non-fatal collision involving a White-winged Dove. All observed collisions were at crossing locations for alternatives that were later eliminated from further consideration.

The study predicted that while potentially fatal collisions of Sandhill Cranes and other large birds are likely to occur, a substantial effect at the population level is unlikely for any species. Mitigation measures to improve visibility of groundwires (SE 15) would reduce the collision risk for large birds. This may include the use of bird diverters on groundwires and guywires, and the use of one-inch OPGW rather than one-half-inch OHGW where practicable. Although either groundwire type presents a collision risk, larger cables increase the visibility of the line and would create a lower risk than smaller cables. An Avian Protection Plan and associated avian conservation strategy would be developed through collaboration between the BLM, cooperating agencies, and the proponent, to mitigate the collision risk and loss of productivity for all birds. The mitigation measures proposed for identified areas of high collision risk would follow the recommendations of the Avian Powerline Interaction Committee (APLIC), including the application of bird diverters (APLIC 2012). Potentially significant impacts could occur, but would likely be restricted to short-duration events such as poor-visibility conditions that prevent birds from detecting the lines or bird diverters in time to avoid collision. Further discussion of bird-powerline interactions at the continental scale is presented in the discussion on cumulative effects, Section 4.17.

Since the transmission line would span most aquatic habitats (SE 8), there should be no significant impacts to aquatic and shorebird nesting habitat. Temporary disturbance to foraging habitat may occur, and some permanent disturbance to foraging habitat may occur in the vicinity of the Lordsburg Playa. Structures would be placed within the Rio Grande floodplain, but they

would not be located near shore habitat and would not permanently affect these species. Maintenance over the life of the Project may cause intermittent disturbance within the Rio Grande floodplain, and a collision risk would be created by conductors and OHGW. The collision risk and any loss of habitat would be addressed through the Avian Protection Plan and conservation strategy. Timing of construction to avoid avian nesting or breeding times would help minimize impacts to birds (SE 12).

Raptors

Disturbance of nesting raptors may be avoided by constructing outside of nesting season (SE 12). Mitigation measures addressing the reduction of ground disturbance and restoration of vegetation would help minimize effects to ground-nesting species such as the Western Burrowing Owl, as well as the small mammal prey base of many raptors (SE 3, 5, and 14). Structure type, design, siting, and application of bird diverter devices on groundwires and conductors would help minimize avian collision potential (SE 7 and 15). All structures, substations, and ancillary facilities would be constructed to APLIC standards to reduce or eliminate the risk of electrocution (APLIC 2006). Measures to reduce the risk of collision and the effects of habitat loss on bird productivity would be addressed through the collaborative development of an Avian Protection Plan and avian conservation strategy.

Passerines and Other Birds

Take or possession of nearly all bird species native to North America, including removal of active nests (defined as containing eggs or young), is prohibited under the MBTA. The timing of construction to avoid the nesting season would mitigate impacts to nesting birds, although construction may occur in some areas following clearance surveys to ensure no active nests are disturbed (SE 12). Mitigation measures addressing the reduction of ground disturbance and restoration of vegetation would help minimize effects to passerines (SE 3, 5 and 14), and the risk of invasive plant colonization would be managed using mitigation measures included in the Noxious Weed Management Plan (POD Appendix B2). Structure type, design, siting, and application of bird diverter devices on groundwires and conductors would help minimize avian collision potential (SE 7 and 9). Measures to reduce the risk of collision and the effects of habitat loss on bird productivity would be addressed through the collaborative development of an Avian Protection Plan and avian conservation strategy.

Amphibians

Aquatic habitats would be spanned, minimizing the potential for direct impacts to many amphibians. Potential effects of erosion on aquatic habitats occupied by amphibians would be mitigated using SE 1, 2, 3, and 8. Direct impacts to amphibians, their eggs, and larvae at stream crossings would be mitigated using SE 8. Amphibians remaining underground during winter and dry seasons cannot be effectively detected or avoided, although they would generally be present only in close proximity to temporary water sources such as washes and stock ponds. These sites would generally be avoided or spanned where possible in consideration of their importance to all wildlife (SE 8). Fencing or covering of excavations would minimize the potential for injury or trapping of amphibians. Any individual dormant or surface-active amphibians in areas subject to

ground disturbance would be at risk, as would active amphibians crossing access roads. Mitigation measures addressing the reduction of ground disturbance and reduced intensity of vegetation management would help reduce the risk to amphibians (SE 3 and 14).

Reptiles

Resource awareness training for construction personnel and implementation and posting of speed limits in construction zones could help minimize the road mortality of reptiles. Mitigation measures that preserve or restore vegetation and habitat, reduce the risk of invasive plant colonization, and minimize the effects of erosion or impacts to riparian or aquatic habitats would reduce potential impacts to habitats occupied by reptiles (SE 1, 2, 3, and 8), and fencing or covering of excavations would minimize the potential for injury or trapping.

Fish

Siting of transmission line structures typically includes avoidance (spanning or re-alignment) of aquatic habitats, due to the inherent potential of ground instability issues in such areas. This creates an additional buffer between aquatic habitats and ground disturbance, which helps minimize erosion and other potential impacts to aquatic resources. Transmission lines would span aquatic habitats and use existing stream crossings, precluding any direct disturbance to fish habitat (SE 2 and 8). BMPs and mitigation measures would effectively control erosion that might otherwise affect waters in the Project area (SE 1, 2, and 3). Although erosion would be effectively controlled with those methods, an elevated risk of erosion may remain in some disturbed areas.

Invertebrates

Aquatic invertebrates are not likely to be affected since the Project would span aquatic habitats (SE 2 and 8). Some invertebrates, their eggs, and larvae could be directly impacted by construction traffic at stream crossings. Mitigation measures directed at reducing erosion would effectively preclude effects to water quality that could potentially affect aquatic invertebrates (SE 1, 2, and 3). Springs would be avoided during development of new construction access (SE 8), and construction activities are unlikely to have any effects on aquifers that support springs. Mitigation measures addressing the reduction of ground disturbance and restoration of vegetation would help minimize effects to terrestrial invertebrates during construction and maintenance (SE 3, 5, and 14).

4.6.4.5 Special-Status Species Impact Overview

This section contains a general discussion of potential impacts and appropriate mitigation measures for species listed under the ESA, and those proposed or candidates for listing; species protected under the BGEPA; the Cactus Ferruginous Pygmy-owl; and the Arizona Striped Whiptail and Chihuahua scurf-pea, which are under review for ESA listing. Detailed, site-specific analysis of impacts and final mitigation measures would be developed during Section 7 consultation with the USFWS. The remaining special-status species known or potentially

occurring within the study corridor are addressed in the biological technical report (Appendix B1).

Impact Levels for Special-Status Species

The following definitions were applied in the analysis of potential Project impacts to special-status species. Table H-7 (Appendix H) provides the mileage of each level of impact to special-status species that may occur under each Project alternative. As discussed in Section 4.6.3.1, "take" of any ESA-listed, proposed, or candidate species would be considered a significant impact. The purpose of this analysis was to estimate the extent of potential impacts, considering existing conditions, to allow a comparison of alternative routes.

Low Impacts – typically occur in areas that are outside the typical range or suitable habitat for the species, including areas heavily affected by human development.

Low-Moderate Impacts – typically occur in areas that pre-existing disturbance, including roads and utilities or minor developments. Suitable habitat may be present, but may be compromised by existing developments. Suitable habitat may also be of moderate quality, may be present only in smaller patches, or may be affected by "type conversion" (e.g., conversion from grassland to shrubland).

Moderate Impacts – typically occur in apparently suitable habitat, and are likely to include permanent loss of substantial portions of that habitat. Often, moderate impacts occur in areas where mitigation measures or existing access roads may assist in minimizing the extent and degree of impacts.

Moderate-High Impacts – occur in habitat that is clearly suitable, generally without existing disturbances; impacts may be difficult to mitigate. Moderate-high impacts may also occur in areas similar to those with moderate impacts, but the total area affected per mile may be greater on steep slopes that require higher amounts of ground disturbance.

High Impacts – occur in areas of the highest value to listed species, such as extensive, intact riparian woodlands or other rare habitat types. Impacts to habitat supporting local endemics, such as species restricted to single springs, would be high.

Mammals

Lesser Long-nosed Bat

A number of known roosts used by Lesser Long-nosed Bats occur within foraging range of the Project study corridor. One roost, in the Peloncillo Mountains, is within 0.25 mile of Subroute 3B. Construction activities such as blasting, drilling, and the use of heavy equipment may transmit ground vibrations that could disturb roosting bats. Near this known roost, these activities would be timed to occur between October and April when Lesser Long-nosed Bats are not present. Other roosts are known to occur within the study corridor, but beyond the distance

where direct disturbance would be anticipated. All known roosts are located more than 2 miles from the BLM preferred alternative.

If preconstruction surveys or other information indicates the presence of additional caves or abandoned mines within the habitat and known distribution of the species that are within 0.25 mile of the Project, these would be surveyed for the presence of bat roosts. Near any active Lesser Long-nosed Bats roosts, activities that could disturb roosting bats would occur between October and April, after the bats have migrated south from Arizona (SE 12).

Large areas of the study corridor contain suitable foraging habitat for Lesser Long-nosed Bats. Some forage plants used by Lesser Long-nosed Bats would be removed during construction. However, studies have shown that agave populations, while variable between years due to annual precipitation, are normally more than adequate to support local populations of nectar-feeding bats (Scott 2004), and that forage plants near roosts are preferred over distant plants (Ober and Steidl 2004). The Project may cause minor loss of plants, generally distant from known roosts, and would be unlikely to significantly affect nectar-feeding bats. Damage to saguaros and agaves would be avoided where possible, but if removal is required they would be transplanted outside of the area of permanent disturbance or used to revegetate temporarily disturbed areas whenever feasible. Larger saguaros (more than 12 feet in height) are less likely to be successfully transplanted (Dimmitt 2011), and their removal would be avoided when possible. Salvage and transplanting would be augmented from suitable nursery stock if necessary, to achieve no-net-loss of forage plants.

Mexican Long-nosed Bat

Mexican Long-nosed Bats are known to roost within foraging range of the Project area in a single roost in the Peloncillo Mountains, shared with Lesser Long-nosed Bats. This roost is within 0.25 mile of Subroute 3B. Construction activities such as blasting, drilling, and the use of heavy equipment may transmit ground vibrations that could disturb roosting bats. Near this known roost, these activities would be timed to occur between October and April when Mexican Long-nosed Bats are not present.

Plants at risk of removal during Project construction would be transplanted or used for onsite revegetation, to achieve no net loss of forage plants. The number of agaves that would be affected by the Project does not represent a significant impact on the population of the plants in the region or availability of this resource for nectar-feeding bats. The portion of the Project within or near the range of the Mexican Long-nosed Bat is generally located in semidesert grassland, where agaves would be rare or absent. The entire potential range of Mexican Long-nosed Bats in the study corridor is within the range of Lesser Long-nosed Bats, and all mitigation measures discussed for that species would be implemented to benefit both species.

New Mexico Meadow Jumping Mouse

New Mexico Meadow Jumping Mouse habitat may be present at the San Antonio crossings of the Rio Grande, although the species has not recently been detected in Socorro County outside of the Bosque del Apache NWR. Nevertheless, any New Mexico Meadow Jumping Mice present would be at risk of direct mortality from vegetation removal. In addition, vegetation maintenance

throughout the life of the Project would require ongoing, intermittent disturbance. Small mammal surveys conducted at that river crossing would provide information on the local status of the Meadow Jumping Mouse. Mitigation measures that minimize effects to riparian vegetation would preserve potential Meadow Jumping Mouse habitat (SE 3, 5, 8, and 14).

Mexican Gray Wolf, Nonessential Experimental Population

No portion of the Project would enter the Gila National Forest, which encompasses the designated Mexican Gray Wolf Recovery Zone; but much of the Project does overlap the NEP boundary. Wolves are long-range dispersers and may enter the study corridor within the NEP boundary. Any alternative in Route Group 3 would pass through areas near the Burro Mountains that are within the dispersal range and habitat tolerance of Mexican Gray Wolves. Mexican Gray Wolves have been introduced into Sonora, Mexico, and may disperse into the United States in the future. However, the potential for the species occurring at present or in the future within the study corridor or being affected by any phase of Project development or operation is very low. If future management allowed Mexican Gray Wolf expansion outside the current Recovery Zone, human presence and construction activity within 1 mile of a wolf den could disturb the animals. Disturbance could affect survival of the pups, which are sensitive to being moved when young. Under management rules covering the NEP, any effect on the Mexican Gray Wolf caused by otherwise-authorized land use is considered legal incidental take, subject to special temporary provisions and restrictions involving den, release, and rendezvous sites (USFWS 1998a). No selective mitigation measures are proposed for the Mexican Gray Wolf.

Jaguar

Linear utilities, such as constructed transmission lines, are likely not a significant barrier to Jaguar movement, as successful dispersal has occurred into and between several mountain ranges in the Southwest with moderate human use of the intervening valleys. All Jaguars recently found in the United States appear to have originated from the nearest reproducing population in northern Sonora, approximately 140 miles south of the United States-Mexico border. While the potential for Jaguars occurring within the Project area is very low, disturbance associated with construction could result in temporary avoidance of those areas by any Jaguars using the area. Mitigation measures that address impacts to vegetation and the effects of erosion would contribute to the minimization of effects to habitat that may be used by Jaguars (SE 1, 2, 3, 4, 5, 14, and 16).

Ocelot

There have been several confirmed sightings of Ocelots in southern Arizona since 2009. Prior to these sightings, the most recent record was from the mid-1960s (AZGFD 2011b; Hoffmeister 1986). The recent sightings could indicate an expansion of the species' range northward, but more likely represent vagrant animals from northern Mexico. Movements of Ocelots in southern Arizona are likely to occur primarily along riparian corridors where elongated ribbons of dense vegetation provide cover for the animals' movements. Removal of vegetation in riparian habitats may be detrimental to continuity of habitat for Ocelots and other animals. Project crossings of riparian habitat would span smaller streams, but engineering constraints may require placement

of structures within the floodplain of larger streams. Vegetation clearing to maintain conductor clearance in compliance with the NESC may require removal of vegetation within the Project right-of-way at stream crossings, and may contribute to riparian habitat fragmentation. Selective vegetation removal, where feasible, would minimize such impacts. Mitigation measures that address vegetation preservation and restoration, erosion prevention, and effects to riparian habitat would minimize impacts to habitats that may be used by Ocelots (SE 1, 2, 3, 4, 5, 8, 14, and 16).

Jaguarundi

Jaguarundis inhabit a wide range of habitats south of the United States, with the common element being dense ground vegetation (de Oliveria 1998). Because dense stands of vegetation in southern Arizona are concentrated along drainages, these areas would be the most likely to support Jaguarundis and their movements. Potential effects on Jaguarundi habitat would be similar to those mentioned above for the Ocelot. Cats could avoid areas subject to disturbance from construction, operation, or recreational traffic. However, based on the lack of any confirmed records in either New Mexico or Arizona (AZGFD 2004b; de Oliveira 1998), and the determination by the USFWS (2001; supported by Brown and González 1999) that Jaguarundis may never have been present in Arizona, no impacts to Jaguarundis are anticipated from development or operation of this Project. Mitigation measures that address vegetation preservation and restoration, erosion prevention, and effects to riparian habitats would minimize impacts to habitats that may be used by Jaguarundis (SE 1, 2, 3, 4, 5, 8, 14, and 16).

Birds

Golden Eagle

Golden Eagles are a wide-ranging species that could occur almost anywhere within the study corridor, outside of urban areas. Because of this Project-wide range and the diversity of habitats that Golden Eagles may use, areas of potential impacts were not mapped in the impact analysis. Prior to construction, surveys would occur and mitigation measures described below would be employed as needed near Golden Eagle nests or other sensitive areas.

Impacts to Golden Eagles could include construction disturbance of breeding or nesting behavior, potentially resulting in nest abandonment. Seasonal avoidance of construction in Golden Eagle nesting areas would minimize disturbance of the birds (SE 12). Mitigation measures that address vegetation preservation and restoration would minimize potential impacts to small mammals, which are important Golden Eagle prey (SE 3, 4, 5, and 14). Transmission line groundwires, conductors, and structures present potential collision hazards for eagles and other birds, particularly during inclement weather when visibility is reduced. This risk can be reduced with mitigation measures SE 7, 9, and 15. Overhead lines are significant sources of avian collision mortality, particularly during dusk, dawn, and at night when the lines are effectively invisible. SunZia incorporates avian protection into its structures in accordance with APLIC recommendations (APLIC 2012, 2006). Increased public access could result in disturbance and shooting of birds. SE 4 and 6 may be employed when feasible and at the

discretion of the landowner or land management agency, to minimize public access to areas occupied by nesting Golden Eagles.

Bald Eagle

Bald Eagles are most likely to occur in the study corridor near the Rio Grande and in the Sulphur Springs Valley in Arizona, where they may prey on waterfowl and Sandhill Cranes foraging in farmland. Bald Eagles nest along the Gila River near Winkelman, Arizona, approximately 10 miles north of the Project study area, and dispersing or foraging eagles have been recorded at Aravaipa Canyon. Bald Eagles would be susceptible to impacts similar to those described for the Golden Eagle. In addition, their habitat is more closely tied to riparian areas that support large fish used as prey and that contain tall trees that are used for nesting or roosting. The Project would not appreciably reduce the amount of available farmland in the Sulphur Springs Valley used by the eagles' prey species, but would present a potential collision risk for all large birds. The collision risk is greatest at dawn and dusk and during inclement weather, when visibility is low. Structure type, design, siting, and application of bird diverter devices on groundwires and conductors (SE 7 and 15) would help reduce the collision risk to Bald Eagles, waterfowl, and Sandhill Cranes.

The effects of vegetation clearing and resultant erosion may adversely affect the birds' habitat and the quality of waters that support their prey. Mitigation measures that address vegetation preservation and restoration, erosion prevention, and stream avoidance would minimize effects to habitat that could be used by Bald Eagles (SE 1, 2, 3, 7, and 14).

Northern Aplomado Falcon

Ground clearing for Project construction could affect areas near Aplomado Falcon nests. Construction in nesting areas would take place between August 1 and January 31, to remain outside of Aplomado Falcon nesting season (SE 12). Because Aplomado Falcons typically use existing nests constructed by other raptor species or corvids, and nest site availability may be a limiting factor for the species, any existing large nests within their habitat would be avoided by Project activities whenever practicable (Keddy-Hector 2000). In addition, many Project alternatives within the range of the species would be adjacent to existing transmission lines, so they would not result in substantial new ground disturbance. The preference of Aplomado Falcons for hunting from low perches reduces the potential for collisions of the birds with groundwires, conductors, and structures. Large areas of available but unoccupied habitat, coupled with the naturally low densities of Aplomado Falcons, would preclude significant negative effects of Project construction related to habitat loss.

While the loss of some vegetation may slightly reduce overall prey abundance, the buffering ability of the large home ranges of Aplomado Falcons would protect against a slight reduction in the prey base of generally abundant bird species. Impacts to Aplomado Falcon habitat would be somewhat mitigated by measures addressing vegetation preservation, as well as restoration and noxious weed control (SE 3, 4, 5, and 6). Additional mitigation measures addressing noxious weed management will be detailed in the POD.

Yuma Clapper Rail

The western terminus of the Project is approximately 3.7 miles west-northwest of Picacho Reservoir, where Yuma Clapper Rails occasionally occur (USFWS 2006). All alternative routes for the Project pass within 1 mile north of the reservoir, with Link C880 approaching approximately 500 feet from the northwest corner of the reservoir. Intermittently suitable habitat forms when the reservoir is filled in some years, but none is present in the portion of the reservoir nearest the Project where the vegetation is dominated by dense tamarisk. Clapper Rails have been recorded colliding with power lines (Shire et al. 2000). However, due to the intermittent presence of suitable habitat and infrequent use of the reservoir by the species, the transmission lines should not present a significant risk. The transmission line is not located between Picacho Reservoir and other nearby areas likely to attract rails, further minimizing the risk of interaction with the Project. Construction practices and design measures, including the application of bird diverters, intended to reduce impacts on waterfowl and other migratory bird species near the reservoir should be sufficient to minimize or eliminate the risk of direct effects to the Yuma Clapper Rail (SE 7 and 15). Water for Picacho Reservoir is largely delivered via canals from the Gila River, and the Project would not affect rail habitat by altering water flow to the reservoir or water quality in the canals.

Piping Plover

Project development may affect some habitat that could be used by Piping Plovers, but would not appreciably diminish the amount of open, sandy shoreline habitat that any migrating or accidental Piping Plovers might use. No mitigation actions are recommended for the Piping Plover.

Yellow-billed Cuckoo

The Yellow-billed Cuckoo requires large patches of dense, mature riparian woodland. Project activities that would compromise the size and structure of those patches could affect the species. As the Yellow-billed Cuckoo avoids habitat edges, creation of access roads through woodlands could fragment habitat and reduce suitability of the surrounding areas. Any Project alternatives crossing or approaching riparian woodlands should use engineering solutions to avoid removal of woodland habitat, in order to reduce potential impacts. Structure design and placement that allows lines to span riparian woodlands at a height sufficient to minimize the need for vegetation removal or tree-topping would be implemented in suitable habitat to reduce impacts to the species (SE 7, 8, and 14). Construction activities within riparian areas would take place outside the nesting period for the Yellow-billed Cuckoo (SE 12), which is approximately late May through late September (Johnson et al. 2007). Mitigation measures that address vegetation preservation and restoration, erosion prevention, and stream avoidance would reduce potential impacts to Yellow-billed Cuckoo habitat (SE 2, 3, 5, 8, and 14).

Mexican Spotted Owl

The Mexican Spotted Owl could potentially occur within the study corridor in the north end of the Galiuro Mountains, in the vicinity of Aravaipa Canyon. The Mexican Spotted Owl is known

to nest in Aravaipa Canyon, Turkey Creek, and other forested canyons (BLM 2009a). Critical habitat is designated in the southeast portion of the Magdalena Mountains in New Mexico and in the Rincon Mountain Wilderness in Arizona, and the species may occur within the study corridor in these areas. However, no habitat suitable for the Mexican Spotted Owl occurs within approximately 0.5 mile of the reference centerline of any of the alternative study corridors, and no impacts to the species or its habitat are anticipated to result from Project construction or operation. Helicopter flight paths during construction and maintenance would be designed to avoid Mexican Spotted Owl habitat by recommended buffer distances. No additional mitigation is proposed for this species.

Cactus Ferruginous Pygmy-owl

Impacts to suitable habitat, including dispersal habitat, would result from vegetation clearing during Project development. Since use of riparian woodlands by the species has greatly diminished in recent years, the primary nesting sites for the species are in cavities in saguaros. Avoidance, salvage, and relocation of saguaros of transplantable size would reduce effects to Cactus Ferruginous Pygmy-owl nesting habitat. Noxious weeds can alter native plant communities, resulting in increased fire frequency and severity to which Sonoran Desert vegetation is not adapted. Such changes adversely affect Pygmy-owl habitat. Mitigation measures contained in Appendix B2 of the POD address noxious weed management. Spanning of washes or riparian habitats and use of selective vegetation clearing in washes or riparian areas, augmented by restoration, would also contribute to preservation of habitat important to Cactus Ferruginous Pygmy-owls (SE 3, 5, 8, and 14).

Southwestern Willow Flycatcher

Southwestern Willow Flycatchers are known to occur within the study corridor along the Rio Grande and San Pedro River, on Cienega Creek east of Vail, Arizona, and downstream of the corridor on Aravaipa Creek and at the confluence of the San Pedro and Gila rivers. Designated critical habitat for the species includes the Rio Grande crossing alternatives and the alternatives crossing the San Pedro River in Arizona.

Clearing of vegetation along riparian corridors for Project construction may impact habitat suitable for Southwestern Willow Flycatchers. Selective mitigation measures that address vegetation preservation and restoration would be implemented to minimize impacts to riparian vegetation (SE 3, 5, and 14). Engineering of structures to span Willow Flycatcher habitat where possible would minimize impacts to these areas and would be the preferred mitigation option where feasible (SE 7 and 8). If engineering limitations preclude spanning in some areas, tall vegetation would not be allowed to exceed NESC conductor clearance requirements, but lower vegetation would be allowed to remain to preserve continuity of habitat to the extent possible.

Transmission line groundwires, conductors, and structures present potential collision hazards for birds, particularly during periods of inclement weather that may affect visibility. Placement of bird diverters on groundwires and conductors has proven effective in mitigating avian collisions (SE 15). Surveys for Southwestern Willow Flycatchers would be performed in areas of suitable

habitat. Construction in areas occupied by Southwestern Willow Flycatchers would be performed outside of the mid-May to mid-August nesting season (SE 12).

Sprague's Pipit

Sprague's Pipits winter in grasslands in southeastern Arizona and southern New Mexico, but all individuals migrate to the northern Great Plains during the nesting season. Therefore, all birds present would be adults capable of avoiding construction activities. However, some grassland habitat used during winter and migration would be lost in construction of the Project. Sprague's Pipits are sensitive to habitat fragmentation (Davis 2004) and may avoid vertical landscape features such as trees, shrubs, and man-made structures (Jones 2010, USFWS 2010c); as such, they may avoid the vicinity of a transmission line in otherwise undisturbed habitat. Postconstruction restoration in areas of habitat suitable for Sprague's Pipit may not be an effective mitigation, since the birds would likely not occupy areas near tall structures. For this reason, no mitigation measures have been identified to benefit Sprague's Pipit.

Reptiles

Sonoran Desert Tortoise

Sonoran Desert Tortoises are highly vulnerable to construction activities. As Desert Tortoises spend much of the year underground, detection can be difficult without intensive surveys, and without such measures the risk of mortality is very high for any Desert Tortoises in areas of ground disturbance. Active Desert Tortoises may take shelter under vehicles, wander into work areas, and potentially become trapped in excavations. However, preconstruction surveys, implementation of construction practices that reduce risk to Desert Tortoises, and construction monitoring are successful at reducing the immediate risk to individual Desert Tortoises posed by construction activities (standard mitigation and SE 1, 2, and 3).

Within areas that support Desert Tortoises, ground clearing for structure pads, other structures, and access roads for the Project would result in the loss of Desert Tortoise habitat, possibly including specific, high-value features such as burrows or calcium licks. In addition to direct habitat loss, Desert Tortoise populations may experience a "road effect," where traffic, collection, or other factors reducing Desert Tortoise survival near roads results in lowered population densities extending well beyond the road itself (Boarman and Sazaki 2006). Unimproved access roads for the Project would have effects of a much lower magnitude, although the availability of any road for recreational traffic can create a higher risk to Desert Tortoises than just that of the direct habitat loss from road construction. The total level of road use would determine the overall level of impact on Desert Tortoises. Postconstruction closures of access roads through gating or reclamation would help minimize these impacts to Desert Tortoises (SE 4 and 6).

Predators of Desert Tortoises, including Coyotes, domestic or feral dogs, and ravens, may be attracted to human activities such as those associated with Project construction. Discarded or unsecured food can augment predator populations, in turn increasing predation pressure on Desert Tortoises. However, BMPs would be employed, which includes securing all solid waste

generated by Project construction. Predator augmentation via increased food resources is not anticipated to be a significant effect on Desert Tortoises.

Transmission structures may locally increase Common Raven densities by providing a nest substrate normally absent from desert valleys. Predation on Desert Tortoises appears to be a learned behavior for ravens, with a small percentage of the raven population apparently responsible for nearly all observed cases of Desert Tortoise consumption. The presence of nesting Common Ravens on Project structures presents a potential risk to Desert Tortoises, with the degree of effects dependent on individual raven behavior. However, as Common Ravens are protected under the MBTA, active raven management can only be conducted under permit from the USFWS. Raven management (including nest removal or lethal take) has not been recommended in the range of the Sonoran Desert Tortoise, as increased predation has not been confirmed to occur at a level that would require such management. Use of modified structure types that do not provide new nesting habitat for predators of Desert Tortoises may reduce predation pressure in areas where other transmission lines are not present (SE 7).

Arizona Striped Whiptail

Individual Arizona Striped Whiptails could be killed during ground-disturbing construction activity. Presence of a biological monitor during construction may minimize direct impacts to individual lizards, and the Project noxious weed plan and mitigation measures addressing vegetation preservation, salvage, and restoration would help preserve grassland habitat in the area (SE 3, 5, and 14).

Tucson Shovel-nosed Snake

Potential impacts to the Tucson Shovel-nosed Snake include loss of individuals during ground-disturbing construction activity, where they could be crushed by equipment or buried in collapsed burrows. Snakes could be killed by vehicles on construction access roads. Resource awareness training for construction personnel, an enforced construction speed limit, and presence of a biological monitor during Project construction would help minimize potential direct impacts to Tucson Shovel-nosed Snakes.

Northern Mexican Garter Snake

Potential impacts to the Northern Mexican Garter Snake could include loss of individual animals during ground-disturbing construction activity and effects to water quality from Project-derived erosion. The upstream crossing of Cienega Creek (Link F600) can effectively be spanned, precluding the need for an access road crossing the creek or into the canyon bottom (SE 8). Due to the angle of crossing, the downstream crossing of Cienega Creek (Local Alternative Link F51) would require placement of one structure for each line in the bottom of a small tributary drainage near its confluence with the creek, and at least three additional pairs of structures east of Cienega Creek in a steep area with high erosion potential. An access road into the canyon bottom would be needed for the pair of structures. Alternatively, helicopter-assisted construction could be used at this location (SE 13). Structure setbacks would reduce impacts to riparian vegetation near the creek, and likely avoid any direct impacts to Northern Mexican Garter Snakes. Mitigation

measures addressing erosion would minimize potential impacts to water quality that might affect prey used by the snakes (SE 1, 2, 3, 5, 7, and 8).

Fish

Apache Trout

Although Subroute 4B would cross Grant Creek on the west side of the Pinaleño Mountains, it would do so approximately 6 miles downstream from permanent water that supports the Apache Trout. The potential for this trout occurring within the study corridor is very low, and would occur only during abnormally high flows of Grant Creek, when fish could be carried to lower elevations that do not contain perennial waters. No impacts to the Apache Trout or its occupied habitat are anticipated to result from Project construction or operation activities.

Gila Chub

The Gila Chub occurs within the study corridor only at the Cienega Creek Preserve. Since it is feasible for the Project to span the upstream crossing of Cienega Creek, and a new road crossing of the creek would not be needed, impacts to the Gila Chub would potentially only be associated with the effects of construction-induced erosion on the water quality of the creek. The terrain at the lower crossing of Cienega Creek (Local Alternative Link F51) may require that a pair of towers be sited within designated critical habitat for the Gila Chub. Standard mitigation measures addressing erosion and SE 1, 2, 3, 5, 7, and 8 would minimize potential effects to stream waters.

Roundtail Chub

Aravaipa Creek supports the only population of the Roundtail Chub in proximity to the study corridor. Link C170 would cross a nonperennial reach of Aravaipa Creek in the northern portion of the Sulphur Springs Valley, approximately 6 miles upstream of the perennial reach of Aravaipa Creek where Roundtail Chubs occur. This link also would span the headwaters of Turkey Creek, a tributary drainage to Aravaipa Creek that supports the Roundtail Chub and other native fish. This location is approximately 0.5 mile from the uppermost limits of the watershed, and approximately 8.5 miles from the confluence with Aravaipa Creek. Potential impacts to the Roundtail Chub and its habitat from the Project would be limited to effects to water quality in Turkey and Aravaipa creeks. Although tower pads may be located on ridgelines forming the Turkey Creek watershed boundary, new access roads would be sited outside the watershed to the extent practicable. Existing access is present in this area, although road improvements may be necessary. Mitigation measures addressing erosion would minimize the potential for sedimentation effects to Turkey and Aravaipa creeks (SE 1, 2, 3, 5, 7, and 8).

Rio Grande Silvery Minnow

Any construction activities that alter the streambed of the Rio Grande could negatively affect Rio Grande Silvery Minnows in the construction area through disturbance and loss of habitat. Deposition of sediments on the substrate downstream may have little direct negative effect on the

fish, although excessive suspended sediments are known to plug or abrade gills in many aquatic species.

The Rio Grande Silvery Minnow could be indirectly affected by local modification of the overall stream system. While the minnow prefers silt substrates, trophic connections to other stream species dependent on cobble-gravel substrates are likely. Construction effects relating to erosion, suspended sediment load, or substrate modification that substantially alter the overall function of the stream system may cause shifts in the species' prey base, modify nutrient input from surrounding riparian zones, or alter competitive or predator-prey relationships; in turn possibly affecting the Rio Grande Silvery Minnow.

The two proposed Project crossing sites of the Rio Grande are complicated by the wide floodplain, roads, canals, and presence of riparian vegetation that may be affected by construction and maintenance activities. Engineering transmission line structures to span riparian woodland associated with the river is more feasible at the northern crossing (Link E180), where structures would likely not be needed within the riparian zone. The width of the riparian zone at the San Antonio crossing may require more extensive vegetation management, with a greater potential to result in erosion that may affect water quality of the Rio Grande downstream of the crossing. However, preliminary engineering indicates that placement of one pair of structures partially within designated critical habitat may be required at either crossing location. Given the existing conditions at both proposed crossing locations, including large areas of cultivated land, temporary disturbance associated with Project construction is not anticipated to result in an appreciable increase in sedimentation with the implementation of mitigation measures addressing erosion (SE 1, 2, 3, 7, and 8).

Spikedace

Direct effects of construction activity on Spikedace would be primarily related to upland topsoil disturbance and disturbance of the stream bed at any road crossings. Disturbed topsoil may erode during heavy rainfall events, increasing suspended sediment load and siltation in streams supporting Spikedace. Spikedace prefer riffles and other rocky areas of flowing water, particularly for spawning; deposition of fine sediment would reduce available habitat. Suspended sediment can also plug or abrade fish gills. Mitigation measures addressing erosion would minimize the potential for sedimentation effects to waterways (SE 1, 2, 3, 5, 7, and 8).

Loach Minnow

Direct effects of construction activity on Loach Minnows would be primarily related to upland topsoil disturbance and disturbance of the stream bed at any road crossings. Disturbed topsoil may erode during heavy rainfall events, increasing suspended sediment load and siltation in streams supporting Loach Minnows. Loach Minnows prefer riffles and other rocky areas of flowing water, particularly for spawning; deposition of fine sediment can reduce available habitat. Suspended sediment can also plug or abrade fish gills. Mitigation measures addressing erosion would minimize the potential for sedimentation effects to waterways (SE 1, 2, 3, 5, 7, and 8).

Desert Pupfish

All Desert Pupfish locations within the study area are located in smaller tributaries upstream from any streams and rivers to be crossed by the Project. Some major systems downstream from pupfish introduction sites support exotic fish, and the portions of any other streams or rivers crossed by the Project are likely to be unsuitable habitat for pupfish should any disperse downstream (USFWS 2005a, c). No effects are anticipated to occur to Desert Pupfish from the construction or operation of the Project.

Gila Topminnow

Gila Topminnows are present in close proximity to the proposed crossing locations of Cienega Creek, and could be affected by any construction activities occurring in the streambed or on adjacent steep slopes where soils may be susceptible to erosion. Gila Topminnows present in the tributaries of Aravaipa Creek, including Turkey Creek, are located several miles downstream from locations where Link C170 would cross the uppermost portion of the Turkey Creek watershed. An existing road that may require improvement is present at this location, and all new disturbance would take place outside the Turkey Creek watershed to the extent practicable. Postconstruction maintenance vehicles could temporarily raise levels of suspended sediment when crossing streams supporting Gila Topminnows or other native fish. However, properly constructed road crossings in the watersheds of Cienega and Turkey creeks should reduce this potential impact to biologically insignificant levels. Mitigation measures addressing erosion would minimize the potential for sedimentation effects to waterways during the construction phase of the Project (SE 1, 2, 3, and 7).

Invertebrates

Chupadera Springsnail

Link A161 would be located approximately 3 miles west of the Willow Spring complex at a lower elevation than the spring. No effects to the Chupadera Springsnail or its designated critical habitat are anticipated.

Socorro Springsnail

Link A161b, a local alternative to Link A161, would pass immediately south (downstream) of the Torreon Spring complex, and may cross the lower portion of the perennial outflow of the spring. Spanning the spring outflow and centering the drainage between adjacent structures would minimize the potential for effects on springsnail habitat (SE 8). The Socorro springsnail would be affected by a reduction in the spring flow (USFWS 1994b); however, construction of the Project is not anticipated to alter the spring hydrology.

Plants

Pima Pineapple Cactus

All areas in suitable Pima pineapple cactus habitat would be surveyed; and where possible, destruction of plants would be avoided. Use of existing roads, when possible, could minimize new habitat loss, and siting of individual structure pads and spur roads should avoid any cacti that may be present. Mitigation measures addressing noxious weed management would minimize the potential for colonization of disturbed ground by invasive plant species (SE 1).

Conservation banks for the Pima pineapple cactus were initiated in 2002 (USFWS 2002b), allowing offsite mitigation for loss of habitat or destruction of individual plants, generally compensating for lost acreage on a 1:1 or 2:1 basis. Transplantation of the cacti is purported to have a high rate of failure, and although not appropriate as a sole mitigation measure, may be conducted if recommended by the USFWS.

Kuenzler's Hedgehog Cactus

The study corridor is outside the known range of the Kuenzler's hedgehog cactus; however, known populations occur within approximately 15 miles of the proposed SunZia East Substation. Surveys throughout the Project area in the foothills of the Gallinas Mountains would assist in determining whether the Kuenzler's hedgehog cactus or a related, unlisted variety is present. Identified Kuenzler's hedgehog cacti would be avoided during detailed siting and engineering to the extent feasible (SE 8), or salvaged for transplantation or donation to an approved conservation facility if necessary.

Acuña Cactus

Because of the presence of potentially suitable habitat in the area and proximity of a known population of the Acuña cactus in the Ninetysix Hills north of Link C620, surveys would be conducted for the species if any suitable habitat is confirmed to be present. Use of existing roads, when possible, could minimize habitat loss, although little access currently exists on Link C620. Siting of individual structure pads and spur roads would avoid any cacti present (SE 8). Plants may be suitable for transplanting, and so those that cannot be avoided could be moved to suitable adjacent habitat if deemed prudent by the USFWS and ADA.

Todsen's Pennyroyal

The distance of the study corridor from all known populations of Todsen's pennyroyal precludes direct effects on the species within its known range. However, the dispersed nature of the populations and incomplete coverage of surveys in the rugged topography preferred by the species suggests that unknown populations may exist. The 2001 recovery plan for the species suggests undocumented populations may exist in suitable habitat on Chupadera Mesa (USFWS 2001), which would be crossed with any subroute from Route Group 1, including the BLM preferred alternative. Potentially suitable habitat along links E85 and E80d was visited in September 2012, to support the Biological Assessment and Section 7 consultation for the Project.

No Todsen's pennyroyal plants were observed, although small patches of gypseous soil were present and other conditions appeared to be similar to habitat near known populations.

Should the Project cross Todsen's pennyroyal populations, construction could have a negative effect on the species. Construction activities could result in direct mortality from ground disturbance, potentially eliminating very small populations. The species appears to have low seed production and low dispersal abilities, increasing sensitivity to the types of disturbance likely to be associated with the Project, as well as increasing the length of time affected populations may need to recover or recolonize disturbed ground, postconstruction. Because populations tend to be small and localized, spanning of identified groups of plants may be feasible (SE 1 and 8). Intensive surveys would occur in any suitable habitat. Standard mitigation measures and SE 1 and 5 addressing erosion and vegetation restoration would contribute to minimizing potential effects to Todsen's pennyroyal and its habitat.

Pecos Sunflower

The Pecos sunflower typically occurs around the margins of wetlands, often in saline soils. No natural populations are known to occur in the study corridor, and no saline wetlands are present at proposed crossing locations of the Rio Grande. Natural populations upstream at Sevilleta NWR and translocated populations south of Socorro on private property are not anticipated to be directly or indirectly affected by the proposed Project. No mitigation measures are proposed for the Pecos sunflower.

Huachuca Water-umbel

The Huachuca water-umbel prefers permanently wet soils at the margins of streams, and benefits from occasional flood-related disturbance. However, the species is susceptible to scouring floods and thus requires refugia for plants or seeds to allow recolonization. The species occurs within the Project corridor at two locations; the Bingham Cienega on the San Pedro River and in the Cienega Creek Natural Preserve east of Tucson. To the extent possible, existing roads would be used for Project construction and maintenance in these areas. Link F600 (Subroute 4C3) has substantial existing access, and no effects to the hydrology of Cienega Creek are anticipated. Local Alternative F51 lacks the same level of access, and crosses Cienega Creek upstream from a short reach of perennial flow. Impacts from construction and maintenance that could adversely affect the water-umbel include any activities that could increase erosion or otherwise increase the effects of scouring floods in Cienega Creek, directly removing water-umbels or their habitat. Due to the marsh-like habitat preferences, this species may be less susceptible to mild increases in siltation than other native aquatic species. Mitigation measures that address erosion prevention and spanning of riparian habitat would minimize any potential impacts (SE 1, 2, 5, and 8).

Chihuahua Scurf-pea

The Chihuahua scurfpea is not known to occur in the study corridor, although suitable habitat is present. Surveys would take place in locations determined necessary, under suitable conditions for plant growth. If Chihuahua scurfpeas are present, impacts could include loss of habitat and removal of any plants present during ground-disturbing activities, particularly clearing of

vegetation. Ground disturbance could allow colonization by invasive plant species, which may compete with the Chihuahua scurf-pea for resources and may alter the plant community and fire regime in the area by increasing the fire fuel load. Standard mitigation measures that address erosion prevention, vegetation restoration, and noxious weed control, as well as SE 1 and 5, would minimize potential impacts to the Chihuahua scurf-pea and its habitat.

4.6.4.6 Biological Resource Conservation Areas

The following biological resource conservation areas are owned, managed, and/or operated by a variety of federal, state, and county agencies, non-profit organizations, and other private owners, or partnerships of these entities:

- USFWS owns and manages the Sevilleta and Bosque del Apache NWRs
- NPS owns and manages Saguaro National Park
- BLM owns and manages the Aravaipa Wilderness, and has partial ownership and cooperates in management with the USFS and TNC of the Muleshoe Ranch CMA
- The AZGFD owns and manages the Cluff Ranch WMA
- Pima County owns and manages the Cienega Creek Natural Preserve and Bingham Ranch and Cienega, and owns a portion of and cooperates with the State Land Department and private owners in management of the A7 Ranch
- The H & E Farm, Three Links Farm, 7B Ranch and Ladder Ranch are all privately owned

Sevilleta National Wildlife Refuge

Links E86b and E101b are the only portions of the Project near Sevilleta NWR. Link E101b passes within 0.85 mile of the southern boundary of the refuge at its closest approach. The north crossing of the Rio Grande (subroutes 1A1, 1A2, and 1A) is approximately 11 miles upstream to the south of the Sevilleta NWR boundary on the river. Transmission lines crossing the Rio Grande would present a potential collision hazard for birds using the Rio Grande corridor. SE 7, 8, 12, and 15 would help reduce this potential.

Bosque del Apache National Wildlife Refuge

Bosque del Apache NWR supports a large contingent of wintering migratory bird species, including very large populations of Sandhill Cranes and waterfowl. These birds move along the Rio Grande corridor daily between feeding sites in farmland and roost sites on the refuge, and would be at risk of collision with structures placed in the flyway. A study of avian collision hazard potential was conducted for proposed Project crossings of the Rio Grande (Appendix B2). Engineering and siting of structures at this Project crossing would involve analysis of bird use of the area, particularly flight paths and altitude. The study looked at potential avian impacts at five proposed Project crossings of the Rio Grande. Some of the results of the study are detailed in the Wildlife Mitigation Measures section of this chapter (Section 4.6.4.4). ESA-listed and candidate species inhabiting Bosque del Apache NWR include the Southwestern Willow Flycatcher,

Yellow-billed Cuckoo, New Mexico Meadow Jumping Mouse, and the Rio Grande Silvery Minnow.

Potential impacts at the Project crossing of the Rio Grande are contingent on the site selected. Engineering of the lines is complicated by two contrasting concerns: potential effects of avian collisions associated with taller structures and lines; and riparian vegetation impacts that would increase with lower structures and conductors, which would in turn affect Southwestern Willow Flycatcher habitat. Effects of Project-induced erosion could potentially affect water quality of the Rio Grande, including downstream locations such as Bosque del Apache NWR. Application of standard and selective mitigation (SE 1, 2, 3, 8, 12, and 14) would minimize potential impacts at the Project crossing. Generally, soils at crossings of the Rio Grande are moderately erodible. Careful siting of structures in areas of lower soil erodibility would further minimize residual erosion effects.

Ladder Ranch

Five streams on the Ladder Ranch support some of the last remaining populations of the threatened Chiricahua Leopard Frog in New Mexico. One of the Chiricahua Leopard Frog locations reported for Cuchillo Negro Creek is within the limits of the study corridor. Link A330b would cross the Ladder Ranch and the five streams, but far downstream from any perennial flow and potential impacts to Chiricahua Leopard Frog habitat. No effects to the Chiricahua Leopard Frog or its habitat are anticipated to result from Project development or operation.

Cluff Ranch Wildlife Management Area

Link B153b passes within 0.25-mile upslope of the Cluff Ranch WMA, and crosses Ash Creek at that point. The transmission line would span Ash Creek; mitigation measures that address spanning of streams and erosion prevention would minimize any potential for effects to this resource. The ponds at Cluff Ranch are attractive to wildlife, waterfowl, and other birds, and Ash Creek may serve as a movement corridor for wildlife traveling between the mountains to the southwest and the Gila River to the northeast. Placement of transmission lines in proximity to this area would present some potential for bird collisions with groundwires and conductors, although the majority of species present are not at a high risk of collision. No specific mitigation measures are proposed for the Cluff Ranch area.

Bonita Grasslands Restoration Project

Potential impacts to the Sulphur Springs Valley Pronghorn population could include habitat fragmentation, disturbance of animals during fawning season, and creation of new access within the valley into previously undisturbed areas. Structures could provide new hunting or nesting perches for Golden Eagles that may prey on Pronghorn fawns; new access roads could potentially encourage development in the valley or support recreational traffic, which could potentially disturb Pronghorns; and disturbance of grassland vegetation could provide opportunities for colonization by noxious weed species that may alter the local plant community.

Regular burning is a common management tool to maintain large areas of healthy grassland by controlling shrubs such as mesquite. The presence of the Project could present a logistical barrier and safety hazard if prescribed burning were desired in the Sulphur Springs Valley. However, shrub management in the area is primarily mechanical at present.

Standard mitigation measures that address erosion prevention, vegetation preservation and restoration, noxious weed management, and access control, as well as SE 1, 3, 4, 5, 6, and 12, would minimize the loss or alteration of grassland habitat and disturbance of Pronghorn in the valley. New or replaced fencing would be designed to be permeable to Pronghorn movement to minimize habitat fragmentation. Construction and non-emergency maintenance would be limited to take place outside Pronghorn fawning season. Potential for impacts to Pronghorns would exist primarily during Project construction; there would be minimal potential for impacts during the operations phase.

Aravaipa Wilderness

Link C170 would be located approximately 3.4 miles to the south of the southern boundary of the Aravaipa Wilderness. Link C592 would cross the San Pedro River approximately 8 river miles upstream of the San Pedro–Aravaipa Creek confluence. There would be no direct impacts on the Aravaipa Wilderness, and potential indirect impacts primarily to surface waters would be mitigated by erosion prevention and vegetation preservation mitigation measures (SE 1, 2, 3, 7, 8, and 14).

Lower San Pedro River Collaborative Conservation Initiative

Each proposed crossing location on the San Pedro River would be within the scoping area for the Lower San Pedro River Collaborative Conservation Initiative. Away from the river crossings, each subroute generally remains outside the scoping area. At the present time, no information is available on specific lands that would be managed as an NWR or on landowners that would participate through conservation easements and other mechanisms. For additional information, please refer to the discussion of individual subroutes in Section 4.6.5 and the discussion on land use in Section 3.10.1.3.

Muleshoe Ranch CMA

Subroute 4C1 would skirt the west side of the Muleshoe Ranch CMA in the vicinity of Soza Mesa (links C331, C361, and C470). Link C331 would cross Hot Springs Canyon, and Link C470 would cross Redfield Canyon, but both links would cross just below the reach of perennial waters in each drainage. The Project would span Hot Springs and Redfield canyons, incorporating a significant setback for structures, and mitigation measures that address erosion prevention and vegetation preservation would preclude any significant effect on local water quality (SE 1, 2, 3, 7, 8, and 14).

H & E Farm

Habitat on the H & E Farm supports wildlife that uses the San Pedro River corridor. Link C660 would cross the San Pedro River 3 miles upstream of the property. The H & E Farm is not within the Project area of influence and no selective mitigation measures are proposed for the farm. Standard mitigation measures would minimize any risk of erosion and siltation affecting water quality in the San Pedro River.

7B Ranch

The mesquite bosque preserved by the 7B Ranch is habitat often used by Southwestern Willow Flycatchers or Yellow-billed Cuckoos, and is important to passerines, raptors, and other migratory or resident birds that use the San Pedro River corridor. Removal of mesquite within the transmission line right-of-way at the river crossing would likely be needed to comply with NESC standards for conductor clearance, and would reduce available bird habitat. Extensive firewood cutting has already impacted such habitat in many areas along the river. Standard Project mitigation measures addressing erosion prevention, vegetation preservation, and restoration would help minimize impacts.

Three Links Farm

The southernmost Project alternative crossing of the San Pedro River occurs at the intersection of links C201, C261, and F40a, and would cross the river 0.37 mile upstream of the south boundary of the Three Links Farm. River flow at the crossing is ephemeral, with the nearest perennial reach being approximately 1.7 river miles downstream within the Three Links Farm property. The floodplain and associated mesquite bosque at this crossing site is approximately 800 feet wide, and may be spanned by the Project; this would avoid impacts to the low-stature mesquite trees that line both banks of the river at this point. Placement of the transmission line across the river would present some collision hazard for birds using the San Pedro River corridor for migration and local movement. However, passerines make up the majority of the bird activity along the river and their movements are likely primarily among vegetation along the river, or higher above the ground during nocturnal migration. Mitigation measures that address the collision risk for birds, and potential impacts to riparian habitat, vegetation removal, and the effects of Project-induced erosion would effectively reduce these issues at this crossing (SE 1, 2, 3, 5, 7, 8, and 14).

A7 Ranch

The A7 Ranch consists of lands on the west slope of the San Pedro River Valley, over a distance of approximately 15 river miles. Within this reach, perennial flow exists for a distance of approximately 6.5 miles along the middle of the length of the A7 Ranch property, but with only a few small segments actually occurring within the property. Link C276 would cross the San Pedro River approximately 850 feet south of the property's southern boundary, and approximately 4.9 river miles upstream of the nearest downstream perennial reach of the river.

Several species identified in Pima County's SDCP are present on the A7 Ranch, and may be affected by Project development. The Lowland Leopard Frog, Bell's Vireo, and other species associated with canyon riparian habitat occur in several of the drainages on the A7 Ranch, including Buehman Canyon, and may also be present at some of the confluences with the San Pedro River. The A7 Ranch contains only a very small reach of Buehman Canyon. Link C441 would cross through the middle of the A7 Ranch in a general south to north orientation, and would cross Buehman Canyon just upstream (within approximately 300 feet) of the A7 Ranch property. Suitable habitat is present on the A7 Ranch for Sonoran Desert Tortoises. Mitigation measures that address potential impacts to riparian habitat, vegetation removal, and the effects of Project-induced erosion would effectively reduce these issues near the A7 Ranch (SE 1, 2, 3, 5, 8, and 14).

Six Bar Ranch

The Six Bar Ranch is adjacent to the A7 Ranch, and protects similar biological resources. Potential effects are similar to those discussed for the A7 Ranch. Mitigation measures that address potential impacts to riparian habitat, vegetation removal, and the effects of Project-induced erosion would effectively reduce these issues near the Six Bar Ranch (SE 1, 2, 3, 5, 8, and 14).

Bingham Ranch and Cienega

Bingham Cienega is a spring-fed marsh within the floodplain on the west side of the San Pedro River, north of Redington, Arizona. A population of the Huachuca water-umbel is present here, but the area was not designated as critical habitat for the species. Effects to water quality at the site could be detrimental to the species, but the San Pedro River and nearby tributaries do not have an upstream surface connection with the cienega. Link C441, the nearest approach of the Project to Bingham Cienega, would cross Edgar Canyon 2.7 miles to the west of it. The Edgar Canyon drainage enters the San Pedro River approximately 0.8 mile upstream of Bingham Cienega. The nearest upstream Project alternative crossing of the San Pedro River is approximately 18 river miles upstream of the cienega on Link C276. Because of the large distances from Project crossings upstream of the cienega, no impacts are likely to occur to this population of the Huachuca water-umbel.

Bar V Ranch

The Bar V Ranch is adjacent to the Cienega Creek Natural Preserve, and protects upland habitat and a portion of Davidson Canyon. Subroute 4C3 would cross this area. Mitigation measures that address potential impacts to riparian habitat in Davidson Canyon, vegetation removal, ground disturbance, and the effects of Project-induced erosion would assist in minimizing impacts to the Bar V Ranch (SE 1, 2, 3, 5, 8, and 14).

Cienega Creek Natural Preserve

Perennial stream flow in the Cienega Creek Natural Preserve supports a variety of important wildlife species, including three special-status fish species. Riparian habitat within the preserve

is important for a wide variety of other wildlife and plant species, including the ESA candidate Yellow-billed Cuckoo. The Project may cross Cienega Creek with either Link F51 or Link F600.

The Link F51 crossing would likely require placement of one structure pair within the floodplain and would affect riparian vegetation, unless engineering design would allow a full span of the creek. However, Link F51 is located downstream from the majority of perennial flow in Cienega Creek, reducing impacts to aquatic species. Due to a narrower width of Cienega Creek and substantial existing access, the Link F600 crossing could easily be spanned using standard structure design and engineering. Link F600 may require the removal of individual trees, but would not cross any substantial patch of riparian woodland.

Potential Project impacts could include habitat fragmentation or loss, removal of vegetation, disturbance of wildlife, and effects of erosion, avian collision with transmission line groundwires or conductors, and colonization by noxious weeds. Standard mitigation measures and SE 1, 2, 3, 5, 7, 8, 9, 12, 13, and 14 would eliminate or minimize these effects.

Saguaro National Park

The Project approaches both units of Saguaro National Park, coming within approximately 1 mile from the west side of the east unit on Link F81a, and approximately 0.7 mile from the east side of the west unit on Link F510. Potential impacts to biological resources in Saguaro National Park resulting from Project development would be limited. Some saguaros and agaves that may be used by foraging nectar-feeding bats that roost in the Park would be removed, but the numbers of plants involved would not be significant for the bats due to abundant available forage in the Park and on adjacent lands. Standard mitigation measures addressing vegetation preservation, salvage, and restoration would further reduce potential impacts to vegetation.

4.6.4.7 Agency-Identified and Other Biological Resource Areas

Wildlife Linkages

The concept of wildlife linkages identifies the importance of corridors connecting large areas of relatively undisturbed, protected natural habitat (wildland blocks) that are threatened by fragmentation resulting from a variety of human-induced impacts. Habitat fragmentation and loss are currently recognized as the principal threats to biodiversity. Impacts to wildlife and their habitat within linkages could include habitat fragmentation resulting from development of new access roads, which would also provide additional access to humans, and could result in increased potential for harassment or loss of some animals. Ground-disturbing activities may affect individual animals and their habitat, and may result in erosion that could affect aquatic resources. Ground disturbance may also allow for colonization by invasive plant species, which may compete with native plants for resources and alter the local plant community and fire regime. Implementation of mitigation measures SE 1, 2, 3, 4, 5, 6, 8, and 14 would minimize these effects. Mitigation measures are applicable to each of the wildlife linkages discussed below.

Galiuro–Pinaleño–Dos Cabezas Linkage

The Galiuro–Pinaleño–Dos Cabezas Linkage system consists of five main strands. Strands A and B provide connectivity between the Galiuro and Pinaleño mountains, and strands C, D, and E link the Pinaleño and Dos Cabezas mountains. Strand A would be crossed by Link 130b, and strand B would be crossed by Link 130a. Strand C would be crossed by links C90 and C110. Strand D would be crossed by links C71, C71a, C72, C90, and C110. Strand E would be crossed by Link C71.

Agriculture forms a substantial barrier in the southern portion of the portion of the Sulphur Springs Valley north of I-10, while the northern portion of the valley is currently largely unfragmented. Project links would cross strands with a mixture of new access roads and existing roads requiring upgrades. The Project would introduce a linear feature in the northern portion of the valley that would cross both strands A and B, perpendicular to the direction of wildlife movement. However, transmission lines are porous to most wildlife movement, and the greatest potential for impacts would be during the construction phase of the Project. Maintenance of vegetation within the transmission line corridor could be beneficial to the resident Pronghorn population, maintaining connectivity for the portions of their range traversed by the transmission line.

The Project would have minor, additive impacts to the connectivity of linkage strands C, D, and E between the Pinaleño and Dos Cabezas mountains. Pre-existing linear developments (UPRR and I-10), which are significantly less porous to wildlife movement than transmission lines, limit wildlife movement to those species able to tolerate the presence of traffic at the risk of collision, or cross through existing box culverts. The Project would have the potential to affect local dispersal of wildlife, and may represent an additional contribution to fragmentation of this portion of the linkage.

Rincon–Santa Rita–Whetstone Linkage

The Rincon–Santa Rita–Whetstone Linkage system consists of six main strands. Strands 1, 2, 3, and 5 are integrated into a network of linkages that interconnect the three ranges, with strands 1, 2, and 3 providing the main routes from the Rincon Mountains south to strand 5, which provides an east-west linkage between the Santa Rita and Whetstone mountains. Strand 4, isolated to the east, provides an isolated north-south linkage between the Rincon and Whetstone mountains. Four of the six strands (1, 2, 3, and 4) of this linkage system would potentially be crossed by Project alternatives. Strand 1 would be crossed by links F40b, F51 and F600; strand 2 would be crossed by links F40a, F40b and F600; strand 3 would be crossed by links F40b and F600; and strand 4 would be crossed by Link F40a. Project links cross strands with a mixture of new access roads and existing roads requiring upgrades. I-10 and the UPRR are significant, pre-existing barriers to wildlife movement south of the Project (in strands 1, 2, 3, and 4), such that any additive effects from Project development would not contribute substantially to a reduction of wildlife movement potential.

Tucson–Tortolita–Santa Catalina Mountains Linkage

The Tucson–Tortolita–Santa Catalina Mountains Linkage system consists of two main strands. Strand A provides connectivity between the Tucson and Tortolita mountains, and strand B provides connectivity between the Tortolita and Santa Catalina mountains. Strand A would be crossed by links F510 and F540, while strand B would not be crossed by the Project. Function of this linkage is compromised by the presence of existing linear developments, including the UPRR right-of-way and I-10. These features create a substantial barrier to wildlife movements through the area. Within the linkage, the Project alignment follows an existing road and would not add significantly to existing fragmentation of wildlife habitat. Because of the existing road, new ground disturbance would be limited to structure spur roads and ancillary construction areas such as splicing, pulling, and tensioning locations.

Ironwood–Picacho–BLM Linkage

The Ironwood–Picacho–BLM Linkage system consists of two main strands. The western strand connects the Picacho Mountains with the Ironwood Forest National Monument, and the eastern strand connects the Ironwood Forest National Monument with the BLM-managed Durham-Coronado Plains. The eastern strand would be crossed by links C810, C810a, C812, C813, C814, C815, C816, and C817. Function of this linkage is reduced by existing linear features that include the CAP, the UPRR, and I-10. The proposed Project would be located entirely adjacent to existing transmission lines and other developments across this linkage, and would represent a very small contribution to further fragmentation to the linkage.

Picacho Reservoir Area

Potential impacts to biological resources at Picacho Reservoir and nearby canals are associated with avian use of the site. The endangered Yuma Clapper Rail is occasionally recorded at Picacho Reservoir, but is only likely to be present during years of abundant rainfall. There is potentially suitable habitat at the reservoir for the Southwestern Willow Flycatcher, but the species has not been documented at the site. Placement of transmission lines in proximity to the reservoir and canals creates a collision hazard for birds approaching or leaving the area. Herons, waterfowl, and other large birds changing altitude as they approach or leave those bodies of water are most susceptible to collisions with wires.

Link C880 passes within 500 feet of the northwest corner of the reservoir, and portions of other links (C890 and C880a, and the western ends of C850 and C860) are between 0.75 and 3.7 miles from it, and would have proportionally less potential as avian collision hazards at those distances. Placement of bird diverters on conductors, groundwires, and guywires (SE 15) would minimize avian collision potential.

Bird Habitat Conservation Areas

Chupadera Mesa

The principal avian habitat of concern on Chupadera Mesa is high-quality grassland and piñon-juniper ecotone. Links A30, A40, A41, A50, A60, A70, E80c, E80d, E81, E83, E84, E85, E86a, and E86b cross portions of this BHCA. Potential impacts to habitat would be primarily from clearing of vegetation for development of access roads, spur roads, and structure sites. Lesser impacts would occur at temporary sites, such as wire pulling and tensioning sites, where preservation or selective removal of trees and cropping of vegetation would be adequate in most instances. Ground disturbance creates potential for erosion and colonization by invasive plant species. Structures may provide hunting perches and nesting substrate for raptors, particularly in grassland where existing perches may not be present. SE 1, 3, 5, and 14 would eliminate or minimize potential impacts.

Luna County Grasslands

Grasslands in this area are important for wintering grassland bird species, and agricultural lands in the Uvas Valley are important feeding areas for wintering Sandhill Cranes and geese. Links A400 and A440 cross portions of this BHCA. The greatest potential impacts from Project development on grassland habitat in the area are related to ground disturbances that may provide opportunities for colonization by invasive plant species. Invasive plant species could alter the native plant community, resulting in loss of suitable habitat for wildlife, and change the local fire regime. The Noxious and Invasive Weeds and Wildland Fire Ecology and Management sections of this chapter (sections 4.6.4.3 and 4.7, respectively) provide additional details relevant to this issue. Transmission lines present a collision hazard for birds; particularly large, less-maneuverable species such as cranes and geese. Placement of lines close to feeding sites in agricultural areas increases the collision risk for these species. Transmission line structures provide potential hunting perches and nest sites for raptors. This can locally increase predation pressure on prey species in grassland habitats, where natural perches may otherwise be rare. SE 3, 5, 7, 14, and 15 would eliminate or minimize potential impacts.

Middle Rio Grande

The Middle Rio Grande BHCA contains significant riparian and adjacent upland habitats along the Rio Grande. These areas support a wide variety of resident and migratory bird species, including the Southwestern Willow Flycatcher and the Yellow-billed Cuckoo. Link A140 would cross this area north of San Antonio, New Mexico, and Link E180 would cross the area north of Socorro, New Mexico. Impacts to these areas resulting from Project development could potentially include minor habitat alteration or loss. Ground-disturbing activities, primarily vegetation removal, may cause erosion that could result in sediment input to the Rio Grande; and ground disturbance may provide habitat suitable for colonization by invasive plant species. SE 1, 2, 3, 5, and 14 would eliminate or minimize potential impacts.

Important Bird Areas (Arizona)

Sabino Creek and Lower Bear Creek

The downstream portion of this IBA south of the CNF boundary overlaps the study corridor, but would not be crossed by the Project. Links F81a and F81b are southwest of the IBA and are separated by at least 1.6 miles of urban development, from the confluence of Sabino Canyon with Tanque Verde Creek. The only potential impact the Project may have on this resource is a potential avian collision hazard for birds migrating into and out of the area seasonally. Since no links occur within 1 mile of the IBA, this hazard should be insignificant for birds within the IBA. No selective mitigation measures are proposed.

Lower San Pedro River

The Lower San Pedro River IBA would be crossed at one of four locations: links C592 near Mammoth, Arizona; C660 near San Manuel, Arizona; C276 near Cascabel, Arizona; or the crossing near The Narrows where links C201, C261, and F40a occur within the limits of the IBA. Potential Project impacts would primarily be the avian collision hazard presented by conductors, groundwires, and structure guywires where the lines cross the river. SE 7, 12, and 15 would minimize effects to avian resources at the river crossing.

Willcox Playa–Cochise Lakes

The Willcox Playa–Cochise Lakes IBA consists of the large, seasonally dry lakebed south of Willcox, Arizona; the associated permanent water features at the south end of the playa at the Apache Power Station; and the Cochise Lakes at the south edge of Willcox. This resource area seasonally supports large numbers of Sandhill Cranes and moderate to large numbers of a variety of shorebirds and waterfowl. Although this IBA is outside the study corridor, wintering waterfowl and Sandhill Cranes in the area cross through the study corridor to forage in farmland in the Sulphur Springs Valley, and would potentially be at risk of collision with transmission lines. SE 7, 12, and 15 would minimize effects to these species.

Colossal Cave Area Karst Resources

Unknown caves and similar features of karst landscapes that support roosting bats, endemic invertebrates, or other wildlife may be present in Paleozoic strata in the Vail, Arizona area and in the San Pedro River Valley. Construction of access and spur roads and placement of structures and their foundations may affect the structural integrity of karst features with a near-surface expression, potentially causing changes in cave atmospheric conditions and adversely affecting roosting bats or endemic invertebrates. Bats are sensitive to temperature and humidity parameters that define suitable roosts. Changes to the physical environment in caves may make roosts unsuitable for use by bats, and may impact endemic subterranean biota. Bats are also subject to human disturbance and substrate vibrations, including those caused by construction equipment or blasting.

Prior to final structure siting, a survey of the Vail karst landscape would likely identify caves and other features with an obvious entrance. Bat roosts identified within the Project right-of-way should be avoided by strategic placement of access and spur roads and structures (SE 8). Bat roosts within 0.25 mile of the right-of-way may be affected by blasting at structure sites. A determination of bat species and roost function should be made, allowing avoidance of sensitive periods for roosting bats (SE 12).

4.6.5 Summary of Impact Analysis Results

This section provides a discussion of potential impacts associated with development of each alternative of the proposed Project, and mitigation measures that would reduce those impacts. Detailed information on the potential distribution of special-status species by link is provided in Appendix B3, and results of the impact analysis are presented in Appendix H, in tables H-6 (Vegetation) and H-7 (Special-status Species).

4.6.5.1 No Action Alternative

Under the No Action alternative, the BLM would not grant right-of-way for construction and operation of the proposed Project. The Project facilities, including transmission lines and substations, would not be built and existing land uses in the Project study area would continue. There would be no new impacts to special-status species, wildlife, vegetation, or habitats occurring within the study area. Under the No Action alternative, it is assumed that current actions and activities in the study area would continue.

4.6.5.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the proposed SunZia East Substation, traveling across Chupadera Mesa to the Rio Grande crossing, then traveling south through the Rio Grande Valley to the proposed Midpoint Substation. The total length of the subroute is 228.8 miles. Potentially significant issues discussed in this section include migratory birds and habitat on Chupadera Mesa and at the Rio Grande crossing, state-listed endangered Desert Bighorn Sheep west of the Rio Grande, and habitat for ESA-listed or candidate species at the Rio Grande crossing and throughout grasslands in the Rio Grande Valley.

Beginning approximately 25 miles west of the SunZia East Substation, vegetation management requirements may affect juniper woodland in the Chupadera Mesa BHCA near its northern boundary. Many juniper trees do not exceed 12 feet in height, but the largest trees would be trimmed or removed. Juniper woodland is fragmented or absent along Link E84 and parts of E85, and effects of the Project would be minimal. However, approximately 7 miles of continuous juniper woodland along the western portion of Link E85 (beginning near milepost 3) and the eastern portion of Link E80d (ending near milepost 3) would require more extensive vegetation management. The right-of-way would encompass approximately 340 acres in this area, although tree removal would be required on a lesser amount, depending on site-specific conditions. Minimizing ground disturbance, trimming or clearing of vegetation within the right-of-way, and

the effects of erosion (SE 1, 2, 3, and 5) would reduce potential impacts to habitat within the BHCA. Although residual effects of vegetation management would occur, the loss of juniper trees would not likely be significant given the naturally patchy nature of the existing woodland-savanna matrix present in this area.

The floodplain at the north crossing of the Rio Grande (Link E180) is approximately 1.25 miles wide, and is within an important bird flight corridor. Approximately 50 percent of the floodplain at this crossing is either active or former farmland, lacking riparian woodland and natural vegetation. An open-canopy, mixed native and non-native woodland on both banks of the river between mileposts 1.2 and 1.8 would require the removal of large trees for the Project's vegetation management needs. However, removal of trees in this area would be minimized to the extent practicable (SE 1, 2, 5, 8, and 14). Although dense, mature woodland suitable for Southwestern Willow Flycatcher or Yellow-billed Cuckoo nesting is not present at this crossing, the habitat could support migrating or foraging individuals. Nesting habitat recovery could occur in the future given the dynamic nature of Southwestern riparian habitat. Vegetation management over the lifetime of the proposed Project could prevent or impair that recovery within the right-of-way. Any vegetation management required would be conducted outside the nesting season for Southwestern Willow Flycatchers and Yellow-billed Cuckoos, except in emergency situations (SE 12).

Large flocks of wintering birds, including Sandhill Cranes, white geese (Snow Goose and Ross's Goose), and other waterfowl, disperse daily from Bosque del Apache NWR and the Ladd S. Gordon Waterfowl Area to forage on agricultural lands along the river. The Rio Grande crossing avian impact assessment study showed that white geese regularly flew at heights well above the proposed transmission line at all surveyed crossing sites during both migratory and foraging flights (Appendix B2). Sandhill Crane and waterfowl, however, were quite variable in flight heights at different crossing points, with some being within the height range of conductors or groundwires. For many bird species, although long-distance flights often take place well above the typical height of conductors or groundwires, collision risk can increase when taking off or landing, and during low-elevation daily flights near feeding areas.

The north river crossing location (subroutes 1A, 1A1, and 1A2) is located approximately 12 miles north of the San Antonio river crossing location (subroutes 1B1, 1B2, 1B2a, and 1B3).[1] When compared to the San Antonio crossing, the floodplain is narrower at the north crossing with lower amounts of farmland and riparian woodland used by foraging Sandhill Cranes, waterfowl, and other migratory birds. However, this could serve to constrain bird flight to a narrower corridor. The north river crossing location is also farther from important night roosts than the San Antonio crossing, possibly reducing daily use by cranes and waterfowl. The avian collision risk study estimated that, while collisions would occur, effects at the population level are not expected.

[1] The avian collision risk study conducted at multiple locations along the Rio Grande (Appendix B2) did not include the north river crossing used by Subroute 1A1, as it had not been identified as an alternative when the study was initiated. Although survey data are unavailable to show differences in daily or seasonal bird use between these locations, the collision risk is assumed to be similar for either proposed crossing location.

Mitigation measures to improve visibility of groundwires (SE 15), such as the use of bird diverters on groundwires and guywires, and the use of one-inch OPGW rather than one-half-inch OHGW where practicable, would reduce the collision risk for large birds. Potentially significant impacts could occur, but would likely be restricted to short-duration events such as poor-visibility conditions that prevent birds from detecting the lines or bird diverters in time to avoid collision. Significant contributions of a single, similar transmission project to long-term declines of cranes, waterfowl, or migrating birds have not been documented. Further discussion of interactions between birds and transmission lines in the Central Flyway and at the continental scale is presented in Section 4.17, Cumulative Effects.

Undisturbed portions of the floodplain at this north river crossing location (Link E180) are within designated critical habitat for the Southwestern Willow Flycatcher, and potentially suitable habitat for the Yellow-billed Cuckoo. The crossing does not contain suitably dense, seasonally flooded nesting habitat for the flycatcher or large patches of mature trees suitable for the cuckoo at present. Vegetation management needs may reduce the potential for future recovery of riparian woodland within the designated critical habitat, although removal of low trees such as coyote willows (*Salix exigua*) may not be required. The river crossing is also within designated critical habitat for the Rio Grande Silvery Minnow. Ground-disturbing activities have the potential to result in erosion that could allow sediments to reach the river. Mitigation measures that address erosion (SE 1, 2, 3, 8, and 13) would reduce the potential for river sedimentation.

Impacts to habitat from vegetation clearing or trimming within the riparian zone may affect birds and other wildlife. Mitigation measures that preserve riparian vegetation, reduce the effects of erosion, and lower the risk of avian collisions (SE 1, 2, 3, 4, 8, 12, 14, and 15) would reduce impacts for birds and their habitat along the river. Allowing smaller trees and shrubs to remain within the conductor zone would preserve cover and allow movement of birds and small wildlife that may be sensitive to open spaces. These selective mitigation measures would reduce riparian impacts from moderate-high to moderate.

Links E200 and E211 would cross a Desert Bighorn Sheep movement corridor in Socorro County west of the Rio Grande, between Polvadera Mountain and Socorro Peak. Potential impacts to Bighorn Sheep could include temporary disturbance from construction noise and the presence of humans during Project development, and intermittent disturbance during maintenance through the life of the Project. The presence of transmission structures and associated corona or wind noise has not been demonstrated to significantly affect habitat use by Bighorn Sheep (Smith et al. 1986). Increased recreational vehicle access, potentially resulting in disturbance to Bighorn Sheep, may result from the construction of new access roads in the area on Link E200 between mileposts 1.5 and 6, but Link E211 is parallel to an existing transmission line with existing access. SE 4, 6, and 12 are designed to minimize the effects of construction disturbance and the potential for increased access to a level that is not expected to be significant.

Suitable habitat for the Aplomado Falcon along the subroute is extensive, particularly in Sierra and Luna counties west of the Rio Grande. However, the southern portion of this subroute parallels existing roads and linear utilities from Link A330a west of Elephant Butte Reservoir, to the Midpoint Substation. Paralleling existing utilities minimizes new disturbance to falcon habitat, and concentrates noise and disturbance during maintenance near areas already subject to

other types of ongoing disturbance. Potentially significant impacts to the species could be avoided through vegetation restoration and erosion prevention (SE 1, 3, 5, and 8), and timing construction and maintenance to avoid the nesting season (SE 12).

Subroute 1A1 passes through the Luna County Grasslands BHCA and habitat for the Sprague's Pipit. New access within the BHCA would be limited to spur roads as links A400 and A440, which cross the Nutt Grasslands within the BHCA, are parallel to an existing line. Vegetation preservation and restoration (SE 3 and 5) would minimize the effects of temporary disturbance. Colocating the Project with existing lines avoids potentially significant impacts to the Sprague's Pipit relating to the species' avoidance of tall structures.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is largely identical to Subroute 1A1 with a length of 230.3 miles, but links E86a and E86b would affect a greater area of Chupadera Mesa with less existing access, partially in steeper terrain.

Table 4-16 provides estimates of the miles of potential suitable habitat for special-status species that would be crossed by Subroute 1A2. Estimates for all alternatives are provided in Appendix B3.

Table 4-16. Estimated Miles of Special-status Species Habitat Crossed by Subroute 1A2

Link	Miles	Northern Aplomado Falcon	Yellow-billed Cuckoo	Southwestern Willow Flycatcher	Sprague's Pipit	Rio Grande Silvery Minnow
A10	2.6					
A161	15.3	12.0				
A161a	9.4	9.4				
A21	10.2					
A260	28.4	11.4				
A330a	14.1	10.0				
A330b	25.5	20.5				
A400	14.6	14.6			9.6	
A440	12.4	12.4			7.0	
A520	0.5	0.5			0.5	
A530	4.0	2.0				
E101b	19.6					
E133	5.9					
E180	4.4	4.4	1.0	1.0		1.0
E200	6.4	2.0				
E211	14.1	14.1				
E82	9.9					
E84a	2.7					
E86a	16.6					
E86b	20.6					

Subroute 1A – North River Crossing

Subroute 1A is shorter than Subroute 1A1, with a total length of 219.5 miles. Subroute 1A is largely identical to Subroute 1A1, but differs in the segment that crosses Chupadera Mesa. The juniper woodland and savanna along Link E80c, beginning near milepost 13.7, is relatively intact and of a higher tree density than on links E84 and E85 (Subroute 1A1). Vegetation management requiring extensive tree removal could occur for a distance of approximately 10.5 miles (approximately 510 acres within the right-of-way) through relatively contiguous juniper woodland. Open, treeless patches do occur throughout the Chupadera Mesa BHCA naturally and as a result of human activities. The proposed Project could result additional fragmentation through the creation of a continuous break in this habitat across the entire BHCA. However, given the often-patchy nature of juniper woodland, and that the species associated with this habitat would typically be capable of moving across such open patches, these effects may be negative but are not likely to be significant. Minimizing ground disturbance, clearing of vegetation within the right-of-way, and the effects of erosion (SE 1, 2, 3, and 5) would minimize potential impacts to habitat within the BHCA.

Subroute 1A also differs from Subroute 1A1 northwest of Elephant Butte Reservoir, where Link A270 is used rather than Link A260. Link A270 is shorter than Link A260, but is not parallel to an existing transmission line. Construction of this link may affect Aplomado Falcons and wintering or migrating Sprague's Pipits. Potentially significant impacts to the Aplomado Falcon could be avoided through vegetation restoration and erosion prevention (SE 1, 3, 5, and 8), and timing construction and maintenance to avoid the nesting season (SE 12). Sprague's Pipits may respond negatively to the presence of transmission structures, but may benefit from measures that reduce effects to vegetation (SE 1, 2, 3, and 5).

Subroute 1B1 – San Antonio Crossing

Subroute 1B1 begins at the proposed SunZia East Substation, traveling across Chupadera Mesa to the San Antonio crossing, then traveling south through the Rio Grande Valley to the proposed Midpoint Substation. The total length of the subroute is 223.6 miles. Potentially significant issues discussed in this section include migratory birds at the San Antonio crossing.

Subroute 1B1 initially uses the same links as Subroute 1A, with similar potential impacts across Chupadera Mesa. After crossing Chupadera Mesa, no potentially significant impacts are identified until reaching Links A111 and A112 east of San Antonio. An SMA of 1,201 acres is designated in this area, for the protection of the Fugate's blue-star. Habitat for this plant may also occur outside the SMA. Surveys for this species may allow direct impacts to be avoided. Minimizing ground disturbance and reducing the risk of invasive plant colonization (SE 1, 5, 6, and 8) would also assist in reducing impacts to be less than significant.

The floodplain at the San Antonio crossing is approximately 2.15 miles wide, although approximately 2.0 miles of the floodplain is within farmland or disturbed areas. Surveys for the avian collision study (Appendix B2) were conducted at this site, which is within an area heavily used by wintering waterfowl and Sandhill Cranes. As discussed under Subroute 1A1, mitigation measures to increase visibility of the groundwires (SE 15) can reduce but not completely eliminate the collision risk, particularly when visibility is poor.

Undisturbed portions of the floodplain at this river crossing location (Link A140) are within designated critical habitat for the Southwestern Willow Flycatcher, and potentially suitable habitat for the Yellow-billed Cuckoo. The Mitchell Fire burned 1,021 acres within the floodplain in 2005. However, a patch of riparian woodland remains on the east bank of the river, and would be affected by Subroute 1B1. This woodland patch totals approximately 37 acres. Of this area, approximately 7 acres of dense coyote willows are present on a sandbar, and may provide suitable nesting habitat for Southwestern Willow Flycatchers. This willow species rarely grows to a height that would mandate intensive vegetation management, and suitable nesting habitat may continue to be present in the right-of-way. However, the remainder of the riparian woodland contains mature cottonwoods and other trees that exceed 12 feet in height, and that portion of the patch would be affected by vegetation management throughout the life of the Project. Any vegetation management required would be conducted outside the nesting season for Southwestern Willow Flycatchers and Yellow-billed Cuckoos (SE 12).

Approximately 20 acres of riparian woodland with numerous large cottonwoods form a contiguous block that may be suitable nesting habitat for Yellow-billed Cuckoos. Construction of the proposed Project would require the removal of the largest trees, creating two smaller patches. Approximately 2 acres would remain to the north, a fragment below the size threshold used by Yellow-billed Cuckoos. Approximately 12 acres would remain to the south, and would potentially remain suitable nesting habitat. However, the extent of habitat affected directly and through fragmentation is potentially significant.

The river crossing is also within designated critical habitat for the Rio Grande Silvery Minnow. Ground-disturbing activities have the potential to result in erosion that could allow sediments to reach the river. Mitigation measures that address erosion (SE 1, 2, 3, 8, and 13) would reduce the potential for river sedimentation. Impacts to other riparian-associated wildlife and associated mitigation measures are discussed under Subroute 1A1.

After crossing the Rio Grande, Link A160 crosses the southern portion of a Desert Bighorn Sheep movement corridor. Potential impacts and mitigation measures are similar to those discussed under Subroute 1A1. The remainder of 1B1 is identical to Subroute 1A.

Subroute 1B2 – San Antonio Crossing

Subroute 1B2, 209.2 miles in length, takes a more southerly route than 1A, 1A1, 1A2, and 1B1, but affects similar vegetation communities. The subroute crosses Chupadera Mesa at a relatively narrow location, with substantial existing access. After reaching Link A90 northeast of San Antonio, the remainder of the subroute is identical to Subroute 1B1.

Subroute 1B2a – San Antonio Crossing

Subroute 1B2a is largely identical to Subroute 1B2, but uses Link A260 to follow an existing transmission line northwest of Elephant Butte Reservoir.

Subroute 1B3 – San Antonio Crossing

Subroute 1B3 is largely identical to Subroute 1B2, but would affect a greater area of Chupadera Mesa with less existing access.

Local Alternative Links for Route Group 1 (Gran Quivira Area)

Biological resources for this group of local alternatives are similar to those along adjacent portions of subroutes 1A, 1A1, 1A2, and 1B1. All alternatives would cross the Chupadera Mesa BHCA, although links E84 and E85 would cross disturbed areas and the smallest amount of juniper savannah, and would require less-extensive tree management. All local alternatives in this group rejoin Link E80D and subroutes 1A1, 1A, or 1B1at the same point.

4.6.5.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 connects the proposed Midpoint Substation to the proposed Willow-500 kV Substation, with a length of 123.9 miles. Potentially significant issues associated with this subroute are nesting habitat for the Aplomado Falcon and wintering habitat for the Sprague's Pipit.

From the proposed Midpoint Substation to the Peloncillo Mountains northwest of Lordsburg, New Mexico, much of this subroute could affect semidesert grassland habitat that may be used by Aplomado Falcons and Sprague's Pipits. Potentially significant impacts to the Aplomado Falcon could be avoided through vegetation restoration and erosion prevention (SE 1, 3, 5, and 8), and timing construction and maintenance to avoid the nesting season (SE 12). Portions of this subroute are parallel to other transmission lines in wintering habitat for the Sprague's Pipit, but potentially significant impacts to the species may occur where no transmission lines are currently present, including links B90 and B120a northwest of Deming, and northwest of Lordsburg on parts of Link B160a.

Subroute 3A2 uses links B160a and B160b to cross the Peloncillo Mountains, where foraging habitat for the Lesser Long-nosed Bat may be affected. Existing access is absent for a substantial portion of the crossing of the Peloncillo Mountains, including a continuous segment approximately 7.8 miles in length. Habitat suitable for movements of Jaguars may be present in the Peloncillo Mountains along Link B160a. Potential impacts to the Lesser Long-nosed Bat are limited to effects to food plants (agaves). Mitigation measures that preserve agaves (SE 1, 3, 5, 12, and 16) would greatly reduce potential impacts to Lesser Long-nosed Bats. Potential effects to the Jaguar would likely be limited to construction-related disturbance of any animals occurring in the area during development. As no Jaguars have recently been detected in the Project area of influence, the potential for the species occurring is considered very low, and mitigation for potential disturbance of Jaguars would not occur unless evidence indicates an individual may be present.

The Chihuahua scurf-pea may occur on this subroute, particularly where Link B160b crosses the San Simon Valley. Potential impacts to the Chihuahua scurf-pea include alteration of habitat and direct mortality of plants from ground-disturbing activities. Standard and selective mitigation measures would reduce the potential for these effects.

Table 4-17 provides estimates of the miles of potential suitable habitat for special-status species that would be crossed by Subroute 3A2. Estimates for all alternatives are provided in Appendix B3.

Table 4-17. Estimated Miles of Special-status Species Habitat Crossed by Subroute 3A2

Link	Miles	Lesser Long-nosed Bat	Northern Aplomado Falcon	Sprague's Pipit	Chihuahua Scurf-pea
B120a	16.8		16.8	9.0	
B120b	24.1		24.1		
B121	14.2		14.2	8.0	
B160a	25.7	12.7	16.0	4.0	
B160d	17.5				13.5
B170	7.5	7.5			
B60	1.6		1.6	1.6	
B90	16.0		16.0	8.0	

Subroute 3A – North

Subroute 3A, with a total length of 123.4 miles, would result in impacts to biological resources similar to those that would occur on Subroute 3A2.

Subroute 3B – South

Subroute 3B, with a total length of 128.6 miles, takes a southerly route after leaving the proposed Midpoint Substation. All resources along this subroute between the Midpoint Substation and Lordsburg are expected to be similar to those present on the links used by subroutes 3A2 and 3A. Potentially suitable habitat for the Aplomado Falcon and Sprague's Pipit is present. A lower proportion of transmission lines is parallel to Subroute 3B compared to subroutes 3A or 3A2, potentially increasing impacts to Sprague's Pipits.

After crossing the foothills of the Pyramid Mountains near Lordsburg, Subroute 3B crosses the Lordsburg Playa parallel to an existing gas pipeline. Sensitive plants and invertebrates, including fairy shrimp, associated with the playa may be affected by ground disturbance. Reducing ground disturbance and avoiding any seasonally flooded pools would reduce impacts to these species (SE 1, 3, 5, 8, and 12).

Much of the remainder of Subroute 3B west of the Peloncillo Mountains is located in or near disturbed former agricultural lands and areas heavily affected by past overgrazing and erosion. The Chihuahua scurf-pea has not been recorded from the vicinity of Subroute 3B, but potentially suitable habitat is widespread. Mitigation measures would be similar to those described under Subroute 3A2.

4.6.5.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Suitable foraging habitat for the Lesser Long-nosed Bat occurs along Subroute 4A, from the west end of Link C170 west to the CAP canal. Potential habitat for the Jaguar may be present along the east flank of the Pinaleño Mountains (Link B153a) and the central Galiuro Mountains (links C170 and C178). Suitable habitat for the Ocelot may occur along links B153a and B153b (north flank of the Pinaleño and Santa Teresa mountains), and on Link C170 in the Galiuro Mountains.

Subroute 4A crosses an ephemeral reach of upper Aravaipa Creek, approximately 5 miles upstream from the nearest permanent water. The floodplain of Aravaipa Creek, both upstream and downstream of Link C170, is affected by ongoing sources of disturbance including access roads and active agriculture, minimizing the need for new ground disturbance during Project construction. Existing access is limited in steeper terrain at higher elevations in the Aravaipa Creek and Turkey Creek watersheds. Construction in these areas would require access roads, but would also be facilitated by helicopters (SE 13). Access roads in this area would typically be reclaimed or blocked from public use (SE 4 and 6), and maintenance would be conducted primarily with the use of helicopters. These measures, standard mitigation measures, and SE1, 2, 3, and 8 would reduce the risk that erosion would affect native fish habitat in Aravaipa Creek. Construction in this area may also result in temporary disturbance to Desert Bighorn Sheep, although construction activities would take place outside identified sensitive seasons (SE 12).

Habitat for the Yuma Clapper Rail is present at Picacho Reservoir near links C880 and C880a. Habitat for the Southwestern Willow Flycatcher (including designated critical habitat) and Yellow-billed Cuckoo is present on Link C592, at the crossing of the San Pedro River. Habitat for the Southwestern Willow Flycatcher is suitable for migrating individuals but unsuitable for nesting at present. However, vegetation management over the lifetime of the proposed Project could prevent or impair future recovery of nesting habitat within the right-of-way. Any vegetation management required would be conducted outside the nesting season for Southwestern Willow Flycatchers and Yellow-billed Cuckoos (SE 12). Impacts to the riparian habitat at this crossing would be high-moderate to high before selective mitigation; SE 1, 2, 3, 4, 8, 12, and 14 would reduce impacts to moderate.

Suitable nesting, foraging, and dispersal habitat for the Cactus Ferruginous Pygmy-owl is present on Subroute 4A, from Link C178 east of the San Pedro River west to the CAP canal. Suitable habitat for Sprague's Pipit is present on Subroute 4A links B153a and B153b. Sonoran Desert Tortoise habitat occurs along portions of all Subroute 4A links, between Link C178 on the west flank of the Galiuro Mountains and west to the vicinity of the CAP canal on Link C850. Habitat for the Tucson Shovel-nosed Snake occurs in areas with sandy soils on Link C850 at the northwest corner of the Picacho Mountains. Potential habitat for the Acuña cactus may be present on suitable soils in the vicinity of the Ninetysix Hills (Link C620).

Potential impacts and mitigation measures for the Lesser Long-nosed Bat, Jaguar, Southwestern Willow Flycatcher, Yellow-billed Cuckoo, and Sprague's Pipit are the same as listed previously for other subroutes. Potential impacts to the Ocelot are probably limited to construction disturbance, which are not able to be mitigated effectively in the absence of detailed information

on Ocelot presence; but the species has a very low potential for occurring within the Project area of influence. No mitigation measures are proposed for the Ocelot.

Impacts to the Cactus Ferruginous Pygmy-owl could include loss of potential nest sites (primarily saguaros) and fragmentation of home range, foraging, and dispersal habitats. Impacts to nesting habitat are reduced by standard mitigation measures that address avoidance or salvage of saguaro cacti. Effects of habitat loss and fragmentation are reduced by SE 1, 3, 5, 8, and 12. Potential impacts to Sonoran Desert Tortoises are primarily direct mortality from construction traffic and ground-disturbing activities. Habitat loss and vegetation impacts are also important, and are mitigated by applying SE 3, 4, 5, and 6. Restricting construction to periods when Desert Tortoises are typically underground (November 1 through March 1) would reduce the risk of Desert Tortoises entering the work area (SE 12). Potential impacts to the Tucson Shovel-nosed Snake include habitat loss and direct mortality resulting from construction traffic and ground-disturbing activities. Application of SE 3, 4, and 6 would minimize these effects. Potential impacts to the Acuña cactus include direct mortality, habitat degradation or loss, and the effects of illegal collecting. SE 1, 4, and 6 would minimize these impacts.

Impacts to the Yuma Clapper Rail would be limited to the collision potential presented by conductors, groundwires, and structure guywires. Placement of bird diverters (SE 15) and use of modified structure types (SE 7) near Picacho Reservoir would reduce the collision potential for this species and other birds.

Subroute 4B – Sulphur Springs Valley

Subroute 4B follows the same path as Subroute 4A, but replaces links B153a and B153b (north of the Pinaleño Mountains) with links C71, C72, C90, C130a, and C130b around the south and west sides of the Pinaleño Mountains. Subroute 4B would cross a large, relatively unfragmented area of semidesert grassland in the northern Sulphur Springs Valley. The Pronghorn population in this valley is the subject of focused conservation efforts by the AZGFD, including extensive mechanical vegetation management, to increase the quality of the grasslands. Timing construction to avoid sensitive periods such as the fawning season would reduce impacts to the species (SE 12).

The Arizona Striped Whiptail does not occur on Subroute 4A, but potentially occurs along Subroute 4B. Application of SE 3 would minimize potential impacts to vegetation, prey, and habitat used by the Arizona Striped Whiptail. Subroute 4A and Subroute 4B share the same route beginning at the north end of the Pinaleño Mountains. From this point, all potential impacts to special-status species and mitigation measures that address these impacts are identical to those listed for Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c begins at the proposed Willow 500 kV Substation, and is parallel to existing transmission lines at a distance of one-quarter to one-half mile until reaching the San Pedro River. The subroute then turns northward along the western side of the San Pedro River Valley before turning west to the Tortolita Substation, then north and west to the Pinal Central Substation. The total length of this subroute is 161.2 miles. Potentially significant issues

discussed in this section include impacts to migratory birds in the Sulphur Springs and San Pedro River valleys, and potential impacts to special-status species along much of the subroute.

Link C110 crosses approximately 5 miles of farmland in the Sulphur Springs Valley, north of Willcox. Large numbers of Sandhill Cranes that travel daily from roosting areas near Willcox Playa to forage in this farmland would be at risk of collision. Link C110 is parallel to existing 345 kV lines, in a relatively narrow corridor to reduce land use impacts. Minimizing distance between adjacent transmission lines can increase overall visibility of the lines to birds, reducing the collision risk. Along Link C110, four transmission lines would be present within a corridor less than 1,000 feet wide. Tubular steel pole or self-supporting lattice structures would be used in place of guyed-V structures (SE 7), which would eliminate the collision risk posed by guywires. Additional mitigation to increase groundwire visibility would be employed if necessary (SE 15).

Potential impacts to Lesser Long-nosed Bats could occur along the majority of Subroute 4C2c. These impacts may include disturbance of roosts and removal of food plants (agaves and saguaro cacti) used by the bats, and may be minimized with standard mitigation measures and SE 1, 3, 5, 8, and 12. Potential effects to the Jaguar or Ocelot could occur during construction or maintenance within potential riparian or montane movement corridors. The potential for either of these species occurring is considered very low, and mitigation for potential disturbance of these species would not occur unless evidence indicates an individual may be present.

A small, introduced population of Pronghorn is present on Allen Flat west of Willcox (Link C260). Similar to the population present in the Sulphur Springs Valley (Subroute 4B), construction activities and vegetation maintenance could result in temporary disturbance to the species. However, removal of shrubs during vegetation management would improve habitat suitability. Timing construction to avoid sensitive periods such as the fawning season would reduce impacts to the species (SE 12).

Suitable nesting habitat for the Southwestern Willow Flycatcher is not currently present within the designated critical habitat at the San Pedro River crossing. Future recovery of nesting habitat could occur if changes in upstream water use allow the river base flow to increase to a level that supports riparian habitat. Any developing riparian woodland under those circumstances could be affected by vegetation management needs over the lifetime of the Project. However, the narrow floodplain is bordered by higher terrain, and spanning of the floodplain would minimize the needs for vegetation management. The effect of existing water use in the San Pedro River is also discussed in Section 4.17, Cumulative Effects. Impacts to wildlife and existing or future riparian habitat at the San Pedro River crossing would be mitigated through measures SE 1, 2, 3, 4, 8, 12, and 14.

Impacts to the Cactus Ferruginous Pygmy-owl include loss of potential nest sites (primarily saguaros) and fragmentation of home range, foraging, and dispersal habitats. Impacts to nesting habitat are reduced by standard mitigation measures that address avoidance or salvage of saguaro cacti. Effects of habitat loss and fragmentation would be reduced to a level not likely to be significant by SE 1, 3, 5, 8, and 12.

Potential direct impacts to Sonoran Desert Tortoises are primarily mortality from construction traffic and ground-disturbing activities. Habitat loss and vegetation impacts are also important,

and are mitigated by applying SE 3, 4, 5, and 6. Restricting construction to periods when Desert Tortoises are typically underground (November 1 through March 1) would reduce the risk of Desert Tortoises entering the work area (SE 12). The creation of new access roads may allow increased recreational access, resulting in potential indirect impacts to the species. Preventing public access to new roads may be feasible in some locations (SE 4), but potentially significant impacts could occur where road closure is not possible.

Potential impacts to the Tucson Shovel-nosed Snake could occur northeast of Red Rock (Link C820) and west of the Picacho Mountains (Link C850). Effects may include temporary and permanent habitat loss and potential mortality during the construction phase resulting from traffic and ground-disturbing activities. As the species is very difficult to detect or avoid, application of SE 3, 4, and 6 would reduce but not eliminate these effects, and potentially significant impacts could occur.

Table 4-18 provides estimates of the miles of potential suitable habitat for special-status species that would be crossed by Subroute 4C2c. Estimates for all alternatives are provided in Appendix B3.

Table 4-18. Estimated Miles of Special-status Species Habitat Crossed by Subroute 4C2C

Link	Miles	Lesser Long-nosed Bat	Yuma Clapper Rail	Cactus Ferruginous Pygmy-owl	Sprague's Pipit	Sonoran Desert Tortoise	Tucson Shovel-nosed Snake
C110	18.8	6.8			5.0		
C201	13.7	13.7		6.7		13.7	
C212	3.9	3.9					
C260	10.9	10.9					
C261	6.4	6.4				4.4	
C441	15.3	15.3		15.3		15.3	
C450	17.0	17.0		17.0		17.0	
C661	3.1	3.1		3.1		3.1	
C670	3.3	3.3		3.3		3.3	
C680	26.1	26.1		26.1		26.1	
C71	4.7	4.7					
C71a	1.0	1.0					
C818	3.0	3.0		3.0		3.0	
C820	15.9	15.9		15.9		2.0	
C830	4.3	4.3		4.3			
C840	2.0	2.0		2.0		2.0	
C850	6.9	6.0	0.9	5.0		2.0	5.0
C880	2.3		2.3				
C880a	2.6		2.6				

Subroute 4C1– San Pedro Valley

Subroute 4C1 is initially identical to Subroute 4C2c from the proposed Midpoint Substation across the Sulphur Springs Valley, but travels along the eastern side of the San Pedro River

Valley and follows an existing pipeline north of the Tortolita Mountains. The total length of the subroute is 139.0 miles. Potentially significant issues associated with this subroute include many of the same special-status species that would be affected by Subroute 4C2c, bird collision risk in the Sulphur Springs Valley, and riparian impacts at the San Pedro River crossing.

Potential impacts to special-status species that occur along this subroute would be generally similar to those associated with Subroute 4C2c, and would be reduced with the same mitigation measures. This subroute crosses Hot Springs and Redfield canyons (links C331 and C361), but would be located downstream of permanent water and designated critical habitat for Gila Chub, Spikedace, and Loach Minnow. Both of these canyons would be spanned, and steep terrain at each crossing would allow structures to be sited at a height above the streambed that would preclude the need for any riparian vegetation management. In the northern portion of the San Pedro River Valley, Subroute 4C1 would require the creation of a greater amount of new access roads relative to Subroute 4C2c, potentially resulting in a higher impact to Sonoran Desert Tortoises.

Link C660 would affect mesquite bosque and a small area of existing riparian woodland within designated critical habitat for the Southwestern Willow Flycatcher at the San Pedro River crossing. No transmission lines are present at this crossing, although the proposed San Manuel Interconnect would be located adjacent to this crossing location once completed. Although no suitable nesting habitat for the Southwestern Willow Flycatcher currently exists at this crossing location, a reach with permanent flow and suitable habitat is located a short distance upstream. Riparian woodland could recover at the proposed crossing location with an increase in the river's base flow, and future vegetation management needs for the Project could affect that recovery. Impacts to riparian habitat at the San Pedro River crossing would be mitigated through measures SE 1, 2, 3, 4, 8, 12, and 14.

After crossing the San Pedro River and the northern foothills of the Santa Catalina Mountains, Subroute 4C1 follows an existing gas pipeline through habitat for the Sonoran Desert Tortoise and Cactus Ferruginous Pygmy-owl. Subroute 4C1 is identical to Subroute 4C2c from Link C830 to the Pinal Central Substation.

Subroute 4C2 – San Pedro Valley

Subroute 4C2 is largely identical to Subroute 4C2c, but differs in the links used to cross the San Pedro River. Subroute 4C2 is 151.8 miles in length. This subroute would cross an ephemeral reach of the San Pedro River at Link C276, within designated critical habitat for the Southwestern Willow Flycatcher. Dense mesquite bosque with small numbers of willows and tamarisk trees may be affected by vegetation management. Impacts to riparian vegetation would be high-moderate to high; however, SE 1, 2, 3, 4, 8, and 12 would result in residual impacts of moderate.

Subroute 4C2a is largely identical to Subroute 4C2c, but crosses the San Pedro River using the same links as Subroute 4C2. After leaving the San Pedro River Valley, Subroute 4C2a follows the existing gas pipeline also followed by Subroute 4C1. The total length of this subroute is 137.8 miles.

Subroute 4C2b is largely identical to Subroute 4C2c, using the same links to cross the San Pedro River but following the existing gas pipeline similar to subroutes 4C1 and 4C2a. Subroute 4C2b is 147.2 miles in length.

Subroute 4C3 – Tucson

Subroute 4C3 is initially identical to Subroute 4C2c, from the proposed Midpoint Substation to the crossing location of the San Pedro River. Subroute 4C3 then continues parallel to existing transmission lines with Link F40a, crosses Cienega Creek with Link F600, passes through Tucson to the Tortolita Substation, then becomes identical to Subroute 4C2c to the Pinal Central Substation. The total length of the subroute is 172.9 miles. Potentially significant impacts that could occur along this subroute include those shared with identical segments of Subroute 4C2c, and impacts to special-status species in Cienega Creek and locations near Tucson.

After crossing the San Pedro River and the links used by Subroute 4C2c, Subroute 4C3 continues through additional foraging habitat for Lesser Long-nosed Bats and potential habitat for Sonoran Desert Tortoises. Link F600 would cross an ephemeral reach of Cienega Creek near an existing gas pipeline and several road crossings, but upstream from permanent reaches within the Cienega Creek Natural Preserve. This section of the creek is within designated critical habitat for the Gila Chub, and the Northern Mexican Garter Snake, Gila Topminnow, Huachuca water-umbel, Yellow-billed Cuckoo, and Southwestern Willow Flycatcher may occur downstream in suitable habitat. Standard mitigation measures and SE 1, 2, 3, and 8 would minimize the potential for any effects related to erosion and sedimentation.

No large trees or suitable nesting habitat for Southwestern Willow Flycatchers are present at this crossing, although existing young cottonwood trees may be affected by future vegetation management needs. However, the entire creek at this location can be spanned using existing access, and terrain at the crossing may allow vegetation greater than 12 feet in height to remain through the lifetime of the Project. Any vegetation management required would be conducted outside the nesting season for Southwestern Willow Flycatchers and Yellow-billed Cuckoos (SE 12). Flow regimes and riparian habitat may also change at this location, and future increases in flow or any recovering riparian vegetation could be affected by maintenance activities. Under current conditions, no significant effects to special-status species or vegetation are expected to occur at this crossing.

Pima pineapple cactus may be present on portions of this subroute from near Cienega Creek to the southeastern outskirts of Tucson. Surveys for the species would occur in suitable habitat along this subroute, and SE 1, 5, and 8 would allow potential impacts to be minimized or avoided.

Link F112 would create a potential collision risk for waterfowl and other birds wintering at Sweetwater Wetlands, immediately adjacent to the Project. Collision risk is often highest near staging and roosting areas, where birds frequently take off and land. Bird diverters and other available measures to increase groundwire visibility (SE 15) would reduce the collision risk at this location.

Portions of the subroute may affect suitable habitat for the Tucson Shovel-nosed Snake near Marana and the Tortolita Substation. Mitigation measures for this species are listed under Subroute 4C2c. From the Tortolita Substation, the remainder of this subroute is identical to Subroute 4C2c.

Local Alternative Links for Route Group 4 (Pinal Central Substation)

Known or potentially occurring special-status species along local alternatives for the planned Pinal Central Substation include the Lesser Long-nosed Bat, Yuma Clapper Rail, Cactus Ferruginous Pygmy-owl, Sonoran Desert Tortoise, and Tucson Shovel-nosed Snake. Potential impacts and appropriate mitigation measures for these species are the same as listed for Subroutes 4A and 4B.

Local Alternative Links for Subroute 4C2 (Winchester Substation)

This local alternative, composed of links C260, C261, and C201, follows existing 345 kV transmission lines past the Winchester Substation, then turns to the north after crossing the San Pedro River. Habitat for three special-status species (Lesser Long-nosed Bat, Jaguar, and Ocelot) is potentially present along these links. Potential impacts and appropriate mitigation measures for these species are identical to those listed for Subroute 4C2. Although critical habitat is proposed for the Southwestern Willow Flycatcher at the crossing of the San Pedro River, no riparian woodland suitable for nesting is present.

Local Alternative Links for Subroute 4C2 (Tortolita Substation)

Special-status species potentially occurring on this local alternative include Lesser Long-nosed Bat, Cactus Ferruginous Pygmy-owl, Sonoran Desert Tortoise, and Tucson Shovel-nosed Snake. Potential impacts and appropriate mitigation measures for these species are identical to those listed for Subroute 4C2.

Local Alternative Links for Subroute 4C3 (Cienega Creek)

Special-status species that are known or may occur along this local alternative include Lesser Long-nosed Bat, Yellow-billed Cuckoo, Cactus Ferruginous Pygmy-owl, Southwestern Willow Flycatcher, and Sonoran Desert Tortoise. Potential impacts and mitigation measures for this local alternative are identical to those listed in subroute 4C2c and for the affected species. Similar to crossing locations on the San Pedro River, no suitable nesting habitat for Southwestern Willow Flycatcher is present at this time. Development of suitable habitat in the future may be impaired by vegetation management needs over the lifetime of the proposed Project.

Additionally, the Northern Mexican Garter Snake, Gila Chub, Gila Topminnow, and Huachuca water-umbel are present within the Cienega Creek Natural Preserve, which would be crossed by Link F51. Potential impacts to these species would be associated with sedimentation of waters (directly affecting the Gila Topminnow and Gila Chub, indirectly affecting the Mexican Garter Snake) or effects of streambed erosion (all species). Mitigation measures that address potential

impacts to streams and erosion (SE 1, 2, 3, and 8) would effectively reduce potential effects to these species.

Local Alternative Links for Subroute 4C3 (Pantano Wash to Rillito River)

Special-status species that are known or may occur along this local alternative include Lesser Long-nosed Bat, Cactus Ferruginous Pygmy-owl, Sonoran Desert Tortoise, and Pima pineapple cactus. Potential impacts and mitigation measures for this local alternative are identical to those listed in subroute 4C2c and for the affected species.

4.6.5.5 Summary of BLM Preferred Alternative

Based on results of the preceding analysis, the following potentially significant impacts to biological resources may occur with construction and operation of the BLM preferred alternative:

- Transmission lines may interfere with Sandhill Crane and waterfowl migration routes and lead to increased bird-powerline collision risk at the Rio Grande crossing and the Sulphur Springs Valley. (Subroute 1A2, 4C2c)
- Impacts may occur to Southwestern Willow Flycatcher designated critical habitat at the Rio Grande crossing, and future impacts may occur to proposed critical habitat at the San Pedro River Crossing. (Subroute 1A2, 4C2c)
- Impacts may occur to the Yellow-billed Cuckoo, Rio Grande Silvery Minnow, and designated critical habitat for the Rio Grande Silvery Minnow at the Rio Grande crossing as a result of vegetation management or erosion. (Subroute 1A2)
- Disturbance associated with construction and maintenance could impact a movement corridor for the Desert Bighorn Sheep west of the Rio Grande in Socorro County. (Subroute 1A2)
- Habitat for the Northern Aplomado Falcon may be affected west of the Rio Grande in New Mexico. (Subroute 1A2, 3A2)
- The Chihuahua scurfpea may be impacted by ground disturbance in western New Mexico and the San Simon Valley, Arizona. (Subroute 1A2, 3A2)
- A small population of Pronghorn is present on Allen Flat, and may be impacted by construction or maintenance activities. (Subroute 4C2c)
- Road construction and habitat loss may impact the Sonoran Desert Tortoise from the San Pedro River Valley to the vicinity of the Tortolita Substation, and near the Picacho Mountains. (Subroute 4C2c)
- Habitat for the Tucson Shovel-nosed Snake may be impacted near the Tortolita Substation and Picacho Mountains. (Subroute 4C2c)

4.7 WILDLAND FIRE ECOLOGY AND MANAGEMENT

4.7.1 Introduction

This section discusses the potential for the proposed Project to increase fire risk regionally, to affect fire management planning, and to constrain fire suppression operations in the vicinity of the Project.

4.7.2 Impact Assessment Methods

Most impacts that could result from the proposed Project on wildland fire ecology and management cannot be quantified or feasibly compared between alternatives. Fires may be ignited naturally, accidentally, or intentionally at any location with burnable vegetation. Incidents involving operation of the proposed Project, such as vehicle and aircraft collisions or failure of any structural components, cannot be predicted. The extent and effects of any fires that do occur would vary with the conditions at that time, as well as the specific resources that would be affected. Impacts to fire planning can be discussed at a broader scale, but any effects on desired fire management, such as the use of prescribed fire, also cannot be predicted for specific areas.

4.7.3 Impact Analysis Results

Section 4.7.3.1 discusses ways in which construction and operation of the proposed Project may directly present an increased risk of fires occurring, and indirect ways in which it may contribute to further alteration of local fire regimes. Section 4.7.3.2 discusses the effects that could result from a fire, should one occur as a result of the proposed Project. Section 4.7.3.3 presents potential effects of the proposed Project on fire management planning, and Section 4.7.3.4 discusses the effects of the presence of a transmission line on firefighting techniques, in the event of a fire in the Project vicinity.

4.7.3.1 Effects on Fire Risk

Although fire is a natural component of many healthy ecosystems, unplanned fires may threaten life, property, resources, and infrastructure, and the effects of such a fire would often be negative. The highly altered conditions now widespread across the Southwest require that the reintroduction of fire be cautious, conducted under safe conditions, and may be preceded by mechanical fuels reduction. The proposed Project could raise the risk of an unplanned ignition through several potential direct and indirect mechanisms as presented in the following discussion. However, the risk cannot be quantified, and varies with the fire threat presented by current weather and fuel conditions rather than being site-specific or associated with a particular alternative.

Construction activities that increase the fire risk are numerous, but that risk can be minimized with proper safety precautions. Blading and other earthwork can create sparks from contact between metal and rock. Welding generates large amounts of sparks and pieces of hot metal that can easily ignite fires. Small engines such as those used on chainsaws can generate sparks, and

vehicles driven or parked with the undercarriage in contact with dry vegetation may also start fires. Overland drive-and-crush is proposed as a selective mitigation measure to minimize ground disturbance, but this measure would increase the fire risk where fine fuels may be ignited by vehicles and so not be used under those conditions. Blasting may be required in some locations, and can pose a fire risk. In recognition of all of these risks, a detailed Fire Protection Plan has been developed as Appendix A4 of the POD.

In summary, the Fire Protection Plan requires the designation of a Fire Marshal by the construction contractor, who would be responsible for ensuring compliance with all mitigation measures for fire safety, as well as coordination and communication with agencies and emergency responders. All engines would be required to have an approved spark arrestor. Refueling, smoking, blasting, welding, and any other activities with a high inherent risk of fire ignition would only be conducted on cleared ground. Welding and similar activities would also require the use of a spotter. The spotter would be equipped with water and tools to quickly extinguish any sparks, and would remain for 30 minutes after such activities cease to ensure that no smoldering vegetation remains. In addition, all contractors would receive training in basic fire suppression to attempt to prevent the spread of any accidental ignitions beyond the work area. If this could not be conducted safely, contractors would contact the appropriate agency and immediately evacuate the work area. Open fires would not be permitted, and proper signage would be employed to indicate where and when activities that pose a fire hazard may take place.

Operation of 500 kV transmission lines generally presents a very low risk of fire ignition, as the scale of the structures minimizes the risk of vegetation contact. However, unforeseen events do have the potential to occur. Transmission structures may fail or be accidentally damaged as a result of human activity such as vehicle or aircraft collisions, or from severe weather, geologic hazards, and other natural events. Vandalism, such as shooting conductors or insulators, is uncommon but is impossible to predict or prevent. However, 500 kV conductors and structures are of sufficient size to be somewhat resistant to physical damage. Physical inspection of the Project would be the responsibility of local operators, but would be conducted as necessary and to industry standards.

Vegetation can contact conductors and ignite fires if the conductor clearance zone is not properly maintained. Vegetation maintenance is described in the POD, including the standards necessary for safe conductor clearance. Maintenance activities, including vehicle and small engine use, safety measures, and agency coordination, would be subject to the Fire Protection Plan similar to construction activities. Vegetation management for the purposes of fire safety inherently affects biological resources, as discussed in Section 4.6.

Although lightning may strike transmission structures, overhead groundwires are designed to capture the current and direct it to a safe ground location. Barring equipment malfunction or failure, lightning would not present an increased fire risk when striking transmission structures. By capturing and safely grounding lightning strikes that may otherwise strike flammable vegetation, groundwires may result in a small, local decrease in fire risk from lightning.

Indirect effects of the proposed Project relate to vehicle traffic and invasive plants. Increased recreational access, such as may occur along access roads, has the potential to result in unplanned ignitions. The increase in human traffic created with new roads also provides an

avenue for introduction of invasive plants. Disturbed areas have a higher risk than undisturbed areas of supporting invasive plants, many of which may be more fire-adapted than native plants and can alter the natural fire regime. Once established in a disturbed area, some plants may be able to successfully expand into surrounding undisturbed habitat, particularly when aided by fires.

4.7.3.2 Effects if the Proposed Project Contributes to Fire Ignition

The effects of an unplanned fire can range from generally beneficial to extremely dangerous, costly, and environmentally damaging. The degree of effects depends on current fuel and weather conditions, whether there is an extensive WUI, and the resources that may be affected.

Beneficial effects of fires primarily occur when fires burn under conditions similar to a typical "natural" fire. Healthy fires in forests remove ground fuels and do not kill the majority of mature trees, although occasional patches of high-intensity burns are expected. The fuel reduction from low-intensity fires reduces the risk that a large-scale, high-intensity fire could occur in the future. Grassland, savanna, and mesquite scrub fires may burn at a high intensity and remove nearly all above-ground vegetation. These vegetation communities are composed of fire-adapted plants that can recover rapidly, either through the existing seed bank or by resprouting from living roots. Regular burning is important to the maintenance of healthy grasslands.

Negative effects of fire, in addition to threats to human safety and property, can affect many other resources. Fires may directly damage cultural resources. Fire, particularly at high intensities, can threaten wildlife. However, mortality of burrowing animals is generally low, and birds or large mammals may be able to avoid direct effects of the fire. Post-fire habitat change may affect individual species either negatively or positively. High levels of erosion can occur after a fire, even in successive years if sufficiently heavy rains do not occur earlier. Erosion can result in loss of topsoil, further loss of cultural resources, degradation of water quality, and the loss of aquatic habitats as sediments fill pools and cover rocky substrates in streams (DeBano et al. 2005). The interaction between fire and non-native plants may result in conversion of native plant communities to non-native-dominated areas. Air quality can be affected over long distances (Sandberg et al. 2002).

No alternatives would cross through montane conifer forest, where some of the most severe fires have occurred in recent years. Chupadera Mesa, with an open-canopy juniper woodland-savanna of moderate height on relatively level terrain, is the most extensive woodland area that would be crossed by any subroute. Every subroute within Route Group 1 would cross some portion of Chupadera Mesa, although the juniper woodland extent and density varies among the subroutes. However, under extreme fire conditions, a fire ignited near certain parts of the proposed Project could rapidly reach nearby montane areas. The 2012 Fox and Grapevine fires in Arizona, discussed in Section 4.7.3.2, are examples of fires that burned at lower elevations in vegetation communities similar to the Project area, but extended into higher elevations.

Fire suppression can result in negative environmental effects. Ground disturbance from the creation of fuel breaks can increase the erosion risk. Fire retardant contains compounds that act as fertilizers, and may support the establishment of invasive plants or alter aquatic ecosystems. Additionally, while retardants can be critical to fire suppression, they pose a threat to cultural

resources; the salts used in these compounds can alter rock art and petroglyph panels. The principle of "minimum impact suppression techniques" may be employed in areas identified as likely to contain sensitive resources, as mitigation for the potential impacts of fire suppression. This may include reductions in the amount of vegetation management and disturbed ground, and the use of adequate buffers between aquatic sites and retardant drops or staging areas. Postfire reclamation may reduce erosion and other impacts of a fire, but can also result in the introduction of non-native plants.

4.7.3.3 Effects on Fire Management Planning in New Mexico And Arizona

The BLM's Resource Management Plan Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a), the Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b), and district or field office RMPs do not specify fire management within utility corridors. However, the presence of utilities may be a constraint to the use of fire as a management tool.

Prescribed burning could occur near transmission lines under suitable conditions, but additional precautions may be necessary to reduce risk to personnel and prevent damage to structures. Intensive fuel reduction or higher-than-normal constraints on weather conditions are measures that could lower the risk of a high-intensity fire burning through a transmission corridor, and permit burning to occur in some cases. Typically, steep terrain or heavy vegetation would preclude prescribed burns, or require a full-suppression response for unplanned fires. These factors would be assessed in site-specific detail in a Prescribed Fire Plan, and would be coordinated with the Proponent and operators of the Project.

4.7.3.4 Effects of the Proposed Project on Fire Suppression

This section discusses the positive and negative effects that the presence of a transmission line can have on fire suppression, as well as the effects of damage to the Project itself from wildland fires. Transmission lines can pose a hazard to firefighting operations through several mechanisms. As human safety is of the ultimate concern in firefighting operations, these risks must be avoided. The risks would be present to some degree with any fire. However, prescribed burns would be planned and conducted under suitable conditions, taking such risks into account. The greatest threat would occur during an unplanned fire in heavy fuels during adverse weather conditions, although vegetation types with such fuels are uncommon along most proposed subroutes.

Transmission lines and other utilities represent major investments in infrastructure, with substantial economic effects incurred to customers and operators if they are damaged. As such, fire personnel and equipment may be diverted from other suppression-related activities for their protection when feasible. In some remote areas, the proposed Project would be the only infrastructure and the only obstacle to letting a fire burn safely to natural or engineered containment boundaries.

Wildland fire suppression ground operations typically use a wide range of vehicles such as light-duty and heavy-duty pickups, fire engines (Type 3, Type 6), tactical and support-type water tenders, bulldozers, and other support vehicles. These vehicles may be suitable for operation on

four-wheel drive roads, but may need certain roads prepared or upgraded by bulldozers to allow adequate access to planned fuel breaks. However, emergency fire road construction by bulldozers is rarely employed on BLM-administered lands within the study area. If a fire were to ignite near the proposed Project but expand into a montane area, emergency road construction could be part of the suppression strategy.

Transmission line rights-of-way and access roads may benefit fire crews directly, and indirectly reduce the impacts of fires and fire suppression on sensitive resources. Emergency fire roads or bulldozed fuel breaks can result in high impacts to some resources, as there is rarely time for proper engineering or surveys to determine where the lowest impact may occur. As discussed below, fire crews cannot safely work in the immediate vicinity of energized transmission lines during a fire, but transmission line access roads may be used to reduce the amount of new, unplanned roads required. Crews may also be able to use the existing utility access road and managed vegetation within the right-of-way as an initial point to expand a fuel break, and then work from a safe distance as the fire approaches. These opportunities may benefit resources that would otherwise be affected by road construction in the absence of proper engineering, and may assist in timely containment of fires that may damage resources.

Transmission lines can be hazardous to fire crews for several reasons. If a sufficient safe zone is not maintained around conductors, falling trees may damage or break the conductors and create an electrocution hazard. Broken conductors pose a direct electrocution hazard in their immediate vicinity, but can also deliver dangerous currents long distances when in contact with conductive objects such as fencing. Smoke contains particles that can carry an electric charge, and dense smoke may allow arcing from the conductor directly to the ground. Adding water to a fire further increases this risk, as the steam generated enhances the air's conductivity. Water streams themselves could conduct electricity if directed near transmission lines. To reduce the hazard posed by energized transmission lines, the Project could be de-energized when conditions would support flashovers through heavy smoke or if other concerns necessitate fire suppression within the conductor zone. This would typically be requested at the discretion of each fire's Incident Commander.

If the Project is not de-energized for a given fire, buffers would be required around structures and conductors for the safety of fire personnel. Buffers around energized transmission lines vary with the structure size and voltage, but would not be less than 100 feet from the outside conductor. This distance may be greater depending on fire behavior and fuel conditions. The outer conductors of the proposed Project would be near the edge of the 400-foot-wide right-of-way. With an additional 100 feet of buffer on each side, this would create a continuous zone nearly 600 feet wide where fire suppression could not safely occur. This area may be wider where other transmission lines are paralleled. As a fire burns through this area, it may increase in intensity or spread beyond containment lines that could otherwise be defended. Vegetation treatments could occur prior to a fire reaching the conductor zone, partially reducing fire intensity.

Air crews, particularly helicopters with water buckets, could be at risk of collision with structures or conductors. Transmission structures may also alter desired flight paths for aerial drops of water or fire retardant, the greatest effect occurring when structures are placed on high points such as ridgelines that could otherwise serve as fuel breaks. Aircraft would also need to avoid dropping water or retardant directly on or near energized transmission lines, for the safety

of ground crews and the proposed Project. Drops could safely occur on or near de-energized lines, although retardant can contaminate insulators, which would require cleaning before re-energizing the line.

Transmission lines and other utilities represent major investments in infrastructure, with substantial economic effects incurred to customers and operators if they are damaged. As such, fire personnel may be diverted from other suppression objectives for their protection when feasible and necessary. In some remote areas, the proposed Project would be the only infrastructure and the only obstacle to letting a fire burn safely to natural or engineered containment boundaries.

4.8 CULTURAL RESOURCES

4.8.1 Introduction

Potential impacts on cultural resources and tribal concerns that would result from the construction and operation of the proposed Project are described in this section.

The anticipated impacts to cultural resources would result from a loss of integrity for prehistoric and historic sites. Four types of impacts that could adversely affect historic properties (cultural resources that have been determined eligible for listing on the NRHP) during and after construction of the proposed Project include:

- Direct and permanent ground disturbance
- Direct and permanent visual and auditory intrusions
- Indirect and temporary visual intrusions
- Indirect and permanent disturbances due to changes in public accessibility and visual intrusions

If the BLM approves the proposed action and issues a right-of-way permit, intensive pedestrian inventories (Class III) within the APE of the Project, including associated access roads, substations, and ancillary facilities, would be conducted prior to construction and in accordance with the PA. All cultural resources identified during the inventory would be evaluated for eligibility to the NRHP, based on the criteria set forth in federal regulation 36 CFR 60.4, which states the following:

> *The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:*
>
> *a) that are associated with events that have made a significant contribution to the broad patterns of our history*
> *b) that are associated with the lives of persons significant in our past*
> *c) that embody the distinctive characteristics of type, period, or method of construction, or that represent the work of a master, or that possess high artistic values or that represent a significant and distinguishable entity whose components may lack individual distinction*

d) that have yielded, or may be likely to yield, information important to prehistory or history

4.8.1.1 Tribal Concerns

Tribal concerns regarding this Project are being compiled and will continue to be documented as the Project becomes more defined. Information on tribal concerns was obtained during several consultation meetings that were held in 2009, 2010, 2011, and 2012. Areas of concern identified by consulted tribes include Mount Graham; Bosque del Apache; Rio Grande; Mesilla Valley; Klondyke and Duncan, Arizona; Deming, New Mexico; Salinas Pueblo Missions National Monument, including Gran Quivira; and the San Simon, Sulphur Springs and San Pedro valleys. An additional concern was raised by the GRIC regarding the Project's possible interference with spiritual communication paths between cultural sites.

Tribes have requested more detailed maps and/or ethnographic studies. Consultation with appropriate land management agencies, tribal governments, Tribal Historic Preservation Offices, and SHPOs is ongoing and will result in a PA that will establish project-specific procedures for complying with the NHPA, including those to follow during the execution of the Project.

The following section describes the impact assessment methodology developed for this Project.

4.8.2 Impact Assessment Methodology

An impact assessment methodology was developed to identify and evaluate the potential impacts to cultural and historic resources associated with the proposed Project. The methodology takes into consideration previous inventories conducted in the area, the sensitivity of cultural resources, and anticipated Project disturbances. The baseline data for the previously conducted inventories and sensitivity of resources were provided in Chapter 3. The results of the cultural resource impact assessment are shown on Figure M 8-1 (see Map Volume). Impacts associated with ancillary facilities, including but not limited to substations, generation stations, and access roads, are assumed to be identified and taken into account within the study corridor analyzed for the transmission lines. The APE would be identified based on site-specific construction plans, including all Project facilities. Cultural resource site locations and necessary mitigation would be determined after Class III surveys are completed in conjunction with the Final POD prior to construction.

The potential cultural and historical resource impacts within the study corridors were calculated by factoring in site density, size and location of the Project area, and site sensitivity. The resulting impact matrix is a projection of impacts based on known site densities of inventoried areas, sensitivities of known sites, and anticipated number of sites.

Site Density

A critical factor in evaluating potential impacts to cultural and historical resources is the amount of previous inventory data available for the Project alternatives. These inventories provide information on the resources identified, and on the resource density in those areas.

Approximately 8 percent of the Project study corridors has been previously inventoried for cultural and historical resources, with some alternatives having more inventoried segments (up to 28 percent) than others.

In order to compare each of the alternatives, the site density for each was calculated based on the number of recorded sites within previously inventoried areas as identified from the Class I data (see Table 3-36), which are assumed to represent the median site density that would be expected along the alternatives. Because there are significant gaps in the Class I data, a judgmental Class II inventory was conducted in areas with potential for high site density, the results of which are summarized in Chapter 3 and documented in a separate report. Areas that were inventoried in the Class II inventory were located adjacent to major rivers and historic trails. The site density for the Class II areas within each of the subroutes was higher than the site density for the Class I areas (see tables 3-37 and 3-42).

In order to anticipate the potential for additional sites in areas not yet inventoried, a combination of the site densities for both the Class I and Class II areas was compiled. Calculations were completed for each of the alternatives, because the site densities and numbers of acres per each alternative are different. This calculation is provided below.

Class I site density by alternative x (total project acres in each alternative – Class II acres for each alternative)
+ (Class II site density for each alternative x Class II acres for each alternative)
= Anticipated number of sites for each alternative

Along with site density, the Project area is an important component in the calculation for the anticipated number of sites. The APE for the Project involves the right-of-way corridor where the transmission lines would be placed, as well as access roads, substations, and other ancillary facilities. At the time of this EIS, specific locations of access roads and ancillary facilities needed for the Project have yet to be defined, although an access model has been developed to address potential ground disturbance, based on slopes, vegetation, and presence of existing access roads. Areas of the proposed alignment that do not have existing access roads and for which there is a steep slope would necessitate more ground disturbance for construction purposes. Conversely, potential ground disturbance would be minimal for areas of the proposed alignment that are relatively flat and where there are existing access roads.

In the absence of specific locations of potential access roads, the analysis of impacts to cultural resources was based generically on the amount of ground disturbance, and on the amount and sensitivity of the existing resources within each subroute.

The typical transmission right-of-way width is 400 feet, but could be up to 1,000 feet in areas where engineering or terrain constraints require a greater than 200-foot line separation. For the purposes of this calculation, the Project area involves a 600-foot-wide study corridor, to accommodate right-of-way width increases due to construction challenges, ancillary facilities, and future access roads. Table 4-19 provides estimates of the number of cultural sites that might be present within the 600-foot corridor for each subroute.

Table 4-19. Anticipated Number of Sites per Subroute Based on Existing Site Density						
Subroute	Area of 600' Corridor (acres)	Percent Previously Surveyed	Site Density in Previously Surveyed Area (sites per 100 acres)	Anticipated Sites in Unsurveyed Areas	No. of Sites in Class II Survey Area	Total Anticipated Sites[1]
1A1	16,634	7.3	0.74	114	4	127
1A2	16,743	8.3	0.72	110	4	124
1A	15,964	6.2	0.80	121	4	133
1B1	16,258	6.6	0.84	127	6	142
1B2	15,214	7.0	1.04	143	6	160
1B3	14,996	7.1	0.84	118	6	133
3A2	9,019	2.8	2.72	243	5	255
3A	8,984	3.9	2.00	172	13	192
3B	9,356	3.1	3.79	344	6	361
4A	9,661	6.2	4.34	393	1	220
4B	9,663	2.5	5.35	507	1	521
4C1	10,106	6.0	3.95	376	3	403
4C2	11,018	11.8	1.84	179	2	205
4C2c	11,727	12.5	1.57	161	5	188
4C3	12,582	29.1	2.73	244	5	349

[1] Anticipated number of sites is rounded to the nearest whole number and includes sites identified during Class I and Class II surveys.

Site Sensitivity

Each of the known sites located within the Class I study corridor was ranked according to sensitivity, on a scale from 1 (low) to 5 (high) (see Table 3-38). The sensitivity ranking was based on several items important in assessing the potential value of the site, including the site's eligibility for listing on the NRHP, type, and presence of specific features (nonmovable items that represent past human activities). In addition, the relative percentage of sites for each category was noted.

The site density calculations discussed above allow for the projection of anticipated sites for each subroute alternative. Although the potential number of future sites is easily calculated, the potential sensitivity is more difficult to assess. Therefore, it is assumed that future sites would share the same percentage of sensitivity currently assigned to the known sites within each of the subroutes. Subroute 1A currently has 18 percent of the sites (n=13) ranked as low sensitivity. When the projected site numbers are applied to Subroute 1A, a total of 24 (18 percent of 133 anticipated sites) would be expected to be ranked with low sensitivity. The results of the anticipated sensitivity analysis, and associated impact level, are presented in Section 4.8.3, Table 4-17.

Impact Levels

The goal of the impact analysis is to evaluate the known and anticipated resources in order to compare the alternative routes. Based on existing Class I data, site densities were developed and the anticipated number of sites for each subroute was calculated. Using site sensitivity levels, Class I sites were ranked accordingly, based on the categories defined below.

- *High Impact Level* – Locations where the sites are already listed on the NRHP, or where special-status sites would be physically affected by construction. These types of sites may be difficult to avoid and most likely would require data recovery studies, which may or may not eliminate high impacts. Mitigation measures or avoidance are often necessary for these areas.
- *High-Moderate Impact Level* – Locations where sites have been determined eligible or would be recommended eligible for listing on the NRHP, and would be physically affected by construction. Data recovery studies would most likely be required for these types of sites, and would involve a great number of features. The discovery of human remains would be possible.
- *Moderate Impact Level* – Locations where sites have not been evaluated for NRHP eligibility, but would likely be recommended eligible for listing and physically affected by construction. Testing studies may be required for these sites to evaluate whether they would be eligible for listing on the NRHP, or to determine the nature and extent of buried deposits in eligible sites.
- *Moderate-Low Impact Level* – Locations where sites have not been evaluated for NRHP eligibility, but would not likely be eligible for listing on the NRHP, and would be physically affected by construction. Testing may be required for these sites in order to evaluate site eligibility.
- *Low Impact Level* – Locations where sites are not eligible for listing on the NRHP, and would be physically affected by construction. No further studies would be required for these types of sites.

For the purposes of this analysis, a significant impact on cultural resources could result if any of the following were to occur from construction or operation of the proposed action:

- Disturbance of a human burial during construction of the transmission line
- Discovery of a buried Paleoindian site during construction
- Indirect or direct impacts to cultural sites (e.g., physical impacts from construction activities, visual impacts from tower construction, potential cumulative impacts from new access road construction, etc.)
- Indirect or direct impacts stemming from the vibrations of construction activities (e.g., use of heavy machinery or blasting and drilling for foundation installation)
- Indirect or direct impacts to locations that are spiritually significant to tribes
- Restricted access to areas where tribes conduct ceremonies or collect plants
- Destruction of existing significant historic structures or features during the construction of the Project
- Vandalism or looting of historic properties during construction or operation due to illegal use of the right-of-way or access roads

Evaluation of Visual Impacts to Historic Properties

Visual resource specialists assessed project contrast using secondary data to define the landscape character (i.e., existing setting). Secondary data sources include topographic maps, aerial photographs, existing land use data, and vegetation databases. Landscape character is a term that

describes existing features in the landscape that cumulatively express a discrete setting, and typically comprises vegetation community type, topography, presence or absence of water, and the presence and type of modifications (e.g., roads, transmission lines, pipelines, development, etc.) that occupy a given area of land. Generally, visual effects to landscapes or settings that have modifications that are similar to the proposed Project in form, line, color, and texture would be considered minimal. For historic properties associated with visual sensitivity, modifications that are contributing factors to the integrity or eligibility will be identified by the cultural resource specialist so that the visual resource specialist can accurately characterize the existing setting and non-contributing modifications. Characterization of the existing setting is a key component in determining the level of project contrast or visual change.

Contrast is defined as the degree of perceived change that occurs in the landscape due to the construction and operation of a proposed facility. Project contrast typically results from (1) landform modifications that are necessary to prepare a right-of-way for construction, (2) the removal of vegetation to construct and maintain a facility, and (3) the introduction of new above-ground elements into the landscape.

Impacts to setting and feeling of historic properties associated with visual sensitivity include the assessment of potential visual effects and level of visual contrast. As part of the baseline data for the visual resource study, contrast ratings were recorded for all Project alternatives. The definitions for the contrast ratings and evaluation of the potential visual impacts to cultural resources are as follows:

- *Weak Contrast* – If the proposed Project would be seen, but is subordinate in the landscape, a weak level of contrast is anticipated between the undertaking and the setting. Based on the level of weak contrast, the evaluation of visual effect to the integrity of the historic property would be negligible. Given the negligible impact of the Project, it is unlikely that a historic property would be adversely affected by the Project.
- *Weak-Moderate Contrast* – If the proposed Project begins to attract attention and is moderately subordinate in the landscape, a weak-moderate level of contrast is anticipated between the undertaking and the setting. Based on the level of weak-moderate contrast, the evaluation of visual effect to the integrity of the historic property could be somewhat diminished. Although unlikely to be substantially altered, the historic property may be adversely affected by the Project.
- *Moderate Contrast* – If the proposed Project attracts attention and is co-dominant in the landscape, a moderate level of contrast is anticipated between the undertaking and the setting. Based on the level of moderate contrast, the evaluation of visual effect to the integrity of the historic property may adversely affect the property.
- *Moderate-Strong Contrast* – If the proposed Project begins to demand attention and is still moderately dominant in the landscape, a moderate-strong level of contrast is anticipated between the undertaking and the setting. Based on the level of moderate-strong contrast, the evaluation of visual effect to the integrity of the historic property may adversely affect the property.
- *Strong Contrast* – If the proposed Project demands attention and strongly dominates the landscape, a strong level of contrast is anticipated between the undertaking and the

setting. Based on the level of strong contrast, the evaluation of visual effect to the integrity of the historic property may adversely affect the property.

Based on the results of the determination of visual effects, mitigation measures may be recommended to reduce project (visual) contrast. Both standard and selective mitigation measures relating to visual resources can be found in tables 2-10 and 2-11.

4.8.3 Impact Analysis Results

Table 4-20 provides a summary of anticipated impact levels for each of the Project alternatives within the Project right-of-way. The table is followed by an evaluation of the anticipated impacts to cultural resources for each subroute, based on the anticipated total number of sites, and the proportion anticipated to experience moderate, moderate-high, or high impacts from the Project.

Table 4-20. Summary of Anticipated Sites and Impact Levels for Alternative Subroutes

Subroute/ Sites	No. of Low	Percent in Subroute	No. of Low-Moderate	Percent in Subroute	No. of Moderate	Percent in Subroute	No. of Moderate-High	Percent in Subroute	No. of High	Percent in Subroute
1A1	25	20	25	20	43	34	31	24	3	2
1A2	8	6	67	54	22	18	22	18	5	4
1A	24	18	31	23	44	33	33	25	1	1
1B1	24	17	34	24	55	39	27	19	2	1
1B2	26	18	44	31	58	40	16	11	—	—
1B3	33	25	41	31	44	33	15	11	—	—
3A2	28	11	99	39	77	30	43	17	8	3
3A	17	9	40	21	112	58	23	12	—	—
3B	65	18	130	36	148	41	18	5	—	—
4A	26	12	22	10	132	60	33	15	7	3
4B	78	15	68	13	323	62	52	10	—	—
4C1	93	23	56	14	202	50	40	10	12	2
4C2	18	9	37	18	127	62	20	10	3	1
4C2c	21	11	36	19	102	54	26	14	3	2
4C3	24	7	87	25	210	60	14	4	14	4

4.8.3.1 No Action Alternative

There would be no impacts to cultural resources attributed to the construction and operation of the Project with the No Action alternative.

4.8.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the proposed SunZia East Substation, heading west across Chupadera Mesa to the Rio Grande crossing at Socorro, then heads south through the Rio Grande Valley to

the proposed Midpoint Substation. The total length of the subroute is 228.8 miles. Based on the results of the Class I study, important known cultural resources for this subroute include four trail segments and two habitation sites. Although Gran Quivira is located outside of the Class I study area, it was included in this study because there could be potential visual effects to the cultural landscape.

One NHT (El Camino Real de Tierra Adentro Trail) and three historic trails (Butterfield, Gila, and General Cooke's Wagon Road/Mormon Battalion) cross Subroute 1A1. Subroute 1A1 crosses the El Camino Real de Tierra Adentro Trail at the Rio Grande (Link E180), where field investigations were conducted. No intact segments of the trail such as wagon road tracks or ruts were identified. The area is previously disturbed by Bosquecito Road, a partially paved and bladed gravel road that occupies the former El Camino Real Trail corridor on the east side of the Rio Grande. On the western side of the Rio Grande, the trail is believed to be under Highway 85. Despite this, the modern road alignments are considered part of the El Camino Real de Tierra Adentro Trail NHT, and retain their historic integrity regarding association, location, setting, and feeling. Standard mitigation, and SE 8 and SE 10 would likely avoid direct impacts to the Butterfield trail; however, visual impacts to the trail will occur.

Speculative segments of the El Camino Real de Tierra Adentro Trail may exist parallel to Link E133, but further field investigations would be required to verify the presence or absence of trail segments in these locations along Link A440. Class II field study has identified segments of the Butterfield Trail along Link A440 that would be visually impacted.

Subroute 1A1 also crosses the Butterfield, Gila, and General Cooke's Wagon Road/Mormon Battalion trail alignments near Deming (Link A440). Class II field studies near Deming (Link A440) identified potential segments of the Butterfield Trail alignment; however, segments of the Gila and General Cooke's Wagon Road/Mormon Battalion alignments were not included in the study. In this area, the Project would parallel an existing 345 kV transmission line, and it is anticipated that the Project will cumulatively add to visual impacts stemming from the existing transmission structures, resulting in a moderate visual impact to the Butterfield Trail at Link A440. Although the construction and operation of the Project could have a direct impact resulting from ground disturbing activities on these Butterfield Trail segments, SE 8 (avoidance of cultural sites through tower placement) and SE 10 (tower placement at maximum distance to reduce visual impacts) would likely be effective in avoiding potential direct impacts. Further evaluation of direct impacts to the Gila and General Cooke's Wagon Road/Mormon Battalion trails would require field studies to verify the presence or absence of trail segments in these locations along Link A440.

Construction of the Project associated with Subroute 1A1 could also physically impact habitation sites LA45163 and LA50766, located along links 330a and 330b. Site LA45163 contains a roomblock and an associated artifact scatter. Site LA50766 contains pithouse structures, roomblocks, and an associated artifact scatter. Both of these sites have moderate-high sensitivity. An existing 345 kV transmission line is adjacent to links 330a and 330b, and it is anticipated that the Project would cumulatively add to the existing visual impacts. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Standard mitigation and SE 8 could be used to lessen impacts to

these sites. Mitigation measures for habitation sites (LA45163 and LA50766) would likely be effective in avoiding significant impacts either through avoidance or data recovery efforts.

Based on site density calculations, 127 sites are estimated, 60 percent of which could have moderate to high sensitivity. Moderate to high sensitivity sites would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery efforts.

Cultural-Visual Assessment Associated with the Gran Quivira

Integrity is the ability of a property to convey its significance. To retain historic integrity, a property must possess some of the seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. Of particular relevance regarding the cultural-visual assessment is the aspect of setting, which is the physical environment of a historic property. Setting may refer to the character of the site in addition to the physical elements of a site, including spatial organization, land use, vegetation, topography, circulation, and small-scale features. Setting also includes the character of the contextual lands that surround a historic property. Views and vistas of the land that surround Gran Quivira are an important component of its cultural landscape; therefore, the cultural-visual assessment was used to evaluate the potential impacts to the setting and feeling of the Gran Quivira.

The Cultural Landscapes Inventory: Gran Quivira – Salinas Pueblo Missions National Monument (NPS 2010) states that 360 degree panoramic views at Gran Quivira are contributing components to the landscape. Prehistorically, views focused on the Gallinas Mountains to the east, with Chupadera Mesa to the west and Mesa de Los Jumanos to the north. Historically, the views would have included the village of Gran Quivira, dirt roads, homesteads, agricultural fields, and grazing lands in the valleys below. During the different periods of use, the views would have changed, but the points of observation remain centered around the ruins on the ridgetop. Representative views from the ridgetop of Gran Quivira were evaluated and studied as part of the cultural-visual assessment. Potential impacts to the cultural landscape setting of Gran Quivira that could result from the construction and operation of the Project were evaluated.

For Subroute 1A1, the alignment around Gran Quivira to the north consists of links E82, E84, and E85 (links E80d and E81 were also evaluated; see below). The methodology for the study can be found in Section 4.8.2. Link E84 is located approximately 4 miles north of Gran Quivira. Existing modern features such as wind turbines, ranches, and NM Highway 55 are considered noncontributing components to the views and vistas of the cultural landscape (*ibid*).

Based on the results of the visual contrast study, a weak contrast rating would result from the construction and operation of the proposed Project when viewed from Gran Quivira. Some transmission line structures would be visible at this distance due to the partial skyline condition. Although the impacts to the views from Gran Quivira are anticipated to be low, selective mitigation measures such as special tower design and placement could minimize the visual impacts.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 varies slightly from 1A1 by using Link E86, north of Subroute 1A1. The total length of the subroute is 230.3 miles. Based on site density calculations, 124 sites are estimated. Subroute 1A2 is predicted to contain mostly sites with low to moderate sensitivity, although 40 percent of the anticipated sites could have moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery efforts.

Subroute 1A – North River Crossing

Subroute 1A is similar to Subroute 1A2, except that 1A is south of Gran Quivira and includes Link E80c. In addition, Subroute 1A uses Link A270 instead Link A260. No known sites were identified on Link A270.

Additional resources identified within 5 miles of Subroute 1A that have the potential to be visually impacted include the Camino Real de Tierra Adentro NHT, the Gila Trail Route, the General Cooke's Wagon Road/Mormon Battalion Trail, and the Butterfield Trail. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 133 sites are estimated. Sixty percent of the anticipated sites within Subroute 1A are predicted to have moderate to high sensitivity, thus requiring mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE8, which would likely be effective through avoidance or data recovery efforts.

Cultural-Visual Assessment Associated with the Gran Quivira

Link E80c is located approximately 6 miles south of Gran Quivira. For this segment, a weak contrast rating would result from the construction and operation of the proposed Project. Based on the distance of the Project and viewing conditions toward the Project where mountains provide a backdrop, visual impacts to Gran Quivira are anticipated to be low. Mitigation measures could further minimize these visual impacts.

Subroutes 1B1 – San Antonio Crossing

Subroute 1B1 varies from Subroute 1A1 as it crosses the Rio Grande at the San Antonio crossing, rather than the Socorro crossing. No cultural resources were identified for this subroute other than those previously addressed in Subroute 1A1.

Additional resources identified within 5 miles of Subroute 1B1 that have the potential to be visually impacted include the Camino Real de Tierra Adentro NHT, the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, the Butterfield Trail, and the Playas Pueblos Archaeological District. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 142 sites are estimated to be identified. Sixty percent of the anticipated sites within Subroute 1B1 are predicted to have moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation measures and SE 8, which would likely be effective through avoidance or data recovery efforts.

Subroutes 1B2 – San Antonio Crossing

Subroute 1B2 varies from Subroute 1A1 in that it crosses the Rio Grande at the San Antonio crossing, rather than at the Socorro crossing. The cultural resources associated with Subroute 1B2 are similar to Subroute 1A1, except that the Playas Pueblo Archaeological District is less than 1 mile from Subroute 1B2. There would be no direct impact to the archaeological district, although there is a potential for visual or other indirect impacts. Further studies would be needed to evaluate the potential visual impact on the archaeological district.

Additional resources identified within 5 miles of Subroute 1B2 that have the potential to be visually impacted include the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, and Playas Pueblos Archaeological District. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 144 sites are estimated to be identified. Fifty-one percent of the anticipated sites within Subroute 1B2 are predicted to have moderate to high sensitivity, and would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation measures and SE 8, which would likely be effective through avoidance or data recovery efforts.

Subroute 1B3 – San Antonio Crossing

Subroute 1B3 varies from Subroute 1A1 as it crosses the Rio Grande at the San Antonio crossing rather than at the Socorro crossing. Subroute 1B3 also crosses the Mockingbird Gap Archaeological District; field investigations would be needed to identify cultural resources that could be impacted from the construction and operation of the Project within the district. In addition to the potential direct impacts to crossing the Mockingbird Gap Archaeological District, the proximity of the Project to the district may contribute to visual or other indirect impacts. If cultural resources are identified during the field investigations, mitigation measures such as SE 8 and SE10 could be used, and would likely be effective in avoiding significant impacts to the archaeological district.

Additional resources identified within 5 miles of Subroute 1B3 that have the potential to be visually impacted include the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, Janos Copper Road route, and Playas Pueblos Archaeological District. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, a total of 133 sites are estimated, 44 percent of which are predicted to have moderate to high sensitivity, and would require mitigation if impacted by

Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8.

Local Alternatives Associated with Gran Quivira

Construction of the Project for local alternatives E81 and E83 could impact habitation sites LA9021 and LA2579. Site LA9021 contains a roomblock, kiva, plaza, and an associated artifact scatter. Site LA2579 contains pithouse structures, historic homestead, and an associated artifact scatter. Both of these sites have moderate-high sensitivity. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Standard mitigation measures and SE 8 could be used to mitigate impacts to these sites. Mitigation measures for habitation sites (LA45163 and LA50766) would likely be effective in avoiding significant impacts to these features either through avoidance or data recovery.

Local Alternative Link E81 is approximately 1.5 miles south of Gran Quivira, and Local Alternative Link E83 is located approximately 2 miles north of the Gran Quivira. Based on the visual contrast study, a weak-moderate contrast would result from the construction and operation of the proposed Project along either of these links. For Local Alternative Link E81, the Project would cross flat to slightly rolling terrain and would be backdropped by adjacent terrain. For Local Alternative Link E83, the Project would cross flat to slightly rolling terrain and would also be backdropped by adjacent terrain, but also partially skylined. NM 55 and the modern facilities of Gran Quivira constitute the only contemporary intrusions into the existing environmental conditions.

Other Local Alternatives for Route Group 1

Local alternatives for Route Group 1 (subroutes 1A, 1B1, 1B2, and 1B3) include links A161b and A361-A430-A481, and could impact known prehistoric sites and historic trail alignments.

Construction and operation of the transmission line and associated access roads located in Local Alternative Link A161b could impact one known site, LA 27569, a prehistoric artifact scatter with features. Field investigations are necessary to evaluate whether the Project would impact site LA 27569. SE 8 could mitigate the potential impact to site LA 27569 through avoidance; however, if avoidance is not possible, testing or data recovery would be used to minimize the impacts to this cultural resource.

In the Las Cruces area (Link A430), field investigations for the Butterfield Overland Mail and Stage Route identified segments of a trail alignment west of Las Cruces with associated artifacts dating to the twentieth century. Link A430 does not parallel any existing transmission lines in this location. Standard mitigation and SE 8 and SE 10 would likely avoid direct impacts to the Butterfield Trail; however, visual impacts to the trail would occur.

Local alternative links A361-A430-A481 also extend across the Gila and General Cooke's Wagon Road/Mormon Battalion Trail alignments. Field investigations were conducted along Local Alternative Link A430 for the presence of the Butterfield Trail. Segments were identified in these areas for the Butterfield Trail, but the Gila and General Cooke's Wagon Road/Mormon Battalion trails were not included in this study. Standard mitigation and SE 8 and SE 10 would

likely avoid direct impacts to the Butterfield Trail; however, visual impacts to the trail would occur.

Evaluation of direct impacts to the Gila and General Cooke's Wagon Road/Mormon Battalion (along Local Alternative Link A430) would require field investigations to verify the presence or absence of trail segments in these locations.

Crossover Links for Route Group 1

Crossover Link A70 for subroutes 1B2 and 1B3 connects with Link A50 from Subroute 1B2, and Link A80 from Subroute 1B3. Crossover Link A70 could impact the Mockingbird Gap Historic Archaeological District and known site LA 67452, a historic house foundation and associated trash scatter. Field investigations would be needed to identify whether the construction and operation of the Project would result in impacts to cultural resources within the archaeological district and site LA 67452. In addition to the potential direct impacts to crossing the district, its proximity may also contribute to visual or other indirect impacts. If cultural resource sites are identified during the field investigations, standard mitigation measures and SE 8 and SE 10 would likely be used to minimize or avoid impacts to cultural resources.

4.8.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 begins at the Midpoint Substation and proceeds west through the Deming area along links B60 and B90. From there it continues west along links B120a and B120b approaching the Lordsburg area, and then onto links B121, B160a, B160d, and B160c. The total length of the subroute is 123.9 miles. Based on the results of the Class I study, important known cultural resources for this subroute include four trail segments and three habitation sites.

Four historic trails (Butterfield, Gila, Janos Copper, and General Cooke's Wagon Road/Mormon Battalion) are crossed by Subroute 3A2. Subroute 3A2 crosses the Butterfield Trail east of Lordsburg along Link B120b where field investigations were conducted. Rock cairns associated with the trail were identified, but no physical segments of the trail were observed. Standard mitigation and SE 8 and SE 10 would likely avoid direct impacts to the Butterfield Trail at this location; however, visual impacts to the trail would occur.

Along Link B120b, the Project would parallel an existing 345 kV transmission line. Visual impacts to the Butterfield Trail corridor along Link B120b are anticipated to be low due to the presence of existing transmission structures. Although the construction and operation of the Project could have a direct impact on potential features associated with the Butterfield Trail resulting from ground disturbing activities, mitigation measures SE 8 and SE 10 would likely be effective in avoiding potential significant impacts. Further evaluation of direct impacts to the Gila trail would require field studies to verify the presence or absence of these trail segments at B120b.

Subroute 3A2 crosses the Gila Trail east of Lordsburg along Link B120b. Subroute 3A2 also crosses the Janos Copper Trail and General Cooke's Wagon Road/Mormon Battalion Trail along Link B120a, west of Deming. Further evaluation of direct and indirect impacts to the Gila, Jano Copper, and General Cooke's Wagon Road/Mormon Battalion Trail would require field studies to verify the presence or absence of trail segments in these locations.

Construction of the Project associated with Subroute 3A2 could also impact prehistoric habitation sites LA49 and LA98750 located along links B90 and B120b. Site LA49 is the type site for the Black Mountain Phase and consists of a large-scale multicomponent habitation site containing pit houses and buried adobe architecture. The site has been subject to extensive vandalism; however, intact segments still remain. Site LA98750 is also a habitation site and contains a roomblock and associated artifact assemblage. Both sites have a moderate to high sensitivity. Site LA49 has a high sensitivity because of its importance for the understanding of the Mimbres Mogollon and because human remains are present.

An existing 345 kV transmission line is adjacent to Link B120b. Extents of the LA98750 site boundary are currently unknown, but would be identified through a Class III inventory prior to the construction of the Project. Recent studies have identified the boundaries of LA49 (Putsavage and Lekson 2010). Standard mitigation and SE 8 could be used to mitigate impacts to these sites. Mitigation measures for habitation sites LA49 and LA98750 would likely be effective in avoiding significant impacts to these sites either through avoidance or data recovery efforts.

Additional resources identified within 5 miles of Subroute 3A2 that have the potential to be visually impacted consist of the Zuñiga route. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on the site density calculations, 255 sites are estimated. Fifty percent of the anticipated sites could have a moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8.

Subroute 3A – North

Subroute 3A is the same as Subroute 3A2 from the Midpoint Substation to Link B160a, near Lordsburg, where Subroute 3A diverges from Subroute 3A2 by continuing to head in a westerly direction to the Willow Substation along links B160a, B160b, and B170. Known sites of low to moderate sensitivity are present along these links, plus one moderate-high sensitivity site, AZ CC:7:3(ASM), which is a prehistoric habitation site containing pithouses and associated artifact scatter.

Construction of the Project associated with Subroute 3A could impact site AZ CC:7:3(ASM). Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Standard mitigation and SE 8 could be used to mitigate impacts to this site, either through avoidance or data recovery efforts.

Additional resources identified within 5 miles of Subroute 3A that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion

Trail, Butterfield Trail, Zuñiga route, Janos Copper Road route, and the ghost town of Shakespeare. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 192 sites are estimated. Seventy percent of the anticipated sites could have a moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery efforts.

Subroute 3B – South

Subroute 3B is the same as Subroute 3A2 from the Willow Substation to Link 150A, but differs from Subroute 3A2 from Lordsburg to the Midpoint Substation along links B80, B110a, B110b, and B112. Subroute 3B crosses the Gila, General Cooke's Wagon Road/Mormon Battalion, and Janos Copper Road trails at links B110a and B112. Sites of low to moderate sensitivity are present along these links.

Construction of the Project associated with Subroute 3B could impact the Gila, General Cooke's Wagon Road/Mormon Battalion, and Janos Copper Road trails along links B110a and B120b. An existing 345 kV transmission line is adjacent to Link B110a, and an existing pipeline is adjacent to Link B112. Further evaluation of direct and indirect impacts would require field studies to verify the presence or absence of trail segments in these locations.

Additional resources identified within 5 miles of Subroute 3B that have the potential to be visually impacted include the Zuñiga route and the ghost town of Shakespeare. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 361 sites are estimated. Forty-six percent of the anticipated sites could have a moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate the potential impacts to these sites include standard mitigation and SE 8.

Crossover Links

Crossover Link B111 for subroutes 3A, 3A2, and 3B connects with Link B120b from Subroute 3A and Link B110a from 3B. Crossover Link B111 could impact two historic trails (Butterfield and Gila). Field investigations conducted for the Butterfield Trail along Link B111 did not identify any physical segments of the trail (segments of the Gila Trail alignments were not included in the study); however, historic artifacts were recorded. No existing utilities were noted in the area. Although the construction and operation of the Project could have a direct impact resulting from ground disturbance activities on the historic artifacts, mitigation measures SE 8 and SE 10 would likely be effective in avoiding potential significant impacts. Further evaluation of direct and indirect impacts to the Gila Trail would require field studies to verify the presence or absence of trail segments in this location along Link B111.

Crossover Link B140 for subroutes 3A, 3A2, and 3B connects with Link B121 from Subroute 3A and Link B112 from Subroute 3B. Crossover Link B140 could impact the Butterfield Trail. Field investigations conducted for the Butterfield Trail did not identify any physical segments; however, rock cairns were observed at this location. No existing utilities were noted in the area. Although the construction and operation of the Project could have a direct impact on the rock cairns resulting from ground disturbance activities, mitigation measures SE 8 and SE 10 would likely be effective in avoiding potential significant impacts; however, visual impacts to the trail would occur.

4.8.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A differs substantially from Subroute 4C2c, sharing only the last few links from Link C830 to the Pinal Central Substation. The cultural resources associated with Subroute 4A are similar to Subroute 4C2c, except that construction and operation of the Project associated with links B153a and B153b of Subroute 4A could impact five prehistoric habitation sites and is within 1.5 miles from the Oak Draw and Marijilda archaeological districts. Known sites of low to moderate sensitivity are present along Subroute 4A.

Prehistoric habitation sites that could be impacted by the construction and operation of the Project associated with Subroute 4A include AZ CC:1:43(ASM), AZ CC:1:58(ASM), AZ CC:1:59(ASM), AZ CC:1:62(ASM), and AZ CC:6:6(ASM). Site AZ CC:1:43(ASM) consists of several one-room structures surrounding a kiva, with a possible low platform mound and associated artifact scatter. Sites AZ CC:1:58(ASM) and AZ CC:1:59(ASM) both contain one-room structures with irrigation canals and associated artifact scatters. Site AZ CC:1:62(ASM) consists of a check dam, irrigation canal, and human remains identified in a midden area. Site AZ CC:6:6(ASM) consists of a habitation area with features and associated artifacts with a long period of reoccurring use from Middle/Late Archaic to Late Prehistoric. These sites were given a moderate-high sensitivity, with the exception of site AZ CC:1:62(ASM), which has a high sensitivity based on the human remains noted at the site. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Standard mitigation and SE 8 could be used to mitigate impacts to these sites.

Although there would be no direct impacts to the Oak Draw and Marijilda Canyon archaeological districts, there is a potential for visual impacts. An existing 230 kV transmission line and US Highway 191 parallel the Project along Link B153a, near the Oak Draw Archaeological District; however, along Link B153a near Marijilda Canyon Archaeological District, these modern features are not present. Further studies would be needed to evaluate the potential visual impacts to these districts.

The San Carlos and other Apache tribes have voiced strong concerns regarding potential impacts to Mount Graham, which is considered a culturally sensitive place. The alternative corridor for Subroute 4A surrounds the Pinaleño Mountains to the east and north, including Mount Graham. A portion of the transmission line of Subroute 4A (links B153a and B153b) would be located in

the background distance zone (approximately 6 miles) viewed from Mount Graham. If visible, the project elements of form, line, color, and texture would be subordinate in the landscape.

Additional resources identified within 5 miles of Subroute 4A that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Zuñiga route, Juan Bautista de Anza route, Verdugo Homestead Historic District, and Camp Grant, including the Camp Grant Reservation/Camp Grant Massacre site. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 220 sites are estimated to be identified. Seventy-eight percent of the anticipated sites could have moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery efforts.

Subroute 4B – Sulphur Springs Valley

Subroute 4B differs substantially from Subroute 4C2c, sharing only the last miles from Link C830 to the Pinal Central Substation. Known sites of low to moderate sensitivity are present along these links; however, no known sites of moderate to high sensitivity were identified for this subroute other than those addressed in Subroute 4C2c.

The San Carlos and other Apache tribes have voiced strong concerns regarding potential impacts to Mount Graham. The alternative corridor for Subroute 4B is located west of the Pinaleño Mountains, approximately 10 miles west of Mount Graham. A portion of the transmission line of Subroute 4B (links C71, C72, C90, C130a, and C130b) would be located in the background distance zone (10 miles or more) viewed from Mount Graham. If visible, the project elements of form, line, color, and texture would be subordinate in the landscape.

Additional resources identified within 5 miles of Subroute 4B that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Zuñiga route, Juan Bautista de Anza route, Verdugo Homestead Historic District, Fort Grant, and Camp Grant, including the Camp Grant Reservation/Camp Grant Massacre site. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 521 sites are estimated. Seventy-two percent of the anticipated sites could have a moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery.

Subroute 4C1 – East of San Pedro Valley

Subroute 4C1 differs substantially from Subroute 4C2c, sharing only the beginning and ending segments. Subroute 4C1 shares the same alignment from the Willow Substation to Willcox (Link

212) and then diverges until Link C830, where it shares the same alignment into the Pinal Central Substation. Subroute 4C1 crosses the San Pedro River near San Manuel along Link C660. Known sites of low to moderate sensitivity are present along Subroute 4C1, as are five prehistoric habitation sites of moderate to high sensitivity.

Construction of the Project associated with Subroute 4C1 could physically impact prehistoric habitation sites AZ BB:6:2(ASM), AZ BB:6:113(ASM), AZ BB:6:114(ASM), and AZ BB:6:115(ASM) located along Link C660. Site AZ BB:6:2(ASM) is a large cobble adobe pueblo with human remains. Site AZ BB:6:113(ASM) contains a possible pit structure with a cobble cluster and an artifact midden. Site AZ BB:6:114(ASM) consists of a vandalized, one-room structure and associated artifact scatter. A probable protohistoric Sobaipuri pot break was also noted within this site. Site AZ BB:6:115(ASM) was vandalized and includes two cobble-lined pit houses, a roasting pit, and an artifact midden. These sites are moderate-high sensitivity, with the exception of sites AZ BB:6:2(ASM) and AZ BB:6:114(ASM), which have high sensitivities given the presence of human remains and the rare protohistoric artifacts. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Standard mitigation and SE 8 could be used to mitigate impacts to these sites.

Additional resources identified within 5 miles of Subroute 4C1 that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 403 sites are estimated. Sixty-three percent of the anticipated sites could have moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery efforts.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 shares most of the same alignment as Subroute 4C2c, diverging only from the 4C2c subroute at Willcox to cross the San Pedro River near Cascabel and reconnecting at Link 441 as it continues along the west side of the San Pedro River. A known site of moderate sensitivity is present along Subroute 4C2, and one prehistoric habitation site of moderate to high sensitivity is located along Link C276.

Construction of the Project associated with Subroute 4C2 could physically impact prehistoric habitation site AZ BB:11:105(ASM), which contains a possible pit house, water control feature, rock pile, rock ring, and an associated prehistoric and historic artifact scatter. Extents of the site boundary are currently unknown, but would be identified during the Class III field study prior to construction of the Project. Standard mitigation and SE 8 would likely be effective in avoiding significant impacts to these sites through avoidance or data recovery.

Additional resources identified within 5 miles of Subroute 4C2 that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 205 sites are estimated to be identified. Seventy-three percent of the anticipated sites could have a moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery.

4C2c – BLM Preferred Alternative

Subroute 4C2c begins at the proposed Willow Substation, heading southwesterly toward Willcox, crossing the San Pedro River near Cascabel, proceeding north along the San Pedro River toward Oracle, then west along Link C680 toward the Tortolita Substation. At the Tortolita Substation, Subroute 4C2c heads north along Link C820, and at the northern end of the Picacho Mountains heads west into the Pinal Central Substation. The total length of Subroute 4C2c is 161.2 miles. Based on the results of the Class I study, important known cultural resources for this subroute include three historic trails (Butterfield Trail, Southern Pacific Mail Line, and Zuñiga Trail) and two habitation sites. In addition, the McClellan Archaeological District is located within 0.25 mile of Subroute 4C2c along Link C820.

Subroute 4C2c crosses the Southern Pacific Mail Trail along Link C850 and the Butterfield and Zuñiga trails along Link C880a. In these areas, the Project would parallel a proposed 500 kV transmission line. In addition, Link C880a has been subject to farming, erasing any evidence of potential trails. Further evaluations of direct and indirect impacts would require field studies to verify the presence or absence of the trail segment along Link C850.

Construction and operation of the Project associated with Subroute 4C2c could also physically impact habitation sites AZ AA:8:331(ASM) and AZ AA:3:136(ASM), located along links C820 and C680. Site AZ AA:8:331(ASM) is a rock shelter, and site AZ AA:3:136(ASM) is a habitation site with possible adobe walls, trash mound, and an associated artifact scatter. Both of these sites have moderate-high sensitivities. Along Link C820, the Project would parallel a proposed 500 kV transmission line, and adjacent to Link C680 there is an existing 500 kV Transmission line. Extents of the site boundaries are currently unknown, but would be identified though a Class III inventory prior to construction of the Project. Standard mitigation and SE 8 could be used to mitigate impacts to these sites.

McClellan Wash Archaeological District is located along Link C820 of Subroute 4C2c. Although the construction and operation of the Project associated with Subroute 4C2c would not directly impact the archaeological district, there is a potential for visual or other indirect impacts. A proposed 500 kV transmission line parallels the Project in this location. Further studies would be needed to evaluate the potential visual impacts on the archaeological district.

Additional resources identified within 5 miles of Subroute 4C2c that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Juan Bautista de Anza route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District. Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations, 188 sites are estimated. Seventy percent of the anticipated sites could have moderate to high sensitivity, which would require mitigation if impacted by Project construction. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which could be effective in through avoidance or data recovery efforts.

Subroute 4C3 – Tucson

Subroute 4C3 is the same as Subroute 4C2c from the Willow Substation to Link C261 near Benson. At this point, Subroute 4C3 continues south around Tucson before heading north to the Tortolita Substation and then north toward the Pinal Central Substation. Based on the Class I data, the differences between Subroute 4C2c and 4C3 include additional crossings of 1 NHT (Juan Bautista de Anza) and 4 historic trails (Gila, Zuñiga, Butterfield, and General Cooke's Wagon Road/Mormon Battalion), 5 historic districts within 0.25 mile, 1 National Historical Landmark (Colossal Cave Mountain Park), and 8 additional habitation and burial sites. Known sites of low and moderate sensitivity are also present within Subroute 4C3.

Historic trails intersect Subroute 4C3 along links F111, F112, F510, and F600. North of Tucson along the Santa Cruz River, Link F510 crosses the Juan Bautista de Anza Trail, Butterfield Trail, Zuñiga Trail, and General Cooke's Wagon Road/Mormon Battalion. Along Link F111 southwest of Tucson, Subroute 4C3 crosses the Gila Trail. Subroute 4C3 also crosses the Butterfield and de Anza trails along links F112, west of Tucson. West of Benson along Link F600, Subroute 4C3 crosses the General Cooke's Wagon Road/Mormon Battalion, Butterfield Trail, and Gila Trail (twice). Field studies west of Benson (Link F600) did not identify any traces of the Butterfield Trail alignment; however, segments of the Gila, Zuñiga, de Anza, and General Cooke's Wagon Road/Mormon Battalion trails were not included in the study. Existing 138 kV and 115 kV transmission lines parallel portions of Link F112, while links F510, F111, and F112 are disturbed from the construction of Tucson. Further evaluation of direct impacts to the de Anza, Zuñiga, Gila, General Cooke's Wagon Road/Mormon Battalion, and Butterfield trails would require field studies to verify the presence or absence of trail segments in these locations along links F111, F112, F510, and F600.

A total of 30 current and proposed historic districts are within the city of Tucson. Five of the 30 historic districts are within 0.25 mile of Link F112, including El Presidio, Winterhaven, Menlo Park, Barrio Anita (proposed), and Rillito Race Track (proposed). An existing 138 kV transmission line parallels Link F112. There would be no direct impacts to the historic districts, although there is a potential for visual or other indirect impacts. Further studies would be needed to evaluate the potential visual impacts to the historic districts.

Colossal Cave Mountain Park is a national historic landmark and is within 0.25 mile of Subroute 4C3 along Link F40b. There would be no direct impact to the national historic landmark, though

there is a potential for visual and other indirect impacts. An existing 345 kV transmission line roughly parallels the Project in this location. Further studies would be needed to evaluate the potential visual impact on the national historic landmark.

Construction of the Project associated with Subroute 4C3 could also physically impact prehistoric habitation and burial sites, located along links F111, F112, F510, and F600; all of these sites have moderate to high sensitivities.

Site AZ AA:12:256(ASM) is a prehistoric habitation site that contains two pit houses, a hearth, a prehistoric artifact scatter, and a historic trash dump. Site AZ BB:13:6(ASM) includes a prehistoric pit house component, as well as the San Agustin Mission, historic kiln, and historic trash dump. AZ EE:2:44(ASM) contains pit structures, hearths, an artifact midden, and a historic trash scatter.

The sites with known human remains include habitation sites at which burials were encountered, as well as instances of sites eroding out of the ground. Site AZ AA:12:46(ASM) is a habitation site containing pit structures, associated artifacts, and burials. Site AZ AA:12:314(ASM) is also a habitation site with multiple pit structures, pit features, burials, and a midden. Site AZ AA:12:781(ASM) consists of an eroded burial washing out of the Santa Cruz River. Site AZ AA:13:17(ASM) is a large habitation site containing a ball court, trash mound, pit structures, pit features, canal, roasting pits, hearths, ramada shelter, and burials. Site AZ BB:13:90(ASM) is an eroded burial washing out of the Santa Cruz floodplain. These sites include human remains that were removed from unsecured locations and repatriated to the appropriate tribe (i.e., Tohono O'odham Nation), in accordance with state and federal laws.

Extents of the site boundaries for the habitation and burial sites are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Standard mitigation and SE 8 would likely be effective in avoiding significant impacts to these sites, either through avoidance or data recovery efforts.

Additional resources identified within 5 miles of Subroute 4C2c that have the potential to be visually impacted include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Saguaro National Park, and Tumamoc Hill Archaeological District/Desert Laboratory National Historic Landmark, Pascua Cultural Plaza, Binghampton Historic Rural Historic Landscape, and 24 historic districts (Verdugo Homestead, Rancho Linda Vista, Aldea Linda, Armory Park, Barrio Libre, Blenman-Elm, Catalina Vista, Colonia Solana, El Encanto Estates, El Montevideo, Indian House, Iron Horse Expansion, Jefferson Park, John Spring, Pie Allen, Rincon Heights, Sam Hughes, San Clemente, Santa Rosa, Speedway-Drachman, University of Arizona Campus, Warehouse, West University, and DeGrazia Gallery in the Sun). Cultural-visual sensitivity assessments will be conducted during the Class III inventory.

Based on site density calculations for Subroute 4C3, a total of 349 sites are estimated. Sixty-eight percent of the anticipated sites could have a moderate to high sensitivity, which would require mitigation if impacted by project construction. Measures that could be used to mitigate

potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery.

Local Alternatives

Construction of the Project associated with subroutes 4A, 4B, and 4C1 for Local Alternative Link C790 could impact known low and moderate sensitivity sites.

Local alternative links for the proposed Pinal Central Substation for subroutes 4A, 4B, 4C1, 4C2, and 4C3 include local alternative links C860, C870, and C890. Construction of the Project could impact known low and moderate sensitivity sites and the Southern Pacific Mail Line (links C850 and C860). A proposed 500 kV transmission line would parallel the Project along this link. Further evaluation of direct and indirect impacts to the Southern Pacific Mail Route would require field studies to verify the presence or absence of the route in these locations (links C850 and C860).

Construction of the Project associated with Local Alternative Link C692 of Subroute 4C1 could physically impact two known high sensitivity sites: a habitation site (AZ AA:8:21[ASM]) and a petroglyph site (AZ AA:8:370[ASM]). Site AZ AA:8:21(ASM) is a large habitation site that contains 15 to 20 trash mounts, a ball court, and 2 structures. Site AZ AA:8:370(ASM) is an anthromorphic petroglyph located south of site AZ AA:8:21(ASM). Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Examples of mitigation measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery; however, visual impacts to AZ AA:8:370(ASM) would occur.

Local Alternatives for Subroute 4C2

Local alternative links for 4C2 include variations around the Willow-500 kV and Tortolita substations. Construction of the Project associated with Subroute 4C2 for local alternative links C260-C261-C201 could impact known low and moderate sensitivity sites.

Construction of the Project with associated local alternatives for Subroute 4C2 could directly or indirectly impact known low and moderate sensitivity sites as well as one moderate-high sensitivity site. Site AZ AA:8:331(ASM) is a rockshelter located along Link C680. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery.

Local alternative links C680-C820 of Subroute 4C2 include known low and moderate sensitivity sites as well as two moderate-high sensitivity. Construction could impact sites AZ AA:8:331(ASM) and AZ AA:3:136(ASM). Site AZ AA:8:331(ASM) is a rockshelter, and site AZ AA:3:136(ASM) is a probable habitation site with possible adobe walls and a trash mound. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Measures that could be used to mitigate

potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery.

Local Alternatives for Subroute 4C3

Local alternative links for 4C3 include variations along Pantano Wash and Rillito Creek. Local alternative links F40b-F51-F60a, F81a-F81b, and C812 for Subroute 4C3 include three historic trails, three habitation sites, and two historic districts. Known low and moderate sensitivity sites are also present in the local alternative links.

Construction of the Project associated with Local Alternative Link F40b of Subroute 4C3 could visually impact the Butterfield Trail, but field studies near Benson did not identify any physical segment of the trail. An existing 345 kV transmission line parallels the Project in this area. Given that no trail segments were identified during field investigation, no impacts can be identified.

Construction of the Project associated with Local Alternative Link F81b could impact 3 historic trails (Butterfield, Zuñiga, and General Cooke's Wagon Road/Mormon Battalion), 3 habitation sites, and 2 historic districts (Fort Lowell Multiple Resource Area and Rillito Race Track). In this area, two existing 138 kV transmission lines and one existing 115 kV transmission line are perpendicular to Link F81b. Further evaluation of direct and indirect impacts to the Butterfield, Zuñiga, and General Cooke's Wagon Road/Mormon Battalion would require field studies to verify the presence or absence of trail segments in these locations along Link F81b.

Three known habitation sites (AZ AA:12:10[ASM], AZ AA:12:781[ASM], and AZ BB:9:14[ASM]) are located along Link F81b. Site AZ AA:12:10(ASM) is a prehistoric habitation site and historic homestead. The prehistoric habitation component includes pit structures, canals, artifact midden, and burials; the historic homestead is the 1893 adobe house of Basilio Cuevas with associated trash scatter. Site AZ AA:12:781(ASM) is a burial eroding out of the bank of the Santa Cruz River. Site AZ BB:9:14(ASM) is a multicomponent site. The prehistoric component includes a habitation with pit structures, pit features, trash mounds, a ball court, and cremations, and the historic component of the site is Fort Lowell. Extents of the site boundaries are currently unknown, but would be identified through a Class III inventory prior to construction of the Project. Measures that could be used to mitigate potential impacts to these sites include standard mitigation and SE 8, which would likely be effective through avoidance or data recovery.

Construction of the Project associated with Local Alternative link F81b could directly or indirectly impact the Fort Lowell Multiple Resources Area and Rillito Race Track historic districts. An existing 138 kV transmission line parallels the Project near the Fort Lowell Multiple Resources Area, but no known utilities are identified in the vicinity of the Rillito Race Track. Further evaluations of direct and indirect impacts to these historic districts would require field studies to verify the presence or absence of contributing components of the districts within the proposed tower locations. Standard mitigation and SE 8 and SE 10 would likely be effective in avoiding potential significant impacts.

Local Alternative Link C812 is compared to links C810-C816-C813-C814-C815 of Subroute 4C3. None of these links is associated with any known cultural resources.

Local Alternatives for Subroutes 4C1, 4C2, and 4C3

Local alternative links for subroutes 4C1, 4C2, and 4C3 include C72-C90-C121-C211. A known moderate sensitivity site is present in these alternative links.

Crossover Links

Crossover links for subroutes 4A, 4B, and 4C1 include links C500, C501, C502, and C174. None of these links would impact any known cultural resource sites. Link C671 is the crossover link for subroutes 4A, 4B, 4C1, and 4C2. This link may potentially impact one moderate sensitivity site.

4.8.4 Mitigation of Impacts

Direct impacts to significant resources can be effectively minimized, if not eliminated, through planning. Standard mitigation measures will be applied to all applicable phases of the Project, including engineering/design, construction, and operation. Application of the following standard mitigation measures would reduce impacts to cultural resources:

- ST 1 – Prior to construction, a detailed POD will be developed to further describe Project features, selective mitigation, and procedures. At a minimum, the POD will address project design, construction and operation considerations, biological considerations (including noxious weed management), archaeological consideration, paleontological considerations, hazardous material management, and reclamation considerations.
- ST 2 – All vehicle movement outside of the right-of-way will be restricted to predesignated access, contractor-acquired access, or public roads.
- ST 3 – The boundary of construction activities will be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents will be applied to rocks or vegetation to indicate survey or construction activity limits.
- ST 14 – Prior to construction, all supervisory construction personnel will be instructed on the protection of cultural and ecological resources. To assist in this effort, the construction CIC or a resource specialist will address: (a) federal and state laws regarding antiquities and plants and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
- ST 15 – Cultural resources will continue to be considered during post-EIS phases of Project implementation, in accordance with an executed agreement. This will involve intensive surveys to inventory and evaluate cultural resources within the selected corridor and any appurtenant impact zones beyond the corridor, such as access roads and construction equipment yards. This also requires completion and approval of a cultural inventory report, approval of an HPTP, and implementation of the HPTP to ensure proper data recovery and recordation prior to construction in the sensitivity areas identified in the HPTP. Monitoring of construction activities will be required to ensure that cultural sites that are to be avoided during construction remain undisturbed.

In addition, several selective mitigation measures would be used to minimize impacts to cultural resources, including the following:

- SE 1 – No widening or upgrading of existing access roads will be undertaken in the area of construction and operation, except for repairs necessary to make roads passable, where soils and vegetation area very sensitive to disturbance, or where existing archaeological sites are present.
- SE 2 – There will be no blading of new access roads in select areas of construction and operation. Existing crossings will be utilized at perennial streams, designated recreational trails, and irrigation channels. Off-road or cross-county access routes will be used for construction and maintenance in selected areas. This will minimize ground disturbance impacts. These access routes must be flagged with an easily seen marker, and the route must be approved in advance of use by the BLM Authorized Officer or landowner.
- SE 4 – All new access roads not required for maintenance would be permanently closed using the most effective and least environmentally damaging methods appropriate to that area (e.g., stock piling and replacing topsoil, or rock replacement), with concurrence of the landowner or appropriate land management agency. This would limit new or improved accessibility in the area.
- SE 6 – To minimize disturbance to sensitive habitats or resources, access roads required for operation and maintenance purposes will be gated or otherwise blocked from public access.
- SE 8 – In designated areas, structures would be placed so as to avoid and/or to allow conductors to span sensitive features such as riparian areas, water courses, roads, trails, bat roosts, and cultural sites within limits of standard tower design. This will minimize the amount of sensitive features disturbed and/or reduce visual contrast.
- SE 10 – At highway, canyon, and trail crossings, structures are to be placed at the maximum distance practicable from the crossing to reduce visual impacts.

Project costs and levels of effort necessary for mitigating the adverse effects to cultural resources are directly correlated with the degree of Project impact (i.e., low, moderate, or high). All mitigation measures will be in accordance with the HPTP for this Project.

Gran Quivira, located within Route Group 1, was evaluated for potential cultural and visual impacts from the proposed Project. Mitigation measures, including special tower design and placement, would minimize the visual impact of the BLM preferred alternative (Subroute 1A2).

Summary

Based on results of the preceding analysis, the following potential impacts to cultural resources were identified:

- Route Group 1
  - Route crosses El Camino Real, Butterfield, Gila, and General Cooke's Wagon Road/Mormon Battalion trails

- Field verification of the proposed crossing of the El Camino Real at the Socorro and San Antonio river crossings did not identify any intact segments, except for present-day alignments; however, these are considered part of the El Camino Real de Tierra Adentro NHT and will be visually impacted
- Field verification of the proposed crossings of the Butterfield Trail west of Las Cruces did identify potentially intact segments, although the setting has been modified by existing transmission and pipelines; visual impacts to the trail in these locations are anticipated to be low due to existing transmission structures
- Potential for direct physical impacts to two known habitation sites
- Potential direct physical as well as indirect and visual impacts to Mockingbird Gap Archaeological District
- Link E84 (BLM preferred alternative) and Link E80c (alternative Subroute 1A) would have a low visual impact to views from the Gran Quivira
- Local alternative links E81 and E83 would have a moderate visual impact to views from the Gran Quivira
- Potential for visual cultural impact: less than 1 mile from Playas Pueblo Archaeological District

- Route Group 3
  - Route crosses Gila, Butterfield, General Cooke's Wagon Road/Mormon Battalion, and Janos Copper trails
  - Field verification of the proposed crossing of the Butterfield Trail did not identify any intact segments along Link B150a; the present-day Doubtful Canyon Road alignment lies within the historic trail corridor, and has been determined to be the Butterfield Trail; visual impacts to the trail will occur
  - Field verification of the proposed crossings (B140 and B120b) did not identify any physical segments of the trail; however, rock cairns associated with the trail confirm its presence in these locations; visual impacts to the trail will occur in these locations
  - Potential direct physical impacts to three known habitation sites

- Route Group 4
  - Crosses Southern Pacific Mail Line, Butterfield, Juan Bautista de Anza, Gila, General Cooke's Wagon Road/Mormon Battalion, and Zuñiga trails
  - Field verification of the proposed crossings of the Butterfield Trail did not identify any intact segments
  - Potential cultural-visual impacts to Fort Lowell Multiple Resource Area and Rillito Race Track
  - Mount Graham area is significant to the San Carlos Apache Nation
  - Potential physical impacts of up to eight known habitation sites
  - Potential visual impacts to five historic districts (El Presidio, Rillito Race Track, Winterhaven, Barrio Anita, and Menlo Park) within 0.25 mile of the Project area
  - A high density of cultural resources within and surrounding the Tucson area
  - Potential cultural-visual impacts to Oak Draw and Marijilda Canyon archaeological districts
  - Potential cultural-visual impacts to the McClellan Wash Archaeological District
  - Potential cultural-visual impacts to Colossal Cave Mountain Park

- The BLM Preferred Alternative (1A2-3A2-4C2c)
  - Crosses El Camino Real, Butterfield, Gila, Janos Copper, Zuñiga, Southern Pacific Mail, and General Cooke's Wagon Road/Mormon Battalion trails
  - Potential physical impacts to five known habitation sites
  - Potential cultural-visual impacts to the Gran Quivira, McClellan Wash Archaeological District, Verdugo Homestead Historic District, Rancho Lina Vista Historic District, ghost town of Shakespeare, and Juan Bautista de Anza route, as well as El Camino Real, Butterfield, Gila, Janos Copper, Zuñiga, Southern Pacific Mail, and General Cooke's Wagon Road/Mormon Battalion trails

4.9 VISUAL RESOURCES

4.9.1 Introduction

This section focuses on the identification and characterization of visual impacts associated with the Project. Visual resource impacts would result from the construction and operation of the proposed 500 kV transmission lines and associated substations. The impact assessment was developed in consultation with the BLM and is consistent with, and adheres to, the BLM VRM system (BLM Handbook 8431 – Visual Resource Contrast Rating).

In general, concern for changes to existing viewsheds and modifications that would alter the landscape character of natural lands is the primary factor considered for identifying and characterizing impacts related to visual resources. Similar to other resources addressed in this Final EIS, effects to visual resources were assessed in terms of initial and residual impacts, both of which consider resource-specific mitigation measures. Initial impacts were identified in consideration of the Project description, standard mitigation, BMPs, and agency consultation. Residual impacts, the primary effects to resources disclosed in this Final EIS, were assessed and disclosed based on the assumption that selective mitigation measures would be implemented during the construction and operation of the Project and that, over time, these selective mitigation measures would reduce impacts to scenery and viewers (viewing locations).

Significant impacts related to visual resources would be the result of high impacts from the Project that cannot be effectively mitigated. Following are general descriptions of anticipated visual impacts that would result from the construction and operation of the Project.

- *High Impacts* would occur for those portions of the Project where Project components (including access, structures, and ancillary facilities) would be dominant or readily apparent from viewing locations frequented by casual observers. In these locations, the Project would introduce form, line, color, and texture inconsistent with existing landscape features. High impacts are expected in high-quality, diverse, and rare or unique and natural landscapes (Class A or Class B), where anything more than minimal change in the landscape would occur.
- *Moderate Impacts* are anticipated for segments of the Project or areas where the Project would be codominant with existing landscape features, and be moderately apparent from viewing locations frequented by the casual observer. Moderate impacts are anticipated in interesting but not outstanding natural landscapes (Class B or Class C), where changes

would modify the inherent quality of the landscape. Typically, moderate impacts are anticipated where the Project would parallel existing linear features that exhibit similar form, line, color, and texture to the Project.

- *Low Impacts* are anticipated for segments of the Project where the Project would be subordinate in the landscape and not readily apparent from viewing locations frequented by the casual observer. Low impacts on scenery are anticipated where the Project would result in minimal change to existing landscape character in interesting and common landscapes (Class B and Class C). In most cases, low impacts are anticipated where the Project would parallel an existing similar HVTL facility or occur within a designated utility corridor with similar modifications in terms of form, line, color, and texture to the Project.

4.9.2 Impact Assessment Methodology

The impact assessment is based on the BLM VRM system 8400 series, BLM and ACC (State of Arizona) approved and legally defended visual resource assessments for 500 kV transmission line projects, and the BLM's (including third-party contractor) experience in conducting visual impact analysis for EHV transmission lines and substations. In addition to Project-level coordination regarding the NEPA and impact analyses, two visual resource workshops were coordinated and conducted with the BLM to develop impact methodology and establish criteria for assessing compliance with applicable VRM classes. Attendees of the workshops included representatives from the BLM Washington Office (Chief Landscape Architect), New Mexico and Arizona State BLM offices (State VRM leads), and VRM specialists from Socorro and Las Cruces (New Mexico), and Safford and Tucson (Arizona) field offices.

The measure of visual impacts is based on visual contrast as defined by the BLM VRM system (BLM Manual 8431). Using the baseline data developed during the Project-level inventory, including a detailed assessment of existing linear facilities within the Project area, the GIS was used to assess initial impacts to scenery and viewing locations in conjunction with field investigations and BLM procedures. Compliance with VRM classifications was determined by a contrast analysis from viewing locations and BLM-approved KOPs. Following are specific techniques that were employed to assess visual impacts to scenery and viewers, and to demonstrate compliance with VRM classes for the Project.

4.9.2.1 Assessment Techniques

Impact assessment techniques for visual resources include performing a contrast analysis for the proposed Project and identifying initial impacts for scenery, viewing locations and KOPs, and compliance with VRM classifications.

Contrast

The first step in identifying potential impacts is to perform a Project-wide contrast analysis to establish a baseline for anticipated landscape change, based on the construction and operation of the Project. Contrast is defined as the degree of visual change that occurs in the landscape, due to the construction and operation of the proposed transmission lines. In the context of EHV

transmission lines, visual contrast typically results from (1) landform modifications that are necessary to prepare the right-of-way for construction, (2) the removal of vegetation to construct and maintain the transmission lines, (3) the construction of temporary and permanent access roads required to erect the structures and maintain the conductors, and (4) the introduction of transmission line facilities (structures, etc.) into the landscape. The visual contrast assessment was performed by comparing the visual elements (form, line, color, and texture) of the existing landscape (identified during the inventory) with the visual elements associated with the proposed Project. Using this method, each Project alternative was assigned one of the five following contrast levels: weak, weak-moderate, moderate, moderate-strong, and strong.

- Strong – contrast demands attention and strongly dominates the landscape
- Moderate-Strong – contrast begins to demand attention and is still moderately dominant in the landscape
- Moderate – contrast attracts attention but is co-dominant in the landscape
- Weak-Moderate – contrast begins to attract attention and is moderately subordinate in the landscape
- Weak – contrast is discernible (visible) but subordinate (does not attract attention) in the landscape

This baseline contrast level was then used when considering impacts to scenery, impacts to viewing locations (viewers), and compliance with VRM objectives, as described below.

Impacts to Scenery

The primary factor in determining impacts to scenery is the level of contrast associated with the Project as compared to existing landscape conditions (e.g., access roads, transmission lines, etc.) and the factors that compose the landscape (e.g., vegetation, landform, water). Initial impacts to scenery were assessed by reviewing the scenery rating (A, B, or C), with contrast accounting for standard mitigation and Project design. Areas of Class A or B scenery that would be substantially altered by the Project (i.e., areas where similar linear facilities do not exist) would result in high impacts. Moderate to low impacts are anticipated for low levels of modification in Class B or C scenery. The results of the impact analysis were mapped and verified (see Figure M 9-1, Map Volume).

Impacts to Viewing Locations (viewers) and KOPs

Initial impacts to viewing locations and KOPs were based on an assessment of baseline contrast, viewing location concern level (moderate or high), and Project visibility; all of which, when combined, allude to the visual dominance of the Project. Project-specific influence zones were developed to quantify visibility specifically associated with the Project (i.e., two 500 kV transmission facilities and associated access roads). Influence zones were developed based on field reconnaissance and photo documentation of existing, similarly scaled facilities in comparable landscapes; a review of agency-approved (BLM, USFS) visual resource assessments relating to 500 kV facilities; in-depth consultation with BLM visual resource staff (local, state, and Washington Office); and photo simulations developed for the Project.

Initial impacts to viewing locations and KOPs were determined by evaluating the Project-specific influence zones associated with viewing locations with the baseline contrast using GIS. A viewshed analysis was also conducted for all alternatives, to ascertain where in the landscape the Project would not be visible. The result of the viewshed analysis was used in conjunction with the GIS impact assessment to verify or modify the resulting initial impacts. Concurrent with the GIS impact analysis, BLM contrast rating sheets were developed during the field investigation for all alternatives from agency approved KOPs. The contrast assessed from each KOP was compared to the results of the GIS impact assessment and refined, as necessary. The results of this impact analysis were mapped for inclusion in the Final EIS (see Figure M 9-2 and Figure M 9-3, Map Volume).

Visual simulations were prepared from agency-approved KOPs to illustrate the range of typical impacts to viewing locations and are included in Appendix D. More specifically, visual simulations were developed to (1) support the contrast rating and impact analysis associated with the Project, (2) illustrate the effectiveness of standard and selective mitigation measures, where applicable, on a case by case basis, (3) disclose anticipated effects of the Project based on the best data available at the time of the Draft EIS, and (4) support the assessment of compliance with designated VRM classes and provide defensible materials for BLM managers to make informed decisions regarding plan amendments.

KOP simulation locations were selected to represent each viewing location type (travel route, recreation area, and residences), associated concern level, and distance (influence zone) from the Project. In this regard, a total of 34 KOP[1] simulation locations were selected in consultation with the BLM during the inventory phase of the visual assessment. Appendix D includes a summary of the locations of the visual simulations (KOPs), associated concern level, and detailed selection rationale.

Visual Resource Inventory Data

Per BLM direction, VRI Classification data was assessed for portions of the proposed Project crossing BLM land (see Figure M 9-4, Map Volume). Appendix D describes the miles and acreage of VRI Classification data crossed by each subroute. The percentage of VRI Classification data (i.e., unit area) affected by the Project was also calculated, as compared to the total unit area crossed.

Compliance with BLM VRM Objectives

Per BLM policy, compliance with VRM classes was evaluated using the contrast rating process (see Figure M 9-5, Map Volume). Pursuant to BLM guidance, Contrast Rating Sheets (BLM form 8400-4) were prepared from agency-approved KOPs and included in Appendix D. In addition, VRM class compliance was assessed by studying the level of change in the landscape (baseline contrast) resulting from the Project, as seen from sensitive viewing locations (regardless of jurisdiction). Sensitive viewing locations included residences, recreation areas,

[1] An additional 13 simulation locations have been removed, with the elimination of Route Group 2 and Subroute 1C.

travel routes, and other viewing locations identified through agency consultation and/or public scoping or comment.

Table 4-21 reflects the management objectives as described in the BLM Manual with regard to changes in the characteristic landscape. A strong project contrast would be compliant in a VRM Class IV objective area, because "the level of change to the characteristic landscape can be high," or management activities may contrast strongly with the existing character of the landscape. Similarly, in a Class III objective VRM area, "change to the characteristic landscape should be moderate." Therefore, moderate project contrast resulting from management activities of the Project would be compliant. Class II VRM objectives allow for weak project contrast, or a "low level of change" in the landscape. Finally, Class I VRM objectives would only allow for very limited management activity (i.e., natural ecological changes) where the level of change in the landscape should be "very low and must not attract attention."

Table 4-21. Visual Resource Management Classifications

Class I	To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II	To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
Class III	To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
Class IV	To provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

In regard to VRM Class compliance, a plan amendment would be required if the Project would remain noncompliant after the implementation of selective mitigation measures. It should be noted that if a segment of the Project crosses Class II or Class III designated landscapes that are not visible from a viewing location or KOP with a moderate or high level of concern, the Project would be in compliance with Class II or Class III objectives. In addition, the Project may not be in compliance, based on Project design and standard mitigation (initial impacts); however, through the assignment of selective mitigation (i.e., using self-supporting lattice structures and restoring access roads), contrast would be reduced and the Project would be in compliance (residual impact). The contrast rating assessment was verified in conjunction with the results of the viewing locations impact assessment and field observation.

4.9.2.2 Conformance with Applicable RMPs

Per BLM VRM system (BLM Handbook H-8431-1), an assessment of all major proposed surface-disturbing activities or developments, such as the proposed Project, must be conducted in order to evaluate compliance with visual management objectives designated in applicable RMPs for BLM administered lands. Conformance or lack thereof with relevant RMPs was determined by assessing visual contrast in context with VRM objectives.

4.9.2.3 Mitigation Planning

Two groups of mitigation measures that are pertinent to the Project (as described in Chapter 2) are standard and selective mitigation measures. Standard mitigation measures would be applied Project-wide (BMPs) and to some extent serve as part of the overall Project description. Mitigation measures beyond these standard measures are referred to as selective mitigation, and are recommended on a case-by-case basis to reduce impacts or address compliance issues in specific locations.

Selective mitigation was applied to all areas of high, moderate-high, and moderate initial impacts to reduce impact levels where necessary and effective, and where feasible based on the Project description. After the implementation of selective mitigation measures at various locations throughout the Project, residual impacts would be reduced to varying degrees depending on site-specific circumstances (e.g., from moderate-high to moderate, from low-moderate to low, etc.).

4.9.3 Impact Analysis Results

Potential visual impacts resulting from the construction and operation of the Project are described in the following section. Visual impacts are described in context with scenery, viewing locations and KOPs, and compliance with BLM VRM classifications. As previously described, impacts to visual resources are residual and based on the assignment (where feasible) of selective mitigation measures for each alternative route. The Map Volume illustrates the results of the impact assessment in regard to scenery, viewing locations and KOPs, and compliance with the BLM VRM objectives impact analysis.

4.9.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Scenery

The majority of impacts (approximately 41.9 percent) along this subroute is associated with Class B scenery and is anticipated to be moderate. Moderate-high impacts (approximately 9.5 percent) and low-moderate impacts (approximately 33 percent) are anticipated to occur along this subroute in Class A and Class B scenery. Low impacts are anticipated along this subroute in Class C scenery, where the Project parallels existing transmission lines (approximately 15.6 percent). High impacts to scenery are not anticipated along Subroute 1A1.

Impacts for Subroute 1A1 between SunZia East and Link A161 are anticipated to be moderate when crossing Class B scenery with few existing transmission lines and linear facilities. Impacts are anticipated to range from moderate-high to moderate along Link E180 where the route crosses the Rio Grande (Class A scenery), and Rio Grande Floodplain and agricultural landscapes (Class B scenery). Although the Rio Grande has been channelized in this area, riparian vegetation is abundant along the river and extends beyond the banks and throughout the adjacent floodplain. Moderate-strong landscape contrast would be introduced where riparian vegetation would be removed for construction access. Contrast would be reduced by

implementing SE 10 (maximize span at crossings) and SE 14 (selective vegetation removal) to reduce contrast created by right-of-way clearing.

Impacts are also anticipated to range from moderate-high to moderate in Class B scenery where modifications are limited to unpaved roads. This would occur along Link E200 where the route crosses Madrean Mountain landscapes and Chihuahuan Desert Creosote Bajadas associated with the San Mateo Mountains, links E101a and E101b where the route crosses juniper hills between Sevilleta NWR and Stallion WSA, links E80d and E85 where the route crosses juniper hills of Chupadera Mesa, and Link A21 where the route crosses rolling juniper savanna east of Claunch.

Low-moderate to low impacts to Class B and Class C scenery are anticipated for Link E211, which would parallel a 345 kV transmission line for approximately 14 miles. Low-moderate impacts to Class C scenery would occur where existing access would reduce landscape contrast (portions of links E133 and E200). Link E211, associated with Class B scenery, occurs within the DOE West-wide Energy Corridor, where there is an existing 345 kV transmission line.

The majority of impacts between Link A161 and the Midpoint Substation (common to subroutes 1A, 1B1, 1B2, and 1B3) are anticipated to be low-moderate to low (approximately 60 percent), because the route would parallel one or more existing transmission lines (115 kV and 345 kV) in Class B and Class C scenery that is associated with the Rio Grande Valley and desert valley plains, respectively. Although parallel to an existing 115 kV transmission line, moderate impacts are anticipated for isolated portions of links A330a and A330b, when crossing rolling to steep terrain associated with deep ravines that occasionally cross the Rio Grande Valley. Landscape contrast would be moderate-strong to strong in these terrain conditions, where new construction access would be required. Moderate impacts would occur in Class B scenery associated with the Rio Grande Valley for the majority of Link A161a, where the route would not parallel existing transmission lines in flat to rolling terrain. Landscape and structure contrast would be stronger along this portion of the route, where new access and new structures would be introduced into Class B scenery. Moderate-high impacts would occur along isolated portions of these links when crossing moderate to steep terrain associated with deep ravines. Landscape contrast would be reduced by implementing SE 10. Links A161 and A161a occur within the DOE West-wide Energy Corridor, where there are existing 345 kV and 115 kV transmission lines.

Viewing Locations and KOPs

Residential

Residences between the SunZia East Substation and Link A161 are generally dispersed, except for some higher concentrations of residences near Socorro. Impacts to residences near Socorro are anticipated to be high along Link E180, where direct views of the Project within 0.5 mile would occur. High to moderate-high impacts to residences are anticipated for Socorro residences and in isolated areas along links A21, E84b, and E80d, west of SR 54 and east of the Sevilleta NWR (see Visual Contrast Rating Worksheets R01 and SO4, and associated simulations 2a and 2b). In these locations, existing transmission lines are not present and residences would have unobstructed views of the Project within 0.5 mile in flat to rolling terrain where access may be visible, resulting in high to moderate-high impacts. Moderate impacts are anticipated along links A21, E80d, E101a, E101b, and E200, where the Project would be viewed by residences within

1 to 2 miles in a landscape setting that is primarily intact. Low-moderate to low impacts are anticipated, where the proposed structures are viewed from residences beyond 2 miles or where the route would parallel an existing transmission line along Link E211 (see Visual Contrast Rating Worksheet SO1). Residences with views of the Project that would be partially screened and viewed in context with existing structures and/or development would have low impacts (see Visual Contrast Rating Worksheet SO18). Through the implementation of SE 7 (self-supporting lattice), impacts could be moderately reduced for portions of Subroute 1A1 that would be backdropped by adjacent terrain for residential viewers with high to moderate initial impacts.

Subroute 1A1 between Link A161 and Midpoint Substation (common to all subroutes in Route Group 1) would generally have limited impacts to high concern residential viewers, primarily low concentration residences, where the Project would be viewed within 0.5 mile. Residences in this area are generally dispersed, except for a higher concentration near the I-25 corridor and the New Mexico SR 26 corridor. Moderate-high to moderate impacts are anticipated for existing residences within 0.5 mile of Link A161 (near the future development of Willow Springs) and would be viewed in context with an existing 115 kV transmission line; therefore, structure contrast would be reduced (see Visual Contrast Rating Worksheet SO24). Links A161, A330a, A330b, A400, A440, and A530 would parallel one or more transmission lines, which would reduce structure contrast because the Project would be in proximity to similar transmission structures, thus reducing impacts for residential viewers. Low-moderate to low impacts to residences would occur where the Project would be viewed beyond 1.0 mile and/or when parallel to existing transmission lines. Impacts were identified for the future development of Willow Springs, which has plat-approved parcels and varying degrees of infrastructure in place to support that development. Impacts are anticipated to be moderate along the southern boundary of the future development, where the Project would cross flat terrain in a natural landscape setting.

Recreation

Overall, high to moderate impacts are anticipated for a portion of Subroute 1A1 (primarily between the SunZia East Substation and Link A161), because high concern level recreation viewers would have views of the route in a landscape with minimal modifications. Near Socorro, high to moderate-high impacts are anticipated for high concern recreation viewers associated with the Stallion WSA, Veranito WSA, Sevilleta NWR, Johnson (Gordy's) Hill SRMA, and the Rio Grande. High impacts for the WSAs and SRMA would be concentrated along the boundaries of the WSAs and along the north side of the SRMA, where dispersed recreational use may occur near Link E133 (see Visual Contrast Rating Worksheet SO14 and associated Simulation 5). The varied terrain near the WSAs and SRMA would provide a background condition for the Project. In this terrain, SE 7 would be effective in reducing contrast through the use of SSL structures. High impacts for viewers associated with the Rio Grande are anticipated for Link E180, which crosses the river and would be partially screened by riparian vegetation (see Visual Contrast Rating Worksheets SO16 and associated Simulation 7). SE 10 and 14 would reduce contrast at the river crossing, where riparian vegetation would be removed for construction.

Impacts are anticipated to be low-moderate for dispersed recreation viewers associated with Cibola National Forest (near the SunZia East Substation), because the route would be viewed within 2 miles, crossing slightly rolling terrain occupied by juniper grassland. Recreation viewers associated with Cibola National Forest and The Box SRMA (see Visual Contrast Rating

Worksheet SO19) would have views of the Project crossing relatively flat terrain in a natural landscape setting (Link E211). Impacts are anticipated to be low, because the Project would be viewed within 2 miles and in context of an existing 115 kV transmission line that would reduce contrast. Similar to Link E211, impacts to recreation viewers associated with the Bosque del Apache NWR, Devil's Backbone WSA, Chupadera Wilderness, and Indian Well Wilderness are also anticipated to be low because Link A161 would parallel an existing 115 kV transmission line in flat terrain. Moderate-high impacts are anticipated for moderate concern viewers associated with the Ladron Mountain/Devil's Backbone Complex ACEC near Link E200. Impacts would be concentrated at the southern end of the ACEC, where dispersed recreation viewers would have views of the Project crossing rolling terrain in a natural, unmodified landscape setting. Self-supporting lattice structures would be used to reduce contrast where views of the Project would be backdropped by adjacent terrain.

There are few recreation viewers associated with Subroute 1A1 between Link A161 and the Midpoint Substation (common to all subroutes in Route Group 1). Low impacts are anticipated for moderate concern viewers associated with the Ladron Mountain/Devil's Backbone Complex ACEC, near Link A161. Low impacts for viewers at Fort Craig National Historic Site are anticipated because the Project would be viewed beyond 5 miles and would be partially screened by topography (see Visual Contrast Rating Worksheet SO27). Low impacts for viewers along the CDTS route are anticipated because the Project would be viewed beyond 4 miles and within context of an existing wind farm near links A400 and A440. Dispersed recreation viewers associated with Cibola National Forest may have views of the Project within 3 miles; however, it would be viewed in context of an existing 115 kV transmission line that would reduce impacts. Low impacts for viewers at El Camino Real International Heritage Center and El Camino Real Lands Recreation Trail and Trailhead are anticipated, because the Project would be viewed in context with existing modifications (I-25) within 2 miles in a backdropped condition; thus, contrast would be reduced. Viewers associated with Elephant Butte State Park, approximately 1 mile from Subroute 1A1, would have low impacts because views would be screened by intervening terrain.

Travel Routes

Between the SunZia East Substation and Link A161, high concern travel routes crossed include WSMR Route 3607 (see Visual Contrast Rating Worksheet SO11 and associated Simulations 4a and 4b), WSMR Route 5 (see Visual Contrast Rating Worksheet SO13), and El Camino Real National Scenic Byway along SR 408 (see Visual Contrast Rating Worksheets SO17 and associated Simulation 8). Viewers associated with the Quebradas Back Country Byway (see Visual Contrast Rating Worksheet SO15 and associated Simulation 6) would have backdropped views of the Project within 1 mile. High to moderate impacts are anticipated for each of these high concern level travel routes where views of the Project would be unobstructed while crossing rolling to steep terrain. Although landscape modifications are limited to unpaved access, adjacent terrain would result in a backdropped condition for portions of this subroute, which would reduce contrast. SE 7 would reduce contrast where views of the Project would be backdropped by adjacent terrain; SE 10 would reduce contrast at the crossing of El Camino Real National Scenic Byway. Impacts are anticipated to be moderate-high where the Project crosses and/or is within 0.5 mile of the following moderate concern level travel routes: US Route 54 (see Visual Contrast Rating Worksheet RO2), SR 55, and US Route 60.

Subroute 1A1 between Link A161 and Midpoint Substation would cross travel routes (including travel routes that provide access to recreation) that have been identified as having a high concern for viewers. High to moderate-high impacts would be concentrated where the Project crosses these routes and/or would be viewed within 0.5 mile. These travel routes include El Camino Real National Byway (see Visual Contrast Rating Worksheets SO30 and associated Simulation 11) and the Geronimo Trail National Scenic Byway and Lake Valley Back Country Byway (see Visual Contrast Rating Worksheets LC21 and LC22, and associated Simulation 24). SE 10 would reduce contrast at the crossing of these scenic designated travel routes. Low-moderate impacts would result where the Project crosses level terrain and would be viewed by I-25 viewers at a rest stop. At this location, the Project would be viewed within 1.5 miles and would be backdropped by adjacent terrain, which would reduce contrast (see Visual Contrast Rating Worksheet SO28). Impacts are anticipated to be moderate-high where the Project crosses and/or is within 0.5 mile of the following moderate concern level travel routes: I-25 (non-scenic portion), SR 107, FR 255, and SR 142. Low-moderate impacts would occur for viewers along SR 26, a moderate concern level travel route, and the Butterfield Trail (see Visual Contrast Rating Worksheets LC26 and associated Simulation 27). The proposed Project would be visible in a linear corridor through flat terrain with two transmission lines and a railroad, which also cross the historic trail.

Compliance

Portions of Subroute 1A1 would not be compliant with VRM Class II lands where strong to weak-moderate contrast would be viewed by travel routes and recreation viewers. In addition, VRM Class III lands would not be compliant where strong to moderate contrast would be viewed primarily by travel route viewers. Subroute 1A1 crosses approximately 14.1 miles of BLM land not in VRM compliance in the Socorro Field Office, 7.9 miles of Class II, and 6.2 miles of Class III (approximately 6.1 percent of BLM land crossed by Subroute 1A1).

Following is a discussion of these individual areas of noncompliance, including the areas where existing landscape conditions and selective mitigation measures could be applied to reduce contrast and bring portions of this subroute into compliance with visual resource management objectives.

Subroute 1A1 between Link A161 and Midpoint Substation

- *Link A260* – High concern viewers associated with El Camino Real National Scenic Byway and residences would have views of strong to moderate-strong project contrast, as Link A260 crosses VRM Class III lands. Compliance with VRM Class III objectives is anticipated, because the Project would parallel an existing 115 kV transmission line. In addition, viewers associated with El Camino Real National Scenic Byway would experience short viewing durations of the Project.
- *Link A330b* – Travel route viewers along the Geronimo Trail/Lake Valley Scenic Byway (along SR 152) associated with a high concern level would have views of moderate project contrast as Link A330b crosses VRM Class III land. Contrast would be reduced through the implementation of SE 7 and 10. In addition, existing modifications include a 345 kV transmission line that the Project would parallel, and a 115 kV transmission line

that parallels this scenic route. Travel route viewers would have a short viewing duration as the Project crosses the road; therefore, compliance with VRM Class III is anticipated.

- *Links A440 and A530* – Travel route viewers along SR 26 associated with a moderate concern level would have views of weak project contrast as links A440 and A530 cross VRM Class II land. Existing modifications along this portion of the subroute include 115 kV and 345 kV transmission lines that would parallel the Project while crossing VRM Class II land (including a 0.5 mile Class II buffer associated with the historic Butterfield Trail, and 2.2 miles Class II lands associated with Cooke's Range) and would be in the foreground of views from SR 26. Based on the rate of speed of moderate concern viewers traveling along SR 26, the Project would be seen for a short viewing duration (approximately 30 seconds and less than 3 minutes, respectively) and viewed through the context of existing modifications with similar line and repetition. Through the application of SE 8, structures would be selectively located to minimize visibility (i.e., maximize backdropping opportunities and avoidance of tower placement on ridgelines). In addition, access roads associated with existing transmission lines should be used to reduce the visibility of access associated with the Project. A low level of visual change would result; therefore, links A440 and A 530 would be compliant with VRM Class II objectives.

Subroute 1A1 between the SunZia East Substation and Link A161

- *Links E101a, E101b, and E133* – High concern level viewers associated with the Veranito WSA, Johnson (Gordy's) Hill SRMA, and the WSMR Route 5 would have views of strong to moderate-strong project contrast in VRM Class II land. Selective mitigation measures would not reduce project contrast to a weak level; thus, portions of links E101a and E133 would not conform to VRM Class II. WSMR Route 3607, a high concern level travel route, would have views of strong to moderate-strong project contrast for a long viewing duration as links E101a and E101b cross VRM Class III land. High concern level viewers associated with the Veranito WSA, Johnson (Gordy's) Hill SRMA, and the WSMR Route 5 would have views of moderate-strong project contrast for a long viewing duration as Link E133 crosses VRM Class III land. Selective mitigation measures would not reduce project contrast to a moderate level; thus, portions of links E101a, E101b and E133 would not conform to VRM Class III.

Impacts to the Gran Quivira Unit of Salinas Pueblo Missions National Monument

Regional modifications to the north of Gran Quivira include a wind farm, pipelines, ranches, NM Highway 55, and other paved or unpaved roads. The majority of Subroute 1A1 (links E82, E84a, E84b, and E85) would not be immediately adjacent to existing utilities or roads and would require new access. Moderate-high impacts to Class B scenery are anticipated for isolated portions of this segment in juniper woodland hills, where the Project facilities would require landform modifications in moderate to steep terrain. Clearing of juniper woodland vegetation would increase landscape contrast in this vegetation community.

For portions of this segment associated with Class B piñon-juniper vegetation, landscape contrast would be reduced by implementing mitigation measure SE 14. Moderate impacts are anticipated for Class B scenery crossing flat to rolling terrain, where modifications are minimal in juniper

woodland savanna. In addition to SE 14, the implementation of a detailed reclamation plan (SE 5) would reduce impacts to scenery by restoring lands within the right-of-way.

Visitors to Gran Quivira would have superior views of the landscape where the Project would be viewed within 4 miles crossing slightly rolling terrain and vegetation associated with the juniper woodland savanna. A portion of Link E84b would be skylined, although the majority of the route would be backdropped by adjacent terrain and would be viewed at a distance of approximately 4 miles in context with existing regional modifications. In addition, access would be partially screened by topography and/or existing vegetation that would reduce contrast for Link E84b. Project components may often be subdued or absorbed into the contextual landscape, reducing visibility of the Project. Overall, Subroute 1A1 would result in low impacts for high-concern level viewers associated with Gran Quivira because the Project, although visible, would be subordinate in the landscape (see Visual Contrast Rating Worksheet SO31b and associated Simulation 47b). Impacts to viewers could be further reduced by modifying the tower height (SE 7) or tower placement (SE 8) for portions of the route that are skylined.

High to moderate impacts are anticipated for the Salt Missions Trail Scenic Byway, a high concern level travel route that Gran Quivira visitors use to access the national monument, because views of the Project would be direct and unobstructed. Viewing duration is anticipated to be short because the Project would cross the road perpendicularly for viewers traveling at a high rate of speed. Implementation of SE 10 would maximize the tower span at the crossing of this scenic designated route to reduce visual contrast (see Visual Contrast Rating Worksheet RP1, which was completed for Link E83 but would have similar contrast rating for Link E84b.)

Subroute 1A2 – BLM Preferred Alternative

Scenery

The majority of impacts (approximately 38 percent) along the BLM preferred alternative is associated with Class B scenery and is anticipated to be moderate. Moderate-high impacts (approximately 14 percent) and low-moderate impacts (approximately 33 percent) are anticipated to occur along this subroute in Class A and Class B scenery. Low impacts are anticipated along this subroute in Class C scenery, where the Project parallels existing transmission lines (approximately 15 percent). High impacts to scenery are not anticipated.

Impacts for Subroute 1A2 between SunZia East and Link A161 are anticipated to be moderate when crossing Class B scenery with few existing transmission lines and linear facilities. Impacts are anticipated to range from moderate-high to moderate in Class B scenery where modifications are limited to unpaved roads. This would occur along Link E200 where the route crosses Madrean Mountain landscapes and Chihuahuan Desert Creosote Bajadas associated with the San Mateo Mountains, Link E101b where the route crosses juniper hills between the Sevilleta NWR and Stallion WSA, links E86a and E86b where the route crosses juniper hills of Chupadera Mesa, and Link A21 where the route crosses rolling juniper savanna east of Claunch.

Impacts are also anticipated to range from moderate-high to moderate along Link E180 where the route crosses the Rio Grande (Class A scenery), and Rio Grande Floodplain and agricultural landscapes (Class B scenery). Although the Rio Grande has been channelized and cultivated in

this area, riparian vegetation is confined to the river and consists of Cottonwood galleries. Moderate-strong landscape contrast would be introduced where riparian vegetation would be removed for construction access. Contrast would be reduced by implementing SE 10 (maximize span at crossings) and SE 14 (selective vegetation removal) to reduce contrast created by right-of-way clearing.

Low-moderate to low impacts to Class B and Class C scenery are anticipated for Link E211, which would parallel a 345 kV transmission line for approximately 14 miles. Low-moderate impacts to Class C scenery would occur where existing access would reduce landscape contrast (portions of links E133 and E200). Link E211, associated with Class B scenery, occurs within the DOE West-wide Energy Corridor, where there is an existing 345 kV transmission line. The majority of impacts between Link A161 and the Midpoint Substation (common to subroutes 1A, 1B1, 1B2, and 1B3) would be similar to Subroute 1A1.

Viewing Locations and KOPs

Residential

Residences between the SunZia East Substation and Link A161 are generally dispersed, except for some higher concentrations of residences near Socorro. Impacts to residences near Socorro are anticipated to be high along Link E180 where direct views of the Project within 0.5 mile would occur. High to moderate-high impacts to residences are anticipated in isolated areas along Links A21, west of SR 54, and east of the Sevilleta NWR (see Visual Contrast Rating Worksheets RO1 and RP4, and associated Simulation 49). In these locations, existing transmission lines are not present and residences would have unobstructed views of the Project within 0.5 mile in flat to rolling or steep terrain where access may be visible, resulting in high to moderate-high impacts. Portions of the Project may be skylined while crossing steep terrain near these residences, resulting in strong contrast. High impacts would be limited to a few residences near Local Alternative Link E86a, where unobstructed views of the Project would occur within 0.5 mile in a landscape setting with limited modifications (KOP RP4). Similar to Subroute 1A1, residences would have views of the BLM preferred alternative within the foreground distance zone with minimal screening. Link E84a would result in low-moderate to low impacts where the Project would be viewed beyond 1 mile in a setting with minimal modifications (see Visual Contrast Rating Worksheet RP2).

Moderate impacts are anticipated along links A21, E101b, and E200, where the Project would be viewed by residences within 1 to 2 miles in a landscape setting that is primarily intact. Low-moderate to low impacts are anticipated, where the proposed structures are viewed from residences beyond 2 miles or where the route would parallel an existing transmission line along Link E211 (see Visual Contrast Rating Worksheet SO1). Residences with views of the Project that would be partially screened and viewed in context with existing structures and/or development would have low impacts (see Visual Contrast Rating Worksheet SO18). Through the implementation of SE 7 (self-supporting lattice), impacts could be moderately reduced for portions of the BLM preferred alternative that would be backdropped by adjacent terrain for residential viewers with high to moderate initial impacts.

Subroute 1A2 between Link A161 and the Midpoint Substation (common to all subroutes in Route Group 1) would have residential impacts similar to Subroute 1A1.

Recreation

Overall, high to moderate impacts are anticipated for a portion of the BLM preferred alternative (primarily between the SunZia East Substation and Link A161), because high concern level recreation viewers would have views of the route in a landscape with minimal modifications. Near Socorro, high to moderate-high impacts are anticipated for high concern recreation viewers associated with the Stallion WSA, Veranito WSA, Sevilleta NWR, Johnson (Gordy's) Hill SRMA, and the Rio Grande. High impacts for the WSAs and SRMA would be concentrated along the boundaries of the WSAs and along the north side of the SRMA, where dispersed recreational use may occur near Link E133 (see Visual Contrast Rating Worksheet SO14 and associated Simulation 5). The varied terrain near the WSAs and SRMA would provide a background condition for the Project. In this terrain, SE 7 would be effective in reducing contrast through the use of SSL structures. High impacts for viewers associated with the Rio Grande are anticipated for Link E180, which crosses the river and would be partially screened by riparian vegetation (see Visual Contrast Rating Worksheets SO16 and associated Simulation 7). SE 10 and SE 14 would reduce contrast at the river crossing, where riparian vegetation would be removed for construction.

Low impacts are anticipated for Link E86a approximately 4.7 miles to the north, which would be visible to viewers associated with Gran Quivira, with superior views of the surrounding landscape. Existing visible modifications to the north of Gran Quivira include residences associated with ranching, two pipelines, unpaved roads, and a wind farm (see Visual Contrast Rating Worksheet SO31c and associated Simulation 47c). In addition, the Project would be partially skylined for viewers where Link E86a crosses rolling to hilly terrain; however, the majority of the Project visible to viewers at Gran Quivira would be backdropped by adjacent terrain and would be subordinate in the landscape setting. Some vegetation clearing may be visible at this distance, although access may be partially to totally screened where juniper woodland vegetation is dense. Impacts to viewers could be further reduced by modifying the tower height (SE 7) or tower placement (SE 8) for portions of the route that are skylined.

Impacts are anticipated to be low-moderate for dispersed recreation viewers associated with Cibola National Forest (near the SunZia East Substation), because the route would be viewed within 2 miles, crossing slightly rolling terrain occupied by juniper grassland. Few recreation viewers are associated with land east of Sevilleta NWR near link E86b; thus, impacts are anticipated to be low along that portion of the BLM preferred alternative. Recreation viewers associated with Cibola National Forest and The Box SRMA (see Visual Contrast Rating Worksheet SO19) would have views of the Project crossing relatively flat terrain in a natural landscape setting (Link E211). Impacts are anticipated to be low, because the Project would be viewed within 2 miles and in context of an existing 115 kV transmission line that would reduce contrast. Similar to Link E211, impacts to recreation viewers associated with the Bosque del Apache NWR, Devil's Backbone WSA, Chupadera Wilderness, and Indian Well Wilderness are also anticipated to be low because Link A161 would parallel an existing 115 kV transmission line in flat terrain. Moderate-high impacts are anticipated for moderate concern viewers associated with the Ladron Mountain/Devil's Backbone Complex ACEC near Link E200.

Impacts would be concentrated at the southern end of the ACEC, where dispersed recreation viewers would have views of the Project crossing rolling terrain in a natural, unmodified landscape setting. Self-supporting lattice structures would be used to reduce contrast where views of the Project would be backdropped by adjacent terrain.

There are few recreation viewers associated with Subroute 1A2 between Link A161 and the Midpoint Substation (common to all subroutes in Route Group 1). Impacts are anticipated to be similar to Subroute 1A1.

Travel Routes

Between the SunZia East Substation and Link A161, high concern travel routes crossed include Salt Missions Scenic Byway, WSMR Route 3607 (see Visual Contrast Rating Worksheet SO11 and associated Simulations 4a and 4b), WSMR Route 5 (see Visual Contrast Rating Worksheet SO13), and El Camino Real National Scenic Byway along SR 408 (see Visual Contrast Rating Worksheets SO17 and associated Simulation 8). Salt Mission Scenic Byway, a travel route that provides access to Gran Quivira, is anticipated to have high impacts where views of the Project would be unobstructed while crossing the scenic byway in flat terrain. Viewers associated with the Quebradas Back Country Byway (see Visual Contrast Rating Worksheet SO15 and associated Simulation 6) would have backdropped views of the Project within 1 mile. High to moderate-high impacts are anticipated for Camino Real and WSMR Route 5 where views of the Project would be within 0.5 mile and unobstructed while crossing rolling to steep terrain with minimal modifications. Although landscape modifications are limited to unpaved access, adjacent terrain would result in a backdropped condition for portions of this subroute, which would reduce contrast. SE 7 would reduce contrast where views of the Project would be backdropped by adjacent terrain, and SE 10 would reduce contrast at the crossing of the Salt Missions Scenic Byway (SR 55) and El Camino Real National Scenic Byway. Impacts are anticipated to be moderate-high where the Project crosses and/or is within 0.5 mile of the following moderate concern level travel routes: US Route 54 (see Visual Contrast Rating Worksheet RO2), SR 55, I-25, and US Route 60.

Subroute 1A2 between Link A161 and the Midpoint Substation would have similar impacts to travel routes associated with Subroute 1A1.

Compliance

Portions of Subroute 1A2 would not be in compliance with VRM Class II lands where strong to weak-moderate contrast would be viewed by travel routes and recreation viewers. In addition, VRM Class III lands would not be compliant where strong to moderate contrast would be viewed primarily by travel route viewers. The BLM preferred alternative crosses approximately 13.8 miles of BLM land not in VRM compliance in the Socorro Field Office, 7.7 miles of Class II, and 6.1 miles of Class III (approximately 6 percent of BLM land crossed by Subroute 1A2).

Following is a discussion of these individual areas of noncompliance, including the areas where existing landscape conditions and selective mitigation measures could be applied to reduce contrast and bring portions of this subroute into compliance with VRM objectives.

Subroute 1A2 between the SunZia East Substation and Link A161

Links E86b, E101b and E133 – High concern level viewers associated with the Veranito WSA, Johnson (Gordy's) Hill SRMA, and the WSMR Route 5 would have views of strong to moderate-strong project contrast in VRM Class II land. Selective mitigation measures would not reduce project contrast to a weak level; thus, portions of links E101b and E133 would not conform to VRM Class II. WSMR Route 3607, a high concern level travel route, would have views of strong to moderate-strong project contrast for a long viewing duration as links E86b and E101b cross VRM Class III land. High concern level viewers associated with the Veranito WSA, Johnson (Gordy's) Hill SRMA, and the WSMR Route 5 would have views of moderate-strong project contrast for a long viewing duration as Link E133 crosses VRM Class III land. Selective mitigation measures would not reduce project contrast to a moderate level; thus, portions of links E86b, E101b, and E133 would not conform to VRM Class III.

- Compliance for Subroute 1A2 between Link A161 and the Midpoint Substation would be similar to Subroute 1A1.

Subroute 1A – North River Crossing

Impacts to visual resources along Subroute 1A would be similar to Subroute 1A1 where links are common (links E80d, E101, E133, E180, E200, E211, A161, and A161a, and from Link A330a to the Midpoint Substation). Impacts described below pertain to visual resources associated with links A22 and E80c (Gran Quivira) and Link A270 (Rio Grande Valley), which are specific to Subroute 1A.

Scenery

Similar to the BLM preferred alternative, the majority of impacts (approximately 46.7 percent) along this subroute is associated with Class B scenery and is anticipated to be moderate. Moderate impacts would occur in Class B scenery associated with the Rio Grande Valley for Link A270, and links E80c and A22 in the Gran Quivira area, where the route would not parallel existing transmission lines in flat to rolling terrain. Landscape and structure contrast would be stronger along these portions of Subroute 1A, where new access and new structures would be introduced into Class B scenery with minimal modifications. Moderate-high impacts (approximately 11.6 percent) are anticipated for Class B scenery when crossing moderate to steep terrain. These isolated occurrences of moderate-high impacts in Class B scenery are limited to deep ravines that cross the valley. Landscape contrast would be reduced by implementing SE 10, where practicable. Low to low-moderate impacts (approximately 25.3 percent) are anticipated for Class B and C scenery. Similar to Subroute 1A1, a limited portion of Class A scenery would be affected by this subroute while crossing the Rio Grande, resulting in moderate-high to moderate impacts due to removal of riparian vegetation.

Viewing Locations and KOPs

Residential

Along an isolated portion of Link A270, high to moderate-high impacts are anticipated for residences west of I-25 (see Visual Contrast Rating Worksheet LC18). Residential viewers would have unobstructed views of the Project within 0.5 mile crossing flat to rolling terrain. Landscape contrast associated with access may be visible, although this portion of the route would not parallel an existing transmission line; thus contrast would not be reduced. Dispersed residences along links A270, E80c, and A22 may also have unobstructed views of the Project within 2 miles crossing flat to rolling terrain, which would reduce landscape and structure contrast. Impacts are thus anticipated to be low to low-moderate.

Recreation

Recreation viewers at Gran Quivira would have superior views of the landscape with minimal modifications where the Project would be viewed within 6 miles. Although the Project would be visible, impacts would be low because the structures would be completely backdropped by adjacent terrain, and vegetation clearing for access would be partially screened by the dense juniper vegetation. Dispersed recreation viewers associated with Cibola National Forest may have views of Subroute 1A (Link A270) crossing flat to rolling terrain in a minimally modified landscape setting. Impacts are anticipated to be strong to moderate when the Project would be viewed within 0.5 to 1 mile.

Travel Routes

Subroute 1A crosses similar travel routes west of the Gran Quivira area, resulting in similar impacts as stated for the assessment of the BLM preferred alternative. Link E80c crosses SR 14; although it is not designated as a scenic road, it turns into SR 55 (Salt Missions Trail Scenic Byway) at the Torrance County line and may be used by Gran Quivira visitors. Subroute 1A also crosses SR 54 near the SunZia East Substation. Impacts are anticipated to be moderate-high for these moderate concern-level travel route viewers where views of the Project would be direct and unobstructed. Viewing duration is anticipated to be short because the Project would cross these roads perpendicularly for viewers traveling at a high rate of speed. The implementation of SE 10 would maximize the tower span at the crossing of this scenic designated route to reduce visual contrast.

Compliance

Compliance for Subroute 1A is similar to the BLM preferred alternative, with the exception of Link A270. Overall, Subroute 1A crosses approximately 14.1 miles of BLM land not in VRM compliance in the Socorro Field Office and Las Cruces District Office, 7.9 miles of Class II, and 6.2 miles of Class III.

Compliance specific to Subroute 1A between Link A161 and Midpoint Substation includes:

- Link A270 – High concern level viewers associated with El Camino Real National Scenic Byway (along SR 1) and a residence would have views of strong project contrast as Link A270 crosses VRM Class III land. Contrast would be reduced through the application of SE 3, 5, and 7. In addition, modifications near this location include two radio towers approximately 300 feet tall. Compliance for Link A270 crossing VRM Class III land is anticipated, because contrast would be reduced to a moderate level through selective mitigation. In addition, the Project would be viewed in context with existing modifications.

Subroute 1B – San Antonio Crossing

Scenery

Subroute 1B1: The majority of impacts (approximately 46.1 percent) along this entire subroute are anticipated to be moderate. Moderate-high impacts (approximately 8.8 percent) are anticipated to occur along this subroute in Class A and Class B scenery associated with the Rio Grande and Rio Grande Valley, respectively. Low-moderate impacts (approximately 31.2 percent) are anticipated along this subroute in lower quality Class B and Class C scenery. Low impacts (approximately 13.8 percent) are anticipated along this subroute in Class C scenery, typically where the Project would parallel existing linear features. High impacts are not anticipated along this subroute. Impacts for Subroute 1B1 between links E80d and A161 are anticipated to vary between moderate and moderate-high, when crossing Class B scenery with few existing transmission lines and linear facilities. Impacts to Class A and Class B scenery associated with the Rio Grande and Rio Grande Floodplain and agricultural landscapes along Link A140 are similar to impacts along Link E180 (Subroute 1A1). However, Link A140 crosses more Class B scenery (approximately 1.3 miles of floodplain and 1.0 mile of agricultural lands) than is crossed by Link E180 (approximately 0.7 mile of floodplain and 0.3 mile of agricultural lands). Other Class B scenery associated with this segment includes the Chupadera Mountains, juniper and grassland hills, and rolling juniper-woodland savanna where modifications are limited to unpaved roads. Moderate-high impacts are anticipated along Link A160, where the Project would cross Class B scenery associated with the Chupadera Mountains and isolated portions crossing moderate to steep terrain. For portions of this segment associated with Class B piñon-juniper vegetation, landscape contrast would be reduced by implementing SE 14, which would selectively remove vegetation to blend the edge of the right-of-way into adjacent vegetation patterns, as is practicable and appropriate. Low-moderate impacts are anticipated along this subroute where it crosses Class C scenery associated with level valley plains (links E90 and A90). In addition, existing access adjacent to and crossing links E90 and A90 would minimize ground disturbance and vegetation clearing required for new access roads, thus reducing landscape contrast.

Impacts to scenery along Subroute 1B1 would be similar to Subroute 1A between the SunZia East Substation and Link E80d, and Link A161 and Midpoint Substation (see Subroute 1A).

Subroute 1B2: The majority of impacts (approximately 43.6 percent) along the entire subroute are anticipated to be moderate; moderate-high impacts (approximately 8.9 percent) are anticipated to occur along this subroute in Class A (Rio Grande) and Class B (Rio Grande

Floodplain, Chupadera Mountains, and Rio Grande Valley) scenery; low-moderate impacts (approximately 32.5 percent) are anticipated in Class B and Class C scenery; and low impacts (approximately 14.8 percent) are anticipated in Class C scenery, typically where the Project would parallel existing linear features. High impacts are not anticipated. Impacts for Subroute 1B2 between the SunZia East Substation and Link A60 are anticipated to be primarily moderate, when crossing Class B scenery with few existing transmission lines and linear facilities. Impacts to Class B and C scenery associated with rolling juniper woodland-savanna and rolling savanna plains are similar to Subroute 1B1, ranging from moderate to moderate-high. Subroute 1B2 crosses less Class B scenery associated with rolling savanna plains; however, some portions appear more natural with fewer cultural modifications such as roads. Landform contrast may be slightly higher than Subroute 1B1, because more vegetation clearing and ground disturbance would be required for new access roads. Landscape contrast for Subroute 1B2 in Class C scenery (Link A60) would be higher, because the Project would require new access roads, whereas most of Subroute 1B1 (Link E90) would parallel an existing road.

Impacts to scenery along Subroute 1B2 would be similar to Subroute 1A between Link A161 and Midpoint Substation (see Subroute 1A), and Subroute 1B1 between links A90 and A160 (see Subroute 1B1).

Subroute 1B3: The majority of impacts (approximately 44.3 percent) along this entire subroute are anticipated to be moderate; moderate-high impacts are anticipated along approximately 10.2 percent of this subroute; low-moderate impacts are anticipated along 30.5 percent; and low impacts are anticipated along 15.1 percent of this subroute. High impacts are not anticipated. Subroute 1B3, between the SunZia East Substation and Link A161, crosses similar Class B and Class C scenery, including rolling juniper-woodland savanna and rolling savanna plains, as does Subroute 1B2. Moderate to moderate-strong contrast is anticipated from the construction and operation of new access roads and right-of-way clearing on moderate to steep terrain within Class B scenery, associated with rolling juniper-woodland savanna (portions of links A40 and A41). There are no existing access roads paralleling these links; therefore, moderate-high impacts along links A40 and A41 are anticipated. A portion of Link A41 parallels an existing unpaved road through Class B scenery associated with rolling savanna plains. The use of existing roads would minimize ground disturbance and vegetation clearing needed for access, thus reducing landscape contrast. Portions of links A50 and A60 in Subroute 1B2 through similar Class B scenery do not parallel existing roads, and therefore contrast from vegetation clearing would be higher for those segments. Impacts along Link A80 would be similar to Subroute 1B2 through similar Class C scenery (moderate-low). US Route 380 parallels Link A80 approximately 0.8 mile to the south.

Impacts to scenery along Subroute 1B3 would be similar to Subroute 1A between Link A161 and the Midpoint Substation (see Subroute 1A), and Subroute 1B2 between the SunZia East Substation and Link A30, and between Link A111 and Link A160.

Viewing Locations and KOPs

Subroute 1B1: Impacts to viewing locations and KOPs along Subroute 1B1 would be similar to Subroute 1A1 between Link A161 and the Midpoint Substation. Impacts to viewers are described

for links that occur between the SunZia East Substation and Link A161 (links E90, A90, A111, A112, A140, A143, and A160).

Residential

Subroute 1B1 would generally have limited impacts to high concern residential viewers, because few residences occur within 0.5 mile of the Project. Residences in this area are generally dispersed with a small group of residences associated with the outskirts of San Antonio. North of San Antonio, high impacts are anticipated for residences with unobstructed views of the Project within 0.5 mile in natural and agricultural landscape settings (see Visual Contrast Rating Worksheet SO20 and associated Simulation 9).

Moderate impacts to residential viewers east of San Antonio (see Visual Contrast Rating Worksheet SO8) would occur where the Project would be viewed beyond 0.5 mile in relatively flat terrain. Adjacent terrain near Link A90 would provide a background condition where SE 7 could be applied to reduce structure contrast. Low-moderate to low impacts are anticipated for residences with views of the Project 0.75 mile and beyond residences (see Visual Contrast Rating Worksheet SO5 and SO21), and where the Project would be partially screened by vegetation.

In addition to impacts discussed for existing high concern residential viewers above, impacts were identified for the future development of Whispering Mountain Ranches (immediately east of Willow Springs), which has plat approved parcels. Moderate impacts are anticipated along the northern boundary of the future development in a natural landscape setting through rough to rolling terrain. SE 7 would reduce contrast where views of the Project would be backdropped by adjacent terrain near Link A160.

Recreation

Low-moderate impacts are anticipated for high concern recreation viewers associated with the Stallion WSA, Little San Pascual Wilderness, Chupadera Wilderness, and the Trinity Historic Marker (see Visual Contrast Rating Worksheet SO10), because the Project would be visible beyond 1.0 mile while crossing flat terrain. Low impacts are anticipated for viewers associated with the Bosque del Apache NWR south of San Antonio, where the Project would be viewed in context with a modified setting (i.e., agricultural and residential development) approximately 5 miles from Link A140 (see Visual Contrast Rating Worksheet SO23).

Travel Routes

The Project would also cross El Camino Real National Scenic Byway, which was classified as a high concern level for travel route viewers. High impacts are anticipated when the Project would cross this route where unobstructed views of the Project would occur within 0.5 mile. Low-moderate impacts are anticipated for viewers along the Quebradas Back Country Byway, where the Project would be visible in a setting with minimal modifications and viewed beyond 1 mile while crossing flat terrain (see Visual Contrast Rating Worksheet SO9 and associated Simulation 3).

Travel routes associated with a moderate level of concern include portions of I-25 that are not designated scenic, US Route 380, and US Route 54. Moderate-high impacts would occur as the Project crosses I-25, with moderate to low-moderate impacts for links A111 and A112, which would parallel US Route 380, approximately 1 mile north of this corridor (see Visual Contrast Rating Worksheet SO22 and associated Simulation 10). Views from US Route 380 would be intermittently screened by topography, thereby reducing contrast.

SE 10 could be applied for areas of high, moderate-high, and moderate impacts to reduce contrast as the Project crosses the travel routes identified above.

Subroute 1B2: Impacts to viewing locations and KOPs along Subroute 1B2 are identical to Subroute 1A1 between Link A161 and Midpoint Substation. Impacts to viewers are described for links that occur between the SunZia East Substation and Link A161 (links A30, A50, and A60). Impacts to viewers at the San Antonio Crossing (links A111, A112, A140, and A160) are identical to Subroute 1B1.

Residential

Subroute 1B2 would generally have limited impacts to high concern residential viewers, because few residences occur within 0.5 mile. High to moderate-high impacts are anticipated for residences west of US Route 54 (see Visual Contrast Rating Worksheet RO1) and along Warm Springs Road southwest of Claunch. Residential views would be unobstructed in flat to rolling terrain; however, the Project would be viewed in a landscape with minimal modifications, resulting in stronger contrast. Moderate impacts to residential viewers associated with this subroute would occur where the Project would be viewed 0.5 to 1 mile in a minimally modified landscape (see Visual Contrast Rating Worksheet SO6). Low-moderate to low impacts are anticipated where the Project would be viewed from residences beyond 1 mile.

Travel Routes

Impacts are anticipated to be moderate-high for US Route 54 and SR 55, where the Project crosses this moderate sensitivity travel route in a natural landscape setting through rolling terrain (see Visual Contrast Rating Worksheet RO2). SE 10 would be applied to reduce contrast as the Project crosses these travel routes.

Subroute 1B3: Impacts to viewing locations and KOPs along Subroute 1B3 are identical to Subroute 1A1 between Link A161 and Midpoint Substation. Impacts to viewers will be discussed for links that occur between the SunZia East Substation and Link A161 (links A40, A41, and A80). Impacts to viewers at the San Antonio Crossing (links A111, A112, A140, and A160) are identical to Subroute 1B1.

Residential

High impacts that are anticipated would occur for residences north of Bingham where structures would be visible within 0.5 mile in a landscape setting with minimal modifications. Moderate impacts would occur for residences with potential views of the Project within 0.5 to 1 mile. Low to low-moderate impacts would occur where the Project would be viewed at 1 mile or beyond (see Visual Contrast Rating Worksheet SO7).

Recreation

Low-moderate impacts are anticipated for high concern viewers associated with the Trinity Historic Marker (see Visual Contrast Rating Worksheet SO10), because the Project would be visible at 1.0 mile where crossing flat terrain in a landscape setting with minimal modifications.

Travel Routes

This subroute parallels US Route 380 (offset by 1.0 mile to the north), which has been identified as a moderate concern level for travel route viewers. Impacts are anticipated to be low-moderate where the proposed structures would be intermittently screened by topography.

Compliance

Subroute 1B1: Subroute 1B1 crosses 5.2 miles of BLM land not in VRM compliance in the Socorro Field Office (4.1 miles of Class II and 1.1 miles of Class III), or approximately 2.3 percent of BLM land crossed by this subroute.

The following is a discussion of the individual areas of noncompliance:

- *Link A90* – A residence near WSMR Route 18 would have views of moderate-strong project contrast as Link A90 crosses VRM Class III land. Selective mitigation measures would not reduce project contrast to a moderate level; thus, Link A90 would not conform to VRM Class III.
- *Links A111, A112, and A140* – An area where high to moderate-strong project contrast and high to moderate concern viewers occur, as the Project crosses VRM Class II land. The application of selective mitigation would not be able to reduce project contrast to a moderate level. Therefore, it would not be in compliance with VRM objectives.

Subroute 1B2: Compliance with VRM objectives for Subroute 1B2 would be the same as those discussed for subroute 1B1. The remainder of BLM land crossed by Subroute 1B2 is in compliance with VRM objectives.

Subroute 1B3: Subroute 1B3 crosses 4.4 miles of BLM land not in VRM compliance in the Socorro Field Office and Las Cruces District Office (4.1 miles of Class II and 0.3 mile of Class III), or approximately 2.1 percent of BLM land crossed by this subroute. The remainder of BLM land crossed by Subroute 1B3 is in compliance with VRM objectives.

Local Alternative and Crossover Links for Route Group 1

Scenery

Local Alternative Links for 1A and 1B – Gran Quivira: Impacts along local alternative links E81, E83, and E82-E84-E85, are similar to Subroute 1A (moderate to moderate-high) crossing Class B scenery associated with rolling juniper-woodland savanna and rolling savanna plains.

More occurrences of moderate-strong impacts are anticipated to occur along links E81 and E85 through rolling juniper-woodland savanna, because new access roads would require ground disturbance on moderate to steep terrain and the removal of dense vegetation, resulting in strong landscape contrast. Portions of links E83 and E82 cross rolling juniper-woodland savanna while parallel to an existing pipeline, which has already modified the landscape; therefore, impacts would be reduced. Contrast would be reduced by implementing SE 14, which would limit the amount of permanent clearing of piñon-juniper vegetation and selectively removing vegetation to blend the edge of the right-of-way into adjacent vegetation patterns, as practicable and appropriate. Moderate impacts are anticipated to occur where the local alternative links cross rolling savanna plains, some of which have been modified into ranches. Regionally, existing modifications include a windfarm, located to the northeast approximately 14 miles from these local alternative links.

Local Alternative Links for 1A, 1B1, 1B2, 1B3: Impacts range from moderate-high to low-moderate along local alternative links A161b and A361-A430-A481. Moderate-strong landscape contrast would result from the construction of new access roads and structure pads on moderate to steep terrain within Class B scenery associated with undulating bajadas and southern foothills of the Magdalena Mountains (Link A161b) and the northern and southern foothills of the Sierra de las Uvas Mountains (Link A481). Landscape contrast along Link A260 and portions of Link A361 would be similar to Subroute 1A, where it crosses the Rio Grande Valley. The proposed structures would introduce strong structure contrast into the landscape (links A161b, A361-A430-A481, and a portion of Link A260) where there are no existing transmission line structures. Low-moderate impacts are anticipated along local alternative links A430 and A481 and portions of A361, which cross Class C scenery associated with desert valley plains. Due to the level terrain of the valley plain, little disturbance to landform would occur; therefore, weak-moderate to weak landscape contrast is anticipated. Structure contrast would be reduced to moderate-strong, where Link A260 occurs within the DOE West-wide Energy Corridor (approximately 9.4 miles) and parallels an existing 115 kV transmission line.

Crossover Links 1B2, 1B3: Crossover Link A70 has similar impacts as Subroute 1B2 crossing Class B scenery associated with rolling savanna.

Local Alternative Links for 1A and 1B – Gran Quivira

Viewing Locations and KOPs

Residential

High impacts would be limited to a few residences near Local Alternative Link E84, where unobstructed views of the Project would occur within 0.5 mile in a landscape setting with limited modifications. Links E81 and E83-E84 would result in limited areas of moderate impacts where the Project would be viewed within 0.5 to 1 mile in a setting with minimal modifications (see Visual Contrast Rating Worksheet RP2). Low-moderate to low impacts are anticipated for high concern residences where each of these local alternative links would be viewed beyond 1 mile.

Recreation

Low-moderate impacts are anticipated for Link E81, approximately 2 miles south of viewers associated with Gran Quivira, where superior views of the Project would occur in a setting with minimal modifications (see Visual Contrast Rating Worksheet SO2b and associated Simulation 1b). Contrast would be greater where access and new structures would be introduced; however, the Project would be completely backdropped by adjacent terrain, which would reduce structure contrast. Some vegetation clearing may be visible at this distance, although access may be partially to totally screened where juniper woodland vegetation is dense.

Low-moderate impacts are anticipated for Link E83, approximately 2 miles to the north, which would be visible to viewers associated with Gran Quivira with superior views of the surrounding landscape. Existing visible modifications to the north of Gran Quivira include residences associated with ranching, two pipelines, unpaved roads, and a wind farm (see Visual Contrast Rating Worksheet SO31a and associated Simulation 47a). In addition, the Project would be partially skylined for viewers where Link E83 crosses rolling to hilly terrain; however, the majority of the Project visible to viewers at Gran Quivira would be backdropped by adjacent terrain. Some vegetation clearing may be visible at this distance, although access may be partially to totally screened where juniper woodland vegetation is dense.

Impacts for Link E84 would be the same as the BLM preferred alternative, Subroute 1A2.

Travel Route

Local alternative links E81, E82, and E83 cross the Salt Missions Scenic Byway, which is associated with SR 55 north of Gran Quivira. High impacts are anticipated where the Project would cross the Salt Missions Scenic Byway (links E83-E84) (see Visual Contrast Rating Worksheet RP1) where unobstructed views would occur in a landscape with few modifications. SE 10 could be applied to moderately reduce contrast. Moderate-high impacts are anticipated where Link E81 crosses SR 55 (without scenic designation) in a landscape with minimal modifications.

Local Alternative Links for 1A, 1B1, 1B2, 1B3

Viewing Locations and KOPs

Residential

Limited portions of Link A161b would result in high to moderate-high impacts for residential viewers near the northern and western boundaries of the Willow Springs development. Structures and portions of access would be visible within 0.5 mile and occur in a natural landscape setting through rolling terrain. Moderate impacts are anticipated for the majority of Link A161b along the western boundary, where structures would be visible to residences beyond 0.5 mile. Similar to Subroute 1A, impacts for future development of Willow Springs would be considered moderate along the northern and western boundaries of the future development. SE 7 would be applied to reduce contrast, because the varying landform and vegetation would provide a background condition for the structures.

Moderate-high impacts are anticipated for residential viewers near Link A260 where the Project would be viewed within 0.5 mile (west of Elephant Butte State Park). These impacts would occur where structures would be visible in moderately steep to flat terrain, and viewed in context with a 115 kV transmission line.

Links A361-A430-A481 would generally have limited impacts to high concern residential viewers where dispersed residences in the Uvas Valley would have views of the Project within 0.5 mile. The Project would be viewed in an agricultural landscape setting with few modifications. Residences with views of the Project between 0.5 and 1 mile are anticipated to have moderate impacts in similar viewing conditions. Low-moderate to low impacts would occur where the Project would be viewed 1.0 mile and beyond (see Visual Contrast Rating Worksheet LC14).

Recreation

Moderate-high impacts are anticipated for moderate concern viewers associated with the Ladron Mountain/Devil's Backbone Complex ACEC along the eastern boundary of the ACEC. Dispersed recreation viewers within the ACEC would have views of Link A161b crossing rolling terrain in a minimally modified landscape setting. The Project would be backdropped for portions of Link A161b by adjacent terrain. Implementation of SE 7 could reduce structure contrast for these recreation viewers.

Low impacts are anticipated for high concern recreation viewers associated with the Elephant Butte State Park because the Project would be screened. Link A260 parallels an existing 115 kV transmission line, approximately 3.0 miles from potential recreation viewers at Elephant Butte State Park; however, adjacent topography would screen the Project from potential viewers within the park (see Visual Contrast Rating Worksheet LC20), resulting in low impacts.

There are no designated recreation areas or facilities associated with local alternative links A361-A430-A481.

Travel Route

Link A161b crosses SR 178/Cienega Camp Road, a moderate concern level travel, which provides access to the southern portion of the Magdalena Mountains. Impacts are considered moderate-high where the Project crosses this travel route in a natural landscape setting through rolling terrain. SE 10 could be applied to moderately reduce contrast as the Project crosses this travel route.

Link A260 crosses the El Camino Real National Scenic Byway, which has been identified as having a high concern for travel route viewers. High impacts would occur where the Project crosses this route west of Elephant Butte State Park (see Visual Contrast Rating Worksheet LC19 and associated Simulation 23). Views of Link A260 crossing this scenic route would be skylined, resulting in high impacts. SE 10 would reduce contrast; however, views of the Project would be unobstructed and remain skylined. Moderate-high impacts are anticipated where Link A260 would be viewed within 0.5 mile of this scenic travel route. This portion of Link A260 parallels an existing 115 kV transmission line; therefore, structure contrast would be reduced.

Link A260 also crosses SR 142, a travel route that has been identified as a moderate concern level, which provides local access to dispersed residences along this travel route. Impacts are considered moderate-high where the Project crosses this travel route in a relatively flat, natural landscape setting with few modifications. SE 10 could be applied to reduce contrast as Link A260 crosses the travel routes identified above.

Links A361-A430-A481 cross SR 26, a travel route associated with a moderate concern level, which provides local access to Hatch and Deming. Impacts are anticipated to be moderate-high where the Project would cross this travel route; however, the Project would be viewed in context with existing modifications, including 115 kV and 345 kV transmission lines crossing flat terrain.

Crossover Links 1B2, 1B3

Residential

High impacts are anticipated for high concern residential viewers of this crossover link north of Bingham. Moderate to low-moderate impacts are anticipated for residences with views of Link A70, beyond 0.5 mile in a landscape setting with few modifications.

There are no recreation or travel route viewers associated with this crossover link.

Compliance

Local Alternative Links for 1A and 1B – Gran Quivira: Local alternative links E83-E84 cross 1.3 miles of BLM land in the Rio Puerco Field Office, which are designated as VRM Class IV. The Project would be compliant with BLM Class IV objectives. BLM land is not crossed by local alternative links E81, E82, or E85.

Local Alternative Links for 1A, 1B1, 1B2, 1B3: Links A361-A430-A481 would be compliant with BLM VRM Class III and Class IV objectives. Local alternative links A161b and A260 cross 4.5 miles of BLM land not in initial VRM compliance in the Socorro Field Office and Las Cruces District Office (Class III).

Following is a discussion of these individual areas of noncompliance, including existing landscape conditions and selective mitigation measures that could be applied to reduce contrast for compliance with visual resource management objectives.

- *Link A161b* – Moderate-strong project contrast would be viewed by existing residences as Link A161b crosses VRM Class III lands. The application of SE 3 and SE 5 would reduce contrast to a moderate level for compliance with VRM Class III.
- *Link A260* – High concern viewers associated with the El Camino Real National Scenic Byway and residences would have views of strong to moderate-strong project contrast, as Link A260 crosses VRM Class III lands. Compliance with VRM Class III objectives is anticipated, because viewers associated with El Camino Real National Scenic Byway would experience short viewing durations of the Project. The remainder of Link A260

parallels an existing 115 kV transmission line; thus, compliance with VRM Class III is anticipated.

Crossover Links 1B2, 1B3: Crossover Link A70 is in compliance with VRM Class III.

4.9.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Scenery

The majority of impacts (approximately 66 percent) along Subroute 3A2 are anticipated to be low-moderate in Class C scenery associated with the Animas and San Simon valleys; moderate-high and moderate impacts (approximately 0.5 percent and 2 percent, respectively) are anticipated to occur along this subroute in Class B scenery associated with foothills; and low impacts are anticipated along this subroute in Class C scenery within valley plains, where the Project would parallel existing transmission line routes (approximately 31.5 percent). No Class A scenery is crossed by this subroute.

Moderate-strong landscape contrast would result for portions of the Project crossing moderate to steep terrain within Class B scenery associated with the foothills of the Peloncillo Mountains (Link 150a), resulting in moderate to moderate-high impacts.

Portions of the Project crossing level terrain associated with the valley plains would result in weak-moderate to weak landscape contrast. Landscape contrast would be reduced in areas where the Project would parallel an existing road(s), resulting in low-moderate impacts to Class C scenery. Impacts would be reduced to low in areas where the Project would parallel existing 345 kV transmission lines (portions of links B120b, B121, and B170) and 115 kV transmission lines (Link B120b and a small portion of Link B121) where vertical elements have been introduced into the landscape, therefore reducing structure contrast.

Viewing Locations and KOPs

Residential

Subroute 3A2 would generally have limited areas of high impacts to high concern residential viewers within 0.5 mile of the Project near Deming. The portion of Subroute 3A2 to the east would be farther from larger concentrations of residences in Deming and Lordsburg; thus impacts are anticipated to be low to low-moderate. Portions of this subroute parallel an existing 345 kV transmission line, which greatly reduces contrast. High impacts would occur north of Deming (Link B90), in an area where existing transmission lines are not present and where the Project is located in close proximity to residences in a largely intact natural landscape. These residences would have an unobstructed view of the proposed structures (within 0.5 mile), but landscape contrast associated with access roads may be screened by vegetation in flat terrain.

Moderate impacts associated with this subroute would occur where the Project is beyond 0.5 mile (Link B90), where the proposed structures would be visible in relatively flat terrain and where associated access would not be visible. Low-moderate to low impacts would occur where the Project would be viewed from residences 1.0 mile and beyond, or would be viewed in context with the existing 345 kV transmission line.

Recreation

High-moderate impacts for high concern recreation viewers associated with the CDNST are anticipated where the Project would cross this trail. Viewers here would view the Project in context with an existing 345 kV line and multiple 115 kV lines converging at the existing Hidalgo Substation (Link B121 and B120b) within 0.5 mile of the crossing of the CDNST and the Project; therefore, contrast would be reduced (see Visual Contrast Rating Worksheet LC33 and associated Simulation 50). High impacts to viewers associated with the Peloncillo Mountains Wilderness are anticipated to occur near the northern boundary. Recreation viewers may have unobstructed views for portions of the Project; however, access views may be screened and structures would be backdropped by adjacent terrain. Implementation of SE 7 would reduce contrast in this area. High impacts are anticipated for recreation viewers associated with the CDTS Route where level unobstructed views of the Project would occur when crossed in a landscape setting with few modifications (Link B90). SE 10 could be applied to reduce contrast when crossing recreation trails. Low-moderate impacts are anticipated for high concern recreation viewers associated with the Hot Well Dunes Recreation Area – SRMA/Campground, and would be concentrated along the southern portion of the recreation area where dispersed camping and OHV use could occur (near Link B160d). These viewers would have views of the structures within 2.75 miles; however, access would be screened by existing vegetation in flat terrain.

Travel Routes

The Project would cross routes inventoried as a moderate level of concern for travel route viewers. Impacts would typically be moderate-high where the Project would cross these routes without existing transmission (US Route 180) in a setting with few modifications. Moderate impacts are anticipated for SR 90, SR 464, and US Route 70, where the Project would be viewed in the context of existing transmission lines (see Visual Contrast Rating Work Sheet LC29). SE 10 could be applied for areas of moderate-high and moderate impacts, to reduce contrast at travel route crossings.

Compliance

BLM lands crossed by Subroute 3A2 are in compliance with VRM objectives.

Subroute 3A – North

Scenery

Overall, Subroute 3A would have low (approximately 31.8 percent), low-moderate (approximately 65.7 percent), moderate (approximately 2.0 percent), and moderate-high (approximately 0.5 percent) impacts; high impacts to scenery are not anticipated. Impacts to scenery for Subroute 3A would be similar to Subroute 3A2 from Midpoint Substation to the end of Link B170. Low impacts are anticipated to be low along Link 160a, where the Project would parallel an existing 345 kV transmission line in Class C scenery. The majority of the route would have low-moderate impacts, with a small area of moderate to moderate-high impacts along Link B160b associated with the foothills of the Peloncillo Mountains.

Viewing Locations and KOPs

Impacts to viewing locations and KOPs along Subroute 3A would be similar to Subroute 3A2 from Midpoint Substation to Link B170.

Residential

There are few dispersed residences along links B160a and B160b. Low to low-moderate impacts are anticipated for residences with views of the Project 1 mile and beyond. Cultural modifications along these links are minimal; however, access would be screened by existing vegetation in flat terrain, resulting in reduced contrast.

Recreation

Similar to Subroute 3A2, high impacts to viewers associated with the Peloncillo Mountains Wilderness are anticipated to occur near the northern boundary. High impacts are anticipated for recreation viewers associated with the CDTS Route where level unobstructed views of the Project would occur when crossed by the Project in a landscape setting with few modifications (Link B90). High impacts are anticipated for high concern recreation viewers associated with the Hot Well Dunes Recreation Area – SRMA/Campground, and would be concentrated along the southern portion of the recreation area where dispersed camping and OHV use could occur (along Link B160b). These viewers would have unobstructed views of the structures within 0.5 mile; however, access would be screened by existing vegetation in flat terrain.

Travel Routes

The Project would also cross travel routes inventoried as a moderate level of concern for travel route viewers. Impacts would typically be moderate-high where the Project crosses these routes without existing transmission (Hackel Road) (see Visual Contrast Rating Work Sheet SA3) in a setting with few modifications. SE 10 could be applied for areas of moderate-high and moderate impacts to reduce contrast at travel route crossings.

Compliance

BLM lands crossed by Subroute 3A are in compliance with VRM objectives.

Subroute 3B – South

Scenery

The majority of impacts (approximately 92.7 percent) along Subroute 3B are anticipated to be low-moderate in Class C scenery associated with the Animas and San Simon valleys. Moderate-high and moderate impacts (approximately 1.6 percent and 4.3 percent, respectively) are anticipated to occur in Class B scenery associated with the foothills of the Pyramid and Peloncillo mountains. Low impacts (approximately 1.3 percent) are anticipated to occur in Class C scenery, where the Project would parallel existing transmission line routes. High impacts to scenery are not anticipated along this subroute.

Impacts to scenery along this Subroute 3B are similar to Subroute 3A; however, more occurrences of moderate to moderate-high impacts within Class B scenery would occur along Subroute 3B (links B112 and B150a). The landscape setting within the foothills of the Peloncillo Mountains crossed by this subroute (Link B150a) has been modified by multiple pipeline routes. Strong structure contrast would result through the introduction of this Project; therefore, impacts would be moderate to moderate-high. Although Link B112 would not parallel existing pipeline routes through the foothills of the Pyramid Mountains, the landscape setting has been modified by mining operations, pipeline routes (which would cross Link B112), and other development associated with Lordsburg. Moderate impacts to Class B scenery associated with these regional modifications are anticipated for links B112 and B150a. There are also more occurrences of low-moderate impacts and fewer occurrences of low impacts Subroute 3B through the Animas and San Simon valleys (Class C scenery) than Subroute 3A. Although this subroute parallels more existing pipeline routes, it does not directly parallel existing transmission lines; therefore, structure contrast would be strong. Landform and structure contrast could be further reduced by implementing selective mitigation measures that would reduce ground disturbance by minimizing the separation between the Project (links B110a, B110b, B112, and B150a) and existing transmission lines and pipeline routes, to the extent practicable (SE 16).

Approximately 7.9 miles of the subroute (portions of links B110a, B110b, B112, and B150a) in Class B and Class C scenery would occur within the DOE West-wide Energy Corridor, where the Project would parallel existing 345 kV transmission lines and pipeline routes.

Viewing Locations and KOPs

Residential

Subroute 3B would have impacts to high concern residential viewers; however, it would be closer in proximity to Deming, Lordsburg, San Simon, and I-10 Corridor residences. Similar to Subroute 3A, portions of Subroute 3B parallel an existing 345 kV transmission line, resulting in reduced structure contrast. High to moderate-high impacts are anticipated for residences

northwest of Deming, south of Lordsburg, and in San Simon (links B150a and B150b). In these locations, Subroute 3B does not parallel existing transmission lines and is within 0.5 mile of residences, with views of a largely intact natural landscape (see Visual Contrast Rating Worksheet SA2). Residential views would be primarily unobstructed; however, access would be screened by vegetation in flat terrain. Moderate impacts associated with this subroute would occur near Lordsburg, where the Project would be viewed within 0.5 to 1 mile in relatively flat terrain where access would be screened by vegetation (see Visual Contrast Rating Worksheet LC30 and associated Simulation 30).

Recreation

Impacts are also anticipated for high concern recreation viewers associated with the CDNST. High impacts would be concentrated where the Project would cross the trail in the Pyramid Mountains, south of Lordsburg (Link B112). Recreation viewers would have unobstructed views of the Project crossing the trail; however, access views would be partially screened (see Visual Contrast Rating Worksheet LC31 and associated Simulation 31). SE 10 could be applied to maximize distance of the span of structures at the trail crossing.

High impacts to viewers associated with the Peloncillo Mountains Wilderness are anticipated to occur near the southern boundary near West Doubtful Canyon Road, which provides access to the wilderness and would be crossed by Link 150a. Recreation viewers may have unobstructed views for portions of the Project; however, views of access may be screened and structures would be backdropped by adjacent terrain (see Visual Contrast Rating Worksheet SA1).

Moderate-high impacts are anticipated for viewers associated with the Shakespeare Ghost Town, where the Project would be viewed crossing rolling terrain in a natural landscape setting (Link B112) (see Visual Contrast Rating Worksheet LC32). The Project would be backdropped by adjacent terrain, reducing structure contrast. Implementation of SE 7 could reduce contrast of the proposed structures.

Travel Routes

Impacts would typically be moderate-high where the Project would cross US Route 180 and I-10, associated with a moderate level of concern for travel route viewers (see Visual Contrast Rating Worksheet LC27 and associated Simulation 28) where there are no existing transmission lines. SE 10 would be applied for areas of moderate-high impacts to moderately reduce contrast where the Project would cross the travel routes identified above.

Compliance

Portions of Subroute 3B would not initially be in compliance with VRM Class II lands, where strong to moderate-strong project contrast would occur in conjunction with high concern viewers; nor would it initially be in compliance with VRM Class III lands, where moderate-high project contrast would occur in conjunction with residential viewers and moderate concern travel routes.

The following is a discussion of these individual areas of noncompliance, including the areas where existing landscape conditions and selective mitigation measures that could be applied to reduce contrast would bring these portions of Subroute 3B into compliance with VRM objectives:

- *Link B112* – High concern level recreation viewers associated with the CDNST would have views of strong to moderate-strong project contrast as Link B112 crosses VRM Class II land. Existing regional modifications along this portion of the subroute include mining operations, multiple gas pipelines, a distribution line, water tanks, communication towers, access roads, and the town of Lordsburg. From the trail, these modifications are seen in the middleground or background distance zone and may appear co-dominant to subordinate in the landscape. Although the Project would be viewed in context with these existing modifications, it would still dominate views from the trail when crossing the CDNST. SE 10 would be implemented to maximize structure spans when crossing the trail, which would reduce project contrast from moderate-high to moderate. Link B112 would remain noncompliant with VRM Class II objectives. Note that the long viewing duration associated with a slower rate of travel for hikers, horseback riders, and mountain cyclists is why, even with industrial type visual modifications, the Project would still not comply with VRM class II objectives.

  Views of moderate-strong project contrast would be visible to travel route viewers associated with I-10, as Link B112 crosses VRM Class III land. The Project would be viewed for a relatively short duration (due to the high rate of speed of I-10) and in context with other linear features and modifications. In addition, SE 10 would be employed to maximize the span of the Project where it crosses the interstate; therefore, project contrast would be reduced to moderate and compliance with VRM Class III objectives is anticipated.

- *Link B150b* – An area where moderate-high project contrast and dispersed residential viewers near San Simon, Arizona occur, as the Project crosses VRM Class III land. The application of SE 16 would reduce contrast for residential viewers to a moderate level, thereby bringing this portion of the subroute into compliance with VRM objectives by moving it next to the adjacent pipeline to the north.

Local Alternative and Crossover Links for Route Group 3

Scenery

Crossover Links 3A, 3B: Crossover links B111 and B140 cross Class C scenery similar to Subroute 3A. Link B111 would have lower overall impacts than Link B140, because it would parallel an existing 115 kV transmission line; therefore, vertical elements have already been introduced into the landscape and structure contrast would be reduced. In addition, construction disturbance for access would not be necessary, due to the existing access road that would parallel the link.

Viewing Locations and KOPs

Crossover Links 3A, 3B: Low-moderate to low impacts are anticipated for residential viewers within 1 to 2 miles of crossover links B111 and B140. There are no recreation or travel route viewers associated with these crossover links.

Compliance

Crossover Links 3A, 3B: BLM lands crossed by crossover links B111 and B140 are in compliance with VRM objectives.

4.9.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Scenery

The majority of impacts (approximately 43.2 percent) along Subroute 4A are anticipated to be moderate within high quality Class B scenery. Moderate-high impacts (approximately 30.9 percent) are anticipated to occur along this subroute in Class A and Class B scenery associated with the San Pedro River, and foothills and bajadas, respectively. Low-moderate impacts (approximately 16.9 percent) are anticipated to occur in moderate quality Class B and low quality Class C scenery, associated with valley plains. Low impacts (approximately 8.9 percent) are anticipated within Class C scenery, where the subroute would parallel existing transmission lines. High impacts are not anticipated along this subroute.

Moderate-high impacts are anticipated to occur, where new access roads would be required on level terrain within Class A scenery associated with the San Pedro River and adjacent floodplain (Link C592). Landscape contrast would be weak to weak-moderate on level terrain with modifications, including travel routes (e.g., SR 77 and unpaved roads) and a pipeline. Landscape contrast may increase at the river crossing where riparian vegetation may be denser, resulting in higher contrast where right-of-way clearing is required. SE 14 would reduce impacts by limiting the amount of permanent clearing of riparian vegetation and selectively removing vegetation to blend the edge of the right-of-way into adjacent vegetation patterns, as practicable and appropriate. Strong structure contrast is anticipated for the river crossing where there are no existing transmission lines, and could be reduced by allowing conductors to span sensitive areas such as the river and floodplain within the limits of standard tower design. Thus, residual impacts to high quality Class A scenery would be reduced to moderate.

Moderate-high to moderate impacts are anticipated along Subroute 4A, where Class B scenery would be crossed by gently to moderately rolling bajadas, transitional foothills associated with the Galiuro Mountains, and the Sonoran Desert Valley. Overall, the introduction of vertical elements to a predominantly natural landscape setting would create strong structure contrast, regardless of terrain. Strong to moderate landscape contrast would occur for portions of this subroute east of the San Pedro River where the landscape is more topographically diverse (i.e., heavily dissected with steeper terrain), resulting in moderate-high impacts. West of the San

Pedro River the terrain is less steep, with more rolling hills to flat valleys; landscape contrast is anticipated to be primarily moderate to weak-moderate. In addition, the presence of cultural modifications such as major travel routes (e.g., SR 79), unpaved roads, and multiple pipeline routes reduce landscape contrast, resulting in moderate impacts to Class B scenery. Contrast would be reduced by implementing SE 14, which would limit the amount of permanent clearing of piñon-juniper and oak woodland (links C153b, C170, and C178), and Sonoran Desert vegetation (links C173, C595, C620, C760, C780, C830, and C840). Contrast would be further reduced by minimizing the separation between links C760, C780, C830, and C840, and existing pipeline routes to the extent practicable, limiting ground disturbance and vegetation clearing required for new access roads (SE 16).

Low-moderate impacts are anticipated to occur along this subroute in Class C scenery associated with the San Simon Valley (B153a), Bear Springs Flat north of the Pinaleño Mountains (Link B153b), and valley plains northwest of the Picacho Mountains (Link C850). Impacts would be reduced to low along Link 153a, where the Project would parallel an existing 230 kV transmission line, US Route 191, and a pipeline route. Low impacts are also anticipated along Link C880a near the Pinal Central Substation, where the Project would parallel an existing 500 kV transmission line and 115 kV transmission lines, to be located less than 1 mile from the subroute.

Viewing Locations and KOPs

Residential

Generally, Subroute 4A would have limited areas of high impacts to residential viewers with views of the Project within close proximity (approximately 0.5 mile). Residential impacts along Subroute 4A from Link C170 to the Pinal Central Substation are primarily dispersed and associated with Klondyke, Mammoth, Eloy, and La Palma. High to moderate-high impacts are anticipated where existing transmission lines are not present and where the Project would be viewed within 0.5 mile for residences near Klondyke and Mammoth. Eloy and La Palma residences are primarily associated with agriculture and other modifications, including several transmission lines and the Pinal Central Substation. Impacts are anticipated to be high for residences immediately adjacent to the Project (within 0.5 mile) where existing transmission lines are not present, and moderate when parallel to existing transmission lines (see Visual Contrast Rating Worksheet TU33 and associated Simulation 46a). The majority of this subroute segment would have low-moderate to low impacts for dispersed residences with views of the Project beyond 2 miles.

Impacts for residences between the Willow-500 kV Substation and Link C170 are concentrated near Swift Trail Junction, Safford, and Pima. Links B153a and B153b would traverse flat to rolling terrain where there are no existing transmission lines, resulting in strong to moderate-strong contrast. Residences with views of these links would have isolated areas of high to moderate-high impacts where the Project would be viewed within 0.4 mile (see Visual Contrast Rating Worksheet SA4 and associated Simulation 32). Moderate impacts are anticipated for residences with views of the Project, between 0.5 mile and 1 mile, crossing relatively flat terrain where associated access would be screened and structures would be backdropped by adjacent terrain, thus reducing contrast. Residential KOPs associated with moderate impacts along this

subroute include Lebanon and Mammoth residences (see Visual Contrast Rating Worksheet TU1). Low to low-moderate impacts are anticipated for the majority of links B153a and B153b where the Project would be viewed beyond 1 mile (see Visual Contrast Rating Worksheet SA6). A portion of Link B153a would parallel an existing 230 kV transmission line, which would reduce project contrast for a few dispersed residences with views of the Project within 2 miles, resulting in low impacts.

Generally, adjacent terrain would backdrop the structures and the implementation of SE 7 could reduce structure contrast for links B153a and C170.

Recreation

High impacts are anticipated where the Project would cross the Arizona National Scenic Trail in the Black Hills, northwest of Mammoth (Link C620). The Project would cross rolling to steep terrain where views would range between unobstructed to completely screened (see Visual Contrast Rating Worksheet TU3) for Arizona Trail users. SE 10 would be applied to maximize distance of the span of structures and modify the tower design to SSL (SE 7), to reduce contrast at the trail crossing.

Moderate impacts are anticipated for high concern recreation viewers associated with the Bear Springs Badlands ACEC, because Link B153b would be within 0.75 mile of the southern ACEC boundary. Along Tripp Canyon Road/County Road 286, which parallels the southern boundary, recreation viewers would have unobstructed views of the Project crossing flat to rolling terrain; however, it would be backdropped by adjacent terrain, thereby reducing contrast (see Visual Contrast Rating Worksheet SA8). Implementation of SE 7 along Link B153b could reduce structure contrast.

Moderate-high impacts are anticipated for the Tom Mix Memorial Rest Area, where the Project would be visible in a relatively flat terrain with existing 115 kV transmission structures (see Visual Contrast Rating Worksheet TU31). Impacts would range between moderate and low-moderate for Cluff Ranch Wildlife Area. In this setting, where modifications are minimal, views of the Project would be intermittently screened by vegetation and terrain for viewers within 0.75 mile (see Visual Contrast rating Worksheet SA7).

Low impacts are anticipated for the Santa Teresa Wilderness and Aravaipa Canyon Wilderness area, where the Project would be screened by vegetation and terrain for viewers within 3.75 miles. Limited views of the Project may occur from superior views (i.e., mountain ridges); however, project contrast would be reduced at this distance. Impacts to Rug Road, a travel route used to access Aravaipa Canyon Wilderness, are described below.

Travel Routes

High to moderate-high impacts would be concentrated where the Project crosses or is within close proximity to the following routes: US Route 191, SR 266, SR 366/Swift Trail Parkway (see Visual Contrast Rating Worksheet SA5 and associated Simulation 33a and 33b), Ash Creek Road (Concern Level 1 Route), portions of Klondyke Road (see Visual Contrast Rating Worksheet SA12), Rug Road (see Visual Contrast Rating Worksheet SA14 and associated Simulation 34a and 34b), and the Pinal Pioneer Parkway (see Visual Contrast Rating Worksheet

TU30). High impacts are anticipated for viewers along Swift Trail Parkway, Ash Creek Road, Klondyke Road, and Rug Road, with unobstructed views of Subroute 4A crossing these scenic designated travel routes where modifications are minimal.

Impacts are anticipated to be moderate where the Project would cross or is within close proximity to moderate concern level travel routes, including Tripp Canyon Road/FR 286, portions of Klondyke Road (see Visual Contrast Rating Worksheet SA13), 4 Mile Road, SR 77 (see Visual Contrast Rating Worksheet TU2 and associated Simulation 35), and Freeman Road (see Visual Contrast Rating Worksheet TU36).

SE 10 would reduce contrast where travel routes associated with high to moderate impacts are crossed. SE 7 would reduce contrast where adjacent terrain would backdrop the Project. The use of SE 11 and (potentially) SE 13 in the Rug Road area would also reduce landscape contrast associated with access roads and structure sites.

Other

Low impacts are anticipated for the St. Anthony's Greek Orthodox Monastery, as the Project would be located beyond 3 miles in a natural landscape setting (see Visual Contrast Rating Worksheet TU32).

Compliance

A portion of Subroute 4A (along Link C620) would result in high to moderate-high project contrast, which would not initially comply with VRM Class III objectives. However, viewers associated with Freeman Road would have a relatively short viewing duration. In addition, the Project would be partially screened and viewed in context with an existing pipeline; therefore, this portion of Subroute 4A would be compliance with VRM Class III objectives.

Subroute 4B – Sulphur Springs Valley

Scenery

Impacts along Subroute 4B are identical to Subroute 4A from Link C170 to Pinal Central Substation. Impacts along Subroute 4B, where it diverges from Subroute 4A, are similar through Class B and Class C scenery. The majority of impacts (approximately 34.1 percent) along this subroute are anticipated to be moderate-high; moderate impacts (approximately 36.2 percent) are anticipated to occur within high quality Class B scenery; low-moderate impacts (approximately 25.3 percent) are anticipated to occur within moderate quality Class B and low quality Class C scenery; and low impacts (approximately 4.3 percent) are anticipated to occur within Class C scenery where the subroute would parallel existing transmission lines. High impacts are not anticipated.

Moderate-high to moderate impacts would occur where this subroute crosses Class B scenery associated with bajadas south of the Pinaleño Mountains (Link C90) and north of the Sulphur Springs Valley (Link C130b). Removal of vegetation for the construction of new access roads

would create moderate to moderate-high landscape contrast. Structure contrast would be strong along links C130b and C90, due to the introduction of vertical elements into a predominantly natural landscape setting, resulting in moderate-high to moderate impacts. Impacts would be reduced to low-moderate along Link C130a and portions of Link C90 within the Sulphur Springs Valley, where the landscape has been modified by roads and agricultural development, thereby reducing landscape contrast.

Low-moderate impacts are anticipated along Link C71, which would cross Class B scenery associated with the southern foothills of the Pinaleño Mountains. Structure contrast would be reduced where it would parallel two existing 345 kV transmission lines (approximately 0.35 mile to the north). Structure contrast would also be reduced along Link C72, crossing similar Class B scenery, when immediately adjacent to the two 345 kV transmission lines, resulting in low impacts. Contrast along Link C71 would be reduced by minimizing the separation of the Project to the existing 345 kV transmission lines, to the extent practicable, limiting ground disturbance and vegetation clearing required for new access roads within Class B scenery (SE 16).

Viewing Locations and KOPs

The majority of Subroute 4B is similar to Subroute 4A, thus impacts to viewers will be discussed for links that occur primarily in the Sulphur Springs Valley and that are not similar to Subroute 4A (links C71, C72, C90, C130a, and C130b).

Residential

Residences in this area are generally dispersed throughout the Sulphur Springs Valley and south of the Pinaleño Mountains. Limited areas of moderate impacts are anticipated for these residences where the Project would be viewed within 1 to 2 miles in a setting with minimal modifications. Low-moderate to low impacts are anticipated for the majority of links C90, C130a, and C130b, where the Project would be viewed beyond 1.0 mile in relatively flat terrain and/or where the Project would be viewed in context with an existing 345 kV transmission line. There are no recreation viewers associated with links C71, C72, C90, C130a, and C130b.

Travel Routes

Scenic or high concern level travel routes crossed by or within close proximity of Subroute 4B include Bonita Aravaipa Road (see Visual Contrast Rating Worksheet SA11). High impacts are anticipated for viewers along this road, with unobstructed views of Subroute 4B crossing these scenic designated travel routes where modifications are minimal. Impacts would be low-moderate for travel route viewers along Bonita Aravaipa Road where the Project would be viewed beyond 3 miles in relatively flat terrain (see Visual Contrast Rating Worksheet SA9).

Subroute 4B also crosses Fort Grant Road and High Creek Road, travel routes associated with a moderate concern level; impacts are anticipated to be moderate-high. This subroute would cross flat to rolling terrain with minimal modifications.

SE 10 would reduce contrast at these travel route crossings, and SE 7 would reduce contrast for portions of the Project backdropped by adjacent terrain.

Compliance

Compliance with visual resource management objectives for Subroute 4B would be the same as those discussed for Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Scenery

The majority of impacts (approximately 31.7 percent) along this subroute are anticipated to be moderate in Class B scenery associated with the San Pedro River Valley, transitional bajadas, and Sonoran Palo Verde Desert plains; moderate-high impacts (approximately 17.8 percent) are also anticipated within the San Pedro River Valley; and low-moderate and low impacts (approximately 25.9 percent and 24.6 percent, respectively) are anticipated to occur within Class B scenery associated with Sonoran Palo Verde Desert plains and Class C scenery. High impacts to scenery are not anticipated along this subroute.

Low-moderate impacts are anticipated to occur within Class B scenery associated with the southern foothills of the Pinaleño Mountains (links C71 and C71a) and bajadas (Link C110). These links parallel two existing 345 kV transmission lines. Low-moderate impacts would also occur within low quality Class C scenery associated with valley plains south of the Winchester Mountains (Link C260). Impacts would be reduced to low, where the subroute parallels two existing 345 kV transmission lines within Class B scenery (agricultural lands) and Class C scenery associated with the Sulphur Springs Valley (Link C110). Contrast could be reduced by minimizing the separation of the Project (links C71a, C110, and C212) to existing transmission line routes, to the extent practicable; limiting ground disturbance and vegetation clearing within Class B scenery (SE 16).

Moderate-high to moderate impacts are anticipated to occur along Subroute 4C2c, where it crosses Class B scenery associated with the west side of the San Pedro River Valley. Along the west side, the terrain is not as steep or as highly dissected as the east side of the river valley; thus, moderate impacts are anticipated for the majority of links C441 and C450. In addition, there are several existing roads and pipeline routes paralleling Link C450, which modify the landscape setting. Contrast along Link C450 could be further reduced by minimizing the separation of the Project to the existing pipeline route, to the extent practicable, limiting ground disturbance and vegetation clearing within Class B scenery (SE 16).

Impacts in Class B and Class C scenery associated with Link C680 are anticipated to be moderate to low, because it would parallel multiple transmission lines, ranging from one to two 115 kV transmission lines, to a 500 kV transmission line and a 115 kV transmission line. In addition to reduced structure contrast, landscape contrast would be reduced where access roads exist for these transmission lines.

Viewing Locations and KOPs

Residential

Subroute 4C2c residential viewers include the Sulfur Springs Valley (near Willcox), San Pedro Valley (including Redington, and San Manuel), Oracle, the Red Rock/Longhoen Trail area, Eloy, and La Palma. High impacts to residences are anticipated near La Palma with views of strong project contrast while immediately adjacent to the proposed Project. Moderate impacts are anticipated for residences near Sulfur Springs Valley (see Visual Contrast Rating Worksheet SA10) and Oracle (see Visual Contrast Rating Worksheet TU4 and associated Simulation 36), where the Project would cross flat to rolling terrain and would be viewed in context with existing linear facilities within 1 mile. Moderate impacts associated with this subroute would occur throughout the San Pedro River Valley and west of San Manuel, where the proposed structures would be visible in relatively flat to rolling terrain in natural landscape settings. In similar conditions, low-moderate to low impacts would occur where the Project would be viewed 1 mile and beyond from residences (see Visual Contrast Rating Worksheets TU9 and TU7). Landscape contrast associated with access may be visible from these superior views; however, the structures would be backdropped by adjacent terrain, which would reduce project contrast. Low-moderate impacts are anticipated for residences with views of the Project in context with several existing transmission lines in flat terrain (see Visual Contrast Rating Worksheet TU28 and TU33).

Recreation

High impacts are anticipated for users of the Arizona National Scenic Tail near the Tiger Mine Trailhead, where Subroute 4C2c crosses the trail, northeast of Oracle (Link C670). The Project would cross rolling terrain where unobstructed views would occur for high sensitivity viewers along the trail (see Visual Contrast Rating Worksheet for TU5 and associated Simulation 37a and 37b). SE 10 would be applied to maximize distance of the span of structures at the trail crossing; and SE 7 would be applied to reduce contrast. Moderate-high to moderate impacts are anticipated for recreation viewers Buehman Canyon Trail. The Project would be visible within 1 mile of these moderate concern level viewers in a landscape with few modifications. Low impacts are anticipated for high sensitivity viewers at Oracle State Park (and associated trails/visitor areas) and Saddlebrook Ranch Golf Club because the Project would be viewed within 1 mile; however, terrain and vegetation would screen the Project, thereby reducing contrast. Low impacts are anticipated for viewers associated with the Biosphere, where views of the Project would occur beyond 2.5 miles in a setting with limited modifications (see Visual Contrast Rating Worksheet TU27). Impacts are anticipated to be low-moderate to low for dispersed recreation users associated with the Rincon Mountains Wilderness, Saguaro National Park (East), and CNF (and associated trails/trailheads), where views of the Project would occur 2 miles and beyond. Visual contrast would be reduced because views of the Project may be screened and/or backdropped by terrain.

Travel Routes

The Project would cross the Redington Road Scenic Drive (a high concern travel route) south of Redington (Link C441). High impacts would occur at this crossing where access may be visible in rolling terrain with minimal modifications. Low-moderate impacts are anticipated for the Pinal

Pioneer Parkway, where Link C680 crosses this route while paralleling multiple transmission lines (see Visual Contrast Rating Worksheet TU35). Low impacts are anticipated for the Mount Lemmon Road, as views of the Project would be beyond 3 miles (see Visual Contrast Rating Worksheet TU8).

Generally, impacts to moderate sensitivity travel routes are anticipated to be moderate-high when crossed by Subroute 4C2. Travel routes crossed by this subroute include SR 77, Cascabel Road (see Visual Resource Contrast Rating Worksheet TU11), Muleshoe Ranch Road (see Visual Contrast Rating Worksheet SA15), Black Hills Mine Road/Catalina Ridge, Webb Road, North Redington Road, and Park Link Drive (see Visual Resource Contrast Rating Worksheet TU29). Moderate-high impacts for moderate concern travel routes are anticipated for viewers associated with SR 77 (see Visual Contrast Rating Worksheet TU34), Cascabel Road, and Muleshoe Ranch Road. Travel route viewers would have unobstructed views of moderate-strong project contrast in landscapes with few modifications. Low impacts are anticipated for the Tom Mix Memorial Rest Area, approximately 1.5 miles from the Project, because it would be screened by vegetation in relatively flat terrain with existing 115 kV transmission structures (see Visual Contrast Rating Worksheet TU31).

Implementation of SE 10 in areas of high to moderate impacts would reduce contrast for travel route crossings. In addition, SE 7 would reduce contrast in areas where varying landform would provide a background condition for the Project.

Other

Low impacts are anticipated for the St. Anthony's Greek Orthodox Monastery, as the Project would be located beyond 3 miles in a natural landscape setting (see Visual Contrast Rating Worksheet TU32).

Compliance

A portion of the BLM preferred alternative route (along links C818 and C820) would not initially be in compliance with VRM Class III objectives where moderate-strong contrast would occur in conjunction with moderate concern viewers associated with Park Link Road. However, based on landscape considerations in this area, the Project could be considered compliant with VRM objectives because of the relatively short viewing duration of the Project and the amount of vegetative screening near this crossing.

Subroute 4C1 – East of San Pedro River

Scenery

The majority of impacts (approximately 45.9 percent) along this subroute are anticipated to be moderate in Class B scenery associated with the San Pedro River Valley, transitional bajadas, and Sonoran Palo Verde Desert plains. Moderate-high impacts (approximately 25.3 percent) are also anticipated along this subroute. Low-moderate and low impacts (approximately 15.1 percent and 12.2 percent, respectively) are anticipated to occur within Class B scenery associated with

Sonoran Palo Verde Desert plains and Class C scenery, where the Project would parallel existing transmission lines. High impacts (approximately 1.5 percent) are anticipated to occur within Class A scenery within the San Pedro River Valley.

High impacts are anticipated to occur within high quality Class A scenery associated with Hot Springs Canyon (Link C331) and the Redfield Canyon (Link C470). New access roads and construction disturbance on the steep slopes would introduce strong landscape contrast within a natural, unmodified landscape setting. Overall, strong structure contrast is anticipated in these high-quality, unmodified landscape settings where the Project would introduce vertical elements. Contrast would be reduced by implementing selective mitigation measures that would allow conductors to span the canyons within the limits of standard tower design, thus reducing disturbance on steep slopes (SE 8 and 10). Moderate-high to moderate impacts are also anticipated along Link C660 in Class A scenery associated with the San Pedro River and floodplain. Weak to weak-moderate landscape contrast would occur where there are several existing roads, and an existing transmission line would reduce structure contrast. In addition, this crossing would be immediately adjacent to the San Manuel Copper Mine Complex to the west, which significantly modifies the existing landscape setting. Therefore, impacts to Class A scenery associated with the San Pedro River and floodplain are anticipated to be moderate.

Moderate-high to moderate impacts are anticipated to occur along Subroute 4C1 where it crosses Class B scenery associated with the east side of the San Pedro River Valley. Strong landscape contrast is anticipated along Link C470 (south of Redfield Canyon) where the Project would cross highly dissected bajadas with steep terrain. In addition, there are no existing roads along this portion of the subroute; therefore, new access would be required for construction. North of the Redfield Canyon (also along Link C470), landscape contrast would be reduced to moderate, where the terrain is less steep and where existing roads cross or parallel this subroute. Overall, strong structure contrast is anticipated in landscape settings with minimal modifications where the Project would introduce vertical elements, resulting in moderate-high to moderate impacts for Class B scenery. Impacts along the west side of the San Pedro River Valley for Subroute 4C1 (links C660, C661, C670, C690, C691, and C693) would be moderate-high to moderate in Class B scenery associated with gently to moderately rolling transitional bajadas and Sonoran Desert Valley. Landscape contrast would be reduced to moderate where links C690, C691, and C693 parallel existing pipelines that have modified the landscape. Contrast could be reduced by minimizing the separation of the Project to existing pipeline routes to the extent practicable, limiting ground disturbance and vegetation clearing within Class B scenery (SE 16).

Low-moderate impacts are anticipated to occur within Class B scenery associated with the southern foothills of the Pinaleño Mountains (links C71 and C71a) and bajadas (Link C110). These links parallel two existing 345 kV transmission lines. Low-moderate impacts would also occur within low quality Class C scenery associated with valley plains south of the Rincon Mountains (Link C270). Impacts would be reduced to low where the subroute parallels two existing 345 kV transmission lines within Class B scenery (agricultural lands) and Class C scenery associated with the Sulphur Springs Valley (Link C110). Contrast could be reduced by minimizing the separation of the Project (links C71a, C110, and C212) to existing transmission line routes, to the extent practicable, limiting ground disturbance and vegetation clearing within Class B scenery (SE 16).

Viewing Locations and KOPs

Residential

Moderate impacts are anticipated for high concern residential viewers in the Sulphur Springs Valley (see Visual Contrast Rating Worksheet SA10), San Manuel, and dispersed residences within the San Pedro River Valley (see Visual Contrast Rating Worksheet TU6 and associated Simulation 38), where structures and portions of access may be visible to residences beyond 1 mile in flat to fairly rugged terrain with few modifications.

Low-moderate to low impacts are anticipated for residences with views 1 mile and beyond or where viewed parallel to existing transmission lines. In addition to impacts discussed for existing high concern residential viewers, impacts were identified for the Willow Springs planned development (Link C691). Impacts are anticipated to be low-moderate in relatively flat terrain in a natural landscape setting.

Recreation

High impacts are anticipated for users of the Arizona National Scenic Tail near the Tiger Mine Trailhead, where Subroute 4C1 crosses the trail, northeast of Oracle (Link C670). The Project would cross rolling terrain where unobstructed views would occur for high sensitivity viewers along the trail (see Visual Contrast Rating Worksheet for TU5 and associated Simulation 37a and 37b). SE 10 would be applied to maximize distance of the span of structures at the trail crossing, and SE 7 would be applied using SSL instead of guyed-"V" structures to reduce contrast. Impacts for high concern recreational viewers associated with Redfield Canyon Wilderness are anticipated to be moderate, where views of the Project may occur within 2 miles. The Project would cross rolling terrain in an unmodified landscape setting; however, views may be partially to completely screened for dispersed recreation viewers. Low-moderate impacts are anticipated for trails associated with the Muleshoe Ranch, where the Project may be intermittently screened by topography and vegetation.

Travel Routes

Moderate-high impacts for high concern travel routes are anticipated for viewers associated with the Pinal Pioneer Parkway, which is crossed by Subroute 4C1. Impacts are anticipated to be low-moderate to low for areas where structures would be visible beyond 1 mile in a natural landscape setting (see Visual Contrast Rating Worksheet TU30).

Impacts for moderate concern travel routes are also anticipated for viewers associated with Muleshoe Ranch Road, San Pedro River Road, North Redington Road/SR 76, SR 77 (see Visual Contrast Rating Worksheet TU34), and Freeman Road (see Visual Contrast Rating Worksheet TU36). Impacts are anticipated to be moderate-high when crossed by this subroute in a landscape with limited modifications. SE 10 would reduce contrast at these travel route crossings by maximizing structure span.

Compliance

Portions of this subroute would not initially be in compliance with VRM Class II land, where high to moderate-strong contrast would occur in conjunction with viewers associated with high concern recreation viewers and dispersed residences. In addition, portions of this subroute would not initially be in compliance with VRM Class III land in conditions similar to those discussed for subroutes 4A and 4B.

The following is a discussion of these individual areas of initial noncompliance, including existing landscape conditions and selective mitigation measures that could be applied to reduce contrast and bring these portions of the subroute into compliance with VRM objectives:

- *Links C331 and C361* – An area where high to moderate-strong contrast and high concern viewers associated with high concern recreation viewers in the Muleshoe Ranch Area and dispersed residences occur as the Project would cross VRM Class II land; contrast could be reduced through the application of SE 5 and SE 7. In addition, consideration of landscape conditions that provide large portions of screening of the Project would bring this portion of the subroute into compliance with VRM objectives.
- *Link C693* – This condition is similar to that discussed for subroutes 4A and 4B, with the exception of being closer to the pipeline that occurs in this area, and is anticipated to be in compliance with BLM VRM Class III (default) land.

Subroute 4C2 – West of San Pedro River

Scenery

Moderate impacts (approximately 35.2 percent) are anticipated along the majority of this subroute within Class B scenery, including the San Pedro River Valley. Moderate-high impacts (approximately 19.8 percent) are also anticipated within the San Pedro River Valley. Low to low-moderate impacts (approximately 20.4 percent and 24.2 percent, respectively) are anticipated within Class B scenery associated with gently rolling bajadas and the Sonoran Desert Valley. High impacts are not anticipated along this subroute.

Moderate-high impacts anticipated along Link C276 where it crosses Class A scenery associated with the San Pedro River and floodplain are similar to Subroute 4A (Link C592), except less Class A scenery would be crossed (approximately 0.33 mile) as compared to Subroute 4A (approximately 0.86 mile).

Moderate-high to moderate impacts are anticipated to occur along Subroute 4C2 where it crosses Class B scenery associated with the west side of the San Pedro River Valley. Along the west side, the terrain is not as steep or as highly dissected as along Subroute 4C1 on the east side, thus moderate impacts are anticipated for the majority of links C441 and C450. In addition, there are several existing roads near this subroute and pipeline routes that parallel Link C450, which modify the landscape setting. Contrast along Link C450 could be further reduced by minimizing the separation of the Project to the existing pipeline route, to the extent practicable, limiting ground disturbance and vegetation clearing within Class B scenery (SE 16).

Class B and Class C scenery associated with Link C680 are similar to Subroute 4C1. Impacts along Link C680 are anticipated to be moderate to low because it parallels multiple transmission lines. In addition to reduced structure contrast, landscape contrast would be reduced where access roads exist for these transmission lines.

Viewing Locations and KOPs

Residential

Subroute 4C2 residential viewers include the San Pedro Valley (including Cascabel, Redington, and San Manuel), Oracle, and the Red Rock/Longhoen Trail area. This subroute would have limited high to moderate-high impacts for residences near Cascabel. Link C276 crosses flat to rolling terrain associated with the San Pedro River Valley, which has been minimally modified. Residential views of strong to moderate-strong contrast may be partially screened by vegetation; however, a portion of Link C276 would also be skylined when crossing the escarpment.

Moderate impacts are anticipated for residences near Oracle (see Visual Contrast Rating Worksheet TU4 and associated Simulation 36), where the Project would cross rolling terrain and would be viewed in context with existing transmission lines and a pipeline corridor within 1 mile. Moderate impacts associated with this subroute would occur throughout the San Pedro River Valley and west of San Manuel, where the proposed structures would be visible in relatively flat to rolling terrain in natural landscape settings. In similar conditions, low-moderate to low impacts would occur where the Project would be viewed 1 mile and beyond from residences (see Visual Contrast Rating Worksheets TU9 and TU7).

Recreation

Moderate-high to moderate impacts are anticipated for recreation viewers along Buehman Canyon Trail. The Project would be visible within 1 mile of these moderate concern level viewers in a landscape with few modifications. Low impacts are anticipated for viewers associated with Saddlebrook Ranch Golf Club and the Biosphere No. 2, where views of the Project would occur beyond 2.5 miles in a setting with limited modifications (see Visual Contrast Rating Worksheet TU27). Impacts are anticipated to be low-moderate to low for dispersed recreation users associated with Oracle State Park and CNF, where views of the Project would occur 2 miles and beyond. Visual contrast would be reduced because views of the Project may be screened and/or backdropped by terrain.

Travel Routes

The Project would cross the Redington Road Scenic Drive (a high concern travel route) south of Redington (Link C441). High impacts would occur at this crossing where access may be visible in rolling terrain with minimal modifications. Low-moderate impacts are anticipated for the Pinal Pioneer Parkway, where Link C680 crosses this route while parallel to multiple transmission lines (see Visual Contrast Rating Worksheet TU35). Low impacts are anticipated for the Mount Lemmon Road, as views of the Project would be beyond 3 miles (see Visual Contrast Rating Worksheet TU8).

Generally, impacts to moderate sensitivity travel routes are anticipated to be moderate-high when crossed by Subroute 4C2. Travel routes crossed by this subroute include Cascabel Road (see Visual Resource Contrast Rating Worksheet TU10 and associated Simulation 39) and Muleshoe Ranch Road, Black Hills Mine Road/Catalina Ridge, Webb Road, North Redington Road, and Park Link Drive (see Visual Resource Contrast Rating Worksheet TU29). Moderate-high impacts for moderate concern travel routes are anticipated for viewers associated with Cascabel Road and Muleshoe Ranch Road. Travel route viewers would have unobstructed views of moderate-strong project contrast in landscapes with few modifications.

Implementation of SE 10 in areas of high to moderate impacts would reduce contrast for travel route crossings. In addition, SE 7 would reduce contrast in areas where varying landform would provide a background condition for the Project.

Compliance

Compliance would be similar to Subroute 4C2c.

Subroute 4C3 – Tucson

Scenery

Impacts along Subroute 4C3 are identical to Subroute 4C2, from Willow-500 kV Substation to Link C212, and from Link C820 to where it would terminate at the Pinal Central Substation. The majority of impacts along this subroute are anticipated to range between low and low-moderate (approximately 36.7 percent and 29.0 percent, respectively), within Class B and Class C scenery where the subroute would parallel existing transmission lines and pipeline routes. Moderate-high impacts (approximately 3.2 percent) are anticipated where the subroute crosses high quality Class A scenery associated with the San Pedro River and Cienega Creek. Moderate impacts are anticipated along this subroute through Class B scenery (approximately 20.3 percent). Approximately 10.7 percent of this subroute crosses developed areas associated with the Tucson metropolitan area. High impacts to scenery are not anticipated along Subroute 4C3.

Moderate-high impacts are anticipated along Link F600 where it crosses the Cienega Creek Natural Preserve (Class A scenery). Existing linear features, such as pipeline routes (approximately 0.10 mile north of the subroute), travel routes (e.g., I-10), a railroad corridor, and trails have introduced contrast adjacent to this landscape setting. Disturbance to riparian vegetation for right-of-way clearing would create landscape contrast. Proposed structures would introduce vertical elements into the landscape, resulting in strong structure contrast. SE 14 would reduce impacts by selective removal of overstory riparian vegetation and the blending of harsh lines created for access. SE 10 would maximize tower spans to avoid sensitive areas such as the creek, where feasible and within engineering limits. Therefore, impacts to high quality Class A scenery associated with Cienega creek would be moderate. Class A scenery associated with the San Pedro River would have moderate impacts because Link F40a parallels two existing 345 kV transmission lines. Contrast would be further reduced by allowing structures to span sensitive areas such as the river and to selectively clear riparian vegetation (SE 10 and SE 14).

Moderate-high to moderate impacts are anticipated to occur along this subroute where Class B scenery associated with moderate rolling bajadas south of the Rincon Mountains would be crossed by portions of Link F600. In this setting, modifications are limited to existing access roads; however, varied terrain would result in stronger landscape contrast for portions of this link crossing south of these mountains. Structure contrast would be reduced to moderate and weak-moderate where the subroute parallels existing transmission lines, reducing project contrast. Contrast would further be reduced by minimizing the separation of the Project to the existing transmission lines, to the extent practicable, limiting ground disturbance and vegetation clearing required for new access roads within Class B scenery (SE 16).

Impacts are anticipated to be low or low-moderate where this subroute parallels one or more existing transmission lines through Class B and Class C scenery (links F40a, F600, F60b, F82, F80, F540, C810, and C810a). Contrast would be reduced by minimizing the separation of the Project to the existing transmission lines, to the extent practicable, limiting ground disturbance and vegetation clearing required for new access roads within Class B and Class C scenery (SE 16).

The landscape setting adjacent to links F111, F112, and F510 has been heavily modified by development associated with the Tucson metropolitan area. In addition, the subroute would parallel existing transmission lines, travel routes (e.g., I-10), railroad corridors, and pipeline routes within the developed area. Thus, contrast to the landscape would be negligible in these highly developed areas.

Viewing Locations and KOPs

Residential

Subroute 4C3 would have higher occurrences of impacts to residential viewers associated with the Tucson metropolitan area (e.g., I-10 corridor). Residences generally occur from the Benson/San Pedro River Valley area west-northwest through the Tucson metropolitan area. Portions of this subroute would have reduced contrast where the Project would parallel existing transmission lines/corridors. High to moderate-high impacts are anticipated for residences immediately adjacent to this subroute (less than 0.5 mile), where the Project would be viewed in both natural landscape settings and highly modified urban settings (see Visual Contrast Rating Worksheet TU24 and TU17). Moderate impacts are anticipated for residential viewers beyond 0.5 mile (see Visual Contrast Rating Worksheet TU12) and/or viewed in context with existing transmission lines. Low-moderate to low impacts would occur when viewed by residences beyond 1 mile and/or when viewed in context with existing transmission lines (see Visual Contrast Rating Worksheet TU28).

Recreation

High to moderate-high impacts are anticipated for the Cienega Creek Preserve, Augie Acuña-Los Niños Park, portions of the Santa Cruz River Park and Juan Bautista de Anza Historic Trail (see Visual Contrast Rating Worksheet TU19 and associated Simulation 43), and Arizona National Scenic Trail at Davidson Canyon (see Visual contrast Rating Worksheet TU37) where the Project would be immediately adjacent to and/or would cross these high concern level recreation

areas. These viewers would have unobstructed views of the Project, primarily structures, with limited views of associated access in both natural landscape settings and in urban development.

Moderate impact recreational viewers include Sentinel Peak Park, portions of the Santa Cruz River Park, and portions of the Juan Bautista de Anza Historic Trail where the Project would be viewed within close proximity; however, contrast would be reduced when viewed in context with existing transmission lines. Low-moderate to low impacts are anticipated for other sensitive recreation viewers that would typically view the Project crossing natural and urban landscape settings, while parallel to existing transmission lines. This includes Saguaro National Park West (see Visual Contrast Rating Worksheet TU25 and associated Simulation 45).

Travel Routes

High to moderate-high impacts would be concentrated where the Project crosses travel routes, and would be viewed within close proximity (less than 0.5 mile) and/or where parallel to existing transmission lines. These travel routes include portions of I-10 (see Visual Contrast Rating Worksheet TU14 and associated Simulation 41), Marsh Station Road, Old Sonoita Highway, Colossal Cave Road, and Valencia Road. Low impacts are anticipated for scenic roadways located within Tucson, with views of the Project beyond 2 miles. In addition, the Project may be partially to completely screened from viewers along these scenic routes and would be viewed in the context of an urban setting (see Visual Contrast Rating Worksheet TU18).

Impacts are anticipated to be moderate-high where the Project crosses or is viewed within close proximity (less than 0.5 mile) of the following moderate concern level travel routes: Cascabel Road (see Visual Resource Contrast Rating Worksheet TU11), Ocotillo Road, and portions of I-10 and I-19. Moderate impacts would occur for viewers along Muleshoe Ranch Road where the Project would parallel an existing transmission line (see Visual Contrast Rating Worksheet SA15).

In areas of high, moderate-high, and moderate impacts discussed above, SE 10 would reduce contrast at these travel route crossings.

Other

Low impacts are anticipated for the Ritz Carlton Resort, as the Project would be located beyond 3 miles in a partially modified landscape setting (see Visual Contrast Rating Worksheet TU26).

Compliance

Compliance with VRM objectives for this subroute would be similar as those discussed for Subroute 4C2, with the exception of additional consideration of a dispersed residential viewer near Link C817. A high concern residential viewer would have views of strong to moderate-strong project contrast in VRM Class III (default) land. Selective mitigation measures would not reduce contrast to a moderate level, thus Link C817 would not conform.

Local Alternative and Crossover Links for Route Group 4

Scenery

Local Alternative Link for 4A, 4B, 4C1: Impacts along Local Alternative Link C790 are similar to Subroute 4A (links C780 and C830). Moderate impacts are anticipated where Link C790 crosses Class B scenery associated with the Sonoran Desert Valley. Impacts are reduced to low-moderate along the portion of Link C790 that parallels an existing 115 kV transmission line and US Route 79.

Local Alternatives Links for 4A, 4B, 4C1, 4C2, 4C3 (Pinal Central Substation): Local alternative subroute links C860, C870, and C890 are anticipated to have similar impacts as Subroute 4A crossing similar Class B and Class C scenery.

Local Alternative Link for 4C1: Local alternative Link C692 crosses similar Class B scenery as Subroute 4C1 (Link C691); however, it does not parallel existing pipeline routes. Similar to Subroute 4C1, strong structure contrast would occur where there are no existing transmission lines, resulting in moderate impacts.

Local Alternative Links for 4C2 (Winchester Substation): Impacts along local alternative subroute links C260 and C261 would be identical to impacts along Subroute 4C3. Impacts along Link C201 would range from moderate to moderate-high, where the link crosses Class B scenery associated with rolling bajadas and the eastern foothills of the Rincon Mountains. In moderate to steep terrain, strong landscape contrast would occur where new access would be required. Landscape contrast would be reduced for portions of this link where there is existing access. The Project would also be introducing vertical elements into a landscape setting where cultural modifications are absent; therefore, strong structure contrast would result.

Local Alternative Links for 4C2 (Tortolita Substation): Impacts along Local Alternative Link C812 are anticipated to be higher (moderate to low-moderate) than impacts anticipated for Subroute 4C3 (Link C810) in similar Class B and C scenery. Landscape contrast would be similar (low-moderate) where both links parallel existing roads. Link C810, however, parallels existing transmission lines, reducing structure contrast to weak, thereby resulting in overall low impacts. Link C812 does not parallel existing structures; therefore, structure contrast would be strong and result in higher impacts. Impacts along local alternative subroute links C810, C810a, C812, C813, and C816 would be identical to impacts anticipated along Subroute 4C3. Local alternative subroute links C814, C815, and C680b would have similar impacts (moderate and low) as Subroute 4C2 (links C680 and C818) crossing similar Class B scenery associated with Sonoran Valley plains.

Local Alternative Links for 4C3 (Pantano-Rillito): Impacts along this local alternative subroute are similar to Subroute 4C3, except this alternative would have lower impacts through similar Class A and Class B scenery associated with Cienega Creek (Link F51) and bajadas south of the Rincon Mountains (Link F40b), respectively.

Moderate impacts are anticipated along Link F51 where it crosses Cienega Creek (Class A). Although more Class A scenery would be crossed by this alternative subroute (approximately 0.6 mile) as opposed to the Subroute 4C3 crossing (approximately 0.3 mile), overall impacts would

be lower. Landscape contrast is similar to Subroute 4C3 (weak-moderate) where existing cultural modifications have introduced linear features into the landscape—including existing pipeline routes, railroad corridor, and trails—creating contrast to landform elements of form, line, and color. Moderate structure contrast is anticipated due to the presence of two existing 345 kV transmission lines, approximately 0.35 mile north of the subroute. SE 14 would reduce impacts by decreasing landscape contrast created by the removal of overstory riparian vegetation and the hard line created by the cleared right-of-way/riparian edge. Contrast would be further reduced by allowing conductors to span sensitive areas, such as the creek, within the limits of standard tower design (SE 8).

More occurrences of low to low-moderate impacts are anticipated along this subroute (links F40b, F51, and F60a) than for Subroute 4C3 (Link F600) in similar Class B scenery south of the Rincon Mountains, where the subroute parallels two existing 345 kV transmission lines. Structure contrast is reduced to moderate, due to the presence of similar structure elements of form, line, color, and texture within the landscape. Contrast would further be reduced by minimizing the separation of the Project to the existing transmission lines, to the extent practicable, limiting ground disturbance and vegetation clearing required for new access roads within Class B scenery (SE 16).

Links F81a and F81b cross the developed Tucson metropolitan area. Link F81b parallels an existing 138 kV transmission line. Overall, this local alternative subroute does not parallel as many vertical features (i.e., transmission lines) or horizontal features (i.e., travel routes, pipelines, and railroad corridors) as Subroute 4C3.

Local Alternative Links for 4C3 (Tortolita Substation): Impacts along this local alternative subroute are identical to impacts anticipated for the local alternative links for 4C3 (links F40b, F51, F60a, and F81a) and 4C2 (C812).

Local Alternative Links for 4C1, 4C2, 4C3: Alternative links C90 and C121 cross similar Class B scenery (agricultural landscapes and bajadas) and Class C scenery (Sulphur Springs Valley) as Subroute 4C2; however, impacts are anticipated to range from moderate-high to low-moderate. Structure contrast would be strong for links C90 and C121 where the Project would not parallel existing transmission lines. Local alternative links C72 and C211 parallel two existing 345 kV transmission lines in Class B scenery, resulting in low impacts because contrast would be reduced.

Crossover Links for 4A, 4B, 4C: Moderate impacts are anticipated along the majority of Link C671 crossing Class B scenery on the western side of the San Pedro River Valley, where existing modifications include a pipeline. In addition, Link C671 is adjacent to the Tiger Mine, which has significantly modified the landscape setting.

Crossover Links for 4A, 4B, 4C1, 4C2: Impacts to crossover links C500, C501, C502, and C174 would be similar to those for Subroute 4C1, ranging from moderate-high to moderate, when crossing similar Class B scenery on the east side of the San Pedro River Valley.

Viewing Locations and KOPs

Residential

Local Alternative Link for 4A, 4B, 4C1: Impacts along Local Alternative Link C790 would be similar to those for Subroute 4A (links C780 and C830). Residences within 2 to 3 miles are anticipated to have low-moderate impacts, where views of the Project crossing flat terrain would occur in a setting without existing transmission lines.

Local Alternatives Links for 4A, 4B, 4C1, 4C2, 4C3 (Pinal Central Substation): Impacts for sensitive viewers would be similar to those for viewers in the La Palma area discussed for Subroute 4A.

Local Alternative Link for 4C1: There are no existing residences associated with this local alternative link. However, impacts are anticipated to be similar to Subroute 4C1 (Link C691) for the future Willow Springs development.

Winchester Substation: Moderate impacts to high concern residential viewers associated with Local Alternative Link C201 would occur in similar conditions to those discussed for subroutes 4C2 and 4C3 in the San Pedro River Valley.

Low-moderate to low impacts are anticipated for residential viewers with views of the Project beyond 1 mile in similar conditions discussed for subroutes 4C2 and 4C3.

Local Alternative Links for 4C2 (Tortolita Substation): Portions of the Tortolita Substation local alternative are similar to Subroute 4C3 and its associated local alternative; thus impacts to viewers for this local alternative are described for links C814, C815, and C680b that are not similar to Subroute 4C3.

Moderate impacts for high concern residential viewers, within 0.5 to 1 mile of this local alternative, would occur where the Project would be viewed in context with existing modifications, including transmission lines, a power station, and substation. Low-moderate to low impacts would generally occur where the proposed structures would be viewed beyond 1 mile in similar conditions.

Local Alternative Links for 4C3 (Pantano-Rillito): High to moderate-high impacts are anticipated to occur along this subroute in both natural landscape settings and highly modified urban settings, where the proposed structures would be visible paralleling existing transmission or where the structures would be seen in areas without existing transmission.

Moderate impacts to high concern residential viewers associated with this subroute would occur in similar conditions to those discussed above, with the exception of where the Project is 0.5 mile and beyond residences in areas where the proposed structures would be visible in relatively flat to rolling terrain, and/or within 0.5 mile parallel to existing transmission lines (see Visual Contrast Rating Worksheet TU15). Low-moderate impacts are anticipated where the Project would be viewed beyond 1 mile or would be viewed while parallel to existing transmission lines.

Local Alternative Links for 4C3 (Tortolita Substation): Impacts to local alternative links (F40b, F51, F60a, F81a, and F81b) would be the same as for Pantano-Rillito local alternative links.

Moderate impacts for high concern residential viewers associated with Local Alternative Link C812 would occur where the proposed structures would be visible in relatively flat terrain in natural landscape settings.

Local Alternative Links 4C1, 4C2, 4C3: High impacts are anticipated for this local alternative (Link 121) where the Project would be viewed within 0.5 mile of Sulphur Springs Valley residences. Moderate impacts are anticipated for residences with views of the Project within 0.5 to 1 mile of Link C121, where the Project would be viewed in context with agricultural development.

Crossover Links for 4A, 4B, 4C1: Impacts from these crossover links for high concern residential viewers east and west of Mammoth would be considered low-moderate to low, and generally occur where the proposed structures would be viewed beyond 1 mile in flat to rolling terrain in a natural landscape setting.

Crossover Links for 4A, 4B, 4C1, 4C2: Low impacts are anticipated for Local Alternative Link C671, for high concern residential viewers near Mammoth, where proposed structures would be viewed beyond 3 miles in moderately rolling terrain in a natural landscape setting.

Recreation

Local Alternative Link for 4A, 4B, 4C1: There are no recreation viewers associated with Local Alternative Link C790.

Local Alternative Links for 4A, 4B, 4C1, 4C2, 4C3 (Pinal Central Substation): There are no recreation viewers associated with these local alternative links.

Local Alternative Link for 4C1: There are no recreation viewers associated with this local alternative.

Local Alternative Links for 4C2 (Winchester Substation): There are no recreation viewers associated with these local alternative links.

Local Alternative Links for 4C2 (Tortolita Substation): There are no recreation viewers associated with these local alternative links, except Link C680. Impacts to Local Alternative Link C680 would be the same as for Subroute 4C2.

Local Alternative Links for 4C3 (Pantano-Rillito): Impacts are anticipated for high concern recreation viewers by which this local alternative would be located. High to moderate-high impacts are anticipated for portions of Colossal Cave Mountain Park, Michael Perry Park, Morris K. Udall Regional Park, and portions of the Rillito River (including Mehl Park) (see Visual Contrast Rating Worksheet TU21 and associated Simulation 44). These impacts would be concentrated where the proposed structures would be visible adjacent to and/or where the Project would cross these features. These viewers would have unobstructed close proximity views of the

structures, with limited views of associated access in both natural landscape settings and in a highly modified urban development landscape.

Moderate impacts are also anticipated in this area, typically were the Project would be in close proximity to recreational viewers, with existing EHV transmission nearby. Moderate impact recreational viewers include Rincon Mountain Wilderness, and portions of Colossal Cave Mountain Park and Cienega Creek Natural Preserve.

Low-moderate to low impacts are anticipated for other sensitive recreation viewers that would typically view the proposed structures in natural and urban landscape settings with existing EHV transmission present. This includes the Arizona National Scenic Trail and portions of Cienega Creek Natural Preserve and east Saguaro National Park (see Visual Contrast Rating Worksheet TU13 and associated Simulation 40a and 40b, TU16 and associated Simulation 42).

In addition to impacts discussed for high concern recreational viewers above, impacts were identified for the future developments of the Urban Loop Trail and Pantano River Park Systems. Impacts are considered to be moderate where the proposed Project would be located near these future facilities.

Local Alternative Links for 4C3 (Tortolita Substation): Impacts to local alternative links (F40b, F51, F60a, F81a, and F81b) would be the same as for Pantano-Rillito local alternative links.

Moderate impacts for high concern recreation viewers associated with the CAP National Recreation Trail would occur, where the Project would parallel the trail in a partially modified setting with multiple transmission lines in the vicinity of Local Alternative Link C812.

Local Alternative Links for 4C1, 4C2, 4C3: There are no recreation viewers associated these with local alternative links.

Crossover Links for 4A, 4B, 4C1: There are no recreation viewers associated these with local alternative links.

Crossover Links for 4A, 4B, 4C1, 4C2: Similar to Subroute 4C1, high impacts are anticipated for viewers along the Arizona National Scenic Tail, where the Project would cross rolling terrain with minimal modifications. Link C671 parallels this scenic trail for a short duration, resulting in unobstructed views to recreation users.

Travel Routes

Local Alternative Link for 4A, 4B, 4C1: High impacts are anticipated for viewers associated with the Pinal Pioneer Parkway, a high concern travel route, which is crossed by Link C790. SE 10 would reduce contrast for this travel route crossing.

Local Alternative Links for 4A, 4B, 4C1, 4C2, 4C3 (Pinal Central Substation): Impacts to the Pinal Central Substation local alternative links would be similar as for Subroute 4A.

Local Alternative Link for 4C1: Similar to Subroute 4C1, impacts were identified for the future conceptual development of Willow Springs (Link C692). Impacts are considered to be low-moderate in relatively flat terrain in a natural landscape setting, where this local alternative crosses the southern and western boundaries of the conceptual development.

Local Alternative Links for 4C2 (Winchester Substation): Impacts to links C260 and C261 would be identical as for Subroute 4C3. Impacts are anticipated to be moderate-high for Link C201, which crosses Ocotillo Road, a moderate concern level travel route. Unobstructed views of the Project would occur for this moderate concern-level travel route in the San Pedro River Valley. SE 10 would reduce contrast at this crossing.

Local Alternative Links for 4C2 (Tortolita Substation): Impacts along these alternative links are identical to impacts anticipated for Subroute 4C2 (Link C680) and 4C3 (links C810, C810a, C813, C816, and C817).

Local Alternative Links for 4C3 (Pantano-Rillito): Similar to Subroute 4C3, this local alternative crosses within close proximity to high concern level travel routes (scenic and other recreation access roads). High to moderate-high impacts occur in similar conditions as discussed for Subroute 4C3. These travel routes include Colossal Cave Road, South Pantano Parkway, Kolb Road, Swan Road, River Road (see Visual Contrast Rating Worksheet TU22), and I-10. SE 10 would reduce contrast at the crossings identified above. Low impacts are anticipated for scenic roadways that are located throughout the foothills in the eastern edge of the valley, where the Project would be viewed in an urban setting and/or screened by development (see Visual Contrast Rating Worksheet TU20 and TU23).

Local Alternative Links for 4C3 (Tortolita Substation): Impacts to these local alternative links are identical to impacts anticipated for the Pantano-Rillito local alternative links (F40b, F51, F60a, F81a, and F81b). There are no travel route viewers associated with Local Alternative Link C812.

Local Alternative Links 4C1, 4C2, 4C3: Fort Grant Road, a moderate concern level travel route, is crossed by Link C121 of this local alternative. Impacts are anticipated to be moderate-high where the Project would cross the travel route; however, the Project would be viewed in context with a modified setting, primarily agriculture and residences. SE 10 would reduce contrast at this crossing by maximizing structure span.

Crossover Links for 4A, 4B, 4C1: Impacts are anticipated to be moderate-high where links C174 and C501 cross Copper Creek Road, associated with a moderate concern level; and where the Project would traverse rolling terrain in a natural landscape setting east of Mammoth. SE 10 would moderately reduce contrast at this crossing.

Crossover Links for 4A, 4B, 4C1, 4C2: There are no travel route viewers associated with crossover Link C671.

Compliance

Local Alternative Link for 4A, 4B, 4C1: No BLM lands are crossed by this local alternative.

Local Alternatives Links for 4A, 4B, 4C1, 4C2, 4C3 (Pinal Central Substation): No BLM lands are crossed by this local alternative.

Local Alternative Link for 4C1: No BLM lands are crossed by this local alternative.

Local Alternative Links for 4C2 (Winchester Substation): No BLM lands are crossed by this local alternative.

Local Alternative Links for 4C2 (Tortolita Substation): BLM lands crossed by this local alternative are in compliance with VRM objectives.

Local Alternative Links for 4C3 (Pantano-Rillito): No BLM lands are crossed by this local alternative.

Local Alternative Links for 4C3 (Tortolita Substation): No BLM lands are crossed by this local alternative.

Local Alternative Links for 4C1, 4C2, 4C3: No BLM lands are crossed by this local alternative.

Crossover Links for 4A, 4B, 4C1: No BLM lands are crossed by this local alternative.

Crossover Links for 4A, 4B, 4C1, 4C2: No BLM lands are crossed by this local alternative.

4.9.3.4 Conformance with Applicable RMPs

An assessment of contrast from agency-approved viewing locations and KOPs indicates that a majority of the Project alternatives would not be in compliance with VRM objectives. In Route Group 1, Subroute 1B3 proportionately has the least amount of noncompliance; whereas Subroute 1A has the greatest amount of noncompliance. In Route Group 3, Subroute 3A has no areas of noncompliance, whereas Subroute 3B has the greatest amount of noncompliance. In Route Group 4, Subroute 4C2 proportionately has the least amount of noncompliance; whereas Subroute 4C1 has the greatest amount of noncompliance. In locations of noncompliance, applied mitigation would not reduce visual contrast to levels consistent with VRM objectives; therefore, these alternatives would not conform to applicable RMPs. Table 4-22 provides a summary by alternative of miles of noncompliance and associated nonconformance, by RMP. A plan amendment would be required for the Project to be in compliance with VRM objectives and to conform to applicable RMPs (Table 4-23).

4.9.3.5 Summary of BLM Preferred Alternative

Based on results of the preceding analysis, the following potentially significant impacts to visual resources may occur with construction and operation of the BLM preferred alternative:

- The introduction of the transmission lines would primarily result in moderate-high impacts to Class B scenery, which is characterized by a minimally modified setting (subroutes 1A2, 3A2, and 4C2c). A limited portion of Class A scenery associated with

the Rio Grande would result in high impacts because the landscape setting is primarily unmodified at this crossing (Subroute 1A2). High impacts to scenery are not anticipated for subroutes 3A2 and 4C2c.

- High to moderate-high impacts would occur for residential viewers near Socorro, Willow Springs (existing and future residences), and other dispersed residences immediately adjacent to the Project (Subroute 1A2). Limited areas of high impacts are anticipated for residences near Deming when immediately adjacent to the Project (Subroute 3A2). Near La Palma, high impacts to residences are anticipated because the Project would be immediately adjacent to these high concern level viewers (Subroute 4C2c).
- Recreation viewers associated with the Stallion WSA, Veranito WSA, Sevilleta NWR, Johnson (Gordy's) Hill SRMA, and the Rio Grande would have high to moderate-high impacts because the Project would be viewed within 0.5 mile where modifications are minimal (Subroute 1A2). Recreation viewers associated with high to moderate-high impacts include the Arizona National Scenic Trail and Buehman Canyon Trail, because the Project would be viewed in a landscape with few modifications (Subroute 4C2c).
- High to moderate-high impacts would occur for travel route viewers along Salt Missions Trail Scenic Byway, WSMR Route 3607, WSMR Route 5, US Route 54, SR 55, Quebradas Back Country Byway SRMA, El Camino Real (SR 408 and I-25), Geronimo National Scenic Byway, Lake Valley Back Country Byway (Subroute 1A2), US Route 180 (Subroute 3A2), Cascabel Road, Redington Road, SR 77, Muleshoe Ranch Road, Black Hills Mine Road/Catalina Ridge, Webb Road, and Park Link Drive (Subroute 4C2c).
- KOPs associated with high to moderate-high impacts for **Subroute 1A2** include RO1 – County Road A020 Residence, RO2 – US Route 54 and Rest Area, RP4 – County Road B001 Residence, SO11 – WSMR S Route 3607, SO13 – Route 5, SO14 – Johnson (Gordy's) Hill SRMA, SO15 – Quebradas Back Country Byway SRMA, SO16 – Rio Grande, SO17 – El Camino Real/SR 408, SO24 – Willow Springs and Whispering Mountain Ranches, LC19 – El Camino Real/I-25, LC21 – Geronimo National Scenic Byway, and LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway. High to moderate-high impacts for KOPs associated with **Subroute 3A2** include SA2 – Hackel Road. **Subroute 4C2c** KOPs associated with high to moderate-high impacts include TU5 – Arizona National Scenic Trail at the Tiger Mine Trailhead, TU11 – Cascabel Road, TU29 – Park Link Drive, and TU34 – SR 77.
- Noncompliance with BLM VRM Classifications is anticipated for Class II designations and Class III designations (Subroute 1A2). Subroute 3A2 and 4C2c would be in compliance with Class II and Class III designations.

Table 4-22. VRM Resource Compliance						
Route Group	Alternative Subroute	Length (miles)	VRM Compliance (miles)			VRM Noncompliance Classification and RMP Nonconformance Route Links *=*unique to subroute*
			Non-BLM	Compliant	Non-compliant	
Route Group 1: SunZia East Substation to Midpoint Substation	**Subroute 1A1**	228.8	118.7	96.0	13.9	• *E101a: Class III (0.1 mile), Socorro RMP 2009 • *E101b:Class II (5.3 miles) and Class III (3.9 miles), Socorro RMP 2009 • *E133:Class II (2.4 miles) and Class III (2.2 miles), Socorro RMP 2009
	Subroute 1A2 – BLM Preferred Alternative	230.3	122.2	94.2	13.8	• *E101b: Class II (5.3 miles) and Class III (3.9 miles) • *E133: Class II (2.4 miles) and Class III (2.2 miles)
	Subroute 1A – North River Crossing	219.5	114.6	90.8	14.1	• *E101:Class II (5.5 miles) and Class III (4 miles), Socorro RMP 2009 • *E133:Class II (2.4 miles) and Class III (2.2 miles), Socorro RMP 2009
	Subroute 1B – San Antonio Crossing					
	Subroute 1B1	223.6	109.6	108.8	5.2	• A90:Class III (0.8 mile), Socorro RMP 2009 • A111:Class II (2.1 miles) and Class III (0.3 mile), Socorro RMP 2009 • A112:Class II (1.6 miles), Socorro RMP 2009 • A140:Class II (0.4 mile), Socorro RMP 2009
	Subroute 1B2	209.2	89.1	114.9	5.2	• A90:Class III (0.8 mile), Socorro RMP 2009 • A111:Class II (2.1 miles) and Class III (0.3 mile), Socorro RMP 2009 • A112:Class II (1.6 miles), Socorro RMP 2009 • A140:Class II (0.4 mile), Socorro RMP 2009
	Subroute 1B3	206.3	84.0	117.9	4.4	• A111:Class II (2.1 miles) and Class III (0.3 mile), Socorro RMP 2009 • A112:Class II (1.6 miles), Socorro RMP 2009 • A140:Class II (0.4 mile), Socorro RMP 2009
	Local Alternative and Crossover Links for Route Group 1					
	Local Alternative Links for 1A, 1B1, 1B2, 1B3					
	A161b	18.6	10.1	8.5	—	
	A260	28.4	4.7	23.7	—	
	Crossover Link s 1B2, 1B3					

Table 4-22. VRM Resource Compliance						
Route Group	Alternative Subroute	Length (miles)	VRM Compliance (miles)			VRM Noncompliance Classification and RMP Nonconformance Route Links *=*unique to subroute*
			Non-BLM	Compliant	Non-compliant	
Route Group 3: Midpoint Substation to Willow-500 kV Substation	**Subroute 3A2 – BLM Preferred Alternative**	123.9	61.5	62.4	—	
	Subroute 3A – North	123.4	65.3	58.1	—	
	Subroute 3B – South	128.6	72.8	55.8	—	B112:Class II (0.8 mile), also associated with BLM avoidance area, Mimbres RMP 1993
Route Group 4: Willow-500 kV Substation to Pinal Central Substation	**Subroute 4A – North of Mt. Graham**	132.9	121.9	11.0	—	
	Subroute 4B – Sulphur Springs Valley	133.0	128.0	5.0	—	
	Subroute 4C					
	Subroute 4C2c – BLM Preferred Alternative	161.2	146.4	14.8	—	
	Subroute 4C1 – San Pedro Valley	139.0	133.7	5.3	—	
	Subroute 4C2 – San Pedro Valley	151.8	137.0	14.8	—	
	Subroute 4C3 – Tucson	172.9	159.7	12.7	0.5	• C817: Class III (0.5 mile), Phoenix RMP 1988
	Local Alternative Links for 4C2 – Winchester and Tortolita Substations					
	C817	1.8	0.7	0.6	0.5	• C817: Class III (0.5 mile), Phoenix RMP 1988

Table 4-23. Proposed Plan Amendments for VRI Classifications and VRM Classifications

Links with VRM Nonconformance for Subroute 1A2	Visual Resource Inventory Classifications Data within VRM Plan Amendment Area for Socorro FO											Visual Resource Management Classifications Data within Proposed Plan Amendment Area for Socorro FO				Total Percent Resource Change in Socorro FO
	Scenic Quality Rating Unit (acres)			Sensitivity Level Rating Unit (acres)			Distance Zone (acres)		VRIC (acres)*			Proposed Plan Amendment Area within 400-foot-wide corridor (acres)	VRM Classifications within 400-foot-wide corridor		Total Percent Resource Change by Link VRM Classifications in Socorro FO Class I: 28,718 Class II: 510,945 Class III: 448,612 Class IV: 517,330	
	A	B	C	H	M	L	FG/MG	BG/SS	Class II	Class III	Class IV		Socorro RMP Existing VRM Class	Proposed Plan Amendment VRM Class		
E101b	0	268	0	0	1	267	268	0	0	1	267	268	Class II	Class IV	Class II: Reduced by 0.05% Class IV: Increased by 0.05%	Class I: No Change
	0	188	0	0	0	188	188	0	0	0	188	188	Class III	Class IV	Class III: Reduced by 0.04% Class IV: Increased by 0.04%	Class II: Reduced by 0.07%
E133	0	116	0	0	0	116	116	0	0	116	0	116	Class II	Class IV	Class II: Reduced by 0.02% Class IV: Increased by 0.02%	Class III: Reduced by 0.06%
	0	107	0	0	107	0	107	0	0	107	0	107	Class III	Class IV	Class III: Reduced by 0.02% Class IV: Increased by 0.02%	Class IV: Increased by 0.13%

*The VRI Classifications are a factor in the final VRM Classifications; however, the resulting VRM Classifications may include other resource management objectives (i.e., cultural, recreation, or geological resources) as defined in the RMP/EIS.

4.10 LAND USE AND RECREATION RESOURCES

4.10.1 Introduction

This section describes and evaluates the potential impacts to land and resource uses that would result from the construction and operation of the proposed transmission lines and substations, and summarizes the assessment results, including the identification of mitigation measures that would be implemented to minimize potential adverse impacts to land and resource uses.

4.10.1.1 Impact Assessment Methodology

An impact assessment methodology was developed to identify and evaluate potential impacts to land and resource uses associated with the proposed action. This methodology consisted of assigning sensitivity classifications to land and resource uses that occur in the study area, identifying initial impact levels based on resource sensitivity and Project-related impacts, developing resource-specific mitigation measures to minimize adverse impacts, and incorporating mitigation measures to assign final impact levels for each Project alternative.

4.10.2 Impact Criteria

Impact levels—high, high-moderate, moderate, low-moderate, and low—were established to determine the impact the Project would have on various land and resource uses. Significant impacts related to land use would be the result of high impacts from the Project that cannot be effectively mitigated. Table 4-24 summarizes the impact criteria used to assign impact levels to the existing land use resources.

Table 4-24. Impact Criteria for Land Use and Recreation Resources

Impact Level	Impact Criteria
High	• Areas where the Project would create a direct long-term conflict with existing residential, commercial, industrial, military, and agricultural uses (e.g., displacement of homes, businesses, or industrial facilities) • Areas where the Project would physically conflict with any designated recreation or preservation use area • Areas where the Project would physically conflict with any officially adopted policies or goals of the affected land-managing agency • Residential areas where the Project would physically conflict with planned subdivisions at the final plat approval stage • Areas where the Project may require extensive efforts beyond standard construction practices, to ensure public or worker safety
High-Moderate	• Areas where the Project is adjacent to existing residential, commercial, industrial, or agricultural uses • Areas where the Project would be adjacent to any designated recreation or preservation use areas

Table 4-24. Impact Criteria for Land Use and Recreation Resources	
Impact Level	**Impact Criteria**
Moderate	• Areas where the Project would create an indirect conflict with residential, commercial, and agriculture uses • Areas where the Project would create short-term impacts to agricultural operations • Areas where the transmission line would require new or expansion of existing right-of-way in a designated recreation area or residential areas (existing and proposed conceptual plans) • BLM right-of-way avoidance areas
Low-Moderate	• Areas where the Project would have an indirect land use impact, or conflict with, and be adjacent to land uses that are compatible with a transmission line • Land uses that were determined to be compatible with a transmission line, but have a lower sensitivity than moderate due to mitigating factors
Low	• Areas where land use is compatible with a transmission line; these areas were found throughout the study corridor and are not detailed in the summary of the analysis

4.10.3 Conformance with Applicable BLM Resource Management Plans

BLM RMPs outline specific management guidelines for their areas, including what development can occur on the lands. In general, areas designated as right-of-way avoidance areas are those that should be avoided, unless there are no viable alternatives. Right-of-way exclusion areas are designated so as not to allow any new rights-of-way across a specific area. To cross a right-of-way exclusion area would require the Applicant to request, and the BLM to approve, an amendment to the RMP, so that the Project would conform to the respective planning decisions (see Section 4.18 for additional information on proposed amendments, and Table 2-16 for alternatives that may require an amendment).

4.10.4 Mitigation Planning

After the application of standard mitigation, selective mitigation would then be applied to effectively reduce impacts where practicable. Specific applications of selective mitigation are described in the impact analysis results below.

4.10.5 Summary of Impact Analysis Results

Impacts to existing and future land uses are summarized in this section. The results of the impact analysis are included in tables H-10 and H-11 of Appendix H, and shown as color-coded centerlines on figures M 10-1 and M 10-2 (see Map Volume). Figures M 10-3 and M 10-4 (see Map Volume) also include baseline information that was used for the impact assessment (see Table 4-20 for a discussion of the impact criteria used to determine the level of impact, and Section 4.10.4 for mitigation planning). Further, the existing land use table and map include impacts to special designations, which are described in Section 4.11.

The BLM preferred and alternative subroutes cross portions of various irrigation and drainage canals and related facilities within agricultural areas of New Mexico and Arizona. The Middle Rio Grande Conservation District and BOR administer canals (including the Rio Grande Conveyance Channel) along the river. The Central Arizona Water Conservation District manages

the CAP facilities on federal lands administered by the BOR in Arizona. The San Carlos Irrigation and Drainage District administers the San Carlos Irrigation Project facilities (under BIA jurisdiction), also in Arizona. Where necessary to construct transmission facilities across canals or other conveyance systems, the transmission Project would be constructed to allow conductors to span these facilities, resulting in low or minimal impacts. An encroachment permit would be required by the BOR or BIA to cross these facilities in accordance with the NEPA and other federal regulations.

The subroutes may cross private and public conservation easements within both New Mexico and Arizona, particularly near the Rio Grande and San Pedro River. Existing conservation easements, to the extent practicable, have generally been avoided by the alternative routes being considered in the EIS. However, some specific conservation easement crossings may not be identified until the final routing is selected and right-of-way acquisition begins. Negotiations with the particular land owner/easement manager would address specific requirements of the conservation easement.

The subroutes may cross lands associated with the Redington and Winkelman NRCDs, both of which have adopted policies to oppose the construction of any new major energy, transportation, or communication corridors through or across the respective district land. Should a route be selected that crosses land within one or both NRCDs, the Project would be inconsistent with the established policies of the NRCDs.

Individual grazing lessees/permittees of record on public lands will be notified if the BLM authorizes the transmission line right-of-way on public lands. The grazing lessee/permittee will have an opportunity to discuss the potential loss of forage and AUM reduction within their respective allotment with the authorized BLM Field/District Office Manager.

4.10.5.1 No Action Alternative

Under the No Action alternative, the BLM would not grant right-of-way for construction and operation of the proposed Project; and Project facilities, including transmission lines and substations, would not be built and existing land uses in the Project study area would continue. There would be no new impacts to land uses occurring within the study area. Under the No Action alternative, it is assumed that current actions and activities in the study area would continue.

4.10.5.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Existing Land Use

There would be 24.9 miles of moderate impact, 67.3 miles of low-moderate impact, and 136.6 miles of low impact for Subroute 1A1. The subroute crosses approximately 5 miles of the EMRTC range, but is approximately 0.75 mile from active testing areas. The subroute may be adjusted within the study corridor to further accommodate testing activities within the EMRTC. A portion of the low-moderate impacts occur where the subroute crosses approximately 0.3 mile

(Link E180) of irrigated agricultural lands. After the application of standard mitigation, SE 7 would be applied to minimize impacts to agricultural operations. Approximately 1.8 miles and 1.9 miles of moderate impacts would occur where links A440 and A530, respectively, cross the Las Cruces District Office right-of-way avoidance areas; and approximately 10.1 miles, 5.8 miles, and 5.3 miles of moderate impacts would occur where links E211, E101b, and E133, respectively, cross the Socorro Field Office right-of-way avoidance areas.

Future Land Use

Future land use impacts would include 12.4 miles of low-moderate impact and 216.4 miles of low impact.

Grazing

Impacts to BLM grazing would include the removal of approximately 181 acres of BLM land within the Las Cruces District Office area, which is approximately 0.00004 percent of available grazing land, and the removal of approximately 151 acres of BLM land within the Socorro Field Office area, which is approximately 0.0001 percent of available grazing land. No BLM land would be removed within the Rio Puerco Field Office.

Impacts to New Mexico state grazing lands would include the removal of approximately: 11 acres (0.00003 percent) from state lands in Lincoln County; 21 acres (0.00003 percent) from state lands in Luna County; 62 acres (0.001 percent) from state land in Sierra County; 101 acres (0.0002 percent) from state lands in Socorro County; and 29 acres (0.00006 percent) from state lands in Torrance County. The total amount of grazing lands removed for this alternative is approximately 224 acres or 0.0001 percent.

Subroute 1A2 – BLM Preferred Alternative

Existing Land Use

There would be 24.9 miles of moderate impact, 76.5 miles of low-moderate impact, and 128.9 miles of low impact for Subroute 1A2. The subroute crosses approximately 5 miles of the EMRTC range, but is approximately 0.75 mile from active testing areas. A portion of the low-moderate impacts would occur where the subroute crosses approximately 0.3 mile (Link E180) of irrigated agricultural lands. After the application of standard mitigation, SE 7 would be applied to minimize impacts to agricultural operations. Approximately 1.8 miles and 1.9 miles of moderate impacts would occur where links A440 and A530, respectively, cross the Las Cruces District Office right-of-way avoidance areas; and approximately 10.1 miles, 5.8 miles, and 5.3 miles of moderate impacts would occur where links E211, E101b, and E133, respectively, cross the Socorro Field Office right-of-way avoidance areas.

Future Land Use

Future land use impacts would include 12.4 miles of low-moderate impact and 217.9 miles of low impact.

Grazing

Impacts to BLM grazing would include the removal of approximately 181 acres of BLM land within the Las Cruces District Field Office, which is approximately 0.00003 percent of available grazing land, and the removal of approximately 151 acres of BLM land within the Socorro Field Office, which is approximately 0.0001 percent of available grazing land. No BLM land would be removed within the Rio Puerco Field Office.

Impacts to New Mexico state grazing lands would include the removal of approximately: 11 acres (0.00003 percent) from state lands in Lincoln County; 21 acres (0.00003 percent) from state lands in Luna County; 62 acres (0.001 percent) from state land in Sierra County; 64 acres (0.00009 percent) from state lands in Socorro County; and 84 acres (0.0002 percent) from state lands in Torrance County. The total amount of grazing lands removed for this alternative is approximately 242 acres or 0.0001 percent.

Subroute 1A – North River Crossing

Existing Land Use

There would be 24.9 miles of moderate impact, 79.0 miles of low-moderate impact, and 115.6 miles of low impact for Subroute 1A. Approximately 1.8 miles and 1.9 miles of moderate impacts would occur where links A440 and A530, respectively, cross the Las Cruces District Office right-of-way avoidance areas; and approximately 10.1 miles, 5.8 miles, and 5.3 miles of moderate impacts would occur where links E211, E101, and E133, respectively, cross the Socorro Field Office right-of-way avoidance areas. The subroute crosses approximately 5 miles of the EMRTC range, but is at least 0.75 mile from any active testing areas.

Future Land Use

Future land use impacts would include 12.4 miles of low-moderate and 207.1 miles of low impacts.

Grazing

Impacts to grazing would include the removal of between 200 and 220 acres of BLM land within the Las Cruces District Office area, which is approximately 0.005 percent of available grazing land; the removal of approximately 165 acres of BLM land within the Socorro Field Office area, which is approximately 0.015 percent of available grazing land; and the removal of between 0 and 4 acres of BLM land within the Rio Puerco Field Office area, which is between 0 and 0.0004 percent of available grazing land.

Impacts to New Mexico state grazing lands would include the removal of approximately: 15 acres (0.00004 percent) from state lands in Lincoln County; 21 acres (0.00003 percent) from state lands in Luna County; 64 acres (0.001 percent) from state land in Sierra County; and 149 acres (0.0002 percent) from state lands in Socorro County. The total amount of grazing lands removed for this alternative is approximately 249 acres or 0.0001 percent.

Subroute 1B – San Antonio Crossing

Existing Land Use

For subroutes 1B1, 1B2, and 1B3, impacts would include 14.5 to 17.0 miles of moderate impacts, 66.1 to 79.4 miles of low-moderate impacts, and 122.3 to 129.7 miles of low impacts. Moderate impacts associated with the Las Cruces District Office right-of-way avoidance areas would occur on Link A530 for 1.9 miles and Link A440 for 1.8 miles. Additional moderate impacts in Subroute 1B are associated with the Socorro Field Office right-of-way avoidance areas that are crossed by links A111, A112, A140, A160, and A80 for 2.1 miles, 2.3 miles, 0.4 mile, 6.0 miles, and 3.0 miles, respectively. Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link A140 (mileposts 1 to 3).

Future Land Use

Future land use impacts would include 13.1 miles of low-moderate and 193.2 to 210.5 miles of low impacts.

Grazing

Impacts to grazing would include the removal of between 200 and 220 acres of BLM land within the Las Cruces District Office area, which is approximately 0.005 percent of available grazing land; the removal of between 200 and 225 acres of BLM land within the Socorro Field Office area, which is approximately 0.02 percent of available grazing land; and the removal of approximately 6 acres of BLM land within the Roswell Field Office area, which is approximately 0.0004 percent of available grazing land.

Impacts to New Mexico state grazing lands would include the removal of approximately: 15 to 45 acres (0.00004 to 0.0001 percent) from state lands in Lincoln County; 21 acres (0.00003 percent) from state lands in Luna County; 62 to 64 acres (0.001 percent) from state land in Sierra County; and 59 to 148 acres (0.00009 to 0.0002 percent) from state lands in Socorro County.

Local Alternative and Crossover Links for Route Group 1

Existing Land Use

Local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 would have 5.0 miles of moderate impacts, 50.7 miles of low-moderate, and 39.3 miles of low impacts. There are no high-moderate or high impacts for existing land use. Link A161b crosses 5.0 miles of a Socorro Field Office right-of-way avoidance area.

Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link A430 (mileposts 4 to 7).

Future Land Use

Future land use impacts for local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 would be low-moderate (3.1 miles) and low (91.9 miles).

SunZia East Substation

The proposed SunZia East Substation footprint would encompass approximately 41 acres of private land, for which the primary land use is livestock grazing. The proposed substation would result in the permanent disturbance of up to 85 acres, affecting the resources available for livestock grazing. The land surrounding the proposed substation is vacant.

4.10.5.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Existing Land Use

Subroute 3A2 would include 0.3 mile of moderate impact, 65.3 miles of low-moderate impact, and 58.3 miles of low impact. Moderate impacts associated with existing land use would occur along Link B120b, where it crosses a Las Cruces District Office right-of-way avoidance area for approximately 0.3 mile.

Future Land Use

Future land use impacts for Subroute 3A2 would include 0.8 mile of low-moderate impact and 123.1 miles of low impact.

Grazing

Impacts to grazing would include the removal of approximately 95 acres of BLM land within the Las Cruces District Office area, which is approximately 0.002 percent of available grazing land; and the removal of 124 acres of BLM land within the Safford Field Office area, which is 0.01 percent of available grazing land.

Impacts to New Mexico state grazing lands would include the removal of approximately: 63 acres (0.001 percent) from state land in Grant County; 60 acres (0.0001 percent) from state lands in Hidalgo County; and 139 acres (0.0002 percent) from state lands in Luna County. The total amount of grazing lands removed for this alternative is approximately 262 acres or 0.0002 percent.

Impacts to Arizona state grazing lands would include the removal of approximately 12 acres (0.00002 percent) from state land in Graham County. Based on fiscal 2011 figures, this would result in a $2.76 loss in grazing revenue.

Subroute 3A – North

Existing Land Use

Existing land use impacts for Subroute 3A would include 0.6 mile of moderate, 60.7 miles of low-moderate, and 62.1 miles of low impacts. There are no high-moderate or high impacts for existing land use. Impacts would occur along Link B120b, which has 0.3 mile of moderate impacts where it crosses a Las Cruces District Office right-of-way avoidance area. Link B160b has 0.3 mile of moderate impacts, where the transmission lines would cross the southern portion of the Hot Well Dunes OHV Recreation area. To mitigate the potential of unauthorized OHV use of new transmission line access roads, the roads would be closed to public access through the use of fences and locked gates. Structures or guywires would be marked with high-visibility devices as required per ST 12, to increase user safety.

Future Land Use

Future land use impacts would include 0.8 mile of low-moderate and 122.6 miles of low impacts.

Grazing

Impacts to grazing would include the removal of approximately 95 acres of BLM land within the Las Cruces District Office area, which is approximately 0.002 percent of available grazing land; and the removal of 110 acres of BLM land within the Safford Field Office area, which is 0.009 percent of available grazing land.

Impacts to New Mexico state grazing lands would include the removal of approximately: 63 acres (0.001 percent) from state land in Grant County; 60 acres (0.0001 percent) from state lands in Hidalgo County; and 149 acres (0.0002 percent) from state lands in Luna County. The total amount of grazing lands removed for this alternative is approximately 272 acres or 0.0002 percent.

Impacts to Arizona state grazing lands would include the removal of approximately 28 acres (0.00006 percent) from state land in Graham County. Based on fiscal year 2011 figures, this would result in an $8.28 loss in grazing revenue.

Subroute 3B – South

Existing Land Use

Impacts associated with existing land use would include moderate impacts along Link B110a for 0.3 mile and Link B112 for 1.5 miles, where the links cross multiple Las Cruces District Office right-of-way avoidance areas. Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link B80 (mileposts 3 to 4) and Link B112 (mileposts 5 to 6).

Future Land Use

Future land use impacts would include 0.5 mile of low-moderate and 128.1 miles of low impacts.

Grazing

Impacts to grazing would include the removal of approximately 60 acres of BLM land available for grazing within the Las Cruces District Office area, which is approximately 0.001 percent of available grazing land; and the removal of approximately 140 acres of BLM land available for grazing within the Safford Field Office area, which is approximately 0.01 percent of available grazing land.

Impacts to New Mexico state grazing lands would include the removal of approximately: 42 acres (0.0007 percent) from state land in Grant County; 28 acres (0.00006 percent) from state lands in Hidalgo County; and 135 acres (0.0002 percent) from state lands in Luna County. The total amount of grazing lands removed for this alternative is approximately 205 acres or 0.0002 percent.

Impacts to Arizona state grazing lands would include the removal of approximately 12 acres (0.00002 percent) from state land in Graham County. Based on fiscal year 2011 figures, this would result in a $2.76 loss in grazing revenue.

Local Alternative and Crossover Links for Route Group 3

Existing Land Use

Crossover links for 3A and 3B would have moderate impacts associated with existing land use along Link B140, where it crosses approximately 1.0 mile of a Las Cruces District Office right-of-way avoidance area. There are no high-moderate or high impacts for existing land use.

Future Land Use

Future land use impacts would include 1.7 miles of low-moderate and 13.5 miles of low impacts.

Midpoint Substation

The proposed Midpoint Substation footprint would encompass approximately 60 acres of private land, for which the primary land use in the area is vacant undeveloped land used for livestock grazing. The proposed substation would result in the permanent disturbance of up to 60 acres, primarily affecting the resources available for livestock grazing. The land surrounding the proposed substation is vacant land.

Lordsburg Substation

The proposed Lordsburg Substation footprint would encompass approximately 35 to 40 acres of private land, for which the primary land use in the area is vacant undeveloped land used for

livestock grazing. The proposed substation would result in the permanent disturbance of up to 40 acres (Option A), primarily affecting the resources available for livestock grazing. The land surrounding the proposed substation is vacant.

4.10.5.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Existing Land Use and Future Land Use

Existing land use for Subroute 4A would have 70.7 miles of low-moderate impacts and 62.2 miles of low impacts. Future land use would have 4.8 miles of low-moderate impacts and 128.1 miles of low impacts. There are no moderate, high-moderate, or high impacts for existing or future land use.

Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link C110 (mileposts 10 to 14), Link C880 (milepost 1 to the end of the link), and Link C880a (entire link).

Grazing

Impacts to grazing would include the removal of approximately 21 acres of BLM land available for grazing within the Safford Field Office area, which is approximately 0.002 percent of available grazing land; and the removal of approximately 18 acres of BLM land available for grazing within the Tucson Field Office area, which is approximately 0.004 percent of available grazing land.

Impacts to Arizona state grazing lands would include the removal of approximately 339 acres (0.0007 percent) from state lands in Graham County and 330 acres (0.0003 percent) from state lands in Pinal County. The total amount of grazing lands removed for this alternative is approximately 669 acres or 0.0004 percent. Based on fiscal year 2011 figures, this would result in a $180.78 loss in grazing revenue.

Subroute 4B – Sulphur Springs Valley

Existing Land Use and Future Land Use

Existing land use for Subroute 4B would have 80.8 miles of low-moderate impacts and 52.2 miles of low impacts. There are no moderate, high-moderate, or high impacts for existing and future land use. Future land use has 4.8 miles of low-moderate impacts and 128.2 miles of low impacts. Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link C880 (milepost 1 to the end of the link).

Grazing

Impacts to grazing include the removal of approximately 18 acres of BLM land available for grazing within the Tucson Field Office area, which is approximately 0.004 percent of available grazing land.

Impacts to Arizona state grazing lands include the removal of approximately 387 acres (0.0008 percent) from state lands in Graham County, and the removal of approximately 330 acres (0.0003 percent) from state lands in Pinal County. The total amount of grazing lands removed for this alternative is approximately 717 acres or 0.0005 percent. Based on fiscal year 2011 figures, this would result in a $225.98 loss in grazing revenue.

Subroute 4C2c – BLM Preferred Alternative

Existing Land Use and Future Land Use

Existing land use would have 82.2 miles of low-moderate impact and 79.0 miles of low impact, and future land use would have 10.3 miles of low-moderate impact and 150.9 miles of low impact. There are no moderate, high-moderate, or high impacts for existing or future land use.

Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link C110 (mileposts 10 to 14), Link C880 (milepost 1 to the end of the link), and Link C880a (entire link).

Grazing

Impacts to grazing would include the removal of approximately 50 acres of BLM land available for grazing within the Tucson Field Office area, which is approximately 0.01 percent of available grazing land.

Impacts to Arizona state grazing lands would include the removal of approximately: 334 acres (0.0003 percent) from state lands in Cochise County; 37 acres (0.00008 percent) from state lands in Graham County; 97 acres (0.0001 percent) from state lands in Pima County; and 303 acres (0.0003 percent) from state lands in Pinal County. The total amount of grazing lands removed for this alternative is approximately 771 acres or 0.0002 percent. Based on fiscal year 2011 figures, this would result in a $206.60 loss in grazing revenue.

Subroute 4C1 – East of San Pedro River

Existing Land Use

Subroute 4C1 would have 0.1 mile of high-moderate impacts, 1.3 miles of moderate impacts, 80.0 miles of low-moderate impacts, and 57.6 miles of low impacts. Subroute 4C1 would cross high-moderate impacts along Link C331 for approximately 0.1 mile where it crosses the Muleshoe Ranch CMA and Swamp Springs-Hot Springs Watershed ACEC, and 1.3 miles of moderate impact where it crosses the Muleshoe Ecosystem Planning Boundary. Subroute 4C1

would have similar mitigation measures applied to the same links as Subroute 4C2c, as described above.

Future Land Use

Future land use impacts for this subroute would include 0.5 mile of high-moderate impacts, 2.5 miles of moderate impacts, 8.7 miles of low-moderate impacts, and 127.3 miles of low impacts. High-moderate impacts would be associated with Link C691 for 0.5 mile, due to new access that would be needed for the subroute to cross land approved for the future Willow Springs residential development. Link C691 would also be associated with 2.5 miles of moderate impact, due to the proposed future Willow Springs residential development.

Grazing

Impacts to grazing would include the removal of approximately 14 acres of BLM land available for grazing within the Tucson Field Office area, which is approximately 0.003 percent of available grazing land.

Impacts to Arizona state grazing lands would include the removal of approximately: 274 acres (0.0002 percent) from state lands in Cochise County; 88 acres (0.0002 percent) from state lands in Graham County; and 309 acres (0.0003 percent) from state lands in Pinal County. The total amount of grazing lands removed for this alternative is approximately 671 acres or 0.0002 percent. Based on fiscal year 2011 figures, this would result in a $166.05 loss in grazing revenue.

Subroute 4C2 – West of San Pedro River

Existing Land Use

For Subroute 4C2, there would be 75.7 miles of low-moderate and 76.1 miles of low impacts. There are no moderate, high-moderate, or high impacts for existing land use. Subroute 4C2 would have similar mitigation measures applied to the same links as subroutes 4C2c and 4C1, as described above.

Future Land Use

For Subroute 4C2, there would be 10.3 miles of low-moderate and 141.5 miles of low impacts. There are no moderate, high-moderate, or high impacts for future land use.

Grazing

Impacts to grazing would be similar to Subroute 4C2c, as described above.

Impacts to Arizona state grazing lands would include the removal of approximately: 271 acres (0.0002 percent) from state lands in Cochise County; 37 acres (0.00008 percent) from state lands in Graham County; 97 acres (0.0001 percent) from state lands in Pima County; and 303 acres (0.0003 percent) from state lands in Pinal County. The total amount of grazing lands removed for

this alternative is approximately 708 acres or 0.0002 percent. Based on fiscal year 2011 figures, this would result in a $206.60 loss in grazing revenue.

Subroute 4C3 – Tucson

Existing Land Use

Existing land use impacts for this subroute would include 2.6 miles of high impacts, 0.1 mile of high-moderate impacts, 5.8 miles of moderate impacts, 69.2 miles of low-moderate impacts, and 95.2 miles of low impacts. The high impacts are associated with Link F111 for 0.6 mile as the subroute crosses several homes in a manufactured home park, a neighborhood/community recreation area for the manufactured home park, and a commercial business; and 0.1 mile of high impact where it crosses residences and a commercial use property. High impacts would occur for 1.0 mile where Link F112 crosses a residential development. Link F510 has 0.9 mile of high impacts where it crosses Pima County Preserved Lands, designated the Avra Valley I-10 Wildlife Corridor.

High-moderate impacts for Link F112 would occur where this link crosses 0.1 mile along Pima County Floodprone Land Acquisition Program (FLAP) preserved land. Link F111 would have moderate impacts for 0.2 mile where it crosses a neighborhood/community park and 0.1 mile where it crosses the Santa Cruz River Park. Link F112 would have a total of 5.5 miles of moderate impacts where it crosses the Santa Cruz River Park, a residential development, and Silverbell Regional Park.

Table E-4 (Appendix E) breaks the high impacts down by link, the specific land uses crossed, and the general location of these land uses.

For Subroute 4C3, approximately 216 residences and lots, 37 commercial/light industrial buildings, and a rental community recreation center with a playground, pool, and basketball court would be impacted. These structures are located throughout the subroute and would have to be acquired and removed due to the density of development in the area.

Mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to the same links as Subroute 4C2c, as well as Link F540 (mileposts 0 to 1 and 2 to 3), Link F510 (milepost 3 to the end of the link), Link F112 (mileposts 0 to 9), and Link F111 (mileposts 14 to 15), to reduce the amount of land occupied by structures within the recreation area.

Future Land Use

Future land use impacts would include 0.3 mile of high-moderate impacts, 6.9 miles of moderate impacts, 15.6 of low-moderate impacts, and 150.1 miles of low impacts. Link F112 has high-moderate impacts for 0.2 mile, where it crosses an area designated by Pima County for residential use that already has existing residences. Link F111 has high-moderate impacts for 0.1 mile, where it crosses a designated residential area with existing residences. Moderate impacts are associated with 6.2 miles of Link F112 and 0.7 mile of Link F111 where land designated for parks and preservation by Pima County is crossed.

Grazing

Impacts to grazing would include the removal of between 7 and 50 acres of BLM land available for grazing within the Tucson Field Office area, which is between 0.002 and 0.01 percent of available grazing land.

Impacts to Arizona state grazing lands would include the removal of approximately: 254 acres (0.0002 percent) from state lands in Cochise County; 37 acres (0.00008 percent) from state lands in Graham County; 211 acres (0.0003 percent) from state lands in Pima County; and 112 acres (0.0001 percent) from state lands in Pinal County. The total amount of grazing lands removed for this alternative is approximately 614 acres or 0.0002 percent. Based on fiscal year 2011 figures, this would result in a $206.60 loss in grazing revenue.

Local Alternative and Crossover Links for Route Group 4

Existing Land Use

SE 7 and SE 8 would be effective in reducing impacts to irrigated agriculture for local alternative links for 4A, 4B, 4C2c, 4C1, 4C2, and 4C3.

Local alternative links for 4C3 would have impacts of 6.8 miles of high, 6.2 miles of moderate, 7.2 miles of low-moderate, and 26.4 miles of low impacts. The high impacts are associated with Link F40b where it crosses near residences for 0.4 mile and designated Pima County Preserved Lands for 0.5 mile. Link F51 has high impacts for 0.7 mile where it crosses the Pima County Preserved Lands designated as the Cienega Creek Natural Preserve. Link F81a has high impacts for 0.3 mile and Link F81b for 4.9 miles, where the links cross the Pima County FLAP. Moderate impacts are associated with Link F81b for 6.2 miles, as the link crosses through Rillito River Park. SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in recreation areas for Link F51 (milepost 1 to 2) and Link F81b (milepost 3 to the end of link).

Local Alternative Link C121 for 4C1, 4C2, and 4C3 would have moderate impacts for approximately 1.1 mile, due to the link crossing near residences and agricultural lands. SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in agriculture areas for Link C121 (mileposts 3 to 7 and 9 to 12).

Table E-5 (Appendix E) breaks the high impacts down by link for local alternative links F81a and F81b, the specific land uses crossed, and the general location of these land uses.

Local alternative links F81a and F81b to Subroute 4C3 would have high impacts to properties. There are approximately 119 residences, 48 commercial/light industrial buildings, and 4 recreation/community centers that would be impacted. These structures, located throughout the length of the links, would have to be acquired and removed due to the density of development in the area.

Future Land Use

Impacts for 4C3 local alternative links would include 0.9 mile of high-moderate, 10.7 miles of moderate, 2.6 miles of low-moderate, and 32.3 miles of low impacts. Although not depicted in the table, impacts detailed in *Existing Land Use* are expected to persist into the future, thus consideration of these impacts must also be taken into account for any potential future land use. Link F81b has 0.1 mile of high-moderate impacts where the link crosses private land. High-moderate impacts occur along Link F51 for 0.6 mile, due to land being used for areas designated by Pima County as parks and preservation, as well as Pima County Preserved Lands Cienega Creek Natural Preserve, as described above. In addition, high-moderate impacts occur along Link F40b, where it crosses 0.2 mile of a Pima County designated residential area, adjacent to two existing residences. Moderate impacts include links F51 where it crosses 0.1 mile of land designated by Pima County for future residences; there are existing residences near the link. Link F81a and Link F81b also have moderate impacts for 0.3 mile and 10.3 miles, respectively, where they cross areas designated by Pima County for parks and preservation and as part of the Pima County FLAP.

Local Alternative Link C121 for 4C1, 4C2, and 4C3 would have moderate impacts for approximately 1.1 miles, due to the link crossing land designated for low-density residential/rural preservation development in Cochise County.

Willow-500 kV Substation

The proposed Willow-500 kV Substation footprint would encompass approximately 25 acres of Arizona State Trust land, for which the primary land use in the area is vacant land used for livestock grazing. The proposed substation would result in the permanent disturbance of up to 35 acres, primarily affecting the resources available for livestock grazing.

Pinal Central Substation

The planned Pinal Central Substation footprint would encompass approximately 33 acres of private land, for which the primary land use in the area is agriculture. The planned substation would result in the permanent disturbance of up to 45 acres, primarily affecting resources available for the cultivation of crops.

4.10.5.5 Summary

Based on results of the preceding analysis, significant impacts are not expected; however, the following potential impacts to land use were identified for the BLM preferred alternative:

- Route Group 1: Subroute 1A2 crosses four BLM right-of-way avoidance areas; two south of the Sevilleta NWR with links E101b and E133, and one west of Socorro with Link E211. These right-of-way avoidance areas are designated for VRM Class II in the Socorro RMP. In the Mimbres RMP, Link A440 crosses a right-of-way avoidance area designated for the Butterfield Trail, and Link A530 crosses a right-of-way avoidance area designated for VRM Class II, both north of Deming, New Mexico.

- Route Group 3: Subroute 3A2 crosses one BLM right-of-way avoidance areas in the Mimbres RMP, approximately midway between Lordsburg and Deming (Link B120b).
- Route Group 4: Subroute 4C2c has potential impacts to agricultural operations, but mitigation measures SE 7 and SE 8 (see Section 4.10.4) would be applied to reduce the amount of land occupied by structures in these areas for links C110, C880, and C880a.

There would be few impacts to land uses throughout the study corridor, because a major portion of the preferred alternative would be constructed along established utility corridors or other linear features, where existing access is available. Approximately 53 percent (273 miles) of the route is parallel to existing or designated utility corridors, including 229 miles parallel to existing transmission lines.

4.10.6 Impacts to Military Operations

4.10.6.1 Introduction

This section provides a summary of impacts to military operations that could result from the construction and operation of the proposed Project. Representatives of the various military installations located within the Project study area have submitted a series of comments to the BLM, which included the military's assessment of potential impacts to flight operations, missile testing, and other testing and training activities conducted by the DOD. The affected areas within which military activities are conducted are described in Section 3.10.3.6. Military designations are also shown on Figure M 10-3 (see Map Volume) and summarized below.

New Mexico

The Northern Call-up Area is located north of the WSMR and contains approximately 1.5 million acres comprising BLM, state, and private lands within Socorro County. The airspace over this land is used for flight operations and training by Holloman and Kirtland AFBs. There is a missile launch facility located approximately 23 miles north of US Route 380 and approximately 14 miles south of US Route 60, in the northern portion of the Northern Call-up Area. Holloman AFB also identified three different airspaces used for low-level flight operations (R5107H, R5107C, and R5107J) located directly north of the WSMR over the Northern Call-up Area. The New Mexico Air National Guard unit based at Kirtland AFB also uses these airspaces for helicopter and tilt-rotor aircraft training operations. Other airspaces west of the WSMR (R5113, R5119, and R5107E) are also used for low-level flight operations. The military has jurisdiction, along with the FAA, over the restricted airspace above the Northern Call-up Area and west of the WSMR, where Holloman AFB routinely conducts low-level flight training operations as low as 100 feet above the ground.

In a letter to the BLM[1], the DOD identified several routes that would have significant adverse effects on the DOD's test mission concerning the WSMR, including the subroutes crossing Fort Bliss McGregor Range, the Northern Call-up Area nearest the WSMR, and the subroute near the LC 94 cruise missile launch facility. In lieu of these routes, the WSMR provided the BLM with a set of alternative routes that were analyzed for feasibility and carried forward for further analysis where appropriate in this EIS. The DOD requested that all routes farthest from the northern border of the WSMR be carried forward for further evaluation. The DOD clarified in their letter that a portion of the WSMR proposed "Route 2" (also named Subroute 1A) would need to be moved farther north to avoid impacts to "critical test profiles," or otherwise would need significant mitigation to "preserve WSMR's unique test capabilities…" Subroutes 1A, 1A1, and 1A2 are approximately 28 miles north of the WSMR.

Arizona

The Electronic Proving Ground is a facility headquartered at Fort Huachuca in Sierra Vista, Arizona that conducts noise tests for electronic combat and electronic warfare equipment. As part of the U.S. Army mission, existing facilities within the Electronic Proving Ground study area, such as power lines, cell phone towers, radio stations, and other "emitters," have been measured and taken into account to form a "zero point" for testing purposes.

Davis Monthan AFB and Pinal Airpark are located in the Tucson metropolitan area. Airspace north of the city is used by the Army National Guard to conduct flight training operations. There are multiple military training routes throughout southern Arizona, with many converging near the town of Redington. The Jackal Low Military Operations Area is located near Aravaipa Canyon, with the lowest altitude of operation at 100 feet above ground level. The Army National Guard trains helicopter pilots near the Pinal Airpark and Picacho Mountains.

4.10.6.2 Summary of Impacts to Military Operations by Subroute

The DOD and representatives of the military installations provided the description of impacts to the affected military operations areas, which are discussed in relation to the Project alternatives in the following section. Potential impacts to military flight operations in restricted airspace could occur if aircraft were to collide with transmission line facilities. In order to avoid potential collisions with transmission line conductors or structures (typical height of 135 feet), pilots would have to adjust the flight altitudes for their low-level training missions to acceptable and safer heights in these areas.

The adjustments to flight operations could be minimized to the extent that mitigation to reduce the heights of the transmission line facilities would be effective. Other mitigation measures proposed by military pilots would include lights placed on towers to make the transmission facilities more visible at night, where indicated.

[1] DOD letter to BLM, signed by Dorothy Robyn, Deputy Under Secretary of Defense (Installations and Environment); Samuel Kleinman, Deputy Under Secretary of Defense (Readiness); and David Duma, Principal Deputy Director (Operational Test and Evaluation). May 11, 2011.

Special Use Airspace designations, including restricted airspace associated with the WSMR, are considered joint-use between the WSMR and FAA. The restricted airspace is designated to protect the safety of nonparticipatory aircraft and persons, but the FAA ultimately maintains control of the airspace. The FAA does not have regulatory control over the placement of structures on the ground, but does have the regulatory control over lighting of any structures considered hazards or structures more than 200 feet in height above ground. The proposed transmission towers are not proposed to exceed 200 feet in height above ground, and therefore construction and operation of the Project would not affect the restricted airspace in a manner inconsistent with the Special Use Airspace designations near the WSMR. As the decision-making authority over issuance of a right-of-way across public lands, the BLM would consider impacts to DOD missions that could be impacted by the Project.

The WSMR test-fires missiles over the Northern Call-up Area onto the WSMR. In the event that a missile may malfunction after it is launched, it would be destroyed by detonation in order to prevent major damage to property and structures within the fallout zone. The fallout zone is an estimated area where debris would be expected to land and is determined by, among other things, the height and location of the missile at the point of detonation. There is the potential for damage to occur to transmission line facilities should a missile be detonated shortly after it is launched that is dependent on distance from the launch site, although the extent of this risk is uncertain.

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 is located within a portion of the Northern Call-up Area and the R5107C/R5107H airspace used for flight operations. Subroute 1A1 is located up to 10 miles north of Subroute 1A, and approximately 4 miles north of the Gran Quivira. Because this subroute (Link E80d) is located approximately 2 miles north of LC 94, WSMR has stated that potential missile launch malfunctions could create a higher risk of potential damage to the transmission lines.

Subroute 1A2 (BLM preferred alternative) is located 3 miles farther north than Subroute 1A1 and 5 miles north of LC 94 within a portion of the Northern Call-up Area, and is on the northern edge of the R5107C/R5107H airspace used for flight operations. Subroute 1A2 is located up to 3 miles north of Subroute 1A1, and approximately 4 miles north of the Gran Quivira. This subroute is 3 miles farther north of LC 94 than Subroute 1A1; however, WSMR has stated that potential missile launch malfunctions could still create a risk of potential damage to the transmission lines.

Subroute 1A is similar to subroutes 1A1 and 1A2, with the exception of the segment south of the Gran Quivira (links A22 and E80c) in place of the segment north of the Gran Quivira (links E82, E84a, E84b, E85, and E86a) and the segment west of I-25 (Link A270 in place of Link A260). As stated by the DOD, construction and operation of the Project with this subroute could impact "critical test profiles," and a higher risk of potential conflict with flight training operations.

The majority of the east-west portion of Subroute 1B1 across the Northern Call-up Area is approximately 28.5 miles north of the WSMR. This alternative was aligned to avoid the LC 94 site that is located in the Northern Call-up Area, to the west of Link E90 and approximately 2 miles south of Link E80d. According to the WSMR, there would be a higher risk of potential

conflict with flight training operations for this alternative because links E81, E80d, E90, A90, and A111 bisect lands below the airspace.

The east/west portion of subroutes 1B2 and 1B2a is approximately 12 miles north of the WSMR. This subroute crosses safety areas (fans) established by the WSMR that extend north into the Northern Call-up Area, potentially leaving the Project susceptible to damage from military tests. According to the WSMR, this subroute may potentially preclude the use of LC 94, resulting in potential significant impacts to the WSMR's testing program. While there are no direct land use impacts to public, private, or military lands crossed by these subroutes, the transmission lines would be constructed on lands below the restricted airspace.

Subroute 1B3 is the closest to the WSMR through the Northern Call-up Area, and would have impacts similar to those noted for subroutes 1B1 and 1B2. In addition, Link A41 may require that the right-of-way cross 1 mile of DOD land where it meets links A70 and A80; impacts to this land have not been determined. The east-west portion of this subroute is approximately 6 miles north of the WSMR.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 (BLM preferred alternative) crosses approximately 20 miles of land below restricted airspace.

Subroute 3A crosses approximately 20 miles of land below restricted airspace.

Subroute 3B crosses approximately 5 miles of land below restricted airspace.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A crosses approximately 36 miles of the Jackal Low Military Operations Area, approximately 71 miles of the Silver Bell Army Heliport training area, and approximately 47 miles of lands below other restricted airspace. It is parallel to approximately 14 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4B crosses approximately 38 miles of the Jackal Low Military Operations Area, approximately 71 miles of the Silver Bell Army Heliport training area, and approximately 25 miles of lands below other restricted airspace. It is parallel to approximately 14 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4C2c (BLM preferred alternative) does not cross any restricted airspace. The alternative subroute is parallel to the existing TEP 345 kV lines where it crosses 18 miles of the Electronic Proving Ground, a DOD testing program area. The testing program could be potentially affected by the operation of new transmission lines; however, the effects have not been described or quantified. Subroute 4C2c crosses approximately 86 miles of the Silver Bell Army Heliport training area, and would also parallel approximately 10 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4C1 does not cross any restricted airspace, but does cross approximately 9.5 miles of the Electronic Proving Ground. Subroute 4C1 crosses approximately 80 miles of the Silver Bell Army Heliport training area, and is parallel to approximately 14 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4C2 does not cross any restricted airspace, but does cross approximately 9.5 miles of the Electronic Proving Ground. Subroute 4C2 crosses approximately 86 miles of the Silver Bell Army Heliport training area, and is parallel to approximately 10 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4C2a does not cross any restricted airspace, but does cross approximately 9.5 miles of the Electronic Proving Ground. Subroute 4C2a crosses approximately 72 miles of the Silver Bell Army Heliport training area, and is parallel to approximately 14 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4C2b does not cross any restricted airspace, but does cross approximately 18 miles of the Electronic Proving Ground. Subroute 4C2b crosses approximately 72 miles of the Silver Bell Army Heliport training area, and is parallel to approximately 14 miles of the Newman Peak Silver Bell Army Heliport military training route.

Subroute 4C3 does not cross any restricted airspace, but does cross approximately 16 miles of the Electronic Proving Ground. Subroute 4C3 crosses approximately 62 miles of the Silver Bell Army Heliport training area, and it parallels approximately 10 miles of the Newman Peak Silver Bell Army Heliport military training route. Davis-Monthan AFB is located north of Link F111, a portion of which is parallel with the runway northwest of the base. While there are commercial and industrial properties adjacent to this portion of the subroute, the potential exists for collision with the transmission line with an aircraft taking off or landing at the base.

4.11 BLM SPECIAL DESIGNATIONS

4.11.1 Introduction

This section describes and evaluates the potential impacts to special designations in the study area that would result from the construction and operation of the proposed transmission lines and substations. Impacts to wilderness, wilderness study areas, and lands with wilderness characteristics are described in Section 4.12.

4.11.2 Impact Assessment Methodology

Special designations within the study area were identified and described in Section 3.11 and Figure M 10-1 (see Map Volume). BLM special designations include congressionally designated national wild and/or scenic rivers; national conservation areas; national byways; and national scenic, historic, or recreation trails. Administrative designations include ACEC and SRMAs. Direct impacts would occur if the Project right-of-way or facilities would be located on lands within the boundaries of a special designation. Indirect and cumulative impacts to special designations, which may include impacts to air quality, earth, water, visual, wilderness, lands

with wilderness characteristics, or other resources, are described in their respective resource sections in this chapter.

4.11.2.1 No Action Alternative

Under the No Action alternative, the BLM would not grant right-of-way for construction and operation of the proposed Project; and Project facilities, including transmission lines and substations, would not be built and existing land uses in the Project study area would continue. There would be no new impacts to special designation areas within the study area. Under the No Action alternative, it is assumed that current actions and activities in the study area would continue.

4.11.2.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 crosses two areas of the Johnson (Gordy's) Hill SRMA (links E180 and E133) used for OHV recreation, within 700 feet of existing roads. Structures or guywires would be marked with high-visibility devices as required per ST 12, to increase user safety. There would be no direct impacts to other special designations for this subroute.

Subroute 1A2 – BLM Preferred Alternative

Impacts to Subroute 1A2 would be similar to those for Subroute 1A1. Subroute 1A – North River Crossing

Impacts to Subroute 1A would be similar to those for Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

For Subroute 1B, there would be no direct impacts to special designations for this subroute.

Local Alternative and Crossover Links for Route Group 1

There would be no direct impacts to special designations by the local alternatives and crossover links for Route Group 1.

4.11.2.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

There would be no direct impacts to special designations for this subroute.

4.11.2.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

There would be no direct impacts to special designations for this subroute.

Subroute 4B – Sulphur Springs Valley

There would be no direct impacts to special designations for this subroute.

Subroute 4C2c – BLM Preferred Alternative

There would be no direct impacts to special designations for this subroute.

Subroute 4C1 – East of San Pedro River

High-moderate impacts may occur along Link C331 for 0.1 mile where it crosses the southwestern corner of the Muleshoe Ranch CMA and Swamp Springs-Hot Springs Watershed ACEC, and along 1.3 miles of moderate impact where it crosses the southwestern edge of the Muleshoe Ecosystem Planning Boundary.

Subroute 4C2 – West of San Pedro River

There would be no direct impacts to special designations for this subroute.

Subroute 4C3 –Tucson

There would be no direct impacts to special designations for this subroute.

Local Alternative and Crossover Links for Route Group 4

There would be no direct impacts to special designations by the local alternatives and crossover links for Route Group 4.

4.12 WILDERNESS, WILDERNESS STUDY AREAS, AND LANDS WITH WILDERNESS CHARACTERISTICS

4.12.1 Introduction

This section describes and evaluates the potential direct and/or indirect impacts to wilderness, WSA, and agency identified lands with wilderness characteristics inventory units within the Project study area that would result from the construction and operation of the proposed transmission lines and substations.

4.12.2 Impact Assessment Methodology

An impact assessment methodology was developed to identify and evaluate potential direct and/or indirect impacts to wilderness, WSA, and lands with wilderness characteristics inventory units that would result from the Project. Per BLM New Mexico State Office direction, direct impacts would occur for portions of the Project where components (including access, structures, and ancillary facilities) would cross lands with wilderness characteristics inventory units or lands designated as wilderness or WSA. The latter condition (i.e., the Project crossing wilderness or WSA) does not occur in the context of the Project. Direct impacts to lands with wilderness characteristics inventory units were characterized by the number of acres that would no longer qualify as potential lands with wilderness characteristics.

Although significant impacts are not expected, indirect impacts may occur for portions of the Project where components would be visible from within wilderness, WSA, and lands with wilderness characteristics inventory units. Per BLM direction, visibility of the proposed facilities could affect outstanding opportunities for solitude and/or primitive and unconfined recreation. In order to assess these indirect impacts, a viewshed analysis was conducted using GIS, to identify potential locations and areas (in acres) within wilderness, WSA, and lands with wilderness characteristics inventory units where proposed Project structures would potentially be visible. The viewshed analysis included proposed Project alternatives that are located 3 miles or less from wilderness, WSA, or lands with wilderness characteristics inventory units. As described in the visual resource study for the Project (see Section 4.9), it has been determined that the visual influence (dominance) of the proposed Project would diminish considerably at a distance of 3 miles. Therefore, wilderness, WSA, and lands with wilderness characteristics inventory units beyond 3 miles from Project alternatives were not assessed. Citizen's Wilderness Inventory Units have been reviewed as part of the inventory of Lands with Wilderness Characteristics on BLM lands.

Following are general descriptions of anticipated direct and indirect impacts to lands with wilderness characteristics inventory units, and indirect impacts to wilderness and WSA that would result from the construction and operation of the Project.

4.12.3 Summary of Impact Analysis Results for Wilderness Areas

4.12.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

No wilderness areas are located within 3 miles of this subroute; therefore, no indirect impacts were identified.

Subroute 1A2 – BLM Preferred Alternative

The impacts from this subroute would be similar to Subroute 1A1.

Subroute 1A – North River Crossing

The impacts from this subroute would be similar to subroutes 1A1 and 1A2.

Subroute 1B – San Antonio Crossing

Link A111 would be visible from approximately 9,891 acres (50 percent) of the Little San Pascual Wilderness Area. The visibility of the proposed link, located approximately 2.5 miles north of the wilderness area boundary, would have an indirect impact affecting the outstanding opportunities for solitude within the wilderness area. The proposed alternative link would also be seen in the context of US Route 380.

Link A160 would be visible from 513 acres (10 percent) of the Indian Wells Wilderness Area. The visibility of the proposed link, located approximately 2 miles northwest of the wilderness area boundary, would have an indirect impact affecting the outstanding opportunities for solitude within the wilderness area.

Local Alternative and Crossover Links for Route Group 1

No wilderness areas are located within 3 miles of local alternatives or crossover links for Route Group 1.

4.12.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

No wilderness areas are located within 3 miles of Subroute 3A2; therefore, no indirect impacts were identified.

Subroute 3A – North

No wilderness areas are located within 3 miles of Subroute 3A; therefore, no indirect impacts were identified.

Subroute 3B – South

The impacts resulting from this subroute would be similar to Subroute 3A1.

Local Alternative and Crossover Links for Route Group 3

No wilderness areas are located within 3 miles of local alternatives or crossover links for Route Group 3.

4.12.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Link C170 would be visible from approximately 2,046 acres (8 percent) of the Santa Teresa Wilderness Area and approximately 2,474 (13 percent) of the Aravaipa Canyon Wilderness Area. The visibility of the proposed link, located approximately 2.9 miles south of the Santa Teresa Wilderness Area boundary and 3.75 miles south of the Aravaipa Canyon Wilderness Area boundary, would have minimal indirect impacts affecting the outstanding opportunities for solitude within the wilderness area. Due to the size and rugged terrain of the wilderness areas, there would still be ample opportunity for solitude within these wilderness areas.

Subroute 4B – Sulphur Springs Valley

Indirect impacts along Subroute 4B would be similar to Subroute 4A along Link C170.

Subroute 4C2c – BLM Preferred Alternative

Links C441 and C201 would be visible from approximately 6,389 acres (17 percent) of the Rincon Mountain Wilderness Area. The visibility of these proposed links, located 2 to 2.5 miles northeast of the wilderness area boundary, respectively, would have minimal indirect impacts affecting the outstanding opportunities for solitude within the wilderness area. Although the proposed Project would be visible, due to the size and rugged terrain of the wilderness area, there would still be ample opportunity for solitude.

Subroute 4C1 – East of San Pedro River

Link C470 would be visible from approximately 8,683 acres (11 percent) of the Galiuro Wilderness Area. The visibility of the proposed link, located approximately 2.3 miles west of the wilderness area boundary, would have minimal indirect impacts affecting the outstanding opportunities for solitude within the wilderness area. Due to the size and rugged terrain of the wilderness area, there would still be ample opportunity for solitude within it.

Link C470 would also be visible from approximately 340 acres (17 percent) of the Redfield Canyon Wilderness Area. The visibility of the proposed link, located approximately 1.5 miles west of the wilderness area boundary, would have minimal indirect impacts affecting the outstanding opportunities for solitude within the wilderness area.

Subroute 4C2 – West of San Pedro River

Links C441 and C276 would be visible from approximately 5,297 acres (14 percent) of the Rincon Mountain Wilderness Area. The visibility of these proposed links, located approximately 2 and 2.5 miles northeast of the wilderness area boundary, respectively, would have minimal indirect impacts affecting the outstanding opportunities for solitude within the wilderness area. Although the proposed Project would be visible, due to the size and rugged terrain of the wilderness area, there would still be ample opportunity for solitude.

Subroute 4C3 – Tucson

Links F40a and F600 would be visible from approximately 8,923 acres (24 percent) of the Rincon Mountain Wilderness Area. The visibility of these proposed links, located approximately 0.6 and 0.7 mile, respectively, would have minimal indirect impacts to outstanding opportunities for solitude because the proposed links would be seen in the context of two existing HVTL. The existing transmission lines are located north of the proposed alternative links, and a portion of these lines parallels the southern boundary of the wilderness area. Due to the size and rugged terrain of the wilderness area, there would still be ample opportunity for solitude.

Link F510 would be visible from approximately 1,979 acres (15 percent) of the West Saguaro Wilderness Area. The visibility of the proposed link, located approximately 2.7 miles northeast of the wilderness area boundary, would have minimal indirect impacts affecting outstanding opportunities for solitude because the proposed alternative link would be seen in the context of existing development associated with the Tucson metropolitan area. Due to the size and rugged terrain of the wilderness area, there would still be ample opportunity for solitude.

Local Alternative and Crossover Links for Route Group 4

Link C201 would be visible from approximately 6,389 acres (17 percent) of the Rincon Mountains Wilderness Area. The visibility of the proposed link, located approximately 2.5 miles east of the wilderness boundary, would have a greater indirect impact to outstanding opportunities for solitude than Subroute 4C2.

Link F40b would be visible from approximately 11,357 acres (31 percent) of the Rincon Mountain Wilderness Area. The visibility of the proposed link, located approximately 0.3 mile south of the wilderness area boundary, would have a greater indirect impact to outstanding opportunities for solitude than Subroute 4C3.

Link F81a would be visible from approximately 21,750 acres (37 percent) of the East Saguaro Wilderness Area. The visibility of this proposed link, located approximately 1.5 miles west of the wilderness area boundary, would have minimal indirect impacts to outstanding opportunities for solitude, because the proposed link would be seen in the context of existing development associated with the Tucson metropolitan area. Due to the size and rugged terrain of the wilderness area, there would still be ample opportunity for solitude.

4.12.4 Summary of Impact Analysis Results for Wilderness Study Areas

4.12.4.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Links E101a and E101b would be visible from approximately 4,741 acres (20 percent) of the Stallion WSA. The visibility of the proposed link, located less than 0.5 mile north of the WSA boundary, would have an indirect impact to outstanding opportunities for solitude. Although the

alternative would be visible, due to the size and rugged terrain of the Stallion WSA, there would still be ample opportunity for solitude.

Link E133 would be visible from approximately 5,064 acres (70 percent) of the Veranito WSA. The proposed link is located along the southern boundary of the WSA, with some areas of the alternative within 0.15 mile of the boundary.

Links E133 and E180 would be visible from approximately 1,211 acres (15 percent) of the Presilla WSA. The visibility of the proposed links, located approximately 2.5 miles north of the WSA boundary, would have indirect impacts to outstanding opportunities for solitude. Although the proposed links would be visible, due to the size and varying terrain of the WSA, there would still be ample opportunity for solitude. Link A161 is more than 5 miles from the WSA boundary; therefore, no indirect impacts were identified.

Subroute 1A2 – BLM Preferred Alternative

The impacts resulting from Subroute 1A2, the BLM preferred alternative, would be similar to Subroute 1A1.

Subroute 1A – North River Crossing

The impacts resulting from this subroute would be similar to subroutes 1A1 and 1A2.

Subroute 1B – San Antonio Crossing

Links E90 and A90 of Subroute 1B1 would be visible from approximately 6,742 acres (28 percent) of the Stallion WSA. The proposed links are located to the east and south of the WSA boundary and would have a greater indirect impact to outstanding opportunities for solitude than Subroute 1A. Links A60 and A90 of Subroute 1B2 would be visible from approximately 5,244 acres (22 percent) of the Stallion WSA. The proposed links, located approximately 2 miles south of the WSA boundary, would have a greater indirect impact to outstanding opportunities for solitude than Subroute 1B1.

Link A111 of subroutes 1B1, 1B2, and 1B3 would be visible from approximately 15,601 acres (76 percent) of the Antelope WSA. The proposed link, located approximately 2.5 miles north of the WSA boundary, would have indirect impacts to outstanding opportunities for solitude. The proposed alternative link would also be seen in the context of US Route 380.

Local Alternative and Crossover Links for Route Group 1

Local Alternative Link 161b would be visible from approximately 1,840 acres (19 percent) of the Devil's Backbone WSA. The proposed link, located approximately 2 miles east of the WSA, would have a greater indirect impact to outstanding opportunities for solitude than Link A161 of Subroute 1B1, which is located more than 5 miles from the WSA boundary.

4.12.4.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

No WSA are located within 3 miles of Subroute 3A2; therefore, no indirect impacts were identified.

Subroute 3A – North

No WSA are located within 3 miles of Subroute 3A; therefore, no indirect impacts were identified.

Subroute 3B – South

Link B150a would be visible from approximately 217 acres (5 percent) of the Peloncillo Mountains WSA. The BLM preferred alternative, located approximately 2.5 miles south of the WSA boundary, would have minimal impacts to outstanding opportunities for solitude. Although the Project would be visible, due to the size and varying terrain of the WSA, there would still be ample opportunities for solitude.

Local Alternative and Crossover Links for Route Group 3

No WSA are located within 3 miles of local alternative or crossover links for Route Group 3; therefore, no indirect impacts were identified.

4.12.4.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

No WSA are located within 3 miles of Route Group 4; therefore, no indirect impacts were identified.

4.12.5 Summary of Impact Analysis Results for Lands with Wilderness Characteristics

4.12.5.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Links E101a and E101b would have direct impacts to the pending lands with wilderness characteristics inventory unit adjacent to Stallion WSA, where they cross approximately 2.1 miles of the northern portion of the unit. This unit contains approximately 1,788 acres of BLM-managed land identified as having wilderness characteristics. Construction and operation of the proposed Project would reduce the inventory unit by approximately 102 acres. Direct impacts to the inventory unit could be minimized by relocating links E101a and E101b (SE 8).

Link A400 would be visible from approximately 3,728 acres (41 percent) of the Nutt Grassland inventory unit. The proposed alternative link, located approximately 400 feet west of the inventory unit's northwestern boundary, would have minimal indirect impacts to outstanding

opportunities for solitude because it would be seen in the context of an existing HVTL that is located east of the proposed alternative link. A portion of the existing HVTL runs immediately adjacent to a portion of the inventory unit's western boundary. Due to the size and varying terrain of the inventory unit, there would still be opportunity for solitude. There are no direct impacts to the Nutt Grassland inventory unit for this subroute.

Subroute 1A2 – BLM Preferred Alternative

The impacts resulting from the BLM preferred alternative would be similar to Subroute 1A1.

Subroute 1A – North River Crossing

The impacts resulting from Subroute 1A would be similar to subroutes 1A1 and 1A2.

Subroute 1B – San Antonio Crossing

Link A160 of subroutes 1B1, 1B2, and 1B3, would be visible from approximately 488 acres (79 percent) of the Chupadera inventory unit. The proposed link, located approximately 1.9 miles northwest of the inventory unit's boundary, would have indirect impacts to outstanding opportunities for solitude. There are no direct impacts to the Chupadera inventory unit for subroutes 1B1, 1B2, or 1B3.

Indirect impacts to the Nutt Grassland inventory unit for subroutes 1B1, 1B2, and 1B3 would be similar to impacts identified for Subroute 1A along Link A400. There are no direct impacts to the Nutt Grassland inventory unit for subroutes 1B1, 1B2, and 1B3.

Local Alternative and Crossover Links for Route Group 1

Link A361 would have a direct impact to the Nutt Grassland inventory unit where it crosses approximately 0.2 mile of the northeastern-most portion of the unit. This unit contains approximately 9,192 acres of BLM-managed land identified as having wilderness characteristics. Construction and operation of the proposed Project would reduce the inventory unit by approximately 8 acres. Direct impacts to the inventory unit could be minimized by relocating Link A361 (SE 8).

Link A361 and A430 would be visible from approximately 8,283 acres (90 percent) of the Nutt Grassland inventory unit. The proposed links, located within the inventory unit boundary (Link A361) and approximately 1.5 miles to the east of the unit boundary (Link A430), would have minimal indirect impacts to outstanding opportunities for solitude, because Link A430 would be seen in the context of an existing HVTL that is located west of the proposed alternative link, which comes within 300 feet of the inventory unit's southeastern boundary.

4.12.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no direct or indirect impacts to lands with wilderness characteristics inventory units for Route Group 3.

4.12.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

There are no direct or indirect impacts to lands with wilderness characteristics inventory units for this subroute.

Subroute 4B – Sulphur Springs Valley

There are no direct or indirect impacts to lands with wilderness characteristics inventory units for this subroute.

Subroute 4C2c – BLM Preferred Alternative

There are no direct or indirect impacts to lands with wilderness characteristics inventory units for this subroute.

Subroute 4C1 – East of San Pedro River

Links C331 and C361 would have a direct impact to the Muleshoe/4-90 inventory unit where it would cross approximately 1.3 miles of its southwestern portion. This unit contains approximately 6,600 acres of BLM-managed land identified as having wilderness characteristics. Construction and operation of the Project would reduce the inventory unit by approximately 110 acres. Direct impacts to the unit could be minimized by relocating links C331 and C361 to the south, in order to avoid crossing the inventory unit (SE8). Links C331 and C361 would be visible from approximately 3,141 acres (48 percent) of the Muleshoe/4-90 inventory unit. The proposed Project links, located between 400 and 500 feet north of the unit's southwest boundary, would have indirect impacts to outstanding opportunities for solitude.

Subroute 4C2 – West of San Pedro River

Links C271 and C266 would be visible from approximately 991 acres (15 percent) of the Muleshoe/4-90 inventory unit. The proposed alternative links, located approximately 2.5 miles south of the inventory unit's boundary, would have indirect impacts to outstanding opportunities for solitude. Although the proposed link would be visible, due to the size and varying terrain of the inventory unit, there would still be ample opportunity for solitude. There are no direct impacts to the Muleshoe inventory unit for this subroute.

Subroute 4C3 – Tucson

There are no direct or indirect impacts to lands with wilderness characteristics inventory units for this subroute.

Local Alternative and Crossover Links for Route Group 4

There are no direct or indirect impacts to lands with wilderness characteristics inventory units for this subroute.

Summary of BLM Preferred Alternative

- Although subroutes 1A2 and 3A2 would result in indirect impacts to outstanding opportunities for solitude for portions of the Stallion WSA, Veranito WSA, Presilla WSA, and Peloncillo Mountains WSA, due to their size and rugged terrain, there would still be ample opportunity for solitude.
- There would be direct impacts to lands with wilderness characteristics for Subroute 1A2 near Stallion WSA.
- Subroute 3A2 would result in indirect impacts to the Peloncillo Mountains Wilderness Area and Rincon Mountains Wilderness Area, which occur 0.5 mile to 2 miles from the boundary, respectively; affecting the outstanding opportunities for solitude within the wilderness area. Although the Project would be visible, there would still be ample opportunity for solitude due to the size and rugged terrain of the wilderness area.
- There would be no direct or indirect impacts to lands with wilderness characteristics for Subroute 4C2c.

4.13 SOCIAL AND ECONOMIC CONDITIONS

4.13.1 Introduction

This section describes the potential effects or impacts to social and economic resources that would result from the construction and operation of the proposed Project. These effects are discussed by subroute and the potential transmission line options (see Chapter 2).

The impact analysis evaluates how the social and economic effects of the construction and operation phases of the Project would be distributed across several counties at different periods; including short-term and long-term impacts. Short-term impacts are considered to be 3 years or less (construction phase), while long-term impacts are considered to be greater than 3 years, extending through the life of the Project (operation phase).

Regulations state that "[e]ffects include…cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect would be beneficial" (40 CFR 1508.8). In addition, indirect effects may include those that are growth-inducing and others related to induced changes in the pattern of land use, population density, or growth rates.

4.13.2 Impact Assessment Methodology

The socioeconomic assessment method is based largely on a Project-specific study conducted by the UA, Economic and Business Research Center, and NMSU Arrowhead Center (2009). The SunZia Southwest Transmission Project EIA was developed to support this EIS (Charney et al. 2012a; Appendix G-1). Components addressed in this study include basic socioeconomic characteristics of the affected counties (population, density, and per capita income); revenue impacts (expected property tax, sales tax, and state-shared sales tax); and economic impacts (number of jobs created [direct and indirect], labor income, and county-equivalent gross domestic product). Using economic modeling software IMPLAN[1], the study estimated impacts across eight New Mexico and five Arizona counties.

Because the length of each alternative subroute is directly proportional to its estimated economic effect, multipliers (based on the results of the EIA) were calculated for each county and applied to each alternative subroute on a per mile basis. The economic impacts resulting from construction and operation of the proposed substations have been incorporated in the estimates of impact for each of the transmission line alternatives associated with the affected counties. Social impacts related to population increases, housing, and emergency services are qualitatively discussed and quantified where possible.

The methodology used to assess economic impacts includes the following measurements (detailed analysis is included in Appendix G-1 and G-2):

- Labor income (also referred to as wages or salary) is measured in dollars. Consists of wages and salaries, including benefits and proprietor income.
- Employment is measured in terms of number of job years. For example, three jobs could refer to three people working 1 year or one person working for 3 years. Jobs refer to both full- and part-time employment, but not full-time equivalent positions. Most of the direct employment associated with the construction and operations of the transmission lines and substations is full-time or greater (construction workers typically work more than 40 hours per week), while many of the jobs created for service sector industries are more likely to be part-time. Most economic impact studies incorporate the discussion of three types of impacts: direct, indirect, and induced. For the purposes of this analysis, indirect and induced impacts are referred to as indirect employment effects.
    - Direct employment effects are the initial changes determined to be a result of the activity under study. In the present context, direct employment effects of construction spending on the transmission lines are the jobs, income, and sales directly associated with construction spending. As presented in Appendix G-1 and G-2, direct employment effects are divided into those associated with labor expenditures (estimated numbers of construction workers, expected labor costs, etc.) and other construction expenditures (the result of purchases of equipment and materials).

[1] IMPLAN is a national input-output model created by the U.S. Bureau of Economic Analysis.

- Indirect employment effects are the impact of local industries supplying goods and services to a project or activity under study, and the effects of the resultant labor earnings being used for purchasing local goods and services. These purchases include groceries, gasoline (not for work purposes), and other typical household spending items.

4.13.2.1 Significant Impacts

For the purposes of this analysis, a significant impact on social and economic values could result if any of the following were to occur from construction or operation of the Project:

- Increase in population that could create shortages of housing and place an excessive burden on local government and community facilities and services
- Increase in revenue for local and state governments
- Creation of a substantial number of jobs, both skilled and unskilled
- Existing properties, including residential, commercial, and industrial units, are taken for right-of-way acquisition and the construction of the Project

4.13.3 Mitigation Planning

Mitigation planning for adverse effects to socioeconomic resources would include standard mitigation measures (see Table 2-10). For example, avoidance of residential properties, public facilities, and other sensitive use areas could reduce impacts to socioeconomic resources. In addition, standard mitigation measures could reduce impacts to quality of life factors, such as reducing visual contrast in sensitive settings.

4.13.4 Summary of Impact Analysis Results

Under the No Action alternative, the BLM would not approve the Applicant's right-of-way application, and would continue to manage the land within the Project corridor consistent with existing field office RMPs. No new structures or facilities associated with the Project would be constructed or operated, and the Project would not cause changes to population, employment or revenues. As a result, no socioeconomic impacts would occur.

4.13.4.1 Population Impacts

Construction

The construction of the transmission lines and substations is expected to take place over a span of 2 to 3 years at various locations throughout the study area, and will employ a maximum of 206 workers per transmission line and 55 workers per substation site (see Section 2.4.10.11). Approximately three to five crews would likely be working at any one time; the locations of these crews are expected to vary significantly depending on mitigation measures and areas that must be avoided during certain times of the year (e.g., avoidance of breeding seasons for nesting eagles) (personal communication, Bedillion 2011). Population growth beyond that caused by direct construction employment is expected to be minimal, because indirect industries (e.g.,

support industries such as restaurant and hotel/lodging) typically employ workers who are already present in local economies.

Approximately 30 percent of all construction workers are expected to come from Arizona or New Mexico, with 10 percent of all workers anticipated to be hired locally within the counties where construction will take place (Charney et al. 2012a, Appendix G1). An assumption is made that all local workers and most in-state workers would commute to the construction site from their homes and therefore would not contribute to population growth. The remaining 70 percent of workers would temporarily relocate within proximity of individual construction sites. Because construction employment would be temporary in nature and developed linearly in New Mexico and Arizona, it is unlikely that relocated workers would also relocate their families. Based on these assumptions, including the likelihood that multiple crews along a 500-mile corridor would be in close proximity to one another, no significant impacts related to population increases are expected from temporary population increases of a few hundred people.

Operations

Because operational employment would be minimal and spread between three cities in New Mexico and Arizona, population increases are expected to be negligible. Not including the surrounding metropolitan areas, the Las Cruces, Tucson, and Phoenix populations in 2009 totaled approximately 100,000; 500,000; and 1,500,000 respectively (U.S. Census 2005-2009b).

4.13.4.2 Housing Impacts

Construction

The temporary population increase during the construction of the proposed Project is expected to have little to no impact on housing availability, because the number of construction workers onsite at any one time would not be significant (less than 206 for transmission line construction and 55 for each substation). Construction workers are expected to temporarily locate across the Project study area. Workers would reside in hotels, campgrounds, and other short-term living options (personal communication, Bedillion 2011). In addition, some would commute from their existing residences in nearby counties. Counties within proximity to where construction would take place in New Mexico and Arizona have a high number of vacant housing units, with nearly 28,000 and 86,000 vacancies, respectively.

There would be no direct impacts to residences for right-of-way acquisition among any alternatives in Route Group 1 or Route Group 3; subroutes 4A, 4B, 4C1, or 4C2; as well as the BLM preferred alternative subroutes. However, the construction of the Project using Subroute 4C3 could result in significant impacts due to the take of approximately 216 residences (in addition to 48 commercial and industrial properties along links F111 and F112 in South Tucson). Local alternative links F81a-F81b would also result in significant impacts to residential properties, resulting in the take of approximately 120 residences (in addition to 37 commercial and industrial properties). The locations of potential right-of-way acquisition are described in Section 4.10.5.3. Residential displacement could cause homeowners to experience a temporary hardship of having to find new housing; however, residents are expected to receive ample notice

to find new housing and would be compensated fair market value for their homes. Even after standard mitigation measures are applied, significant impacts to residents would result from the construction of the Project and acquisition of right-of-way for Subroute 4C3 or the local alternative (F81a-F81b).

Operations

Based on the estimated population increases presented above, no shortage of housing or other impacts are expected to result from the housing demands of people relocating to New Mexico and Arizona during operations. Tables 3-61 and 3-62 (see Chapter 3) illustrate the abundance of vacant housing units within the New Mexico and Arizona counties where construction would take place.

The BLM preferred alternative would not require the acquisition of any homes. However, impacts remaining from the acquisition of homes from right-of-way acquisition for Subroute 4C3 could extend beyond the construction phase into operations. The displacement of homes where communities have existed for many years, and where residents have deep social ties, may result in impacts that cannot be mitigated by fair market value compensation. For these reasons, it is very likely that strong opposition to Subroute 4C3 would result. In addition, long-term property tax revenues generated by the use of the land for a utility right-of-way could be lower than the property taxes generated by existing homes and businesses in the affected area. The resulting tax revenue would depend on the condition of the affected properties and other economic variables specific to Tucson and Pima County.

4.13.4.3 Economic Impacts

The following section focuses on direct and indirect impacts associated with the construction of the Project for each alternative subroute. Because economic impacts for transmission line construction are, for the most part, directly proportional to the length of the transmission line route, only major differences between subroutes are discussed. Transmission line Option A and Option B present similar impacts within route groups, because each involves the development of two parallel transmission lines (see Section 2.4.1). Since the construction of converter stations needed for a DC line (Option B) is more time consuming and requires more expensive materials than that for an AC line, a greater number of jobs and wages are expected to result from the construction of this option. Results are summarized to include a range between the two options, and total county impacts for alternative subroutes within the group. Tax revenue impacts would vary for options A and B, and are dependent on the rates within each state and county.

The estimate of employment and income associated with Project development includes only the construction phase, because operations employment would likely be based in only three counties: Doña Ana County in New Mexico, and Pima and Maricopa counties in Arizona. (It is noted that none of the Project facilities would be constructed in Doña Ana or Maricopa County.)

Employment and Income

The results of the employment and income analysis for construction are based on a number of key assumptions:

- Approximately 10 percent of all construction workers, on average, would be hired locally in all counties as subcontractors.
- An additional 20 percent of workers would be hired within New Mexico or Arizona, but from outside the county in which work takes place.
- In-state hires would spend 40 percent of their income in-county, and 60 percent elsewhere in the state.
- Workers from out-of-state would spend 40 percent of their income in the county they are living and working, an additional 40 percent elsewhere in the state, and 20 percent outside of the state.
- All construction workers would receive per diem for living expenses equal to 15 percent of their total labor income. This additional money would be spent on items such as lodging, food, restaurants, entertainment, and fuel.

State and Local Sales and Income Tax Revenue

The construction and operation phases for each alternative presented for the proposed Project would result in state and local tax revenue in New Mexico and Arizona. In addition to revenue generated by direct spending on materials and labor, revenue would also be generated by workers who spend their income throughout New Mexico and Arizona. Similar to employment and income impacts previously discussed, tax revenue is directly related to the length of the transmission lines.

The following summarizes the various direct and induced tax revenue sources.

Direct Sales Tax (New Mexico and Arizona): Direct sales taxes paid as a result of construction or operation of the facilities. Sales tax is the only direct tax in New Mexico.

Direct State-Shared Sales Tax (Arizona): Direct sales tax collected by the state and shared with all cities and counties.

Induced Local Sales Tax (New Mexico and Arizona): Locally imposed sales tax paid when workers earn and spend money locally.

Induced State-Shared Sales Tax (Arizona only): Sales tax collected when workers earn and spend money anywhere in the state.

Induced State-Shared Income Tax (Arizona only): Income tax shared with cities and towns, including those that may not be impacted. Arizona state-shared income tax revenue is distributed 2 years after collection.

Property Tax Revenues

The average expected property tax revenues by route group for New Mexico and Arizona were evaluated for both the construction and operation phases. Property taxes in New Mexico are levied at the local government level. For the purposes of this Project, the evaluation of taxable improvements is done at the state level, since SunZia is a multiple-county project. Property taxes from construction of the Project would be collected through an estimated 3-year construction period, depending on which development option is selected. Property taxes collected during the operations phase would take place beginning in 2016 through the life of the Project, expected to be at least 50 years.

The largest amount of property tax revenues are expected to result in 2016, the year in which construction of the transmission lines and substations are to be completed. New Mexico is expected to receive a greater amount of property tax revenue, because most of the construction would take place across the state. Between approximately $5 million and $9.4 million per year would benefit New Mexico beginning in 2016. Arizona is expected to receive between $1 million and $5.3 million during this same time. Every year following 2016 would yield approximately 4 percent less revenue in New Mexico and Arizona, due to depreciation.

Route Group 1: SunZia East Substation to Midpoint Substation

Job creation, labor income, and tax revenue estimates vary slightly between subroutes within Route Group 1, including Subroute 1A2, the BLM preferred alternative. Economically, Socorro and Sierra counties would benefit the most from the construction and operation phases of the Project, because the two counties contain a majority of all subroute mileage. Direct and indirect economic impacts would result in communities such as the city of Carrizozo in Lincoln County (largest city in proximity to the proposed SunZia East Substation); the town of Mountainair in Torrance County[1]; Socorro and the unincorporated community of San Antonio in Socorro County; Elephant Butte, Truth or Consequences, and Williamsburg in Sierra County; and Deming in Luna County. Operations employment would likely have the greatest impact in Doña Ana County, and not in the actual location of the transmission line and substation facilities.

The approximate range (between Option A and Option B) of direct and indirect jobs, income tax revenue, and property tax revenue that could be created in New Mexico is summarized as follows:

- Jobs (job years) generated from construction of transmission lines: 2,108 to 2,206 (1,212 to 1,275 direct and 896 to 931 indirect)
- Income tax revenues generated during construction (not including substations): $33.1 to $32.4 million
- Property tax revenues generated during construction: $9.4 million to $13.7 million
- Property tax revenues during operations: $26.3 million to $49.8 million

[1] Calculations used in the EIA included Subroute 1A in Socorro County, but Subroute 1A2 crosses 28 miles in Torrance County.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Similar to Route Group 1, economic impacts for alternative subroutes within Route Group 3 also vary slightly. Subroute 3A and 3A2 the BLM preferred alternative, are expected to create a slightly larger economic impact than Subroute 3B, because it is approximately 5 miles longer. Luna and Hidalgo counties would experience a majority of the benefits of job creation, labor income, and tax revenue. The communities of Deming in Luna County, Lordsburg in Hidalgo County, and Silver City in Grant County would experience the greatest impacts from the Project.

In Arizona, economic impacts associated with alternative subroutes within Route Group 3 are expected to benefit the communities of Bowie and Willcox in Cochise County and Safford in Graham County, as well as small unincorporated rural communities in the vicinity of the Project. Shared impacts would also be created across the state.

The approximate range of direct and indirect jobs, income tax revenue, and property tax revenue that could be created in New Mexico and Arizona is summarized below.

New Mexico:

- Jobs (job years) generated from construction of transmission lines: 829 to 868 (476 to 501 direct and 353 to 367 indirect)
- Income tax revenue generated during construction (not including substations): $13 million to $12.7 million
- Property tax revenues during construction: $3.5 million to $3.9 million
- Property tax revenues generated during operations: $8.6 million to $9.9 million

Arizona:

- Jobs (job years) generated from construction of transmission lines: 426 to 556 (200 to 264 direct and 226 to 292 indirect)
- Income tax revenue generated during construction (not including substations): $3.9 million to $4.8 million
- Property tax revenues during construction: $1.2 million to $2.3 million
- Property tax revenues generated during operations: $1.6 million to $2.7 million

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroutes 4A and 4B would result in similar economic impacts, due to each route crossing similar distances in Graham and Pinal counties. Subroutes 4A and 4B would benefit Safford in Graham County; San Manuel, Mammoth, Oracle, and Casa Grande in Pinal County; and a small portion of north Pima County. Subroute 4C2c, the BLM preferred alternative, and subroutes 4C1 and 4C2 would have similar economic impacts, because each crosses mostly undeveloped land and passes near rural communities.

A greater number of construction jobs and tax revenues would be generated from the development of Subroute 4C3, relative to other subroutes, because of its length. However, due to

its large population and workforce, Pima County and the Tucson metropolitan area are anticipated to benefit from the construction of any subroute included in Route Group 4. Given the potentially higher costs of acquiring residential, commercial, and industrial properties for the right-of-way to construct Subroute 4C3, tax revenues relative to the total Project cost (proportional to the distance of alternatives) would be greater for Subroute 4C3 than for the other subroutes, including the BLM preferred alternative. In addition, there would be a greater local indirect economic effect associated with economic activity (e.g., employment income, and sales taxes from purchases) generated with services associated with property acquisition and urban infrastructure construction.

The approximate range of direct and indirect jobs, income tax revenue, and property tax revenue that could be created in Arizona for all alternatives is summarized below.

Arizona:

- Jobs (job years) generated from construction of transmission lines: 1,552 to 1,768 (823 to 851 direct and 729 to 917 indirect)
- Income tax revenue generated during construction (not including substations): $14.1 million to $14.5 million
- Property tax revenue during construction: $3.3 million to $11.1 million
- Property tax revenue generated during operations: $6.6 million to $22.8 million

4.13.4.4 Emergency Services

Construction of Transmission Lines and Substations

Fire Services

Without standard mitigation measures, the construction of power lines and substations in remote, rural locations could create an increased risk of fire danger. For existing populations, areas in proximity to subroutes 1B2 and 1B3 are underserved relative to Subroute 1B1, with the closest fire departments located in the city of Socorro to the west and the small community of Mountainair to the north in Torrance County. Fire services along I-25 between San Antonio and Truth or Consequences are also sparse; more than 50 miles of this stretch are characterized as undeveloped vacant land. The nearest fire services along this route would come from the communities of San Antonio or Elephant Butte. Links A330a and A330b (present in subroutes 1A1, 1A2, 1A, 1B1, 1B2, and 1B3) are within proximity to fire departments in the communities of Elephant Butte, Truth or Consequences, Arrey, and Hillsboro; however, access to these links may be difficult given the terrain and the presence of few roads from I-25 west toward the links. Fire service to links A400 and A440 (present in subroutes 1A, 1B1, 1B2, and 1B3), which cross Sierra and Luna counties, would either come from Hatch to the east or Deming southwest of the routes. Local alternative links A361 and A430 are within closer proximity to fire services than are A400 and A440. A small portion of subroutes 3A or 3A2, and 3B, and links B110b and B120b (which cross Grant County) may be underserved and would depend on fire services from

Lordsburg to the west or Deming to the east. All other routes between Lordsburg and the Arizona border would depend on services from Lordsburg.

In the eastern portion of the study corridor, the Bowie Volunteer Fire District would serve the eastern portion of Arizona and is within closer proximity to the links in Subroute 3B than in 3A. Links C130a and C130b within Subroute 4B are not within close proximity to fire services; services to both of these areas would come from the BLM Fire Department in Safford. Link C620 within subroutes 4A and 4B just north and west of Mammoth is among the most underserved portion of Pinal County due to its remote location. Link C820 within subroutes 4C2, 4C2c, and 4C3 crosses a desolate area that is underserved by fire services. Much of the routes southeast of the planned Pinal Central Substation are not in proximity to fire services.

While gaps in fire services are present across portions of New Mexico and Arizona, the construction of any Project alternative would require a Fire Marshal to be onsite when construction activity is in progress, and any additional periods where fire safety is an issue (Section 2.2.2, Appendix A4 of the POD). The Fire Marshal is responsible for arranging the dispatch of fire suppression personnel and equipment to the Project site within 15 minutes. With these mitigation measures in place, no impacts are expected to result from the construction of transmission lines and substations across all route alternatives.

Medical Services

Some locations in New Mexico and Arizona are not in proximity to trauma services; however, helicopter services may be available to respond in cases where advanced levels of trauma services are needed (see Section 3.13.8.2, Medical Services). The availability of these expedited trauma services at multiple hospitals in these cities indicates that minimal impacts are expected to result to medical services throughout the study area.

Operations

When compared to the estimated number of residents living in Las Cruces, Tucson, and Phoenix in 2009, impacts to local government services would be minimal due to negligible population increases resulting from the Project. The operation of the transmission lines and substations is not expected to impact existing medical and emergency services and will not require the development of new facilities for public services such as fire, medical, or police enforcement. Section 3.13.8 and Appendix A8 of the SunZia POD (specifically Table A8-1) present lists of emergency providers that could be used during operations**.**

4.13.4.5 Other Impacts

Other potential social and economic impacts that have been identified as public concerns include effects to associated grazing and ranching operations, recreation and tourism, and property values that could occur during construction or operation of the Project.

Impacts to grazing lands that could occur as a result of loss of vegetation from Project construction have been estimated and included in the assessment of land use impacts for BLM

lands (see Section 2.4 and Section 4.10.5). Grazing and ranching operations could be temporarily affected by Project construction, where access is restricted by construction activities. Mitigation measures would be applied to minimize the impacts during construction in coordination with land owners and managers, such as structure installation and repair of fences and gates. Overall, permanent ground disturbance would be approximately 6 acres per mile of right-of-way. Typically, grazing could continue within the Project right-of-way during operation of the transmission lines, and more than 80 percent of the vegetation within the right-of-way would not likely be disturbed by construction of these facilities, and would remain open for grazing.

Impacts to recreation and tourism have been identified by the public during the scoping process. The description of land use impacts to recreation areas or trails resulting from Project construction or operation have been described in Section 4.10.5 and visual impacts to recreation users have been described in Section 4.9.3. The Project would not substantially change the use of recreation areas or trails, and the number or type of recreation users would not be likely to change; therefore, economic effects to recreation are not anticipated. Changes in the tourist economy are not anticipated.

Studies have been reviewed regarding the potential effects to property values in proximity to HVTLs. These studies examine a range of contributing factors to real-estate value impacts from HVTLs, such as the effects of visibility and their extent of encumbrance (e.g., restrictions, easements, and encroachments), while controlling for general market factors, property types, and site-specific conditions. The studies have found that often no effect to property values occur based on the presence of HVTLs; in studies where effects were found, the effects generally resulted in a 10 percent or smaller reduction in property value (Chalmers et al. 2009; Delaney and Timmons 1992; Jackson 2010; Jackson et al. 2010).

4.13.4.6 Summary of Impacts for the BLM Preferred Alternative

This section summarizes the social and economic impacts in New Mexico and Arizona for the BLM preferred alternative, including subroutes 1A2, 3A2, and 4C2c. Overall, the economic impacts resulting from the construction and operation of the Project do not vary greatly within each route group, and an estimated range of effects for the BLM preferred alternative is provided below. The greatest variance in the level of impacts across alternatives would result from the development of two AC lines (Option A) versus one AC and one DC line (Option B). The BLM preferred alternative, as a combination of subroutes and local alternatives, is approximately 9 miles (2 percent) longer than the longest route evaluated in the EIA[1]. This increase in length is assumed to be within the accuracy of analysis presented in the EIA, and the estimated range of economic effects provided below.

Population impacts are expected to be minimal during construction and operations; construction crews are expected to be dispersed across a large construction corridor, while operations employment will be based in established, populated cities in New Mexico and Arizona.

[1] Tax revenues for Torrance County are not included.

The total number of jobs (job years) that would be created in New Mexico and Arizona during construction of the proposed Project would range between 5,822 and 6,357 (including transmission lines and substations between Option A and Option B). Between 127 and 150 jobs would be created by the operation of the transmission lines and substations. The following is a summary of the estimated employment and revenue by state.

New Mexico:

- Jobs (job years) generated from construction of transmission lines: 3,044 to 3,186 (1,750 to 1,840 direct and 1,294 to 1,346 indirect)
- Jobs (job years) generated from construction of substations: approximately 690 (470 direct and 220 indirect)
- Operations jobs: 41 to 50 (25 to 31 direct and 16 to 19 indirect)
- Income tax revenues generated during construction (includes transmission line and substations): $60.0 million to $93.5 million
- Yearly income tax revenues from operations: $200,000 to $400,000
- Property tax revenues from construction: $12.9 million to $17.6 million
- Property tax revenues during operations: $34.9 million to $59.7 million

Arizona:

- Jobs (job years) generated from construction of transmission lines: 2,387 to 2,514 (1,133 to 1,207 direct and 1,254 to 1,307 indirect)
- Jobs (job years) generated from construction of substations: 220 to 270 (110 to 130 direct and 110 to 140 indirect)
- Operations jobs: 86 to 100 (41 to 47 direct and 45 to 53 indirect)
- Income tax revenues generated during construction(includes transmission line and substations): $24.6 million to $28.0 million
- Yearly income tax revenues from operations: $300,000 to $700,000
- Property tax revenues from construction: $6.3 million to $12.9 million
- Property tax revenues during operations: $10.1 million to $25.5 million

4.14 ENVIRONMENTAL JUSTICE

4.14.1 Introduction

An environmental justice population is defined as one that exceeds 50 percent of the entire population of an affected area, or for the purposes of this EIS, as an affected area in which populations have an equal or greater percentage of residents living below the poverty level of or New Mexico or Arizona. A description of the geographic distribution of environmental justice populations is presented in Section 3.14, by census tracts located within approximately 3 miles of each proposed subroute. Once a potential environmental justice population is identified,

according to EO 12898, further analysis must take place to determine whether a project's impacts would be significant and disproportionately affect an environmental justice population.

This section focuses on the identification and characterization of environmental justice impacts associated with the Project; the general methodology for impact assessment; impact levels for environmental justice populations; and the presentation of the analysis of impacts by route group, including impacts that are common to all routes.

For this analysis, impact levels to potential environmental justice populations can be categorized as high, moderate, low, or no impacts. Table 4-25 summarizes the impact criteria used to assign impact levels to potential environmental justice populations; these levels are assessed based on the distance from the environmental justice population to the proposed alternative routes.

Table 4-25. Impact Criteria Summary

Impact Level	Impact Criteria
High	High impacts occur in areas where the Project could create direct, long-term, and significant impacts to existing environmental justice populations. These impacts include the condemnation of residential, commercial, industrial or other properties, and visual impacts to residences or public places in rural or urban areas. High impacts to environmental justice populations are experienced where property condemnation is disproportionate (occurs at a much higher rate) compared to condemnation experienced by non-environmental justice populations. High impacts are likely to occur most frequently in dense urban areas because these properties are more difficult to avoid than in rural areas.
Moderate	Areas where the Project would create a direct or indirect, short- or long-term impact to existing environmental justice populations. These impacts could include potential visual impacts in a rural or urban area. Short-term impacts are typically associated with construction and could include noise and dust generation as well as temporary traffic congestion. Long-term impacts could result from the permanent alteration of residential views. Overall, moderate impacts to environmental justice populations can typically be characterized as areas within close proximity to the line (usually 1 mile or less) that will experience similar long-term impacts as non-environmental justice populations. The presence of moderate impacts does not mean that an environmental justice population is disproportionately impacted when compared to other populations.
Low	Areas where the Project would create a direct or indirect, short- or long-term impact to existing environmental justice populations. Long-term impacts could include visual impacts at greater distances. Similar to moderate impacts, short-term impacts are typically associated with construction and could include noise and dust generation as well as temporary traffic congestion; but to a lesser degree than residents living close to the lines. Generally, low impacts to environmental justice populations would be located between 1 and 3 miles from any Project alternative or just beyond. The presence of low impacts does not mean that an environmental justice population is disproportionately impacted when compared to other populations.
No Impacts	Areas where no potential environmental justice populations have been identified within 3 miles of the Project alternatives.

4.14.2 Impact Assessment Methodology

An impact, or effect, is defined as a modification to the environment brought about by an outside action. These impacts can be positive or negative and may be short- or long-term in nature. Impacts can also be direct or indirect. An example of an indirect, short-term impact to an environmental justice population would be an increase in available low-skilled, service sector

jobs to supply goods and services to construction workers that would not last beyond the duration of a project's construction.

Environmental justice populations for the Project were geographically identified by census tract, within a 3-mile radius on either side of a subroute. Census tracts were used, rather than smaller areas of geographic data (i.e., census blocks or block groups), because estimates for smaller geographies were not available at the time of the study. In rural areas, census tracts could cover large areas with low population densities. If census tracts in rural and urban areas were identified to be an environmental justice population, land use inventory data (such as field verification and aerial photography) were used to confirm the specific type of land uses that could be impacted by a route. Although the type of impacts to rural and urban areas would be similar in most cases (e.g., the condemnation of a residence), the level of impact was also determined according to the proximity and density of the environmental justice population to the potential impact. For example, rural residential properties could experience moderate impacts from a distance of 2 miles of the transmission lines, while a residence just outside 1 mile from the lines could experience low impacts due to existing lines or the presence of other structures commonly associated with a built urban environment.

Standard mitigation measures for related resources such as land use, visual, biological, and public safety would serve as mitigation measures for environmental justice populations. Examples of these measures include the use of structures that minimize visual impacts, compliance with local air quality standards for dust, and the minimization of corona to reduce interference with radio and television signals.

4.14.3 Summary of Impact Analysis Results

4.14.3.1 No Action Alternative

Under the No Action alternative, the BLM would not approve the Applicant's right-of-way application, and would continue to manage the land within the Project corridor consistent with existing field office RMPs. The land along the Project corridor would be expected to remain in its existing condition, with no new structures or facilities constructed or operated. As a result, no new environmental justice impacts would occur. In the absence of this Project, other projects may be constructed that would have similar impacts in other locations.

4.14.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A, 1A1 (North River Crossing) and 1A2 – BLM Preferred Alternative

Six potential environmental justice tracts across three counties are crossed by subroutes 1A, 1A1, and 1A2, the BLM preferred alternative. Of the six, one tract in Lincoln County, one tract in Torrance County, and three tracts in Socorro County could experience low to moderate impacts. Census tracts 9602 and 9637 located in Lincoln and Torrance counties are characterized by low-density residential properties, and subroutes 1A, 1A1, and 1A2 cross within 0.5 mile of potential environmental justice populations within these tracts. Subroutes 1A, 1A1, and 1A2 also cross within a 0.25 mile of low-density residential properties and agricultural areas near the

community of Escondida, just north of the city of Socorro. Proximity to these properties indicates the potential for moderate impacts. Higher density environmental justice populations located 1 mile south in Socorro could experience low impacts, because of their distance from the line. Table 4-26 contains the numbers of Hispanic, other minority, and low-income populations (see Section 3.14 for descriptions of these populations) located in each census tract crossed by Subroute 1A2. However, because these populations are spread across many square miles of land, the number of individuals that could be impacted would be much less.

Table 4-26. Impacts to Environmental Justice Populations – Route Group 1

County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income[3]	Low-income Percent of Total[3]
Lincoln	9602		●		0.7	1,826	625	34.2	68	0.0	315	20.0
Torrance	9637		●		1.1	2,294	1,120	48.8	81	0.0	542	31.2
Socorro	978100	—		●	1.6	4,741	2,274	48.0	642	13.5	1,031	21.7
Socorro	978301	—	●		43.3	2,981	1,785	59.9	580	19.5	1,207	40.5
Socorro	978302	—		●	2,089.60	3,863	1,644	42.6	801	20.7	1,110	28.7
Socorro	978303	—	●		179.3	3,624	2,318	64.0	837	23.1	1,010	27.9

[1] Number of people per square mile
[2] Represents total population and does not equal total of races or ethnicities presented in other columns.
[3] Population with income in the past 12 months below poverty level for whom poverty status is determined.
Source: U.S. Census 2011a and 2011b

Subroute 1B – San Antonio Crossing

Subroutes 1B1, 1B2, and 1B3 cross similar environmental justice populations as Subroute 1A2, but are differentiated by proximity to the community of San Antonio. Table 4-26 is representative of the impact levels expected to result from each subroute variation within Subroute 1B. Link A140, which crosses the Rio Grande (present in each subroute), crosses within approximately 0.1 mile of an existing residential property and within a 0.5 mile of approximately 25 rural residential properties.

4.14.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A North and 3A2 – BLM Preferred Alternative

Low to moderate impacts could occur to potential environmental justice populations in New Mexico as a result of the construction and operation of Subroute 3A or Subroute 3A2. Potential environmental justice populations within census tracts 5 and 9700 in Luna and Hidalgo counties could experience low to moderate impacts due to residences located within 0.5 to 2.0 miles of these subroutes (Table 4-27). Residential development in these areas is characterized as low-density residential development.

Subroute 3B – South

Subroute 3B crosses a majority of the same census tracts in New Mexico as subroutes 3A and 3A2, resulting in similar impacts. In addition, Subroute 3B is within closer proximity to residences. Within census tract 5 in Luna County, Link B80 crosses agricultural properties and comes within less than 0.5 mile to a rural residential development located north of the city of Deming. Impacts to this portion of Luna County are expected to be moderate, because no residential properties are directly crossed by this subroute; however, indirect impacts to these populations could possibly result. Census tracts 9700 and 9882 in Hidalgo County are expected to experience low to moderate impacts, respectively. Link B112 crosses agricultural property southeast of Lordsburg and continues directly south, coming within 3 miles of nearly all residential properties in the city. Overall, a majority of Subroute 3B does not come within proximity to any environmental justice populations (Table 4-27).

Table 4-27. Impacts to Environmental Justice Populations – Route Group 3

County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income[3]	Low-income Percent of Total[3]
Luna	5	—	●		2.6	4,643	2,426	52.3	273	5.9	1,542	33.2
Hidalgo	9700	—		●	0.7	2,195	684	31.7	467	19.3	455	28.1
Hidalgo	9882	—	●		614.7	2,579	1,997	77.4	934	36.2	584	22.6

[1] Number of people per square mile
[2] Represents total population and does not equal total of races or ethnicities presented in other columns.
[3] Population with income in the past 12 months below poverty level for whom poverty status is determined.
Source: U.S. Census 2011a and U.S. Census 2011b

4.14.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A crosses Graham, Cochise, Pima, and Pinal counties, and is largely characterized by undeveloped land and scattered rural residential developments. Some developed portions of Pinal County are the only areas along this route that are expected to impact environmental justice populations (Table 4-28). Hispanic, other minority, and low-income populations in Mammoth (census tract 6.01) are expected to experience moderate impacts, because a majority of the community is within proximity to Subroute 4A. Nearly all residential developments in this census tract fall within 1 to 3 miles of the subroute.

Subroute 4B – Sulphur Springs

Impacts would be similar to Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Moderate impacts could occur to environmental justice populations within 3 miles of the Project in Cochise County (census tract 2), and in Oracle and San Manual (census tract 6.01) (Table 4-28).

Populations within census tracts 12 and 20, located in the vicinity of the Pinal Central Substation, could experience low to moderate impacts. Link C880a, which connects to the planned Pinal Central Substation, is located within 0.75 mile of more than 200 residential homes and multiple agricultural properties.

Link C880a (which connects to the planned Pinal Central Substation) is common to all subroutes within Route Group 4, and is located within 0.75 mile of more than 200 residential homes and multiple agricultural properties.

Table 4-28. Impacts to Environmental Justice Populations – Subroutes 4A, 4B, 4C1, 4C2, 4C2c

County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income	Low-income Percent of Total
Cochise	2	—	●		14.8	10,090	2,958	29.3	706	7.0	1,780	17.6
Pinal	6.01	—	●		11.2	7,490	4,221	56.4	2,567	34.3	1,967	26.3
Pinal	12	—	●		42	5,176	2,057	39.7	1,539	29.7	1,352	26.1
Pinal	20	—		●	208.2	10,782	8,253	76.5	5,183	48.1	2,908	27.0

[1] Number of people per square mile
[2] Represents total population and does not equal total of races or ethnicities presented in other columns.
Source: U.S. Census 2005-2009 ACS

Subroute 4C1 – East of San Pedro River

Subroute 4C1 crosses environmental justice populations similar to subroutes 4A and 4B. Northeast of Willcox in Cochise County (census tract 2), Link C110 crosses two residential properties and comes within immediate proximity to approximately 12 rural residences located on large agricultural properties, a majority of which are less than 0.1 mile from the line. In addition, environmental justice populations within the town of Oracle (census tract 6.01) could be impacted by Subroute 4C1 (Table 4-28).

Subroute 4C2 – West of San Pedro River

Impacts would be similar to Subroute 4C2c, the BLM preferred alternative.

Subroute 4C3 – Tucson

Subroute 4C3 crosses the most densely populated portion of the study corridor, passing through the city of Tucson. The average population density of census tracts that are crossed or fall within

1 mile of the subroute is 3,780 people per square mile (Table 4-29). Chapter 3 identified a large number of potential environmental justice populations throughout Tucson.

As indicated in Section 3.10, up to 216 residential, 37 commercial or industrial, and 6 other properties in Tucson could be displaced (condemned) as part of the right-of-way acquisition for links F111 and F112. All potential condemnations are located within 13 environmental justice census tracts, resulting in the largest disproportionate share of potential impacts to these populations when compared to all other Route Group 4 subroutes; these tracts are likely to experience the highest level of impacts in southern Tucson. Displacement would not be the only potential economic impact on these residences and surrounding neighborhoods, as construction in these areas could jeopardize the social cohesion of neighborhoods by creating both physical and perceptual boundaries of separation between homes and commonly visited places, including commercial businesses and public gathering places. These potential high and moderate impacts may result in strong opposition from tight-knit communities throughout Tucson if there is a widespread perception of injustice. The total population of the tracts that may experience high impacts is approximately 76,500; approximately 62 percent of these residents are Hispanic and nearly 30 percent are below Arizona's poverty level.

Table 4-29. Impacts to Environmental Justice Populations within 1 mile of Subroute 4C3

County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income	Low-income Percent of Total
Pinal	12		●		42	5,176	2,057	39.7	1,539	29.7	1,352	26.1
	20			●	208.2	10,782	8,253	76.5	5,183	48.1	2,908	27.0
Pima	1	●			1,823.30	442	144	32.6	131	29.6	240	54.3
	2	●			6,573.30	4,178	3,014	72.1	1,609	38.5	1,194	28.6
	3		●		3,290.20	1,320	468	35.5	517	39.2	507	38.4
	4		●		4,790.30	3,001	583	19.4	445	14.8	953	31.8
	9		●		6,230.00	3,511	1,535	43.7	1,434	40.8	1,440	41.0
	10		●		2,017.80	1,056	723	68.5	619	58.6	335	31.7
	11	●			6,283.70	2,704	2,414	89.3	1,729	63.9	707	26.1
	12		●		2,573.70	3,619	2,517	69.5	2,168	59.9	1,180	32.6
	13.02		●		3,716.90	2,411	1,225	50.8	1,066	44.2	1,183	49.1
	21		●		3,013.10	6,038	4,565	75.6	3,031	50.2	1,538	25.5
	22	●			2,637.40	7,916	6,085	76.9	4,245	53.6	2,445	30.9
	23	●			5,545.00	5,918	4,258	71.9	2,357	39.8	3,157	53.3
	24	●			5,080.60	7,228	5,822	80.5	3,783	52.3	2,575	35.6
	25.01	●			2,350.40	6,045	3,864	63.9	2,558	42.3	1,014	16.8
	25.03	●			3,618.30	3,721	2,538	68.2	1,520	40.8	847	22.8
	41.04	●			5,536.30	9,824	6,229	63.4	5,031	51.2	3,493	35.6
	41.1		●		7,828.60	3,838	3,028	78.9	2,299	59.9	748	19.5
	41.11	●			3,299.70	8,912	6,634	74.4	4,543	51.0	2,387	26.8

Table 4-29. Impacts to Environmental Justice Populations within 1 mile of Subroute 4C3

County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income	Low-income Percent of Total
	41.12		●		3,761.70	3,518	2,465	70.1	986	28.0	822	23.4
	44.07		●		4,370.10	6,668	4,274	64.1	4,178	62.7	1,780	26.7
	44.12	●			3,761.70	3,480	1,405	40.4	886	25.5	548	15.7
	44.14		●		4,787.30	3,707	2,174	58.6	1,396	37.7	330	8.9
	44.15		●		627.1	1,669	843	50.5	464	27.8	221	13.2
	44.18	●			334.5	4,100	360	8.8	518	12.6	685	16.7
	45.04	●			1,844.60	6,985	3,557	50.9	2,111	30.2	2,071	29.6
	45.06	●			3,924.80	5,060	1,616	31.9	677	13.4	1,127	22.3
	45.09		●		6,127.40	8,350	3,006	36.0	2,682	32.1	2,910	34.9
Totals					**3,778.2[3]**	**130,395**	**77,403**	59.4	**54,522**	41.8	**37,790**	29.0

[1] Number of people per square mile
[2] Represents total population and does not equal total of races or ethnicities presented in other columns.
[3] Represents average population density per square mile for all census tracts combined.
Source: U.S. Census 2005-2009 ACS

Low impacts to environmental justice populations are expected to take place between 1 and 3 miles of links F111 and F112 (Table 4-30). Impacts would be direct, and both temporary and permanent. Direct impacts that may result include permanent scenic impacts and temporary issues associated with construction of the transmission line, such as increased traffic congestion.

Table 4-30. Impacts to Environmental Justice Populations between 1 and 3 miles of Subroute 4C3

County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income	Low-income Percent of Total
Pinal	21			●	20.5	5,559	1,618	29.1	1,117	20.1	975	17.5
Pima	5			●	10,455.90	6,879	854	12.4	1,232	17.9	2,953	42.9
	6			●	4,341.30	5,323	854	16.0	690	13.0	1,304	24.5
	7			●	4,116.90	5,189	2,122	40.9	1,433	27.6	861	16.6
	8			●	1,497.60	1,732	967	55.8	635	36.7	384	22.2
	13.01			●	9,022.00	8,529	5,097	59.8	2,834	33.2	3,464	40.6
	14			●	7,145.60	6,286	1,818	28.9	2,559	40.7	2,888	45.9
	15			●	4,935.80	4,447	496	11.2	884	19.9	1,373	30.9
	16			●	4,291.10	3,376	443	13.1	343	10.2	558	16.5
	20			●	4,117.70	7,320	4,637	63.3	2,751	37.6	1,705	23.3
	25.04			●	5,920.50	5,667	4,046	71.4	2,376	41.9	1,471	26.0

Table 4-30. Impacts to Environmental Justice Populations between 1 and 3 miles of Subroute 4C3												
County	Census Tract	High Impact	Moderate Impact	Low Impact	Population Density[1]	Total Population[2]	Hispanic	Hispanic Percent of Total	Other Minority	Other Percent of Total	Low-income	Low-income Percent of Total
	26.01			●	5,481.30	6,494	3,819	58.8	2,816	43.4	3,096	47.7
	26.02			●	6,776.50	5,184	1,851	35.7	1,445	27.9	1,663	32.1
	27.01			●	5,490.30	6,066	1,409	23.2	1,677	27.6	1,273	21.0
	35.01			●	7,289.70	8,112	5,096	62.8	3,808	46.9	2,670	32.9
	37.01			●	8,721.60	9,192	7,720	84.0	4,266	46.4	2,840	30.9
	37.02			●	6,534.20	7,912	6,952	87.9	4,500	56.9	3,818	48.3
	37.04			●	8,012.50	5,296	4,813	90.9	3,216	60.7	1,511	28.5
	38.01			●	10,184.40	3,871	3,458	89.3	1,892	48.9	1,052	27.2
	38.02			●	5,075.00	5,608	5,236	93.4	2,661	47.5	2,052	36.6
	39.01			●	3,128.60	2,196	2,110	96.1	911	41.5	337	15.3
	39.02			●	3,769.10	2,752	2,393	87.0	978	35.5	739	26.9
	41.06			●	169.8	8,125	4,762	58.6	3,617	44.5	2,095	25.8
	43.1			●	446.1	1,623	1,008	62.1	893	55.0	229	14.1
	44.11			●	1,042.30	6,940	2,222	32.0	2,207	31.8	1,837	26.5
	44.14			●	4,787.30	3,707	2,174	58.6	1,396	37.7	330	8.9
	44.19			●	191.9	7,084	1,990	28.1	1,398	19.7	1,117	15.8
	44.2			●	144.5	5,272	1,712	32.5	1,438	27.3	991	18.8
	45.07			●	4,062.30	7,954	2,120	26.7	1,202	15.1	1,766	22.2
	45.08			●	3,950.40	5,120	1,621	31.7	710	13.9	1,166	22.8
	46.26			●	5,915.60	3,415	751	22.0	861	25.2	588	17.2
Totals					**4743.2[3]**	**172,230**	**86,169**	**50.0**	**58,746**	**34.1**	**49,106**	**28.5**

[1] Number of people per square mile
[2] Represents total population and does not equal total of races or ethnicities presented in other columns.
[3] Represents average population density per square mile for all census tracts combined.
Source: U.S. Census 2005-2009 ACS

The average population in these areas is 4,743.2 people per square mile, with a population total of approximately 172,000 residents. Approximately 50 percent of the residents are Hispanic and 30 percent are below the poverty level.

Local Alternative Links

Alternative links F81a and F81b north of Subroute 4C3 could experience high impacts to environmental justice populations; though impacts are expected to be slightly less disproportional than expected for links F111 and F112. Section 3.10 identified 119 residences, 48 commercial and industrial, and 4 other properties that could be acquired. Only 23 of these properties (13.5 percent) were located in census tracts that did not contain environmental justice populations. Of the 23 properties, only 2 were residences; signifying that 117 of the 119 residences (98.3 percent) were located in low-income environmental justice census tracts.

Approximately three-fourths of the commercial (including office) properties (76.2 percent) were located in environmental justice census tracts.

Impacts across these 10 census tracts are expected to be high[1]. The same type of public opposition discussed for south Tucson routes may result from low-, medium-, and high-income residents within proximity to north Tucson routes.

Route Group 4 – Summary of Impacts

Impacts are expected to be the highest in the Tucson metropolitan area (Subroute 4C3), where large numbers of environmental justice populations are expected to be disproportionately impacted by a large amount of residential, commercial, and industrial property condemnation. The local alternative links for Subroute 4C3 would result in fewer impacts to environmental justice populations, but would still result in a disproportionate impact to these populations. Moderate impacts are expected to result from Subroute 4C1 and 4C2 near the communities of San Manuel, Mammoth, and Oracle; however, these impacts are not expected to be disproportionate and therefore are not considered significant impacts to environmental justice populations. The fewest impacts to environmental justice populations are expected to take place along subroutes 4A and 4B.

4.14.3.5 Overhead Transmission Line Options and Substations

Of the two design options presented for the Project, impacts to environmental justice populations are expected to be similar for Option A and Option B. The type of overhead transmission line system determines the size of each substation that would need to be constructed. The planned Pinal Central Substation (located in census tract 12) is the only substation located in proximity to potential environmental justice populations. Construction of Option A is expected to result in 5 acres of temporary disturbance and no permanent disturbance. Because expected disturbance for this option is minimal, additional impacts to environmental justice populations are not anticipated in census tract 12, beyond construction of the transmission lines. The construction of the DC line presented in Option B would require the temporary disturbance of 10 acres and permanent disturbance of 45 acres associated with the expansion of the planned Pinal Central Substation. This disturbance would further impact environmental justice populations. Therefore, in some places, impacts could increase from moderate to high for populations located closest to the substation.

4.14.3.6 Summary of BLM Preferred Alternative

No significant impacts to environmental justice populations are expected to result from the construction and operation of the BLM preferred alternative.

[1] Due to proximity (less than 3 miles), links F111 and F112 (southern Tucson routes) and local alternatives F81a and F81b (northern Tucson routes) have the potential to impact the same census tracts. The Pima County environmental census tracts along links F81a and F81b are not included in a table and consist of only low-income census tracts. These tracts include tracts 27.01, 27.02, 28.01, 29.03, 30.01, 40.10, 45.06, 45.07, 45.08, and 45.09.

4.15 HEALTH AND SAFETY/HAZARDOUS MATERIALS

4.15.1 Introduction

This section describes the potential impacts from EMFs, audible noise, radio and television interference, environmental contamination, and hazardous materials related to construction, operation, and decommissioning of the proposed Project. Potential emissions of pollutants considered harmful to public health and the environment are discussed in Section 4.2, Climate and Air Quality (also see Table 3-2, Ambient Air Quality Standards).

4.15.2 Impact Assessment Methodology

A *Preliminary EMF and Corona Effects Study* was prepared for the Project (Schaerer et al. 2011). This study analyzed the two different options that may be implemented under the Proposed Action, Option A and Option B.

EMFs and corona effects were analyzed using the Bonneville Power Administration's Corona and Field Effects Program software, for a variety of conductor configurations and minimum conductor heights relating to options A and B. EMF, audible noise, and radio and television interference from a transmission line are based on the electrical and physical characteristics of the transmission line. The Corona and Field Effects Program uses the electrical and physical characteristics of the transmission line to calculate resulting fields and interference effects. Once values were calculated, they were compared to recommended limits for EMF based on the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

The impacts for Option B (one 500 kV AC line and one 500 kV DC line) that would yield the maximum level of effect are described below.

The ADEQ monitors hazardous waste in Arizona (AAC Title 18, Chapter 8 describes hazardous waste management for Arizona); and the NMED monitors hazardous waste in New Mexico (NMAC Title 20, Chapter 4 describes hazardous waste management for New Mexico).

A variety of chemicals and hazardous substances would be used during construction of the Project. The storage, handling, and use of all chemicals would be conducted in accordance with applicable laws, ordinances, and regulations.

4.15.2.1 Significant Impacts

Under the NEPA, significant effects on public health and safety or from hazardous materials would occur if the Project would:

- expose people residing or working in the vicinity of the Project area or structures to safety hazards or a significant risk of loss, injury, or death
- use, store, or dispose of petroleum products or hazardous materials in a manner that results in a release to the aquatic or terrestrial environment in an amount equal to or

greater than the acceptable quantity for that material, or creates a substantial risk to human health

- mobilize contaminants currently existing in the soil, groundwater, or underground storage tanks, creating potential pathways of exposure to humans or wildlife that would result in exposure to contaminants at levels that could be harmful
- expose workers to contaminated or hazardous materials at levels in excess of those permitted by OSHA in 29 CFR §1910, or expose members of the public to direct or indirect contact with hazardous materials from the Project's construction or operation

4.15.3 Impact Analysis Results

4.15.3.1 No Action Alternative

Under the No Action alternative, the BLM would not approve the Applicant's right-of-way application and would continue to manage the land encompassing the Project area. It is expected that the site would continue to remain in its existing condition, with no new structures or facilities constructed or operated on the site. As a result, no hazardous materials would be used and no impacts related to the use of hazardous materials would occur.

4.15.3.2 Action Alternatives

Electric and Magnetic Fields

Since neither Arizona nor New Mexico has any established limits on EMF levels, this analysis defers to the ICNIRP (1998), which publishes recommended limits for EMF based on a collaboration of international scientists. These guidelines are more stringent than the guidelines presented by the IEEE. The ICNIRP and IEEE values are expressed as reference exposure limits for both occupational and general public exposure.

Electric Field

The electric field strength is a measure of the force per unit charge at a given point in space relative to a charged object, and is measured in kilovolts per meter (kV/m). ICNIRP reference levels for electric field strength are 8.33 kV/m for occupational exposure and 4.16 kV/m for general public exposure. At the edge of the right-of-way, electric field levels are 2.6 kV/m, which is well below the reference level for general public exposure. The average electric field level within the right-of-way is 5.6 kV/m, which is above the general public exposure reference level but below the level for occupational exposure. The maximum potential electric field level within the right-of-way is 12.0 kV/m, which is above the reference level for both occupational and general public exposure. It should be noted that this electric field level is applicable only to Option B (see 4.15.2). During periods of outage on one of the DC line conductors, the electric current at ground-surface level resulting from ground electrode use would remain at essentially zero. Should both lines use AC, the maximum electric field level within the right-of-way would

be 9.1 kV/m, with an average level of 5.3 kV/m. The electric field levels at the right-of-way are projected to be well below the reference levels, at 2.6 kV/m (Schaerer et al. 2011).

Magnetic Field

Magnetic field values are the magnetic flux density at a given point in space, which is measured in milligauss (mG). ICNIRP reference levels for magnetic flux density are 4,167 mG for occupational exposure and 833 mG for general public exposure. Under all potential alignment configurations, all magnetic field levels are projected to be well under the ICNIRP reference level for general public exposure. The maximum potential level within the right-of-way would be 496.6 mG (Schaerer et al. 2011).

Audible Noise

Construction Noise

During construction, noise would be generated by the equipment used for grading (access roads, structures, and substations), assembly and erection of towers, wire pulling and splicing, equipment installation (substations), and rehabilitation activities (Table 4-31). Estimates of noise from these activities are complicated by the fact that noise levels continuously rise and fall (i.e., the quantity, distribution, and usage of equipment vary with the type of activity). The closest sensitive receptors are residences within 200 feet of the proposed centerline.

Table 4-31. Typical Noise Levels for Construction Equipment

Equipment	Typical Noise Levels (dBA from 50 feet)
Front loaders	85
Backhoes, excavators	80-85
Tractors, dozers	83-89
Graders, scrapers	85-89
Trucks	88
Concrete pumps, mixers	82-85
Cranes (movable)	83
Cranes (derrick)	88
Forklifts	76-82
Pumps	76
Generators	81
Compressors	83
Pneumatic tools	85
Jack hammers, rock drills	98
Pavers	89
Compactors	82
Drill rigs	70-85
Source: CPUC and BLM 2006	

In determining the impacts of noise, the important factor is the proximity of the activity to wildlife and the persons detecting the sound. The Project area is primarily located in rural open space with background noise typical of such settings. Wildlife most likely would avoid temporary construction disturbance. Where construction would occur near more populated areas, the noise from IEEE construction (and subsequent maintenance) might be audible and could result in temporary high impacts; however, such noise would be short-term and possibly considered only as a nuisance. Given the temporary nature of construction of the Project, impacts from noise are anticipated to be negligible.

Transmission Line and Substation Noise

Audible noise is measured as dBA and calculated at a height of 5 feet above the ground, per IEEE Standard 656-1992. There are no national or state regulations for audible noise levels from transmission lines; however, EPA guidelines recommend levels below 55 dBA for a day-night average in the outdoors. When applied to transmission lines, this is often measured at the edge of the right-of-way. Conductors are most audible when wet. Therefore, analysis was conducted assuming foul weather conditions. Based on these conditions, audible noise levels are under the EPA recommended level of 55 dBA. The highest noise level within the right-of-way was 49.3 dBA, with an average of 47.7 dBA (Schaerer et al. 2011). Therefore, noise levels would be well below the EPA recommended levels of 55 dBA, once the lines are operable.

Noise Ordinances

The City of Tucson adopted the Neighborhood Preservation Ordinance (NPO)—including Section 16-31, Excessive Noise—which addresses limits to residential, commercial, and industrial properties and provides limits to sound levels that carry beyond the property line. Audible noise produced by substations and transmission lines would fall well below the strictest threshold of 62 dBA within residential areas established in the NPO. Noise related to construction activities is exempt from the NPO from sunrise to 8:00 p.m., Monday to Saturday, except legal holidays.

Interference

Radio and television interference is the degradation of a radio signal by radio frequency electromagnetic disturbances, and is reported as the field strength of the interference. This interference is measured in decibels of one microvolt per meter (dBµV/m).

Radio Interference

The Radio Noise Design Guide recommends a radio interference limit of 38 dBµV/m for HVTLs. Within the right-of-way, interference would have an average level of 40.7 dBµV/m, with a possible maximum of 50.0 dBµV/m. At the edge of the right-of-way, the level of interference is predicted to be at or below the recommended 38 dBµV/m (Schaerer et al. 2011).

Television Interference

Television interference due to transmission lines has not been heavily studied under the new digital television program. There are currently no set guidelines established; however, the Federal Communication Commission has indicated that a signal-to-random noise ratio of 17 dB or greater should be sufficient for reception. Based on this information, a rough limit of 19 dBμV/m was given for television interference for this Project. The predicted average interference within the right-of-way is 22.1 dBμV/m, with a maximum of 30.5 dBμV/m. At the edge of the right-of-way, the interference is predicted to be below the limit of 19 dBμV/m (Schaerer et al. 2011).

Hazardous Materials

Construction and operations activities would comply with all applicable federal, state, and local regulations regarding the use of hazardous substances. Hazardous materials would not be drained onto the ground or into streams or drainage areas. Totally enclosed containment would be provided for all trash. All construction waste, including trash, litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials, would be removed and transported to a disposal facility authorized to accept such materials.

The construction or maintenance supervisor would ensure that all applicable federal, state, and local laws are obeyed. These include, but are not limited to, the RCRA; CERCLA; Toxic Substance Control Act; state regulations; Clean Air Act; CWA; and emergency planning and community right-to-know. In addition, regulations of the OSHA would be followed. Health and safety procedures to respond to accidental release of hazardous materials would be developed as part of the POD, during the engineering design phase of the Project. The Applicant would coordinate with the land-management agencies to incorporate specific agency requirements into the POD.

Petroleum products such as gasoline, diesel fuel, crankcase oil, lubricants, and cleaning solvents would be present onsite during construction. These products would be used to fuel, lubricate, and clean vehicles and equipment, and would be contained within fuel trucks or in approved containers. When not in use, such materials would be stored properly to prevent drainage or accidents.

Sulfur Hexafluoride

SF_6 is an inorganic compound that is colorless, odorless, nontoxic, and nonflammable (under standard conditions). It is generally transported as a liquefied compressed gas. SF_6 is used in a number of applications, including as a gaseous dielectric medium in the electrical industry for insulation and current interruption in electric transmission and distribution equipment; it is a gaseous dielectric medium for high-voltage (345 kV and greater) circuit breakers, switchgear, and other electrical equipment. SF_6 gas under pressure is used as an insulator in gas-insulated switchgear, because it has a much higher dielectric strength than air or dry N_2, making it possible to significantly reduce the size of electrical gear. This makes gas-insulated switchgear more suitable for certain purposes such as indoor placement, as opposed to air-insulated electrical gear, which takes up considerably more room. Gas-insulated electrical gear is also more resistant

to the effects of pollution and climate, as well as being more reliable in long-term operation because of its controlled operating environment.

SF_6 is considered a highly potent GHG with a global warming potential greater than that of CO_2, when compared over a 100-year period. The EPA (2008) is concerned that if SF_6 should leak from electrical equipment, it would contribute to global warming. Currently, the EPA is collaborating with the electric power industry by forming the SF_6 Emission Reduction Partnership for Electric Power Systems, with the goal of identifying and implementing cost-effective solutions to reduce the use of this GHG.

The circuit breakers at each of the substations would be filled with SF_6. There would be a small amount of ongoing leakage of SF_6 over time, resulting in emissions of this pollutant.

4.16 EFFECTS OF THE UNDERGROUND MITIGATION ALTERNATIVE

4.16.1 Introduction

In response to public concerns about the risk of migratory birds colliding with overhead transmission lines crossing the Rio Grande, the feasibility of building the proposed transmission lines underground was evaluated. Two studies were completed in order to evaluate whether burying a segment of the proposed transmission lines beneath the river crossing would be warranted for the Project. The first study, which was conducted between 2009 and 2010, concluded that there would be a minimal risk of mortality to Sandhill Cranes and other waterfowl as a result of collisions with overhead transmission lines. The results of this study are summarized in the biological resource impact analysis (Section 4.6.4.4). A technical feasibility study was also conducted to evaluate the operational, economic and other environmental factors associated with underground transmission lines, and is described below (SunZia 2011).

The feasibility study included a comparison of the estimated costs associated with undergrounding and the costs for equivalent overhead transmission line facilities. Two segment distances for the representative underground cable river crossing were evaluated as follows:

- Approximately 1,650 feet, which represents the minimum underground distance required to cross the river and adjacent canals. This crossing would require 1,800 feet of cable in order to transition from under the river to the surface-level transition stations.
- Approximately 12,000 feet (2.3 miles), which would be the distance necessary to cross the river and adjacent floodplain, agriculture, and densely vegetated areas.

The cost analysis identified low- and high-range cost estimates for various Project options associated with potential underground cable systems. The majority of underground transmission projects in recent years have used XLPE technology, and that system was evaluated because it is likely the most technically feasible option.[1] For comparison, estimates of typical overhead

[1] The alternative transmission line cable system technologies are described in Chapter 2, Section 2.3.3.2. The cost analysis is based on 500 kV AC cables, because 500 kV DC cables using XLPE insulation are presently not feasible. The low-range cost represents the lowest manufacturer estimate for materials, does not include circuit breakers within the transition stations, and

transmission line construction costs and underground transmission line costs are included in Table 4-32.

Table 4-32. Cost Estimate Ranges

Length and Cost Range	Underground		Overhead[1]	
	One Circuit	Two Circuits	One Circuit	Two Circuits
1,650-foot Low Range	$15,921,130	$31,453,275	$407,694	$815,388
1,650-foot High Range	$21,730,882	$43,081,519	—	—
12,000-foot Low Range	$44,965,163	$90,093,136	$2,729,462	$5,458,924
12,000-foot High Range	$56,667,285	$113,490,595	—	—

[1] A range of cost estimates is not necessary to evaluate estimated overhead line costs, because overhead 500 kV transmission line construction is a common practice and costs are better known.

The cost of a 1,650-foot underground segment of 500 kV transmission line would be approximately 39 to 52 times greater than the cost of a similar length of overhead 500 kV transmission line. The cost of a 12,000-foot underground segment of 500 kV transmission line would be approximately 16 to 21 times greater than a similar length of overhead 500 kV transmission line.

In addition, the risk of operational problems for underground transmission lines is greater, and the repair time for outages is normally much longer than that for overhead transmission lines. Outages on overhead transmission lines are most often caused by weather-related events (e.g., lightning or strong storms) or accidental collisions with conductors or structures. Outages on an overhead transmission line are typically repaired within 24 hours, because the damaged areas are relatively easy to locate, access, and repair. Outages on underground transmission lines are most often the result of ground excavation in the vicinity of the buried cables, or a failure of accessories such as terminations and splices. The typical time needed to repair failure of accessories such as terminations and splices is often lengthy, because additional effort is required to identify, access, expose, and repair the damaged component; possibly taking several days or weeks to fully restore service. The worst-case scenario for a 500 kV underground transmission line is that it could take months to repair if new cables need to be manufactured. A consistently operating transmission line is necessary to maintain the overall integrity of the regional transmission system and to provide power to consumers. The potential long-term outages associated with an underground 500 kV transmission line would be unacceptable for a circuit carrying bulk power to major load centers.

As discussed above, the costs to safely install underground transmission lines would be considerably higher than comparable overhead line construction. Operational risks and maintenance concerns would also be greater with underground transmission than with overhead lines.

---

does not include an in-service spare cable. The high-range cost represents the highest manufacturer estimate for materials, includes circuit breakers within the transition stations, and includes an in-service spare cable. The in-service spare cable would be intended to reduce outage times in the event of a cable failure. It would represent approximately 6 percent of the total cost for the 1,650-foot scenario, and approximately 8 percent of the total cost for the 12,000-foot scenario.

The XLPE cables are typically placed in duct banks in an excavated trench up to approximately 10 feet deep, with manhole access to vaults for cable splicing and maintenance placed approximately every 1,500 to 1,700 feet. Crossing under the Rio Grande would require Horizontal Directional Drilling (HDD), placing the duct banks at a depth of approximately 20 feet below the riverbed. The underground alternative's two 500 kV XLPE cable system circuits would require a total of four duct banks, all within a 100-foot right-of-way when trenches are used, and 140 feet wide in the HDD section. Transition stations are required to connect the XLPE cables to overhead lines, and to transition from the excavated trenches to the HDD river crossing. Transition stations are superficially similar to electrical substations, and each would be approximately 350 feet by 600 feet (4.8 acres). Work areas approximately 350 feet by 600 feet would also be required adjacent to each transition station.

Overhead transmission and two underground alternatives for crossing the Rio Grande floodplain are discussed in this section, for each proposed crossing location. The HDD-only alternative includes overhead transmission lines located within the floodplain connecting to one transition station on each side of the river, and an HDD crossing under the river and adjacent canals. The full-floodplain alternative includes transition stations at the outer edges of the floodplain and at each riverbank for a total of four, and an HDD crossing under the river and canals.

The San Antonio Crossing would require an HDD length of 1,650 feet. The full-floodplain alternative is approximately 12,000 feet long, requiring approximately 7,950 feet of excavated trench to connect the four transition stations. The North Crossing would require an HDD length of 1,750 feet. The full-floodplain alternative is approximately 6,500 feet long, requiring approximately 2,350 feet of excavated trench to connect the four transition stations. Engineering has not been completed for the North Crossing, and the floodplain may not be wide enough at this point for the four transition stations needed in the full-floodplain alternative. However, the estimated configuration is included in the discussion to allow comparison of all alternatives.

All underground or overhead alternatives would result in temporary and permanent disturbance to agricultural fields and riparian vegetation (Table 4-33). Much of the Rio Grande floodplain is occupied by cultivated farmland, where new sources of temporary ground disturbance would have a low impact on many sensitive resources, although land use and deeply buried cultural artifacts may be affected. Overhead lines in the remainder of the floodplain are required to reach the HDD transition stations near the river in the HDD-only alternatives. Disturbance associated with those overhead lines is included in the acreage estimate in Table 4-33, so that all estimates are for comparable lengths of transmission line across the entire floodplain.

Table 4-33. Ground Disturbance for Rio Grande Crossing Alternatives

Alternative	Ground Disturbance (Acres)[1]		
	Disturbance within Native Vegetation	Disturbance within Farmland	Total Ground Disturbance
North Crossing			
Overhead alternative	9.5	8.7	18.2
HDD-only alternative (1,750 feet underground)	14.2	13.3	27.5
Full-floodplain alternative (6,500 feet underground)	23.4	20.4	43.8

Table 4-33. Ground Disturbance for Rio Grande Crossing Alternatives			
Alternative	Ground Disturbance (Acres)[1]		
	Disturbance within Native Vegetation	Disturbance within Farmland	Total Ground Disturbance
San Antonio Crossing			
Overhead alternative	10.1	15.4	25.5
HDD-only alternative (1,650 feet underground)	18.9	18.6	37.5
Full-floodplain alternative (12,000 feet underground)	21.9	32.8	54.7
[1] A portion of this total is temporary disturbance that may be restored			

4.16.2 Soil Resources

At the San Antonio Crossing, the HDD-only alternative would occur over approximately 1,650 feet, include two transition stations, and require 9.6 acres of permanent disturbance. The open-trenching alternative would occur over approximately 12,000 feet, include open trenching and four transition stations, and require 19.5 acres of permanent disturbance. The permanently disturbed area under both alternatives, including the acreage occupied by the transition stations, could result in disturbance of soils that are moderately to highly susceptible to water erosion and moderately susceptible to wind erosion. Mitigation measures applied elsewhere in the Project area where surface disturbance would occur, would minimize permanent residual impacts to soil resources.

At the North Crossing (Link E180), the HDD-only alternative would occur over approximately 1,750 feet and would include two transition stations, resulting in permanent disturbance of 10.2 acres. The open-trenching alternative would occur over approximately 6,500 feet and include open trenching and four transition stations. The permanently disturbed 13-acre area would be trenched and occupied by transition stations. Both alternatives could result in disturbance of soils that are moderately to highly susceptible to water erosion and moderately susceptible to wind erosion. Mitigation measures applied elsewhere in the Project area where surface disturbance would occur would minimize permanent residual impacts to soil resources.

No designated Prime or Unique Farmland soils are present within the areas of effect for either underground crossing method.

4.16.3 Paleontological Resources

No fossil localities were identified within 1 mile of the centerline for Link A140, including at either crossing. The closest fossil locality is an early Pleistocene locality within 1 mile of Link A112, which is approximately 2 miles from the eastern end of the proposed underground cable system.

The Underground Transmission Line would have a greater potential to impact paleontological Resources at the North Crossing. The centerline for Link E180 crosses two areas with a PFYC of 4 that are less than 1 mile from the Rio Grande. The open-trench alternative has the potential to have the greatest impact to paleontological resources, since it would have a greater area of disturbance than the HDD-only alternative.

4.16.4 Water Resources

A potentially significant impact to water resources for both the North Crossing and the San Antonio Crossing would be to the Rio Grande, which is considered impaired and has restrictions for discharges from nonpoint sources. Project construction would require CWA Section 402 and Section 404 permits, as well as Section 401 Water Quality Certification. There may also be impacts from trenching in areas with shallow groundwater, close to the Rio Grande. The horizontal drilling method could also impact shallow groundwater. Trenching or drilling into shallow groundwater may provide a way for contamination to enter the aquifer. There are no other perennial streams, wells, or springs within 600 feet of the centerline for links E180 or A140 within 1 mile on either side of the Rio Grande.

4.16.5 Biological Resources

An underground crossing of the Rio Grande has the potential to affect two ESA-listed species: the Southwestern Willow Flycatcher and the Rio Grande Silvery Minnow. Critical habitat for both species is present at the San Antonio Crossing and the North River Crossing..

The most substantial terrestrial impacts would be associated with trenching to bury the line in the Rio Grande floodplain. The trenched area would disturb a 100-foot width for the length of the trench. Part of the permanent disturbance would result from construction of underground vaults and associated manholes. In addition, two transition stations (four for the longer alternatives) would disturb an area 350 feet by 600 feet, and two laydown areas each would require 350 feet by 600 feet of disturbed area. These areas of disturbance would be unique to the underground line. In contrast, the overhead line would have ground disturbance associated with the transmission structures, and vegetation maintenance may occur within an approximate 400-foot-wide corridor. Access roads would be required for both underground and overhead alternatives.

The greatest impact to Southwestern Willow Flycatcher critical habitat would be habitat loss resulting from vegetation management required for each of the alternatives. Vegetation management for overhead transmission lines requires the trimming or removal of large trees, but shrubs and low-growing trees may be allowed within the right-of-way under some conditions. Vegetation management for the safety of the duct banks for the underground alternative precludes any trees or plants with deep, invasive roots in the vicinity of the right-of-way. The overhead alternative, then, may require moderate levels of vegetation management in a 400-foot-wide right-of-way; while the underground alternative would require very aggressive vegetation management within a more narrow corridor, perhaps 200 feet wide (Table 4-34). In addition, a transition station would be partially located within riparian woodlands on the east bank of the Rio Grande for all of the underground alternatives.

Table 4-34. Affected Southwestern Willow Flycatcher Critical Habitat			
Alternative	Critical Habitat affected (acres)		
	Ground disturbance	Vegetation management	Total
North Crossing[1]			
Overhead alternative	5.7	15.9	21.6
HDD-only alternative (1,750 feet underground)	7.1	6.4	13.5
Full-floodplain alternative (6,500 feet underground)	7.5	4.7	12.2
San Antonio Crossing (all designated critical habitat)			
Overhead alternative	10.1	14.1	25.5
HDD-only alternative (1,650 feet underground)	18.9	18.6	37.5
Full-floodplain alternative (12,000 feet underground)	21.9	32.8	54.7
San Antonio Crossing (presently suitable nesting habitat only)[2]			
Overhead alternative	1.9	8.0	9.9
HDD-only alternative (1,650 feet underground)	2.8	3.3	6.1
Full-floodplain alternative (12,000 feet underground)	2.8	3.3	6.1

[1] Estimates of ground disturbance and vegetation management for the overhead alternative at the North Crossing are based on preliminary engineering that was completed for the BLM preferred alternative. Estimates at the San Antonio Crossing are based on typical conditions presented in the Project description.

[2] Suitable Southwestern Willow Flycatcher nesting habitat in riparian woodland only occurs at the San Antonio crossing at present.

While future vegetation management could permit suitable Southwestern Willow Flycatcher nesting habitat to recover within the floodplain, there is currently only a small area of dense willows and large cottonwoods at the San Antonio Crossing. Much of the eastern side of the San Antonio Crossing floodplain within designated critical habitat, formerly a large stand of tamarisk, burned in 2005 and is now dominated by weeds and annual grasses. Vegetation at the North Crossing consists of an open-canopy forest dominated by cottonwoods and Russian olives, with small numbers of tamarisk, willows, and other trees. Dense, suitable nesting habitat is present only in very small areas, if at all. The extent of future riparian woodland recovery cannot be estimated at this time at either crossing; however, effects to future recovery of critical habitat would be fully considered during Section 7 consultation with the USFWS.

The active channel of the Rio Grande and 300 feet of the adjacent floodplain (unless bounded by levees nearer than 300 feet) were designated as critical habitat for the Rio Grande Silvery Minnow. Ground disturbance in the surrounding floodplain may result in runoff carrying increased amounts of sediment into the river, thus affecting critical habitat for the minnow. Potential effects to critical habitat for this species would therefore increase with the amount of ground disturbance within the entire floodplain, as presented in Table 4-34. Any increase in erosion and sedimentation could also affect all other species present in the Rio Grande, such as aquatic birds, fish, reptiles, and amphibians.

The underground transmission line crossing the Rio Grande would affect other organisms, especially riparian birds, mammals, invertebrates, and plants. An example would be the Yellow-billed Cuckoo, a candidate for listing under the ESA; but there are many other species with no special status. Desert riparian systems are centers of biodiversity, largely because they contain unique assemblages of plants and animals dependent on them for water, a scarce resource throughout much of the Southwest.

A potential benefit of underground transmission lines is that the risk of bird collisions with overhead transmission lines is reduced or avoided. The risk of avian collision with power lines is dependent on site-specific conditions, including land use and proximity to feeding or roost sites. In the case of this Project, where the species of highest concern are Sandhill Cranes, Snow Geese, and other waterfowl, mortality from collision with transmission lines (EPG 2011) would be a very small addition to the natural mortality and hunting that these species withstand (see Section 4.17.4.6). Although the underground alternatives may reduce collision risk, impacts to the Southwestern Willow Flycatcher and other riparian species would increase with the intensive vegetation management needed for duct bank safety and the siting of transition stations in the floodplain.

4.16.6 Cultural Resources

The 1,650-foot (San Antonio Crossing) and 1,750-foot (North Crossing) segments would involve installation underneath the river for the HDD-only alternatives. Based on the preliminary design work, it is anticipated that the HDD installation under the river could extend up to 20 feet below the river grade, with a right-of-way width of 140 feet. Evidence of past land use would most likely be buried by silt deposits as the the river may have shifted over time. It is possible that buried features associated with resource procurement may be located within the flood plain. Currently, no known sites are recorded in this location, although the San Antonio irrigation ditch may be historic. The proposed HDD alternatives would most likely avoid impacting the feature. Cultural resource impacts for the HDD-only alternatives would most likely occur from buried sites that are currently unknown.

The longer 12,000-foot (San Antonio Crossing) and 6,500-foot (North Crossing) segments would involve HDD installation underneath the river and excavation of trenches to bury the transmission line the remainder (6,000 to 10,000 feet) of the distance. As mentioned above, the HDD-only alternative currently has no known sites recorded in this location, although some of the linear features may be historic. The trench excavation is anticipated to disturb a corridor 100 feet wide, with a trench depth between 6 and 10 feet. Depending on the termination of the longer segment, there is a possibility of impacting El Camino Real Trail, linear canal features that may be historic, and possibly some known archaeological sites. Other impacts to cultural resources could occur through unanticipated discoveries identified during the trench excavations. Types of cultural resources that may be present in the floodplain include resource procurement and temporary habitation features.

4.16.7 Visual Resources

Generally, the HDD-only alternatives would remove riparian vegetation for two transition areas that would be needed on each side of the river. The HDD-only alternatives would minimize landscape contrast (when compared to the open-trenching alternatives), because clearing of riparian vegetation would be limited to areas immediately adjacent to the river associated with the transition areas. Additional floodplain clearing would be required (for both riparian and agriculture vegetation) for the open-trenching alternative, which would result in greater landscape contrast than the HDD-only alternative. Overall, the overhead transmission line alternative would have lower landscape contrast than both underground alternatives because vegetation clearing at riparian crossings would be spanned to the extent practicable. Vegetation removal along the river and within the floodplain would be limited to structure pad areas and spur roads.

Transition areas would be required for both underground alternatives and would be similar to a switchyard or substation facility. Although a total of four transition areas would be required for the open-trenching alternative, structure contrast would be reduced as compared to the HDD-only and overhead transmission line alternatives. The HDD-only alternative would underground the transmission line for a short duration to cross the river, whereas the open-trenching alternative would underground the line for the entire floodplain.

Near Socorro, the Rio Grande is associated with Class A scenery and Class B scenery is primarily associated with the adjacent floodplain and agricultural areas. Although the Rio Grande has been channelized in this area, riparian vegetation is abundant along the river and extends beyond the river banks into the adjacent floodplain. Due to the presence of dense, tall riparian vegetation, strong landscape contrast would be introduced where riparian vegetation would be completely removed to accommodate clearing associated with the underground portion of either alternative. Recreation viewers associated with KOP SO16 (Rio Grande) would have views of both underground alternatives within the foreground distance zone. Vegetation clearing may be apparent for these viewers; however, the transition areas may be screened by riparian vegetation from this viewpoint, which would reduce visual contrast. Vegetation clearing associated with the overhead transmission would not be as substantial; however, the structures would be visible above the riparian vegetation when crossing the river. Travel route viewers along SR 408 (SO17 and SO18) would have views of the open-trenching alternative and transition areas that would traverse the floodplain. Structure contrast would be reduced when undergrounded and removal of vegetation would primarily occur within agricultural land; thus, landscape contrast would be reduced. The open-trenching alternative may reduce impacts for residences with views of the entire floodplain near Socorro, because structure contrast would be reduced. Residences with views of the HDD-only alternative would have views of structure contrast and landscape contrast associated with the transition areas and overhead transmission lines crossing the floodplain. When compared with the overhead transmission line alternative, the HDD-only may result in greater visual contrast due to the presence of both overhead transmission line and transition area facilities and clearing associated with riparian vegetation.

The crossing near San Antonio is also associated with Class A and B scenery similar to the northern crossing; however, riparian vegetation is not as abundant along the river and the adjacent floodplains have been converted to agriculture. Resulting contrast would be strong

where riparian vegetation would be removed to allow underground construction, although vegetation removal would not be as extensive as the northern crossing. Residential viewers associated with KOPs SO20 and SO21 would have views of the open-trenching alternative and transition areas that would traverse the floodplain. Structure contrast would be reduced when undergrounded, and removal of vegetation would primarily occur within agricultural land; thus, landscape contrast would be reduced. Residences with views of the HDD-only alternative would have views of structure contrast and landscape contrast associated with the transition areas and overhead transmission lines crossing the floodplain. Riparian vegetation clearing at the San Antonio Crossing would not be as substantial as the Northern Crossing; thus, impacts to scenery and viewing locations would be lower for the underground alternatives.

4.16.8 Land Use

All impacts to land use within the Rio Grande floodplain for any of the crossing alternatives are restricted to temporary or permanent loss of production in flood-irrigated agricultural fields. Although guyed-"V" structures are the standard design proposed for the Project, tubular steel monopole structures would be used in agricultural fields as a mitigation measure to minimize loss of production. Each structure would still require a 200-foot by 200-foot work area, but 25 to 50 percent of this area could be cultivated following construction. For the purposes of this discussion, the entire work areas are included as permanent loss of production as the area still useable for farming activities depends on details of structure siting, cultivation techniques, and configuration of the surrounding field.

Preliminary engineering indicates that some farming activities may be restricted or changed, but not completely eliminated, within the 100-foot right-of-way used for the excavated trench in the full-floodplain alternative. Crops with shallow roots, and those that do not need deep cultivation, may be allowed within the right-of-way. Light farm equipment may not be restricted, although heavy equipment, storage of large volumes of materials such as hay bales, and permanent structures would not be permitted.

In the HDD-only alternative at the San Antonio Crossing, permanent impacts to existing land use would result from the siting of 10 overhead transmission structures and one transition station in flood-irrigated agricultural fields, resulting in a total permanent disturbance of approximately 14 acres. Preliminary engineering for overhead structures indicates that no additional access roads would be required, and that all ground disturbance would be contained within a 200-foot by 200-foot work area. Temporary disturbance within farmland may include a work area 350 feet by 600 feet associated with construction of the transition station, which would result in a net temporary loss of approximately 4.8 acres of production.

In the full-floodplain alternative at the San Antonio Crossing, the direct land use impacts would include crossing six agricultural fields. Two transition stations sited in agricultural fields would result in a permanent disturbance and loss of production of up to 9.6 acres. Three manholes would be required within farmland, totaling approximately 0.14 acre of permanent disturbance. An existing access road is located within approximately 200 feet of the Project centerline. From this existing road, a 24-foot-wide spur road could be constructed to each manhole, resulting in permanent disturbance of up to 0.24 acre. Temporary disturbance associated with the excavated trench would occur for approximately 4,100 feet in a right-of-way 100 feet wide, resulting in a

temporary loss of production of 9.4 acres. Two work areas could be associated with the transition stations, resulting in an additional 9.6 acres of temporary loss of production. The total permanent disturbance to farmland for this option would be approximately 10 acres, and temporary disturbance would be approximately 19.1 acres.

The overhead alternative would require a total of 12 transmission structures, each with an associated work area 200 by 200 feet, for a total potential permanent loss of 11 acres of production. The work areas may extend to nearby existing roads, possibly eliminating the need for spur roads.

In the HDD-only alternative at the North Crossing, permanent impacts to existing land use would result from the siting of four overhead transmission structures and one transition station in flood-irrigated agricultural fields, resulting in a total permanent disturbance of approximately 8.5 acres. Similar to the San Antonio Crossing, existing access is likely to be adequate and no additional roads would be required. Temporary disturbance within farmland may include a work area 350 feet by 600 feet associated with construction of the transition station, which would result in a net temporary loss of approximately 4.8 acres of production.

In the full-floodplain alternative at the North Crossing, the direct land use impacts would include crossing three agricultural fields, all of which are west of the Rio Grande. Two transition stations sited in agricultural fields would result in a permanent disturbance and loss of production of up to 9.6 acres, although one transition station may be located west of the agricultural fields. No manholes would be required in agricultural fields for this alternative, as the distance between transition stations could be spanned with a single reel of XLPE cable. One manhole may be required east of the Rio Grande, depending on final siting of the easternmost transition station, but the manhole location would not affect current land use. Temporary disturbance associated with the excavated trench would occur for approximately 500 feet in a right-of-way 100 feet wide, resulting in a temporary loss of production of 1.1 acres. Two work areas could be associated with the transition stations, resulting in an additional 9.6 acres of temporary loss of production. The total permanent disturbance to farmland for this option would be approximately 9.6 acres, and temporary disturbance would be approximately 10.8 acres.

The overhead alternative would require a total of four transmission structures, each with an associated work area 200 by 200 feet, for a total potentially permanent loss of 3.7 acres of production. The work areas may extend to nearby existing roads, possibly eliminating the need for spur roads.

4.17 CUMULATIVE EFFECTS

4.17.1 Introduction

This section addresses the cumulative effects of the proposed action that would result from the construction and operation of the Project, combined with other reasonably foreseeable future actions.

A cumulative impact, as defined by the CEQ (40 CFR 1508.7), is the impact on the environment that results 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 actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. Reasonably foreseeable future actions, while not part of the proposed action, refer to future projections or estimates of what is likely to take place when a proposed action is implemented. This allows for future impacts, cumulative and otherwise, to be estimated as required by the NEPA. Cumulative impacts are interdisciplinary, multijurisdictional, and usually do not conform to political boundaries.

The analyses for potential cumulative effects are presented in the following sections:

Process and Methods of Analysis identifies the general methods and analysis used in analyzing the potential cumulative effects for the Project.

Past, Present, Future, and Reasonably Foreseeable Future Actions identifies land uses, activities, and projects within the Project cumulative areas of analysis; and includes an Energy Development Forecast Analysis that describes potential energy development scenarios. As indicated in this forecast, the projected ground disturbance associated with up to 4,500 MW of potential electrical generation development would be 40,270 acres. Estimates for potential ground disturbance would vary based on site specific conditions, design, and technologies.

Cumulative Effects by Resource analyzes potential cumulative effects by resources for both the Project and energy development scenarios.

4.17.2 Process and Methods of Analysis

Impacts and effects are terms that are recognized to be synonymous by the CEQ (40 CFR 1508.8) and according to the CEQ's *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997b). For this analysis, projects that could result in similar cumulative effects include linear projects such as roads, transmission lines, and pipelines; and large area developments such as military installations, planned area developments, substations, conventional and fossil-fueled power plants, and renewable energy developments.

This analysis evaluates the significance of the proposed action's contribution to cumulative effects, which are assessed in three basic steps. The first step is to identify the cumulative effects' study area, or area of analysis, for each resource and relevant period; the second step is to identify and describe past, present, future, and reasonably foreseeable future actions that are similar in kind and effect as the proposed action, or have considerable impact to environmental resources to which the proposed action's effects will cumulatively contribute; and the third step is to evaluate the proposed action for the potential to have cumulative contributions to environmental effects that could significantly affect the environment. It is assumed that mitigation measures as those identified for the SunZia Project could be utilized for similar future or reasonably foreseeable future projects.

The alternative routes for the Project traverse various ecological zones and jurisdictions, both natural and man-made features, and lands with several different owners. Quantitative data describing potential effects of reasonably foreseeable future actions or development were used where available. Where reliable quantitative data could not be found, qualitative data were used

to best assess the cumulative effects of the proposed action, according to the assessment of resource specialists.

The methods used to assess cumulative effects are resource dependent, and include the following:

- *Scoping meetings, interviews, and comments on the Draft EIS* used to identify proposed projects, development plans, environmental resources, local knowledge, and community concerns. Fourteen scoping meetings occurred throughout the Project area, along with numerous interviews with local experts, stakeholders, and various agency staff.
- *Trend analysis* used quantitatively where data allowed, such as for renewable energy development; and qualitatively used when interviewing local experts, such as with land use and development patterns.
- *GIS overlays and impact analysis* used to understand spatial and temporal relationships of the proposed action with past, present, and reasonably foreseeable future actions. In addition, a GIS impact analysis was used to analyze direct and indirect effects of the proposed action's alternatives.
- *Energy development forecast analysis* used to forecast reasonably foreseeable future renewable energy development based on RMPs, local plans, existing and planned energy development projects, typical energy development units (EDU), and transmission facility configurations.

4.17.2.1 Scoping and Project Issues

Numerous issues were identified during the scoping process that resulted in the desire of agencies and residents to expand the study area and range of alternatives. The major areas of concern included the San Pedro River Valley, Aravaipa/Klondyke, Mount Graham/Safford, Bosque del Apache and Sevilleta NWRs, Rio Grande corridor, and military installations.

In addition, a large volume of scoping comments and comments on the Draft EIS identified environmental resources within the study area; especially relating to migratory birds, listed species, habitat fragmentation, preservation of wilderness and wilderness-like areas, cultural resources, aesthetics, private property, property values, and local economies. A thorough review of environmental resources was conducted. Existing conditions are documented in Chapter 3, and include the following:

- Climate and Air Quality
- Earth Resources
- Paleontological Resources
- Water Resources
- Biological Resources
- Wildland Fire Ecology and Management
- Cultural Resources
- Visual Resources
- Land Use and Recreation Resources
- Special Designations

- Wilderness, Wilderness Study Areas, and Wilderness Characteristics
- Social and Economic Conditions
- Environmental Justice Conditions
- Health and Safety/Hazardous Materials

4.17.3 Past, Present, Future, and Reasonably Foreseeable Future Actions

Throughout this portion of Chapter 4, the terms past, present, future, and reasonably foreseeable future are used to apply to projects or any actions within the cumulative area of analysis for a particular resource(s). These terms are defined as follows:

- *Past* refers to a project or other action that resulted in impacts that occurred prior to the preparation of this EIS.
- *Present* refers to a project or other action that would have impacts occurring during the preparation of this EIS.
- *Future* refers to any project or other action that is currently planned for development. Although a project may be designated as "future," this designation does not necessarily mean that it would be constructed and operate in the "reasonably foreseeable" future. The effects of future projects that are currently speculative or unknown, such that there is not enough concrete or finite information allowing for the analysis of the effects associated with the future action, are not fully analyzed herein.
- *Reasonably foreseeable future* refers to future actions or projects "for which there are existing decisions, funding, formal proposals, or which are highly probable, based on known opportunities or trends" (BLM NEPA Handbook at § 6.8.3.4.). To constitute a reasonably foreseeable future action, a project must be concrete enough that consideration of its effects would be useful to the decision-maker.

4.17.3.1 Parameters

Timeframe

Past, present, future, and reasonably foreseeable future actions are relative to the baseline conditions established for the proposed Project. The baseline conditions for the cumulative effects analysis are defined as the No Action alternative. The No Action alternative indicates the BLM would not grant right-of-way; Project facilities, including transmission lines and substations, would not be built; and the existing environmental conditions (including the identification of past and present actions, events, and occurrences as described in Chapter 3) would persist.

Evaluating the proposed action against the baseline conditions provides a reference point in time to gauge cumulative effects. Overall, the timeframe for the cumulative effects analysis is based on the lifespan of the proposed action, which could exceed 50 years; however, it is difficult to forecast future actions with certainty. Reasonably foreseeable future actions are those that are currently identified, and could potentially be actualized within a standard planning time horizon. Typically, city and county comprehensive or general plans, BLM RMPs, utility transmission

plans, etc., are updated every 10 years to identify planning and infrastructure priorities, directions, and budgets for the foreseeable future. For this reason, 10 years is a reasonable horizon and represents the furthest point from which to anticipate future actions. The Project would result in different impacts during construction and operation. This cumulative impacts analysis includes identification of the potential cumulative impacts that could occur during the construction and operation periods for the Project. Decommissioning of the Project would occur well beyond the 10-year horizon for the cumulative impacts analysis, and the scope of potential impacts during the timeframe of decommissioning are considered speculative and cannot be meaningfully analyzed.

Identification of Geographic Area of Effect by Resource

The geographic extent of cumulative effects varies according to the affected resource. For example, cumulative effects to air quality and social and economic conditions have regional importance, whereas cumulative effects to visual resources are more site-specific and tend to have a more narrowly affected geography. The geographic area of effect is identified within each resource section in this analysis.

4.17.3.2 Identification of Past, Present, Future, and Reasonably Foreseeable Future Actions, Land Uses, and Projects

Past and present activities and land uses within the study area are described in detail in Section 3.10. These include agriculture, grazing, mining, and general recreation; residential, industrial, and commercial development; transportation and utility corridors; conservation easements, parks, and open space; and military installations.

Future and reasonably foreseeable future actions include those projects or proposed developments that have been identified either in a plan or through public records searches, conversations with local officials, and general research. Table 4-35 and Figure 4-1 summarize the known past, present, future, and reasonably foreseeable future activities; land uses; and projects considered in the cumulative effects assessment[1]. Land uses or activities with a status of "present" are included in the baseline conditions and impacts analysis, presented in chapters 3 and 4 respectively. Facilities associated with the proposed Project are not included in this list.

For this analysis, reasonably foreseeable future actions were identified within the Project study area, including renewable energy generation projects outside of the study area that could feasibly interconnect with facilities provided by existing local utility owners or the proposed Project. Projects defined as "future," although not reasonably foreseeable future, have been identified and listed in Table 4-35.

Transmission Lines

In addition to the proposed Project, there are plans for other interstate transmission lines that could be constructed in New Mexico and Arizona (see Table 4-35).

[1] The map of Cumulative Effects Activity Locations, Figure 4-1 is not all inclusive of activities listed in Table 4-35 due to scale limitations.

The High Plains Express transmission line system is proposed to provide a new 500 kV AC interconnection between Wyoming and Arizona, through Colorado and New Mexico. Although various alternatives have been evaluated in feasibility studies, the project routes cannot be reasonably identified and therefore cannot be meaningfully evaluated in this analysis.

The Southline Transmission Project is proposed as a 225-mile, 345 kV transmission line system between Afton, New Mexico and the Apache (Power Plant) Substation in Cochise County, Arizona, and would also require upgrades to existing transmission lines between Apache and the Saguaro Substation in Pinal County. Southline submitted a right-of-way application to the BLM and will be subject to its own NEPA process.

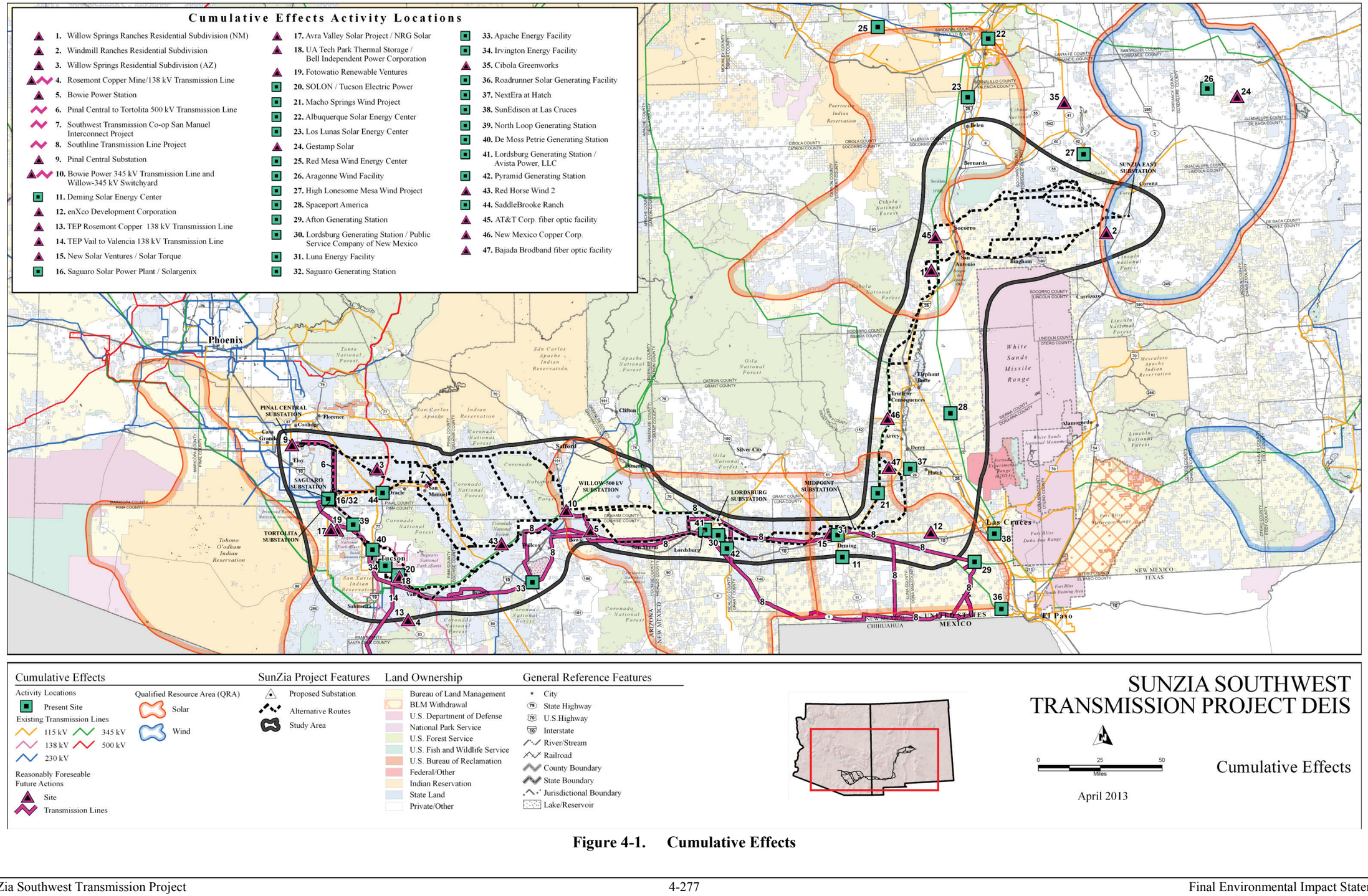


Figure 4-1. Cumulative Effects

This page intentionally left blank.

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis												
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Land Development Subdivisions											
Rural residential development	Dispersed throughout the study area	Present	All Counties	●	●	●	●	●	●	All Counties	●
New Mexico											
Willow Springs Ranches Residential subdivision, NM	Plat-approved 50,000 acres of new residential development. Approximately 26 miles south of Socorro, west of I-25 (Socorro County)	Present and RFF	Socorro	●	●	●	●	●	●	Socorro	●
Windmill Ranches residential subdivision	Plat approved 16,000 acres of new residential development, approximately 20 miles north of Carrizozo, west of US Highway 54 (Lincoln County)	Present and RFF	Lincoln	●	●	●	●	●	●	Lincoln	
Arizona											
Willow Springs residential subdivision	Tentative plat approval 4,600 acres (not contiguous) of new residential development, approximately 6 miles northeast of SR 79, 13 miles northwest of Oracle (Pima County)	RFF	Pinal	●	●	●	●	●	●	Pinal	
SaddleBrooke Ranch residential subdivision	Residential subdivision, partially constructed, approximately 9 miles west of Oracle (Pima County)	Present and RFF	Pima	●	●	●	●	●	●	Pima	●
Agriculture and Range											
Farming	Cultivated private land throughout the study area	Present	All Counties	●	●	●	●	●	●	All Counties	●
Grazing	Dispersed throughout the study area	Present	All Counties	●	●	●	●	●	●	All Counties	●
Conservation Easements	Dispersed throughout the study area, with concentrations along the Rio Grande, San Pedro River, and Pima County, Arizona	Present and RFF	All Counties	●	●	●	●	●	●	All Counties	

[1] Cumulative analysis areas for Climate and Air resources, and Social and Economic resources include counties listed for each project.

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Transportation and Access											
I-10	East-west alignment, major interstate highway through NM and AZ	Present	Doña Ana Luna Hidalgo Cochise Pima			●	●	●	●	Doña Ana Luna Hidalgo Cochise Pima	●
US Route 70	East-west alignment parallels I-10, beginning just south of Las Cruces, NM	Present	Otero Doña Ana Luna Hidalgo Greenlee Graham			●	●	●	●	Otero Doña Ana Luna Hidalgo Greenlee Graham	●
Union Pacific Railroad	East-west alignment, adjacent to I-10 in NM and AZ, crossing southern portions of the study area	Present	Doña Ana Luna Hidalgo Cochise Pima			●	●	●	●	Doña Ana Luna Hidalgo Cochise Pima	●
New Mexico											
I-25	North-south alignment runs through western portion of study area, connecting Las Cruces, Truth or Consequences, and Socorro	Present	Socorro Sierra Doña Ana			●	●	●	●	Doña Ana Luna Hidalgo Cochise Pima	●
US Route 54	Northeast-southwest alignment, crossing the eastern portion of the study area	Present	Torrance Lincoln			●	●	●	●	Torrance Lincoln	●
US Route 60	North-south alignment, north of Socorro, crossing the northwestern portion the study area	Present	Socorro			●	●	●	●	Socorro	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
US Route 180	East-west alignment, parallels I-10 within the NM portion of the study area, proceeding west past Las Cruces to Deming, then turning north	Present	Luna Grant			●	●	●	●	Luna Grant	●
US Route 380	East-west alignment connecting into US Route 85, just north of San Antonio	Present	Socorro Lincoln			●	●	●	●	Socorro Lincoln	
SR 1	North-south alignment, paralleling I-25 to the south before ending at Truth or Consequences	Present	Socorro Sierra			●	●	●	●	Socorro Sierra	●
SR 26	North-south alignment, west side of I-25 just south of Derry, connecting to US Route 180, just north of Deming	Present	Sierra Doña Ana Luna			●	●	●	●	Socorro Sierra	●
SR 51	East-west alignment, south of Elephant Butte Reservoir	Present	Sierra			●	●			Sierra	●
SR 52	East-west alignment, north of Truth or Consequences Municipal Airport; proceeds west from I-25	Present	Socorro Sierra			●	●	●	●	Socorro Sierra	●
SR 55	Northwest-southeast alignment turning northwest from US Route 54, crossing through the northeastern portion of the study area	Present	Torrance Lincoln Socorro			●	●	●	●	Torrance Lincoln Socorro	●
Atchison, Topeka, and Santa Fe Railroad	North-south alignment paralleling I-25 in the northeastern portion of the study area	Present	Socorro Sierra Doña Ana			●	●	●	●	Socorro Sierra Doña Ana	●
Burlington Northern Santa Fe Railroad	North-south alignment along I-25 in NM	Present	Socorro Sierra Doña Ana			●	●	●	●	Socorro Sierra Doña Ana	●
Arizona											
I-19	North-south alignment, major interstate highway from Tucson, AZ to Mexico	Present	Pima			●	●	●	●	Pima	●
US Route 191	North-south alignment, southern portion of the study area, east of Cochise, before connecting to I-10	Present	Graham Cochise			●	●	●	●	Graham Cochise	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
SR 77	North-south alignment, east of the Tortolita Substation, adjacent to the Coronado National Forest	Present	Pima Pinal			●	●	●	●	Pima Pinal	●
SR 79	Northwest-southeast alignment, east of Pinal Central, connects to SR 77 east of Tortolita Substation	Present	Pinal			●	●	●	●	Pinal	●
SR 87	North-south alignment crossing the study area south of Coolidge	Present	Pinal			●	●	●	●	Pinal	●
SR 287	East-west alignment, south of Coolidge	Present	Pinal			●	●	●	●	Pinal	●
Freeway between US Route 60 and I-10 near Picacho Peak State Park	North-south alignment, future transportation corridor just east of planned Pinal Central Substation	Future				●					
Arizona Eastern Railroad	North-south alignment connecting Safford and Bowie	Present	Graham Cochise			●	●	●	●	Graham Cochise	●
Airports											
New Mexico											
Alamogordo White Sands Regional Airport	4 miles southwest of Alamogordo	Present	Otero				●			Otero	
Lordsburg Municipal Airport	0.5 mile southeast of Lordsburg	Present	Hidalgo				●	●	●	Hidalgo	
Carrizozo Municipal Airport	1 mile northwest of Carrizozo	Present	Lincoln				●			Lincoln	
Deming Municipal Airport	2 miles east of Deming	Present	Luna				●			Luna	
Socorro Municipal Airport	3 miles south of the town of Socorro	Present	Socorro				●			Socorro	
Truth or Consequences Municipal Airport	Adjacent to I-25, 7 miles north of Truth or Consequences	Present	Sierra				●			Sierra	
Hatch Municipal Airport	3 miles west of Hatch	Present	Doña Ana				●			Doña Ana	

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Arizona											
Benson Municipal Airport	3 miles northwest of Benson	Present	Cochise				●			Cochise	
Marana Regional Airport	3 miles west of Marana	Present	Pima				●			Pima	
Marana Airport/Pinal Airpark (Western Army National Guard Aviation Training Site)	7 miles northwest of Marana, west of I-10	Present	Pima				●			Pima	
San Manuel Airport	3 miles north of San Manuel	Present	Graham				●	●	●	Graham	
Tucson International Airport	6 miles south of Tucson	Present	Pima				●	●	●	Pima	
Private Airstrips	Dispersed throughout the study area	Present	All Counties			●	●	●	●	All Counties	●
Mining and Minerals											
New Mexico											
Alley Gypsum Mine	Gypsum mine approximately 30 miles north of Las Cruces	Present	Doña Ana	●						Doña Ana	
Caballo Project	Aggregate mine approximately 14 miles southwest of Truth or Consequences	Present	Sierra	●						Sierra	
Chivo Pit	Aggregate pit approximately 6 miles northwest of Truth or Consequences	Present	Sierra	●			●	●	●	Sierra	
Cotton City Gravel Pit	Aggregate pit approximately 20 miles southwest of Lordsburg	Present	Hidalgo	●						Hidalgo	
Coyote Cliff No. 1 Mine	Zeolites mine approximately 18 miles south of Truth or Consequences	Present	Grant	●			●			Grant	
Coyote Cliff No. 2 Mine	Zeolites mine approximately 18 miles south of Truth or Consequences	Present	Grant	●			●			Grant	

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Cuchillo Pit	Aggregate pit approximately 3 miles north of Truth or Consequences	Present	Grant	●			●			Grant	
Florida Mine	Aggregate mine approximately 14 miles southeast of Deming	Present	Luna	●			●			Luna	
Fort Seldon Quarry	Aggregate and caliche mine approximately 13 miles northwest of Las Cruces	Present	Doña Ana	●			●			Doña Ana	
Frank Smyer Pit	Aggregate pit approximately 13 miles east of Deming	Present	Luna	●			●	●	●	Luna	
Gary/Lordsburg Pit	Aggregate pit approximately 8 miles southwest of Lordsburg	Present		●			●				
Hill Pit – Doña Ana County Transportation Division	Aggregate pit approximately 8 miles northwest of Las Cruces	Present	Hidalgo	●			●	●	●	Hidalgo	
Hopper Quarry	Aggregate mine approximately 10 miles southwest of Deming	Present	Luna	●						Luna	
Lordsburg Aggregate Production Facility	Aggregate and other approximately 4 miles southwest of Lordsburg	Present	Hidalgo	●			●	●	●	Hidalgo	
Luchini Pit	Aggregate pit approximately 13 miles north of Truth or Consequences	Present	Sierra	●			●	●	●	Sierra	
Luna HA-0175 Pit	Aggregate pit approximately 31 miles west of Las Cruces	Present	Doña Ana Luna	●			●	●	●	Doña Ana Luna	
Mimbres K-13	Aggregate mine approximately 13 miles northwest of Deming	Present	Luna	●						Luna	
Mimbres Pit	Aggregate pit approximately 19 miles northwest of Deming	Present	Luna	●						Luna	
Mesilla Valley Cobble Quarry	Aggregate mine approximately 25 miles northeast of Las Cruces	Present	Doña Ana	●						Doña Ana	
Morgan Pit	Aggregate pit approximately 2 miles southwest of Truth or Consequences	Present	Sierra	●			●			Sierra	
New Mexico Copper Corp.	Pending authorization 6 miles west of Caballo	RFF	Sierra	●	●	●	●	●	●	Sierra	●
North Lemitar Pit	Aggregate pit approximately 8 miles north of Socorro	Present	Socorro	●			●	●	●	Socorro	
O'Kelly Quarry	Aggregate mine approximately 6 miles south of Deming	Present	Luna	●			●			Luna	

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Picacho Peak Pit	Aggregate pit approximately 6 miles northwest of Las Cruces	Present	Doña Ana	●						Doña Ana	
Rainbow Mine	Calcite mine approximately 16 miles northwest of Las Cruces	Present	Doña Ana	●			●			Doña Ana	
Socorro Perlite Quarry	Perlite mine approximately 4 miles southwest of Socorro	Present	Socorro	●			●	●	●	Socorro	
South Socorro I-25 Pit	Aggregate pit approximately 5 miles southwest of Socorro	Present	Socorro	●			●	●	●	Socorro	
T.E.A.A No. 3	Gemstone mine approximately 34 miles southeast of Socorro	Present	Socorro	●						Socorro	
Wallin Material Source	Aggregate mine approximately 23 miles southeast of Truth or Consequences	Present	Sierra	●						Sierra	
Arizona											
Johnson Camp Mine	Copper mine approximately 65 miles east of Tucson	Present	Cochise	●						Cochise	
Mission Mine	Copper, moly mine approximately 20 miles southwest of Tucson	Present	Pima	●		●	●			Pima	
Rillito Mine	Cement mine approximately 20 miles northwest of Tucson	Present	Pima	●		●	●			Pima	
Rosemont Mine	Copper mine approximately 30 miles southeast of Tucson	RFF	Pima	●	●	●	●			Pima	
Safford Mine	Copper mine approximately 8 miles north of Safford	Present	Graham	●		●				Graham	
Sierrita Mine	Copper, moly mine approximately 25 miles south of Tucson	Present	Pima	●		●	●			Pima	
Mining Claims	Dispersed throughout the study area	Present	All Counties	●	●	●	●	●	●	All Counties	●
Leaking Underground Storage Tanks and CERCLIS Sites											
Leaking Underground Storage Tanks	35 sites, within Tucson city limits	Present/Past	Pima		●	●	●	●	●	Pima	●
CERCLIS	3 sites, within Tucson city limits	Present/Past	Pima		●	●	●	●	●	Pima	●
Communication Facilities											
Baja Broadband	Pending fiber optic facility approximately 15 miles west of Hatch	RFF	Sierra	●	●	●	●	●	●	Sierra	●
AT&T Corp.	Pending fiber optic facility 8 miles west of Socorro	RFF	Socorro	●	●	●	●	●	●	Socorro	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Military Installations and Airspace											
New Mexico											
Northern Call-up Area	Private and public land along the northern boundary of WSMR that is evacuated and closed during live missile launches from WSMR—approximately 690,560 acres	Present	Socorro Torrance			●	●		●	Socorro Torrance	●
Restricted Airspace	Surrounding WSMR (see map M-10-3E Military Designations)	Present	Socorro Lincoln Torrance							Socorro Lincoln Torrance	●
Stallion Army Air Field	18 miles southeast of Socorro; manages airborne assets in the northern portion of WSMR	Present	Socorro							Socorro	
White Sands Missile Range	10 miles east of I-25 and approximately 3 miles east of Bosque del Apache NWR—approximately 2.2 million acres	Present	Socorro Lincoln Sierra Doña Ana			●				Socorro Lincoln Sierra Doña Ana	
Arizona											
Davis-Monthan AFB	2 miles southeast of Tucson	Present	Pima				●	●	●	Pima	●
Fort Huachuca (Electronic Proving Ground)	Noise tests for electronic combat and electronic warfare equipment; area covers the San Pedro River Valley, and portions of Pima, Santa Cruz, and Cochise counties	Present							●	Pima Santa Cruz Cochise	
Restricted Airspace	Within areas of Graham, Pinal, and Cochise counties (see map M-10-3W Military Designations).	Present	Graham, Pinal Cochise							Graham, Pinal Cochise	●
Buffalo Soldier Electronic Test Range	Within Pima and Cochise counties	Present	Pima and Cochise							Pima and Cochise	●
Pinal Airpark	See Marana Airport above.										

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Designated Utility Corridors, Transmission Lines, and Energy Facilities											
Utility Corridors in Arizona and New Mexico											
West-wide Energy Corridors	Designated by the DOE Section 368 of the Energy Policy Act of 2005—the western portion of the NM alternatives follow the corridor to the south, approximately mid-way down, where the corridor proceeds to the southeast stopping at the southernmost point of the NM alternatives; the corridor then proceeds west, terminating just after crossing into AZ, with the alternatives following the corridor until its termination	Present	Socorro Sierra Doña Ana Luna Hidalgo Cochise			●	●	●	●	Socorro Sierra Doña Ana Luna Hidalgo Cochise	
BLM Socorro Field Office RMP designated utility corridors	A utility corridor generally two miles wide established along the Interstate 25 corridor	Present	Socorro	●	●	●	●	●	●	Socorro	●
Transmission Lines in Arizona and New Mexico											
Arizona Public Service Co. 115 kV Transmission Line	San Manuel Substation west to the Saguaro Substation	Present	Pinal			●	●	●	●	Pinal	●
Arizona Public Service Co. 230 kV Transmission Line	South of Eloy, AZ, west of I-10 to the southeast, before turning to the east-southeast into the Saguaro Substation	Present	Pinal			●	●	●	●	Pinal	●
Arizona Public Service Co. 345 kV Transmission Line	Western edge of the study area near the Ironwood Forest National Monument; turns northeast, terminating at the Saguaro Substation	Present	Pinal			●	●	●	●	Pinal	●
Arizona Public Service Co. 500 kV Transmission Line	Northern edge of the study area south, crossing over SR 79 before terminating at the Saguaro Substation near I-10	Present	Pinal			●	●	●	●	Pinal	●
Bureau of Reclamation 138 kV Transmission Line	Southwest and west of the Saguaro National Park, south of the Saguaro Substation in AZ	Present	Pima			●	●	●	●	Pima	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
El Paso Electric 345 kV Transmission Lines	Northern portion of the study area to the southwest of I-25 and US Route 60, parallel to I-25 east of Las Cruces, NM	Present	Socorro Sierra Luna			●	●	●	●	Socorro Sierra Luna	●
Public Service Co. of New Mexico 345 kV Transmission Lines	North of Luna Substation, west past the Hidalgo and Lordsburg substations; parallels US Route 70	Present	Luna Grant Hidalgo			●	●	●	●	Luna Grant Hidalgo	●
Salt River Project 500 kV Transmission Line	Northern boundary of the study area, south of Coolidge, AZ	Present	Pinal			●	●	●	●	Pinal	●
Southwest Transmission Co-op Inc. 115 kV Transmission Line	Northern boundary of study area to the southeast into the Winchester Substation and out of the study area	Present	Pinal Cochise			●	●	●	●	Pinal Cochise	●
Southwest Transmission Co-op Inc.230 kV Transmission Line	Northeast of Safford, AZ to the south; parallels a portion of US Route 191	Present	Graham Cochise			●	●	●	●	Graham Cochise	●
Tri-State G & T Association, Inc. 115 kV Transmission Lines	West of Belen, NM and south, paralleling US Route 60 and I-25 west of Socorro, NM; splits with one segment proceeding west to Truth or Consequences, NM and terminating at Luna Substation, west of Deming, NM	Present	Socorro Sierra Luna			●	●	●	●	Socorro Sierra Luna	●
Tucson Electric Power Co. 138 kV Transmission Line	Northwest to north crossing I-10 and Davis-Monthan AFB, proceeding northwest to the north of Tucson to the Saguaro Substation, in AZ	Present	Pima Pinal			●	●	●	●	Pima Pinal	●
Tucson Electric Power Co. 161 kV Transmission Line	North of the Saguaro National Park northwest to the Saguaro Substation in AZ	Present	Pima Pinal			●	●	●	●	Pima Pinal	●
Tucson Electric Power Co. 345 kV Transmission Line	West of the Willow-500 kV and Winchester substations, crossing I-10 and the southwest corner of the San Xavier Indian Reservation	Present	Graham Cochise Pima			●	●	●	●	Graham Cochise Pima	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Western Area Power Administration 115 kV Transmission Lines	Saguaro-Tucson segment along I-10 corridor in Pinal and Pima counties, and Tucson-Apache, southwest of Willcox, Arizona, segment crosses San Pedro River north of Benson in Cochise County.	Present	Pinal Pima Cochise			●	●	●	●	Pinal Pima Cochise	●
Bowie 345 kV Transmission Line(s)	Two proposed 345 kV generation tie-lines between proposed Bowie Power Plant (Cochise County) and proposed Willow-345 kV Substation (Graham County)	RFF	Cochise Graham	●	●	●	●	●	●	Cochise Graham	●
Tucson Electric Power Co. Pinal Central Substation to Tortolita Substation	Proposed 500 kV transmission line located between the planned Pinal Central Substation and the Tortolita Substation, adjacent to the Saguaro Power Plant east of I-10	RFF	Pinal	●	●	●	●	●	●	Pinal	●
Southwest Transmission Co-op Inc., San Manuel Interconnect Project	Proposed 230 kV transmission line that proceeds southwest from an existing Southwest Transmission Co-op Inc. line to the San Manuel Substation south of Mammoth, AZ, northeast of San Manuel, AZ	RFF	Pinal	●	●	●	●	●	●	Pinal	●
Southline Transmission Line Project	Proposed 345 kV transmission line corridor that will run from El Paso, TX into southeastern AZ, near the Palo Verde Hub	RFF	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal	●	●	●	●	●	●	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal	●
Tucson Electric Power Co. Rosemont Copper 138 kV Transmission Line Project	Permitted 138 kV transmission line located in Pima County between a proposed substation near Sierrita to the proposed Rosemont Mine	RFF	Pima	●	●	●	●	●	●	Pima	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Tucson Electric Power Co. Vail to Valencia 138 kV Transmission Line	Permitted 138 kV transmission line located in Pima and Santa Cruz counties.	RFF	Pima Santa Cruz	●	●	●	●	●	●	Pima Santa Cruz	●
High Plains Express Transmission Project	Proposed 500 kV high-voltage transmission line through WY, CO, NM, and AZ	Future	Lincoln Socorro Catron Greenlee Graham Pinal			●				Lincoln Socorro Catron Greenlee Graham Pinal	
Pipelines in Arizona and New Mexico											
Chevron Pipeline Co. 8-inch and 6-inch Product El Paso Albuquerque Terminal Pipeline	East of Belen, NM, south through the Sevilleta NWR, east of Socorro, crossing the Bosque del Apache NWR before continuing east of Las Cruces and I-10	Present	Socorro Sierra Doña Ana			●	●	●	●	Socorro Sierra Doña Ana	●
El Paso Gas Co. California System Main and Branch Pipelines	Southern boundary of the study area, south of Las Cruces and north along US Route 191	Present	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal			●	●	●	●	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
El Paso Gas Co. El Paso System Branch Pipelines	West along the southern boundary of the study area, south of Las Cruces	Present	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal			●	●	●	●	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal	●
El Paso Gas Co. California High Pressure System Main Line Pipeline	West along the southern boundary of the study area, south of Las Cruces	Present	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal			●	●	●	●	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal	●
El Paso Natural Gas Co. Permian-San Juan Pipeline	Northeast corner of the study area, southeast of Corona, NM, near the proposed SunZia East Substation	Present	Lincoln Socorro			●	●	●	●	Lincoln Socorro	●
Kinder Morgan SFPP L.P. El Paso to Tucson to Phoenix Pipeline	West along the southern boundary of the study area, south of Las Cruces; follows I-10 to Eloy, AZ	Present	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal			●	●	●	●	Doña Ana Luna Hidalgo Grant Cochise Pima Pinal	●
TransWestern Pipeline Co. and Enron Mainline and Mainline Loop Pipelines	Northeast corner of the study area, southeast of Corona, NM, near the proposed SunZia East Substation	Present	Lincoln Socorro			●	●	●	●	Lincoln Socorro	●

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Minor and Branch Pipelines	Dispersed throughout the study corridor	Present	All Counties			●	●	●	●	All Counties	●
Substations in New Mexico											
Hidalgo Substation	Located north of I-10, northeast of Lordsburg	Present	Hidalgo			●	●	●	●	Hidalgo	●
Luna Substation	Located west of Deming, north of I-10	Present	Luna							Luna	
Substations in Arizona											
Pinal Central Substation (permitted)	Planned 500 kV substation, east of Casa Grande, north of Eloy, and south of Coolidge in Pinal County	RFF	Pinal	●	●	●	●	●	●	Pinal	●
Tortolita Substation	500 kV substation, southeast of Eloy in Pinal County (TEP)	Present	Pinal			●	●	●	●	Pinal	●
Willow-345 kV Substation	345 kV substation interconnecting planned Bowie Power Plant with TEP 345 kV transmission lines northwest of Bowie, and south of Safford in Graham County.	RFF	Graham	●	●	●	●	●	●	Graham	●
Vail Substation	South of I-10 and the Davis-Monthan AFB, east of the San Xavier Indian Reservation in Pima County	Present	Pima							Pima	
Winchester Substation	North of I-10, east of the San Pedro River in Cochise County	Present	Cochise			●	●	●	●	Cochise	●
Minor Distribution Substations	Dispersed throughout the study corridor	Present	All Counties			●	●	●	●	All Counties	●
Power Plants in New Mexico											
Afton Generating Station Power Plant	275 MW natural gas power plant west of I-10, northwest of El Paso	Present	Doña Ana		●					Doña Ana	
Pyramid Generating Station	160 MW natural gas power plant 30 miles southeast of Lordsburg	Present	Hidalgo		●					Hidalgo	
El Paso Electric Company	350 MW natural gas power plant in Sunland Park, within Doña Ana County	Present	Doña Ana		●					Doña Ana	
Lordsburg Generating Station	80 MW natural gas power plant north of I-10, east of Lordsburg	Present	Hidalgo		●	●	●	●	●	Hidalgo	

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Luna Energy Facility	600 MW natural gas power plant, northwest of the Luna Substation, east of Deming	Present	Luna		●	●	●	●	●	Luna	
Estancia Basin Biomass Facility	35 MW biomass power generation plant located on 50 acres, approximately six miles south of Estancia	Future	Torrance								
Power Plants in Arizona											
Apache Power Plant	400 MW coal-fired power plant near Benson Arizona, east of Highway 19, south of I-10	Present	Cochise		●		●			Cochise	
DeMoss Petrie Generating Station	85 MW natural gas power plant near I-10 and Grant Road within Tucson	Present	Pima		●	●	●	●	●	Pima	
North Loop Generating Station	108 MW natural gas power plant near I-10, approximately 14 miles southeast of the Saguaro Substation in Pima County	Present	Pima		●		●	●	●	Pima	
Irvington Power Plant	496 MW coal fired, liquid fuel (oil), and natural gas power plant west of Davis-Monthan AFB within Pima County	Present	Pima		●		●	●	●	Pima	
Saguaro Power Plant	395 MW natural gas and 1 MW solar power plant adjacent to the Saguaro Substation and NW of Tortolita Substation, within Pinal County	Present	Pinal		●	●	●	●	●	Pinal	
Sundance Generating Station	450 MW natural gas power plant within the City of Coolidge, Pinal County	Present	Pinal		●		●			Pinal	
Coolidge Generating Station	575 MW natural gas-fired power plant in the City of Coolidge, Pinal County	Present	Pinal		●		●			Pinal	
Bowie Power Station	Planned 1,000 MW natural gas fired power station in Cochise County	RFF	Cochise		●		●			Cochise	
Renewable Energy in New Mexico and Arizona											
Roadrunner Solar Electric Facility PV	20 MW Solar Project	Present	Doña Ana		●					Doña Ana	
NextEra at Hatch CPV	5 MW Solar Project	Present	Doña Ana		●	●	●	●	●	Doña Ana	

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Sun Edison at Las Cruces	12 MW Solar Project	Present	Doña Ana							Doña Ana	
Cibola Green Works	50 MW Solar Project	RFF	Torrance		●		●			Torrance	
BP Solar (PV)/Energy Novo	22 MW Solar Project	Future									
Deming Solar Energy Center	5 MW Solar Project	Present	Luna		●	●	●		●	Luna	
enXco Development Corp.	600 MW Solar Project	RFF	Doña Ana	●	●	●	●		●	Doña Ana	
Bright Source Energy	Solar Project	Future	Luna							Luna	
Gestamp Solar	11 MW Solar Project	RFF	Guadalupe							Guadalupe	
Bright Source Energy	Solar Project	Future	Hidalgo							Hidalgo	
First Solar, Next Light Renewable Power, LLC	Solar Project	Future	Doña Ana							Doña Ana	
Warm Springs Renewable Energy Corp.	Solar Project	Future	Sierra							Sierra	
Edge Renewable Energy, LLC	Solar Project	Future	Luna							Luna	
SolarReserve, LLC	Solar Project	Future	Luna							Luna	
New Solar Ventures/Solar Torque	300 MW Solar Project	RFF	Luna	●	●	●	●	●	●	Luna	
Saguaro Solar Power Plant/Solargenix (Solar Trough)	1 MW Solar Project	Present	Pinal	●	●	●	●	●	●	Pinal	
Avra Valley Solar Project	20 MW Solar Project	RFF	Pima			●	●		●	Pima	

Table 4-35. Past, Present, Future, and Reasonably Foreseeable Future Activities within Cumulative Area of Analysis											
Land Use/Activity	**Location/Description**	**Status**	**Climate and Air Resources[1]**	**Earth Resources**	**Water Resources**	**Biological Resources**	**Cultural Resources**	**Visual Resources**	**Land Use & Recreation Resources**	**Social and Economic Conditions[1]**	**Health & Safety/ Hazardous Materials**
Pioneer Green Inc. (near Red Rock)	Solar Project	Future	Pinal							Pinal	
Pioneer Green Inc.	Solar Project	Future	Pinal							Pinal	
Safford Solar Energy Center	Solar Project	Future	Cochise							Cochise	
UA Tech Park Thermal Storage Demonstration Project; Bell Independent Power Corp.	5 MW Solar Project	RFF	Pima	●	●	●	●	●	●	Pima	
Fotowatio Renewable Ventures	25 MW Solar Project	RFF	Pima			●	●		●	Pima	
SOLON/Tucson Electric Power	1.6 MW Solar Project	Present	Pima	●	●	●	●	●	●	Pima	
Macho Springs	50 MW Wind Project	Present	Luna			●	●	●	●	Luna	●
Gallo Canyon Wind, LLC/First Wind	Wind Project	Future	Lincoln							Lincoln	
Macho Springs Power, LLC/Element Power	Wind Project	Future	Luna							Luna	
Type 2 Wind Application; Tucson BLM Field Office	Wind Project	Future	Pinal							Pinal	
Red Horse Wind 2	Wind Project	RFF	Cochise							Cochise	
Lighting Dock (Raser Technologies)	Geothermal Project	Future	Hidalgo							Hidalgo	

RFF – reasonably foreseeable future

[1] The same renewable energy projects are also identified in Table 4-38, Existing Renewable Energy Projects within the Cumulative Analysis Area

Renewable Energy Development

Table 4-36 identifies present, future, and reasonably foreseeable future renewable energy development projects within the cumulative areas of analysis.

Table 4-36. Present, Future, and Reasonably Foreseeable Future Renewable Energy Projects

Name	County	Land Area (acres)	Generation (MW)	Status
Solar Projects – New Mexico				
Albuquerque Solar Energy Center	Bernalillo	20	2	Present
NextEra at Hatch	Doña Ana	39	5	Present
Roadrunner Solar Electric Facility PV[1]	Doña Ana	182	20	Present
Sun Edison at Las Cruces	Doña Ana	100	12	Present
Deming Solar Energy Center[1]	Luna	50	5	Present
Las Lunas Solar Energy Center	Valencia	50	5	Present
Gestamp Solar	Bernalillo	76	11	RFF
enXco Development Corp.[1]	Doña Ana	3,000	600	RFF
New Solar Ventures/Solar Torque[1]	Luna	3,840	300	RFF
Cibola Green Works	Torrance	160	50	RFF
First Solar, Next Light Renewable Power, LLC[1]	Doña Ana	640	N/A	Future
GA Solar (PV)	Guadalupe	2,500	300	Future
Bright Source Energy[1]	Hidalgo	6,573	N/A	Future
Bright Source Energy[1]	Luna	7,520	N/A	Future
Edge Renewable Energy, LLC[1]	Luna	6,183	N/A	Future
SolarReserve, LLC[1]	Luna	3,840	N/A	Future
BP Solar (PV)/Energy Novo[1]	Sierra	160	22	Future
Warm Springs Renewable Energy Corp.[1]	Sierra	3,158	20	Future
First Solar, Next Light Renewable Power, LLC	Valencia	865	—	Future
Monzano Energy Park (Solar Array)	Valencia	300	18	Future
Solar Projects – Arizona				
SOLON/Tucson Electric Power[1]	Pima	14	1.6	Present
Saguaro Solar Power Plant/Solargenix (Solar Trough)[1]	Pinal	7	1	Present
Avra Valley Solar Project[1]	Pima	300	20	RFF
Fotowatio Renewable Ventures[1]	Pima	305	25	RFF
UA Tech Park Thermal Storage Demonstration Project; Bell Independent Power Corp.[1]	Pima	200	5	RFF
Pioneer Green Inc.[1]	Pinal	960	N/A	Future
Pioneer Green Inc. (near Red Rock)[1]	Pinal	640	N/A	Future
Safford Solar Energy Center[1]	Cochise	22,891	250	Future
Wind Projects – New Mexico				
Red Mesa Wind Energy Center	Cibola	5,000	102	Present
Aragone Wind Facility	Guadalupe	9,600	90	Present
Macho Springs[1]	Luna	1,900	50	Present
High Lonesome Mesa	Torrance	4,626	100	Present
Vaughn Wind, LLC/First Wind	Guadalupe	7,363	N/A	Future
Gallo Canyon Wind, LLC/First Wind[1]	Lincoln	36,553	N/A	Future
Macho Springs Power, LLC/Element Power[1]	Luna	1,119	N/A	Future

Table 4-36. Present, Future, and Reasonably Foreseeable Future Renewable Energy Projects				
Name	**County**	**Land Area (acres)**	**Generation (MW)**	**Status**
La Sierrita Wind, LLC/Invenergy	San Miguel	5,783	N/A	Future
Cedar Hills Wind, LLC/First Wind	Torrance	4,640	N/A	Future
Red Canyon Wind, LLC/First Wind	Torrance	12,576	N/A	Future
New Mexico Renewable, LLC	Union, Torrance, and Chaves	21,429	N/A	Future
Wind Projects – Arizona				
Type 2 Wind Application; Tucson BLM Field Office[1]	Pinal	10,115	N/A	Future
Red Horse Wind 2	Cochise	5,760	51	RFF
Geothermal Projects – New Mexico				
Lighting Dock (Raser Technologies)[1]	Hidalgo	N/A	10	Future

[1] These projects are also included in Table 4-35. Some of these projects are located outside of the project area but within a resource cumulative analysis area
N/A indicates information is not available
PV – photovoltaic
RFF – reasonably foreseeable future

Along with the existing and planned renewable energy projects identified above, transmission facilities other than the proposed Project could be built. For these projects, land area requirements for access roads and transmission facilities should be considered for cumulative effects.

Land area for access roads for transmission facilities could range from 1.6 acres per mile up to 6.7 acres per mile, depending on slope and distance to existing access roads.

Land area for transmission facilities, which includes construction yards, concrete batch plants, laydown sites, wire pulling and tensioning sites, and wire splicing sites for 115 kV line, is assumed to be 3 acres per mile.

4.17.3.3 Energy Development Forecast Analysis

As identified in Chapter 1, the Project is proposed to increase transfer capability in an electrical grid that is currently insufficient to support the development, access, and transport of additional energy-generating resources, including renewable energy, in New Mexico and Arizona. It is the intent of the Applicant to provide infrastructure to increase transfer capability in areas of potential renewable energy generation. Increasing interstate transfer capability and access to renewable resources is needed to meet federal energy policy objectives, such as the EPAct of 2005, as well as state RPS.

The Applicant's purpose for the proposed Project is to provide access to renewable energy resources in the Southwest and to increase general reliability. At this time, the Applicant is not accepting, reviewing, or processing any interconnection requests. In addition, the BLM is unaware of any generators planning to interconnect with the SunZia Project. In light of the Applicant's stated purpose, an attempt to provide an analytical tool has been developed herein to

provide a means to assess the cumulative effects of the types of renewable energy projects that may ultimately interconnect with the Project. These development scenarios are offered as analytical tools, and not meant to imply that there are currently specific or known cumulative effects from generators.

A Final Wind PEIS (BLM 2005) and a Final Solar PEIS (BLM and DOE 2012) have been used to assess cumulative impacts, alternatives, and mitigation measures associated with wind and solar energy development on BLM-administered land. The Restoration Design Energy Project completed by the Arizona State BLM Office, intended to identify suitable areas for renewable energy development in Arizona, was also assessed during the cumulative analysis.

Renewable Energy Development Setting

New Mexico

Wind: New Mexico ranks seventeenth in total wind capacity installed in the United States, and twelfth in wind potential; with an annual potential estimated to be 435 million MWh (AWEA 2011; New Mexico Energy 2011a). Current wind development within New Mexico is located primarily on its central and eastern plains. New Mexico has the potential to produce many times its own electrical need, which puts it in a position to export wind electricity.

Solar: New Mexico contains some of the best potential for solar energy development, and ranks second for potential solar power in the United States (New Mexico Energy 2011b).

Geothermal: In New Mexico, low (less than 190 degrees Fahrenheit), moderate (190 to 300 degrees Fahrenheit), and high (greater than 350 degrees Fahrenheit) temperatures for geothermal resources can be found in many locations throughout the state (Bland 2010). Areas along the Rio Grande corridor and the southwest corner of the state provide some of the best geothermal resources, but few areas in these locations have been developed. The majority of current geothermal uses in New Mexico are for spas, space heating, greenhouses, and fish farms.

Arizona

Wind: A 2003 wind energy survey conducted by the National Renewable Energy Laboratory (NREL) identified several areas in the state as having commercial-grade wind resources. According to NREL Data, wind speeds and conditions are greater in the northern portion of the state. The potential for wind development for the state of Arizona is more than 30 million MWh (AWEA 2011); annual wind speed averages at 50 meters above the ground greater than 16 mph (NAU 2011).

Solar: Arizona is among the four states with the highest concentrations of solar resources (NREL, WREZ 2009). There is a large potential for solar energy development in Arizona due to land availability, identified solar resources, and the state's goal of accelerating renewable energy development through incentives and the ACC-mandated renewable energy standards (RES). The land and water resources in Arizona are sufficient to support the amount of solar generation that would be required to meet RES requirements for the next 20 years (Frisvold 2009).

Geothermal: These resources are present in Arizona, especially in the south. While Arizona does not contain any high (greater than 350 degrees Fahrenheit) temperatures for geothermal resources, there is substantial heat flow that could be used. Arizona geothermal potential is in the low-to-moderate range, which is excellent for geothermal heat pumps and space heating, as opposed to electricity generation, which requires a higher temperature resource (Allison 2011).

Qualified Resource Areas

Qualified Resource Areas (QRA) were developed using the Western Renewable Energy Zones (WREZ) (WGA and DOE 2009) (Table 4-37; Figure 4-1, Figure 4-2 and Figure 4-3). The WREZ were developed in 2008 by the Western Governors' Association and the DOE, with the Zone Identification and Technical Analysis (ZITA) workgroup (WGA and DOE 2009).

Table 4-37. Potential Renewable Energy Resource Capacity by QRA in MW

QRA	Solar[1]	Wind[1]	Geothermal[1]
AZ-SO	6,623	0	—[2]
NM-CT	3,183	0	—[2]
NM-EA	83	11,290	—[2]
NM-SE[3]	0	1,894	—[2]
NM-SO	4,347	0	—[2]
NM-SW	6,149	0	—[2]
Total	**20,385**	**13,184**	**2,527**

[1] Source: Western Governors' Association. "Western Renewable Energy Zones-Phase One Report: Table 1 Renewable Energy Generating Capacity Summary." June 2009. Available at www.westgov.org/wga/publicat/WREZ09.pdf

[2] Geothermal sources are believed to exist within the study areas, because of the presence of geological systems that have been correlated with geothermal resource potential in other areas; but specific locations have not been identified.

[3] Although it is possible for the proposed Project to interconnect with NM-SE, the QRA is located at a distance that would make the feasibility of interconnection unlikely, and would only contribute marginally to the energy potential of the region when compared to the larger NM-EA QRA.

The criteria used in developing the WREZ for wind and solar included: (1) locations where NREL wind power class is 3 or greater, at 50 meters above the ground, and slope is less than 20 percent; (2) solar is greater than 6.5 kilowatt hours per square meter per day of direct normal insolation[1], and slope is greater than 2 percent. The QRA boundaries were defined to encompass areas within which future renewable energy generation projects could feasibly interconnect with facilities provided by existing local utility owners or the proposed Project.

Overall Potential of Renewable Resources within Qualified Resource Areas

Table 4-38 lists the overall potential generation capacities (in total megawatts) of renewable resources within QRAs that are within the vicinity of the proposed Project.

Summary of Present and Reasonably Foreseeable Future Renewable Energy Projects

Table 4-38 is a summary of the generating capacities and land areas of present renewable energy projects. Approximately 2,600 MW of solar power developments have been identified as

[1] The rate of delivery of direct solar radiation per unit of horizontal surface.

reasonably foreseeable future projects. According to available records, future wind development projects have been identified that could comprise more than 119,000 acres (see Table 4-36), primarily consisting of leases or options on New Mexico state lands.

It is assumed that large land leases will not be developed in their entirety; facility siting processes and future demand will determine the specific development configurations of wind generation facilities. These projects fall within or near the QRAs identified on Figure 4-2 and Figure 4-3, and in Table 4-37; and could interconnect with facilities provided by existing local utility owners or the proposed Project. Specific information is not available to determine the individual generating capacities, configuration, development timing, or impacts of these future wind projects. However, it is reasonable to assume that between 5,000 and 10,000 MW of wind generation capacity will be developed in the future, given the large land areas that have been leased or optioned, and the combined renewable energy potential of over 13,000 MW within these areas (Table 4-38).

Table 4-38. Existing Renewable Energy Projects within the Project Area[1,2]

		Wind	Solar
New Mexico	MW	342	49
	Land Area (acres)	Up to 17,000	Up to 500
Arizona	MW	0	2.6
	Land Area (acres)	0	Up to 21

[1] Includes projects that are currently in production of electricity or under construction within the study area and in proximity to the QRAs (see Figure 4-1)
[2] Megawatt total is based on existing Project information

Methods

A potentially large number of wind, solar, and geothermal development combinations could be considered; but for the purposes of this analysis, three energy development scenarios are provided, based on (1) the overall potential for renewable resources, (2) two transmission facility scenarios, and (3) typical renewable EDUs.

Overall Potential for Renewable Resources

A reasonable overall potential for renewable resources is estimated based on the following four factors:

- **Physical potential** areas identified within the western United States that exhibit the necessary qualities of raw renewable resource potential (WGA and DOE 2009)
- **Renewable portfolio standards** adopted by individual states that provide market-based mechanisms to increase renewable energy generation (EPA 2009)
- **Development applications** for leases to site individual renewable energy generation facilities on public land.
- **Interconnection requests** (contractual or transactional) for potential generation projects to interconnect with existing transmission owners (see Table 1-2, Summary of Generation Interconnection Requests to Existing Transmission Owners within the Project Area).

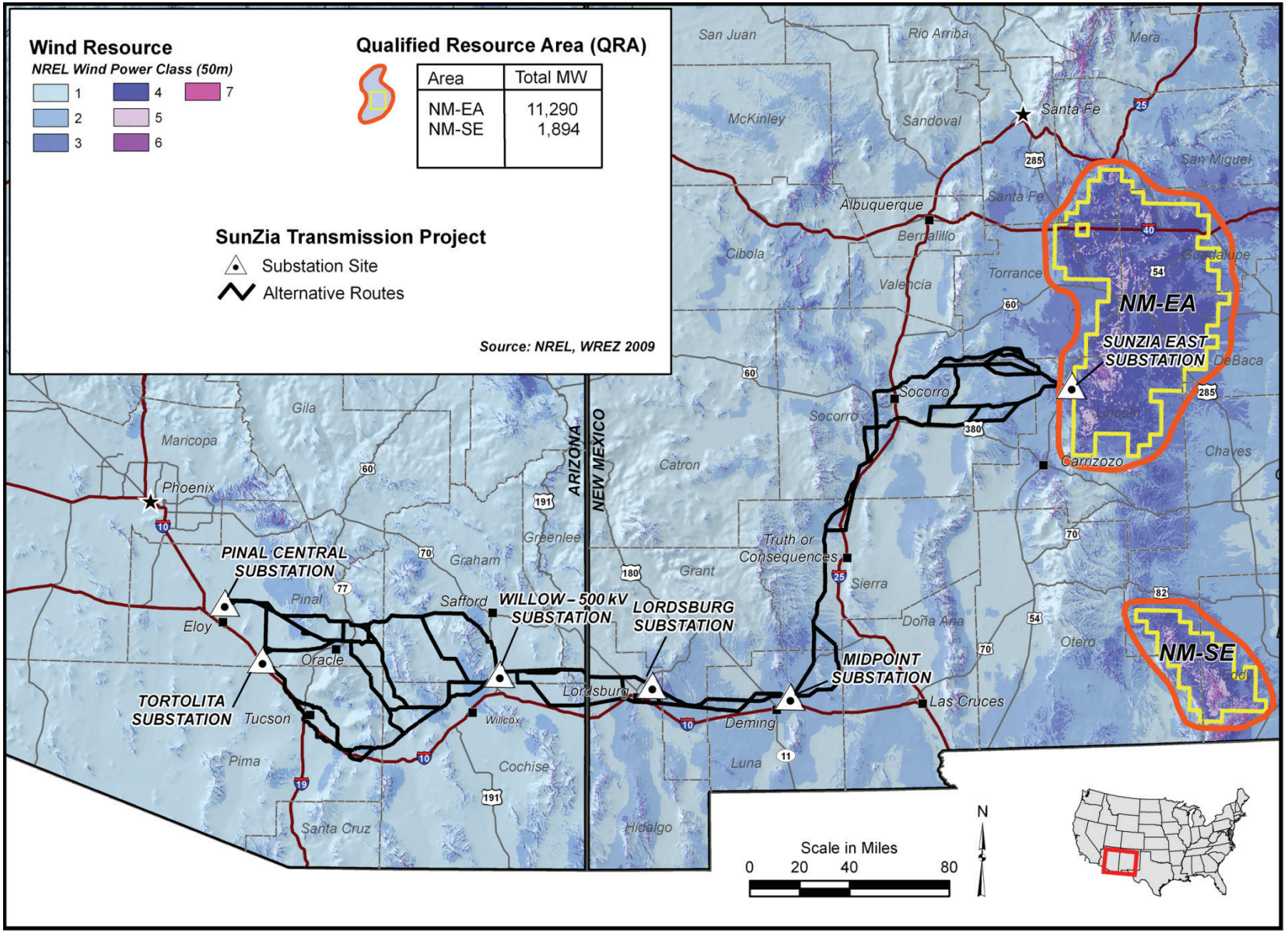


Figure 4-2. Qualified Resource Areas for Wind

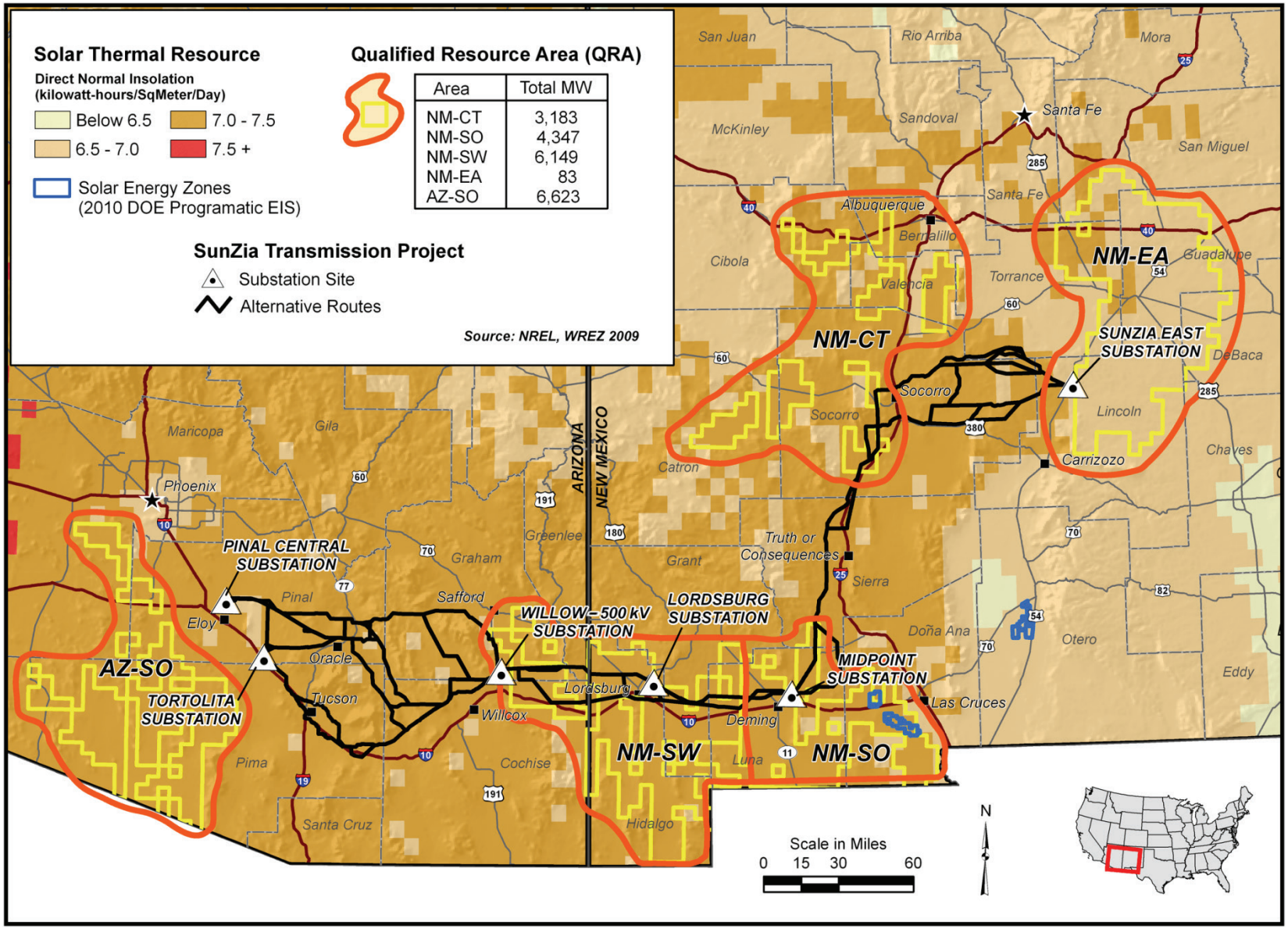


Figure 4-3. Qualified Resource Areas for Solar

Transmission Facility Scenarios

The following two combinations of transmission facilities are considered by the proposed Project:

- *Option A* – Construction of two 1,500 MW AC transmission facilities, with a combined total of 3,000 MW transmission capability
- *Option B* – Construction of one 1,500 MW AC and one 3,000 MW DC transmission facility, with a combined total of 4,500 MW transmission capability

Typical Potential Renewable Energy Development Units

Renewable EDUs represent the likely incremental building blocks of renewable energy projects that could be economically constructed. Individual renewable energy projects could consist of multiple EDUs. Four potential types of renewable EDUs that could interconnect with the SunZia transmission lines include a 100 MW solar PV facility, a 160 MW solar thermal facility, a 100 MW wind facility, and a 50 MW geothermal facility.

Energy Development Scenarios

Using the overall potential for renewable resources, two different transmission facility scenarios identified for the proposed Project, and the EDUs identified above, two energy development scenarios were developed and are described below (options A and B). Option A is based on the assumption that two AC lines would be built with a combined total of 3,000 MW of transmission capability, and on the assumption that a total of 24 EDUs would be constructed: 6 in Arizona (4 solar PV, 1 solar thermal, and 1 geothermal) and 18 in New Mexico (4 solar PV, 1 solar thermal, 12 wind, and 1 geothermal). These projects would use 2,420 MW of the 3,000 MW of transmission capability built in Option A, with the remaining 580 MW being used by other existing types of generation facilities.

Option B is based on the assumption that one AC line and one DC line would be built with a combined total of 4,500 MW of transmission capability, and on the assumption that 42 EDUs would be built: 3 in Arizona (2 solar PV and 1 solar thermal) and 39 in New Mexico (36 wind, 2 solar PV, and 1 geothermal). These projects would use 4,210 MW of the 4,500 MW of transmission capability built in Option B, with the remaining 290 MW being used by other existing types of generation facilities.

In developing these scenarios, it is assumed that some portion of the Project's transfer capability would be utilized by nonrenewable generation resources. As previously discussed, FERC Order 888 compels transmission owners to provide open access to its facilities without discrimination, including discrimination as to type of generation requesting interconnection and transmission service.

Further, renewable generation (depending on type, location, local and regional meteorology, and other factors) exhibits certain patterns of availability and intermittency. Should buyers of renewable generation so desire, they may arrange for regulation generation services from other

sources on the grid, or from within their own inventory of generation assets. Some of the generation noted above in the two options that is indicated to come from "other types of generation facilities" might be comprised from such regulation generation services and may, in fact, flow over and across all or part of the Project's transmission facilities.

Although no specific existing or planned project is identified to interconnect with the proposed Project, probable areas are estimated for any of the potential renewable energy projects, based on the amount of potential energy resources identified by QRA.

Potential land area requirements per energy development scenario were calculated based on the percentage of renewable energy production by type per QRA, and the energy mix determined above for options A and B, which yielded a potential capacity per QRA for each option. The results were then calculated with the assumed land area per megawatt to yield the total land area estimate per QRA per option. The results can be found in Table 4-39.

Table 4-39. Potentially Affected Land Area for the Energy Development Scenario

QRA	Wind (MW)	Solar (MW)	Geothermal (MW)	Total Land Area[1] (Acres)
Option A				
NM-CT	—	100	—	700
NM-SO	—	200	—	1,400
NM-SW	—	260	50	2,170
NM-EA	1,200	—	—	12,000
NM-SE	—	—	—	—
AZ-SO	—	560	50	4,270
Option B				
NM-CT	—	—	—	—
NM-SO	—	100	—	700
NM-SW	—	100	50	1,050
NM-EA	3,600	—	—	36,000
NM-SE	—	—	—	—
AZ-SO	—	360	—	2,520

[1] Land area calculations are based on 7 acres per MW for solar energy development and 10 acres per MW for wind energy development, and is an estimate for area of potential ground disturbance.

As indicated in this forecast, the projected ground disturbance associated with up to 4,500 MW of potential electrical generation development would be 40,270 acres. Estimates for potential ground disturbance would vary based on site-specific conditions, design, and technologies.

4.17.4 Cumulative Effects by Resource

4.17.4.1 Introduction

The results of the cumulative effects analysis are presented below for each of the resources. Cumulative effects were evaluated with respect to each of two scenarios, described as follows.

- **Scenario 1: SunZia Project** – The proposed Project alternatives, including the construction and operation of two adjacent 500 kV transmission lines within one right-of-way, up to 1,000 feet wide, that would occur within a specific geographic area as defined for each resource
- **Scenario 2: Energy Development Scenario** – The energy development scenario is defined to include the construction and operation of future renewable energy generation facilities, which could include reasonably foreseeable future projects as defined in Section 4.17.3.3.

The greatest amount of renewable energy development that would be accessible for potential interconnection with the Project is in the QRA NM-EA, adjacent to the eastern terminus of the Project, as indicated on Figure 4-2, and Table 3-31. Compared with Option B, impacts could occur from the development of additional renewable energy projects located where interconnection with intermediate substations is provided with Option A, in addition to potential impacts within QRA NM-EA. However, Option B was used as a basis for the energy development scenario analysis because it would likely represent the greater overall amount of resource impacts relative to the amount of generation.

Cumulative impacts resulting from all of the past, present, or reasonably foreseeable future actions would be relevant to any of the alternative subroutes. However, there would be variation according to site-specific project development. The analysis of cumulative impacts is generalized to address the range of past, present, and reasonably foreseeable future actions with respect to each resource study and cumulative analysis area.

The analysis also addresses secondary or indirect impacts that could occur from facilities constructed beyond the Project area of analysis (e.g., new wind turbines and associated gen-tie transmission lines in Guadalupe County, New Mexico). In addition, other energy projects that might be developed in the long-term (not reasonably foreseeable) future are briefly discussed, although cumulative impacts of these future actions cannot be analyzed in detail because there is insufficient information about such projects at this time.

Past, present, and reasonably foreseeable future actions that were considered for this analysis are described in Table 4-35. Following is a summary of cumulative effects for the Project and energy development scenarios during construction and operation.

4.17.4.2 Climate and Air Quality

Cumulative Effects Analysis for SunZia

Area of Analysis

The area of analysis for the cumulative air quality effects associated with the Project comprises the counties that are included in the study area: Doña Ana, Lincoln, Socorro, Sierra, Luna, Grant, and Hidalgo counties in New Mexico, and Graham, Greenlee, Cochise, Pima, and Pinal counties in Arizona. In addition, the Project will emit GHGs, which are implicated in the global issue of climate change.

Construction

As described in Section 4.2, transmission line and substation construction could result in air pollutant emissions from fugitive dust, traffic, construction equipment, travel on paved and unpaved roads, helicopters, and the construction and operation of several concrete batch plants. None of the impacts is expected to exceed any federal, state, or local ambient standards, and impacts would be localized and temporary. Appropriate mitigation measures would be used to minimize emissions according to federal, state, and local permits to be issued by the relevant authorities.

Cumulative ambient impacts from the construction phase of the Project and other existing sources of air pollutant emissions have been quantified in Appendix F. Estimated ambient impacts resulting from the proposed Project that are below EPA-designated SILs include impacts from CO and SO_2 for both transmission line and substation construction for all averaging periods. The impacts would be considered temporary in nature, and would not significantly impact air quality, regardless of other sources of air pollutant emissions that may impact the same geographic area.

In cases where estimated Project impacts exceed the SILs, the Project impact was added to a representative background concentration and then compared with ambient standards. Background concentrations represent monitored pollutant concentrations due to all existing pollutant sources. With the exception of PM_{10} within the West Pinal County PM_{10} nonattainment area, projected impacts plus background concentrations are below all ambient standard limitations. Because of high background concentrations of PM_{10} within the West Pinal County PM_{10} nonattainment area, maximum total 24-hour PM_{10} impacts (Project + background) from transmission line and Pinal Central Substation construction were projected to potentially exceed the numerical value of the PM_{10} standards; although an actual exceedance of the standard due to Project activities is unlikely because this is based on a worst-case analysis, as explained in Section 4.2.3.5.

With respect to reasonably foreseeable future actions, estimated Project impacts that are below SILs would be considered insignificant contributors to any future cumulative effects. For projected impacts above SILs, the likelihood of overlap with other development impacts is slight, because the proposed Project impacts would be relatively small, temporary, and localized. Emissions related to transmission line construction would affect different areas as the construction activity progresses, and substation emissions would affect the immediate area of the substation. In addition, transmission line or substation construction emissions—such as dust or emissions from construction equipment that are emitted near ground level—do not produce measurable impacts at regional scales. Project-related traffic would represent a negligible portion of total traffic on public roads.

Because Project construction impacts will be temporary and localized, other reasonably foreseeable projects whose air quality impacts are primarily related to their construction, rather than operation, were not analyzed further. Construction impacts from wind and solar projects, subdivisions, transmission lines, and substations would also be temporary and localized, and would thus be unlikely to overlap in time and space with Project construction impacts.

Two reasonably foreseeable future projects were considered to have the type of ongoing air pollutant emissions that could potentially overlap with Project construction emissions to impact air quality. The proposed Bowie Power Station and Rosemont Copper Project would have ongoing emissions during operation, unlike other types of future activities (listed in Table 4-35) such as subdivisions, transmission lines, oil pipelines, and substations that primarily emit during temporary construction periods. At this time, it is uncertain whether either of these projects were to be operational when SunZia would be constructed.

Bowie Power Station submitted an application to the ADEQ for a combined construction/operating permit in October 2010 for a 525 MW natural gas-fired, combined cycle power plant. The power station would be located approximately 2 miles north of Bowie, Arizona, in Cochise County. Subroute 3B would be located approximately 4 miles north of the proposed power project.

The Rosemont Copper Project is a proposed open pit copper/molybdenum/silver mine, located 30 miles south of Tucson, Arizona, in Pima County. Subroute 4C3 would be located approximately 8 to 10 miles northeast of the mine.

The potential for cumulative impacts of SunZia construction emissions with Bowie Power Station operation emissions was examined. As noted above, impacts modeled for SunZia were below the SILs, temporary in nature, and considered insignificant contributors to any future cumulative effects. Therefore, only NO_2, PM_{10}, and $PM_{2.5}$ were considered because impacts from SunZia construction activities are projected to be below SILs for all other modeled pollutants (see Appendix F). The Bowie Power Station permit application (Bowie Power Station 2010) shows modeled impacts for criteria pollutants that will be emitted from the power station. Maximum projected Bowie impacts were combined with maximum projected impacts from SunZia transmission line construction and from construction of the Willow-500 kV Substation for comparison with ambient standards. When added to a representative background concentration, all combined impacts would be within ambient standard limitations.

An estimate of the cumulative impacts of SunZia transmission line construction and operation of the Rosemont Copper Project is based on the Draft Technical Support Document for Air Quality Permit No 55223, issued by the ADEQ (2012). The addition of worst-case impacts resulting from Project construction of the transmission lines using Subroute 4C3 within Pima County, and to a lesser extent for other alternatives, to maximum predicted impacts from Rosemont could potentially exceed the numerical value of the 24-hour PM_{10} and $PM_{2.5}$ standards, but would show compliance with the 1-hour NO_2 standard.

An actual violation of any of the particulate matter standards due to the additional impact of SunZia transmission line construction when added to operation impacts from the Rosemont Copper Project and other local sources would be unlikely for a number of reasons. Maximum impacts from both projects would occur close to the emission sources and rapidly decrease with distance. In addition, the screening method used to estimate SunZia impacts is highly conservative and represents worst-case 1-hour impacts, even for the 24-hour PM_{10} and $PM_{2.5}$ averaging periods. Longer averaging periods result in lower actual concentrations because of increased wind meander that spreads and dilutes the plume. Furthermore, the 24-hour PM_{10} and $PM_{2.5}$ standards are all based on 3-year averages of sub-maximum concentrations (e.g., 98th

percentile or high, second high impacts, etc.). The screening model used for the SunZia modeling calculates only maximum concentrations and the SunZia transmission line impacts will only occur for a short period of time (days to weeks) in the vicinity of Rosemont.

With respect to GHGs, emissions from construction of the Project will total between 4,300 and 105,000 tons of CO_2e per year, depending on timing and phasing of construction. Maximum emissions would total approximately 289,000 tons of CO_2e over the construction period. In contrast, the United States' energy-related CO_2 emissions totaled 6,215 million tons in 2010 (EIA 2011a); energy related CO_2 constitutes approximately 80 percent of total U.S. man-made GHG emissions (EIA 2011b). The maximum annual GHG emissions from Project construction would represent approximately 0.0017 percent of annual United States energy related emissions, a minor additional contribution to cumulative emissions.

Operation

Emissions and impacts from operation of substations and transmission lines would be qualitatively similar to those from construction, but in much lower quantities. In addition, a negligible amount of SF_6, a GHG, could be emitted from circuit breakers during substation operation.

Under Option B, approximately 198 tons of CO_2e (as SF_6) per year would be emitted from operation of all the substations. The amount of CO_2e would be less for Option A. This represents 0.000003 percent of annual energy-related emissions in the United States, a negligible amount.

Global Climate Change

As discussed in Section 3.2, the climate of the Southwest has undergone profound changes over time. Climate change is a normal part of the aging and evolution of the Earth and of changes in the factors that control climate, such as solar intensity and ocean currents, that occur over multi-year to multi-decadal cycles. In recent years, however, concern has risen that human activities may be influencing climate in ways that have not occurred in the past.

According to the U.S. National Oceanic and Atmospheric Administration's National Climatic Data Center, the "greenhouse effect" is a natural process that helps to regulate the temperature of the planet. It results from heat absorption by certain gases in the atmosphere (GHGs) and the re-radiation downward of some of that heat. Water vapor is the most abundant GHG, followed by CO_2 and other trace gases. Without a natural greenhouse effect, the average temperature of the Earth would be approximately 0 degrees Fahrenheit (-18 degrees Celsius), instead of its present 57 degrees Fahrenheit (14 degrees Celsius). Thus, the concern is not with the greenhouse effect itself, but whether human activities are enhancing the effect through GHG emissions from fossil fuel combustion and deforestation (Easterling and Karl 2011).

Human activity has clearly been increasing the concentration of GHGs in the atmosphere in recent years (primarily CO_2 from the combustion of coal, oil, and gas). Pre-industrial levels of CO_2 were approximately 280 parts per million by volume (ppmv) and current levels are greater than 390 ppmv, increasing at a rate of 1.9 ppm per year since 2000. The global concentration of CO_2 in the atmosphere today far exceeds the natural range over the last 650,000 years of 180 to

300 ppmv. According to the United Nation's Intergovernmental Panel on Climate Change, by the end of the twenty-first century, CO_2 concentrations could be 75 to 350 percent above the pre-industrial concentration (*ibid*).

Global surface temperatures have increased approximately 0.74 degree Celsius (plus or minus 0.18 degree) since the late nineteenth century, and the linear trend for the past 50 years of 0.13 degree Celsius (plus or minus 0.03 degrees) per decade is nearly twice that for the past 100 years. However, the change in surface temperatures is not uniform. Recent warming trends have been greatest over North America and Eurasia between 40°N and 70°N. Indirect indicators of warming, such as borehole temperatures, snow cover, and glacier recession data, are in substantial agreement with the more direct indicators of recent warmth (*ibid*).

Precipitation changes have been spatially variable over the last century. On a regional basis, increases in annual precipitation have occurred in the higher latitudes of the Northern Hemisphere and southern South America and northern Australia. Decreases have occurred in the tropical region of Africa and southern Asia. Northern Hemisphere snow-cover extent has consistently remained below average since 1987 and has decreased by approximately 10 percent since 1966 (*ibid*).

With respect to the consequences for the climate of the Project area, federal and state land managers, scientists, stakeholders, and partners at an August 2010 workshop noted that climate change models for the southwestern deserts predict general warming and drying with increasing precipitation variability year to year, leading to increasing conflicts between competing water uses. Workshop attendees also agreed that increasing environmental stress is expected as a consequence of shifting ecosystem boundaries and species distributions, expansion of non-native species, and other potential effects leading to increasingly unstable biologic communities (Hughson et al. 2011).

Record-setting wildfires are likely due to rising temperatures and related reductions in spring snowpack and soil moisture. Increased frequency and altered timing of flooding will increase risks to people, ecosystems, and infrastructure. Ozone pollution, which in many areas of the Southwest increases as summer temperatures rise and clouds decrease, may also increase as a result of climate change (US Global Change Research Program 2012).

More intense, longer-lasting heat waves will result in increasing demands for air-conditioning, depleting electrical generation and distribution capacity, resulting in increased risks of brownouts and blackouts. In addition, electricity supply will be affected by changes in the timing of river flows and where hydroelectric systems have limited storage capacity and reservoirs, since increased year-to-year variability of precipitation is expected (US Global Change Research Program 2012).

Because GHG emissions from proposed projects contribute to climate change on a global scale, project-specific impacts of GHG missions on the local environment cannot be quantified. As a global pollutant, it is also important to consider GHG emissions with a broad view. While the proposed Project would emit GHGs during construction and a much smaller amount of GHGs during operation, the proposed transmission lines would also allow for the transport of power generated by renewable energy projects to western power markets and load centers. Both

Arizona and New Mexico have RES that require a certain percentage of electricity delivered by regulated utilities to come from renewable sources. The Arizona mandate is 15 percent by 2025, while the New Mexico mandate is 20 percent by 2050. The proposed Project would help to achieve these goals.

With respect to climate change, renewable energy such as wind and solar have limited GHG emissions, as compared with a conventional fossil fuel-fired generating facility. The renewable energy facilities that the Project is designed to serve could potentially replace a portion of the market demand currently served by older, fossil fuel-fired power plants, or displace a portion of future demand that might otherwise be served by facilities with higher GHG emissions.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction

Construction of renewable energy projects would be unlikely to contribute substantially to cumulative impacts with SunZia. As noted above, the major air pollution impacts resulting from the Project would occur during the construction phase of the transmission line and substations, and impacts would be localized and temporary. Similarly, emissions from the construction of other renewable energy projects would also have localized and temporary impacts that are unlikely to overlap in time and space with Project impacts.

Operation

One objective associated with the national goal of facilitating development of renewable energy is to replace a portion of market demand served by existing or new fossil-fueled power plants. The Project's objective, in part, is to achieve the national goal. Table 4-40 and Table 4-41 outline the direct emissions from combustion-related generation and outline the types of displacement of emissions that could occur if renewable energy ultimately replaces combustion related energy. Table 4-40 shows the direct emissions of SO_2, NO_x, mercury, and CO_2 from combustion-related generation (including coal, natural gas, and other fuels) that could be offset or displaced by solar or wind projects (assumed to have negligible emissions) on a "per MWhr" basis. The information presented in Table 4-40 represents composite emissions factors developed for the six-state area (Arizona, California, Colorado, Nevada, New Mexico, and Utah) considered in the Draft Solar PEIS (BLM and DOE 2010). Emissions displaced by a particular solar or wind energy facility could be estimated by multiplying the facility's annual output, in MWhr, by the emissions factors shown in Table 4-40. This would approximate the maximum amount of displaced emissions.

Table 4-41 shows a similar comparison of direct emissions from various types of power generation facilities for a number of pollutants. Assuming that an increase in availability of renewable energy would ultimately displace some combustion-related power generation, the likely result would be lower air pollutant emissions than if no new renewable energy would be available to serve the demands of the market. The estimated emissions, including GHGs that could contribute to climate change, are shown in both of these tables.

Table 4-40. Annual Emissions from Combustion-related Power Generation				
Combustion Emissions[1] (kilogram per year per MWhr)				
Pollutant	**SO_2**	**NO_x**	**Mercury**	**CO_2**
Annual Emissions	0.69	1.0	8.0 x 10-6	716
[1] Composite emission factors for a six-state study area based on individual state composites weighted by the power generated in each state; information derived from EPA's eGRID information system at www.epa.gov/cleanenergy/energyresources/egrd/index.html Source: BLM and DOE 2010				

Table 4-41. Annual Emissions for Various Power Generation Types (ton/MW)1					
Type of Energy Generation	**SO_2**	**NO_x**	**CO_2**	**Particulate Matter**	**CO**
Wind	0	0	0	0	0
Solar	0	0	0	0	0
Geothermal	0.8	0	700.8	0	0
Coal	8.6	21.6	8,843	1.3	1.5
Natural gas combined cycle	0.05	0.7	3,542–5,142	0.03	0.7–3.8
Oil combined cycle	2.4	1.8	6,220	1.4	NA
Nuclear	0	0	0	0	0
Wood-fired	0.5	9.0	11,959	1.7	17
Solid waste-fired	13.6	70.2	13,256	3.0	2.7
[1] Excludes construction-phase, maintenance activity, and incidental emissions Source: BLM 2005					

4.17.4.3 Earth Resources

Cumulative Effects Analysis for SunZia – Geology

Area of Analysis

The geographic scope of analysis is at the level of individual geomorphic features, such as basins and mountain ranges.

Construction

Cumulative effects to projects resulting from geological hazards relate to the siting of projects in areas that are prone to seismic activity, flooding, or fissures. Geological hazards could have cumulative effects on the construction of the Project through direct loss of equipment or injury to personnel because of seismic activity or flooding. Reasonably foreseeable future actions that would likely be affected by geological hazards include transmission lines, oil and gas pipelines, and power generation. As more projects are sited to avoid geological hazards, suitable siting

locations may become increasingly occupied, thereby forcing future projects towards areas of greater geological hazard.

Operation

Geological hazards could have cumulative effects on the operation of the Project, either through direct loss of equipment or injury to personnel, or indirect loss of transmission service, because of seismic activity, subsidence, or flooding. Subsidence in particular may have a cumulative effect on projects. The continual drawdown of groundwater in the Southwest, mostly for domestic and farming purposes, has resulted in subsidence of the ground surface in numerous areas.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction

The development of renewable energy projects within QRAs could result in 10,000 to 40,000 acres of developed land. The greater acreage occupied by renewable energy developments corresponds to a greater chance that one of the associated projects could be directly affected by geological hazards.

Operation

The development of renewable energy projects within QRAs could result in 10,000 to 40,000 acres of developed land. Groundwater supplies for cooling and maintenance of solar facilities could result in increased ground subsidence and cause the opening of fissures, thereby destabilizing the ground surface.

Cumulative Effects Analysis for SunZia – Mineral Resources

Area of Analysis

The geographic scope of analysis for mineral resources is considered for each individual geomorphic feature crossed by the Project (i.e., the Jornada del Muerto, Rio Grande Valley, Chupadera Mountains, Uvas Valley, Lordsburg Mesa, Animas Valley, Peloncillo Mountains, San Simon Valley, Sulphur Springs Valley, San Pedro Valley, Little Rincon Valley, Pantano Wash, and Santa Cruz Valley). Cumulative effects to mineral resources are generally localized and are unlikely to spread beyond a given geomorphic feature where the effects would occur; therefore, projects that do not occur in the same basins or mountain ranges as the proposed Project would not have cumulative effects to mineral resources associated with the Project.

Construction

Past, present, and foreseeable future projects within the Project study area could add to the cumulative effects to mineral resources. Cumulative effects to mineral resources would primarily

be associated with ground disturbance and surface occupation of mineral resource areas (such as copper, gold, or coal) that would remove or restrict access to mineral resources.

Examples of reasonably foreseeable future projects that may have cumulative effects on mineral resources include planned subdivisions and transmission lines. The Willow Springs and Windmill Ranches subdivisions are located in areas that are within close proximity to mining districts and mining leases that, when constructed, could add to the cumulative effects on mineral resources. Reasonably foreseeable future transmission line facilities that could potentially have cumulative effects on mineral resources include: (1) the Pinal Central Substation to Tortolita Substation line, which could cross areas with current mining claims and operations west of the Picacho Mountains; (2) the San Manuel Interconnect, which could cross areas with current mining claims and operations in the San Pedro River Valley; and (3) the Southline Transmission Line Project, which could cross areas with current mining claims and operations south of Lordsburg, New Mexico. Ground disturbance associated with expansions of any past or present projects could have cumulative effects to mineral resources. Active mines such as the zeolite mines near Truth or Consequences and the copper mines in the Tucson area could add to the cumulative effects to mineral resources.

Construction activities would occur in locally short-lived phases; therefore, construction-related interruptions to present mineral resource access and extraction would be minimal and limited in scope.

Operation

Cumulative effects to mineral resources associated with the operation of the Project include any change in land ownership or leasing rights associated with project-related land acquisitions that could prevent the present and future exploration for and mining of mineral resources. However, development of the Project and other reasonably foreseeable future projects could also lead to the discovery of new mineral resources.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction

Cumulative effects associated with construction of potential solar, wind, or geothermal renewable energy developments outside the study area that could tie into the transmission capability of the Project could potentially be positive relative to mineral resources, by increasing access to previously undisturbed areas. This makes it more economical to extract mineral resources from previously difficult to access areas. Reasonably foreseeable future solar renewable energy developments include projects being developed by Gestamp Solar, enXco Development Corporation, New Solar Ventures, Avra Valley Solar, Fotowatio Renewable Ventures, and UA Tech Park Thermal Storage Demonstration Project.

Operation

Cumulative effects would be associated with areas occupied by future renewable energy projects that may exclude present or future mineral resource exploration and extraction. Solar facilities are contiguous facilities that typically occupy their entire project footprint; whereas wind and geothermal facilities are spread out and would not limit mineral-resource extraction outside the footprint of the individual structures. In this way, the construction of separate towers and access roads for wind energy facilities has similar effects to mineral resources as those of transmission lines.

Although most fuels currently used in the operation of fossil-fueled power plants within the cumulative analysis area are supplied by natural gas or coal from distant sources, such fuels could potentially be extracted locally to supply power plants in the future. To the extent that such extraction and delivery of fuels would become economically feasible, cumulative impacts from mineral extraction could occur, subject to land and minerals management regulations and mitigation.

Cumulative Effects Analysis for SunZia – Soil Resources

Area of Analysis

The geographic scope of analysis for soil resources is considered to be the Project study area, within 1 mile of the study centerline. Cumulative effects to soil resources are generally localized and are unlikely to spread beyond a given local area where the effects would occur; therefore, projects that do not occur in the same localized area as the Project would not have cumulative effects to soil resources associated with the Project.

Construction

Cumulative effects to soil resources would result from present and reasonably foreseeable future projects. Ground-disturbing activities could cumulatively impact soil resources by exposing erosion-susceptible soils, thereby increasing erosion rates beyond natural levels. The impact of critical concern, as stated by citizen groups, is soil erosion associated with the creation or improvement of access roads (Cascabel Working Group 2010a). Access road plans that incorporate appropriate construction methods, including following natural landscape contours instead of running perpendicular to contours and erosion-control structures, would mitigate the potential for increasing erosion beyond natural levels.

The development or expansion of residential subdivisions, such as Willow Springs Ranches and Windmill Ranches in New Mexico and Willow Springs in Arizona, would have cumulative effects to soil resources; whereas proper management of present or future agriculture and grazing areas would prevent cumulative effects on soil resources. In addition, development of mining claims could have cumulative effects to soil resources as ground-disturbing activities occur. Reasonably foreseeable transmission line projects that may occur within the soil resource area of analysis include Bowie 345 kV Transmission Line, Pinal Central Substation to Tortolita Substation 500 kV Transmission Line, Southwest Transmission Co-op San Manuel Interconnect

Project, and Southline Transmission Line. Reasonably foreseeable future substation projects that would occur within the soil resource area of analysis include the Pinal Central Substation and Willow 345 kV Substation. Reasonably foreseeable future solar renewable energy developments include projects being developed by New Solar Ventures/Solar Torque, Saguaro Solar Power Plan/Solargenix, UA Tech Park Thermal Storage Demonstration Project, and SOLON/Tucson Electric Power.

Linear facilities, including transmission lines, pipelines, interstate highways, other roads, and railroads, have incremental effects to soil resources relative to their associated areas of ground disturbance (Table 4-42). Estimates for total land disturbance from a linear feature are estimated as 3 acres per mile for existing transmission lines, 3 acres per mile for pipelines 6 inches or greater in diameter, 24 acres per mile for interstate highways, 3 acres per mile for other roads, and 6 acres per mile for railroads. The Project would have a higher amount of ground disturbance (up to 5.8 acres per mile of permanent disturbance) relative to existing transmission facilities. The 460-mile length of the proposed Project would have approximately 2,700 acres of permanent ground disturbance that could result in impacts to soil resources. Colocating the proposed Project with existing linear facilities could reduce the cumulative effects to soil resources.

Table 4-42. Land Area of Disturbance for Linear Facilities

Linear Facilities	Total Distance (miles)	Land Area (acres)[1]	Percentage of Land Area within Study Area[2]
Existing Transmission Lines (115 kV and larger)	2,800	8,400	0.050
Pipelines (6 inches in diameter or bigger)	3,100	9,300	0.056
Interstate Highways	1,200	28,800	0.172
Other Roads	36,200	108,600	0.650
Railroads	1,000	6,000	0.036
Total	**44,300**	**161,100**	**0.964**

[1] These totals were calculated using the following average criteria of land area disturbance: existing transmission lines = 3 acres/mile; pipelines = 3 acres/mile; interstate highways = 24 acres/mile; other roads = 3 acres/mile; railroads = 6 acres/mile
[2] The total study area is 16,700,000 acres

The application of appropriate BMPs and mitigation measures during construction would reduce potential impacts to acceptable levels. Some examples of these mitigation methods include proper access road construction methods that limit water channelization and gully erosion, restoring landscapes to natural contours, and reseeding vegetation.

Operation

Cumulative effects to soil resources related to the operation of present or reasonably foreseeable future projects would most likely be caused by any ground disturbance associated with the expansion or maintenance of facilities. Maintenance activities associated with transmission lines, pipelines, and generating facilities would likely include removal of vegetation and could result in unauthorized use of Project access roads by OHVs, as reported for existing pipeline and

transmission line access roads (Cascabel Working Group 2010a). Incremental impacts from pipelines and modern transmission lines differ in that pipeline access roads hold closely to the pipeline alignment regardless of terrain, and transmission line access roads generally include spur roads that follow contours to structure sites off a main road leading to impacts that are more discontinuous. Removal of surface vegetation and unauthorized use of access roads could potentially lead to increased erosion rates; however, implementation of appropriate mitigation measures would reduce these effects.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction

Ground disturbance associated with the construction of future renewable energy projects would have cumulative effects to soil resources by potentially increasing soil erosion rates, resulting in a loss of the resource. Generally, the degree of cumulative effects would be determined by the amount of ground disturbance associated with a future project. Solar generation facilities have cumulative effects to soil resources over small, concentrated areas; whereas wind generation facilities have cumulative effects over large, more dispersed areas, resulting in greater total ground disturbance and cumulative effects to soil resources. Any reasonably foreseeable future renewable energy projects that occur outside of the Project study area would not have any cumulative effects to soil resources.

Operation

Ground disturbance associated with the operation of reasonably foreseeable future renewable energy projects would have cumulative effects to soil resources by potentially increasing soil erosion rates, resulting in loss of the resource. Generally, cumulative effects associated with the operation of these facilities would be less than facility construction.

4.17.4.4 Paleontological Resources

Cumulative Effects Analysis for SunZia

Area of Analysis

The geographic scope of analysis for paleontological resources is based on the extent of the geological formation. A particular geological formation may not be affected by different projects in the same region. In addition, not all geological formations contain paleontological resources. Formations composed mostly of volcanic rocks typically do not contain fossils, and paleontological resources typically are not found throughout a fossil-bearing geological formation.

Construction

Incremental impacts to paleontological resources would result from past, present, and reasonably foreseeable future projects that may be cumulatively associated with the Project during ground-disturbing activities in fossiliferous geological units. The construction phase of any new project could have the greatest impact to paleontological resources because of these ground-disturbing activities and possible direct loss of a paleontological resource. The construction of projects that encompasses one large contiguous area (e.g., subdivisions) could add to the cumulative effects to geological units at a local or broader level. For example, the proposed Willow Springs Ranches subdivision crosses a geological unit that has high potential for paleontological resources, and could have a greater cumulative effect when combined with the Project. However, the planned Windmill Ranches subdivision crosses an area that has low potential for paleontological resources and, therefore, would have little or no cumulative effects.

Ground disturbance associated with linear projects, such as transmission lines, pipelines, and roadways, could have cumulative effects on a broader scale, because of the greater distance covered and the higher chance of crossing numerous geological formations. For example, the proposed Southline Transmission Project closely parallels the proposed SunZia Project in southern New Mexico; possibly crossing the same geological formations, thus having a greater cumulative effect. In contrast, the proposed Centennial West Clean Line, which is north of the Project, could impact paleontological resources in different geological units, but may not have cumulative effects to some paleontological resources associated with the Project. Expansions to existing airports, or construction of new roads, could have cumulative effects to paleontological resources if ground-disturbing activities occur in geological formations with high PFYCs. The proposed freeway between US 60 and I-10 near Picacho State Park could impact paleontological resources, but only a small portion of this project overlaps SunZia; thus, the cumulative effects associated with SunZia would be small. Using BMPs and mitigation measures, cumulative effects and impacts to paleontological resources can be reduced.

Operation

There are no direct cumulative effects to paleontological resources from existing projects where no ground-disturbing activities are planned. These projects may have indirect cumulative effects from increased access to a possible paleontological resource by the use of access roads. However, SunZia could have incremental impacts to paleontological resources where these present projects are located. For example, the present I-25 and US Route 191 are located in areas having geological formations with high PFYCs; therefore, the SunZia Project could add to the cumulative effects on paleontological resources for these areas. The expansion or continued use of aggregate pits or mines in areas with high PFYCs could have cumulative impacts on paleontological resources. The proposed re-activation of the Copper Flat Mine, west of Caballo Reservoir, could have cumulative effects if expansions are proposed in areas with high PFYCs. The cumulative effects of the Project on paleontological resources associated with the operation of transmission lines and pipelines would be minimal, since impacts from existing projects would only result from repair of access roads and vegetation removal.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction

Reasonably foreseeable future projects that are most closely linked to the SunZia Project and likely to result in impacts to paleontological resources are renewable generation projects, including wind and solar. Currently planned wind generation projects in New Mexico and Arizona could potentially occupy up to 96,000 acres; whereas currently planned solar generation projects in New Mexico and Arizona could potentially occupy up to 42,000 acres (see Table 4-36). Renewable projects outside the geographical area could potentially have impacts to paleontological resources, but not cumulative effects associated with the Project. The construction of new renewable energy projects could have cumulative effects to paleontological resources if built in areas with high PFYCs.

Two hypothetical transmission scenarios, including transmission facilities and EDUs, were created to analyze cumulative effects from reasonably foreseeable future renewable energy projects developed to use the transfer capability of the Project. Under Option A, paleontological resources would potentially be impacted by future solar development in the NM-CT, NM-SW, and NM-SO QRAs and geothermal development in the NM-SW QRA, equaling approximately 4,270 acres of potential impact. Fossiliferous geological units and their contained paleontological resources in the NM-CT, NM-SW, and NM-SO QRAs include the Palomas and Baca formations, Gila Conglomerate, and 111 Ranch Beds. Under Option B, paleontological resources would potentially be impacted by future solar development in the NM-SW and NM-SO QRAs and geothermal development in the NM-SW QRA, equaling approximately 1,750 acres of potential impact. One reasonably foreseeable future solar project in the NM-SW and NM-SO is the New Solar Ventures/Solar Torque project. The AZ-SO QRA is outside the area of analysis for paleontological resources and therefore would not have cumulative effects associated with the Project, unless tie-ins to it were needed. It is possible that construction of the Project would help advance renewable energy projects that would need to tie-in to the SunZia Project, thus adding to the incremental impacts on paleontological resources.

Operations

After construction, renewable energy projects would not have cumulative effects to paleontological resources during routine operations, unless ground disturbance occurred in those areas with high fossil potential. However, the Project could add to the cumulative effects on paleontological resources in areas where existing solar and wind projects are located in areas with high PFYCs (e.g., Deming Solar Energy Center).

4.17.4.5 Water Resources

Cumulative Effects Analysis for SunZia

Cumulative effects to water resources may result from past, present, and reasonably foreseeable future projects that may require increased usage of groundwater or surface waters. These

cumulative effects could also result in the degradation of a water resource by increased sedimentation or additions of a contaminant.

Area of Analysis

The geographic scope of analysis for water resources is considered the local watershed (i.e., Rio Grande, Elephant Butte Reservoir, Mimbres River, Upper and Middle Gila River, San Pedro River, and Santa Cruz River watersheds). These watersheds cover large areas and, therefore, may be affected by numerous past, present, and foreseeable future projects.

Construction

The addition of new subdivisions (e.g., Willow Springs Ranches, Windmill Ranches, and Willow Springs) would increase the usage of water for culinary and irrigation purposes, thus increasing the drawdown of groundwater. The past, present, and future use of water for agricultural purposes will add to the cumulative effects in a watershed. For example, approximately 3,284 acres along the Lower San Pedro River were identified as being cleared for farming (Smith et al. 2006). Construction-related activities usually use water for dust control, which would incrementally increase with the size and duration of a project. This would have a temporary small increase in the usage of water for a given area. In addition, expansion of existing transportation features, such as airports, airfields, interstates, and highways, could have cumulative effects to water resources. The construction of new transmission lines, such as the Bowie 345 kV line and the Southline transmission line, is within close proximity to the proposed Project, possibly impacting the same water resources; therefore adding to the cumulative effects. Transmission line access roads typically cross, or are close to, perennial and intermittent streams. The construction of new access roads in the past has increased the erosion and sedimentation of an area that has impacted a water resource (Cascabel Working Group 2010). Construction of new pipelines could have cumulative effects to water resources in those areas with perennial and intermittent streams, water bodies, or wetlands. All construction activities within one watershed could result in incremental additions of contaminants to a water resource. However, the use of BMPs and mitigation measures would limit most cumulative effects and therefore not degrade conservation efforts, such as those at Three-Links Farm (*ibid*).

Operation

The operation of past, present, and future projects can have different cumulative effects than construction activities. Existing land used for agriculture will continue to use water; therefore, any use of water for the Project could have cumulative effects to water resources associated with farmlands. Existing pipelines and transmission lines have little impact on water resources once completed. Periodic vegetation removal or repair to access roads could have indirect effects because of soil erosion, increasing the sedimentation to a water resource. Operation of large power plants that use fossil fuels require a substantial amount of water for cooling and steam production for generating electricity. Natural gas-fueled plants within the study area include the Luna and Afton plants in New Mexico, the Saguaro Generating Station, and the future Bowie Power Station in Arizona. The Apache and Irvington coal-fired plants are also located in southern Arizona. A water-cooled, natural gas-fueled 500 MW generating plant would typically

use approximately 2,500 acre-feet per year, and a coal-fired plant may use greater quantities. The effluent discharge from water-cooled plants, or those producing steam for turbines, could produce incremental increases in contaminants to water resources. Some mining operations, such as those for extracting copper, use a large amount of water for leachate ponds. The reactivation of the Copper Flat Mine, west of Caballo Reservoir in Sierra County, could have cumulative impacts to water resources because of water usage and incremental increases in contaminants to water resources. The Copper Flat Mine lies within a watershed that is also crossed by the one of the SunZia alternative routes.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction

Reasonably foreseeable future projects that are most closely linked to the proposed Project and likely to result in cumulative effects to water resources are renewable generation projects. The construction of new wind power facilities could have cumulative effects if built in areas with water resources, such as perennial and intermittent streams. The construction of new solar and wind facilities, as well as their associated access roads and tie-ins to existing transmission lines could affect surface and groundwater flow systems, leading to increased erosion and sedimentation. There would also be an incremental increase of water usage during construction of wind-power and solar-power facilities. Ground-disturbing activities within QRAs could result in increased sedimentation into surface waters. There is only one QRA (north of Carrizozo, New Mexico) for wind facilities overlapping the Project that could have potential cumulative effects to water resources. There are four QRAs for solar facilities overlapping the Project that may have potential cumulative effects to water resources (NM-EA, NM-CT, NM-SO, and NM-SW), and another that may have a tie in to SunZia (AZ-SO). There are currently four reasonably foreseeable future solar projects in New Mexico totaling 7,076 acres, and three reasonably foreseeable future solar projects in Arizona totaling 805 acres that could have cumulative effects associated with SunZia.

Operation

Wind projects would have little impact to water resources after being built. Solar projects would require varying amounts of water, depending upon the type of generation technology. While PV or dish engine solar facilities require a relatively small amount of water to clean the panels, solar thermal installations using conventional wet-cooling require a large amount of water. According to the Draft Solar PEIS (BLM and DOE 2010), thermal solar facilities using wet-cooling technology may use up to 5.6 to 18.4 acre-feet/year/MW that would be withdrawn from either groundwater or municipal supplies for generation plants, where treated wastewater or other sources are not available. Therefore, development of solar thermal generation facilities may increase the local drawdown of groundwater. In some locations that have experienced historic aquifer declines from irrigation, added groundwater drawdown could increase the potential for land subsidence and earth fissures. This could have an indirect effect of increasing erosion and sedimentation. Typically, the parabolic-trough technology requires the least amount of acreage per megawatt (*ibid*). However, overall acreage for a solar facility can vary between right-of-way applications, depending upon various factors, including increased acreage due to avoidance of a

sensitive resource. Solar facilities using wet-cooling technology could produce wastewater that may be treated onsite in evaporation ponds or leach-fields. This wastewater, if discharged to surface waters after treatment, could increase the flow of ephemeral or intermittent streams, which could also increase erosion and sedimentation. The Project could add to the incremental impacts to water resources associated with present solar projects that are within the same watersheds, such as New Solar Ventures/Solar Torque in Luna County, New Mexico.

4.17.4.6 Biological Resources

This section discusses effects of the Project on biological resources, when viewed in the context of ongoing activities and future development in the region. In addition, the effects of future regional renewable energy development scenarios in the context of the proposed Project are considered.

Cumulative Effects Analysis for SunZia

Area of Analysis

The cumulative effects analysis area for biological resources could include the overall range of any population of wildlife that may be affected by the Project. For some migratory bird species, this could include much of North and South America. By necessity, the discussion in this section focuses on cumulative effects occurring within the Southwest, including effects on dispersal between populations. The limitations of available information, particularly regarding future actions, prevent this discussion from providing detail relating to all individual activities or affected species in the region. However, the Project may contribute to effects caused by past, present, and reasonably foreseeable future activities occurring in the following areas:

- The study corridor, extending 4 miles on each side of the centerline, used in the analysis of the affected environment for biological resources
- The Rio Grande bird migration corridor, a part of the Central Flyway
- The middle and lower San Pedro River Valley bird migration corridor
- Other major habitat blocks, flight paths, or bird concentration areas that would be crossed by the Project
  - Chupadera Mesa
  - Uvas Valley – lower Rio Grande
  - Willcox Playa – northern Sulphur Springs Valley

- Major watersheds, stream systems, or their tributaries if crossed by the Project
  - Middle Rio Grande
  - Middle and lower San Pedro River
  - Aravaipa Creek
  - Cienega Creek

- Contiguous habitat blocks that may be affected by the Project, such as mountain ranges or intermontane valleys

The majority of identified past, present, or reasonably foreseeable actions could be considered to share cumulative effects with any of the alternative subroutes, including the BLM preferred alternative.

Construction

Construction of the proposed Project would have several types of effects on biological resources in common with other current and future developments in the region. Ground disturbance and the resulting habitat loss is an effect common to all new development, and in most cases, results in additive cumulative effects to biological resources. Related direct effects restricted to the vicinity of construction areas include associated noise and disturbance of local wildlife. The proposed Project would contribute to ongoing loss of natural habitat in the cumulative effects analysis area where ground disturbance is required, although this is mitigated where possible by siting the proposed Project near existing areas of disturbance. Any future development may contribute to habitat loss, although most reasonably foreseeable actions within the cumulative effects analysis area are likely to be near previously disturbed areas. In general, most types of development avoid high-sensitivity habitats such as montane canyons and riparian woodlands.

Some indirect effects of construction can result in off-site effects that are greater than the additive effects of habitat loss within a construction area. Initially, invasion of noxious weeds and other non-native plants tend to concentrate around areas of recently disturbed ground, expanding outward into undisturbed habitat under favorable conditions. Each additional ground-disturbing activity provides a new potential foothold for invasive plants, and could allow effects to extend rapidly beyond the initial area of disturbance. Erosion, particularly where construction occurs in steep terrain or near surface water, may result in silt being carried downstream, potentially altering stream substrate and aquatic habitat. Although these effects may occur with current and future development in the cumulative effects analysis area, standard and selective mitigation measures for the proposed Project would minimize any contribution to these cumulative effects to the extent feasible.

Operation

The effects of operation of the proposed Project include those related to the presence of access roads and associated maintenance activities, and the presence of transmission structures and lines in the environment. In general, locating multiple linear utilities in the same area minimizes cumulative effects on biological resources. Total ground disturbance is reduced because access roads may serve multiple projects, and other effects to biological resources such as maintenance activities, recreational or other use of access roads, and risk of invasive plant spread would affect a smaller portion of the landscape than if utilities were widely separated. However, utility corridors may create edge effects or act as dispersal barriers, and so colocating utilities is not universally beneficial in these cases.

Cumulative effects are expected to vary with the species being considered. Wildlife sensitive to crossing open ground—including roads and areas subject to vegetation management such as rights-of-way for linear utilities—may cross small, open spaces, but avoid those above a certain width. For these species (often small mammals or forest birds), multiple utilities adjacent to one

another may create a substantial barrier to dispersal. Within the arid Southwest, most other species are adapted to relatively low vegetation cover with scattered open spaces, and "soft" barriers such as fences or utility access roads with low traffic may not prevent or substantially reduce dispersal (McGregor et al. 2003). Other "hard" barriers such as major highways, canals, railways, and similar features may nearly eliminate dispersal of some terrestrial animals (Garland and Bradley 1984; Riley et al. 2006) and even birds (Jacobson 2005). The net effect of all types of fragmentation can isolate populations in small patches, reducing genetic exchange with adjacent populations. Inbreeding depression or local extirpation can result, if a completely isolated patch does not support a population of sufficient size.

Some grassland species, including the ESA candidate Sprague's Pipit, tend to avoid areas near tall structures. Others, such as some small mammals and the Desert Tortoise, may not respond to the structures directly, but may suffer increased predation from raptors and ravens using the structures as nest sites or for foraging perches. Desert Tortoises are also highly susceptible to road mortality and harassment or illegal collection by humans. For these species, siting the Project near adjacent utility corridors with existing access would not result in a significant cumulative impact, as the effects described would already be ongoing. However, widely spaced transmission lines in habitat for these species can have a substantial cumulative impact, with effects extending well beyond the individual rights-of-way.

Each of the effects previously described may increase locally in intensity when multiple projects are sited adjacent to one another. Individual animals may be at greater risk of disturbance or mortality from concentrated activities. However, the benefits of reducing total ground disturbance when multiple linear utilities are colocated may outweigh the negative effects of locally increased intensity of disturbance in many cases.

Bird collision with transmission lines and other tall, man-made structures is a recognized problem, but the effect at the population or species level can be difficult to estimate (Manville 2009). Extrapolating local studies near mortality sources to observations of population-wide declines is problematic, given site-specific habitat differences, unusual weather events that cause mass mortality, biased mortality estimates in individual studies, or other factors. The estimated cumulative impact of all unintentional human-caused mortality sources is approximately one billion bird deaths annually, which is approximately 5 to 10 percent of the total land-bird population in North America (Erickson et al. 2005). Although some factors are ranked differently by various studies, collision with buildings is the greatest man-made cause of unintentional bird mortality, followed by transmission lines, domestic and feral cats, and perhaps pesticides. Transmission line collisions, estimated to cause 130 to 174 million (or 13 to 17 percent) of the annual human-caused bird deaths, represent between 0.6 and 1.7 percent of all land-birds in North America (Lilley and Firestone 2008).

For legally harvested species, hunting can be the largest human contribution to mortality, and perhaps the largest cause of mortality of any source for waterfowl. Annual harvest may total approximately 4 to 10 percent of the population for species with low reproductive rates such as the Sandhill Crane (Kruse et al. 2010), or more than 30 percent for some species of ducks and geese that produce large clutches annually. In 2009, approximately 13.1 million ducks were harvested from a population of approximately 40.9 million (Raftovich et al. 2010; USFWS 2010d). Within the Central Flyway, which includes the Rio Grande Valley, approximately 3.1

million waterfowl were harvested from a population estimated at 7.7 million in the winter of 2009-2010 (Kruse 2010).

Collision is primarily a population-level threat to species already at risk from other factors, or to long-lived species with low reproductive rates (Drewitt and Langston 2008). In the context of the threats discussed above, the Project would not be expected to present a collision risk significant at the population level to any species in the region. While the proposed Project would be a small contribution to the overall collision hazard for birds in the Southwest, the cumulative effect of all transmission lines may be substantial, particularly to migratory birds. These effects can often be mitigated with bird diverters or similar devices—an option particularly useful in important migratory bird corridors such as riparian areas. Colocated transmission lines may also have lower collision rates than isolated transmission lines, as the overall visibility of multiple lines in proximity aids visual detection and avoidance of the lines by birds.

The following examples represent known locations where the Project would be located adjacent to existing or planned transmission lines, in areas with the potential for an increased risk of bird collision. No portion of the Project would be located adjacent to existing transmission lines when crossing the Rio Grande. Two 345 kV lines are adjacent to the proposed location of Link C110 in the Sulphur Springs Valley, which is an important winter foraging area for Sandhill Cranes and raptors. Link C660 crosses the San Pedro River adjacent to the planned San Manuel Interconnect. Existing transmission lines are present along the Santa Cruz River near Sweetwater Wetlands, and the Pinal Central-Tortolita line would be located near the CAP and Picacho Reservoir. Each of these transmission lines would increase the risk of bird collision when sited individually, but as described above, colocation of multiple transmission lines can reduce the cumulative collision risk through increased visibility of the transmission corridor.

The effects of grazing, both past and present, can be cumulative with the effects of transmission line construction and operations. Much of the Project area is composed of grasslands, and grazing occurs on most federal and state lands. Historically, the amount of grasslands in the Southwest was greater than it is today. For example, 16 percent of the upper San Pedro River Valley grasslands were converted to mesquite woodland in just 20 years, from 1970 to 1990 (Kepner et al. 2000). Grazing and fire suppression can both favor shrubs at the expense of grasses under some conditions, and have contributed to the historic decline of the semi-desert grassland vegetation type. Transmission line construction, associated access roads, and ancillary facilities can remove large areas of potential grazing lands. Solar and wind facilities (see below) require even more land and greatly contribute to these ongoing cumulative impacts. Grazing wildlife such as the Pronghorn may be negatively impacted by the cumulative impact of barbed-wire fencing, cattle grazing and by transmission line construction, which can cause temporary disturbance and alter or reduce habitat.

Erosion resulting from road construction can be a substantial cumulative impact. The floodplains of many major rivers contain a variety of existing agricultural and residential activities, and surrounding uplands often contain extensive networks of formal and informal roads. Transmission line access roads and work areas create additional ground disturbance, adding to existing conditions that can result in unnaturally high levels of erosion. Access roads for transmission line maintenance can be washed out by capturing stormwater flow resulting from summer monsoons or winter rainstorms. Sediment can then enter washes, and eventually

perennial streams such as the San Pedro River, reducing water quality and degrading aquatic habitat for fish, reptiles, and amphibians. Soil erosion in uplands results in lower moisture-holding capacity and loss of nutrient-rich topsoil from the watershed. In addition to their direct contribution to erosion, access roads associated with transmission lines may open up previously roadless areas to future development and recreational users and the creation of additional roads (Cascabel Working Group 2010a).

The following examples represent some of the cumulative effects that may be shared between the proposed Project and wind generation facilities identified in the cumulative effects analysis area. The Macho Springs Wind Project, located northeast of Deming, New Mexico, may impact grassland species, such as the Aplomado Falcon and the Sprague's Pipit. All wind energy facilities would impact vegetation and wildlife.

The following examples represent some of the cumulative effects that may be shared between the proposed Project and solar generation facilities identified in the cumulative effects analysis area. The Deming Solar Energy Center is located in farmland and a low-density residential area, and would have minimal biological impacts. The New Solar Ventures-Solar Torque facility, also near Deming, New Mexico, may impact grassland species such as the Aplomado Falcon. The UA Tech Park Thermal Storage facility and SOLON-Tucson Electric Power facility are located in urban Tucson and would have minimal biological impacts, although there is a small amount of suitable Pima pineapple cactus habitat at the UA project site. The Avra Valley Solar Project and the Fotowatio Renewable Ventures facility are located outside of the urban area in undeveloped desertscrub habitat, where habitat for the Tucson Shovel-nosed Snake may be impacted. All solar facilities would impact vegetation and wildlife.

The SunZia Project may also share cumulative impacts with several existing natural gas and coal-fired power plants in the cumulative effects analysis area. The Luna Energy Facility, near Deming, New Mexico, is located in grassland habitat in an area containing agriculture and development. The area is now low-quality habitat for the Aplomado Falcon, but the power plant may have contributed to habitat degradation. The Lordsburg Generating Station is located in desertscrub that is marginal habitat for the Aplomado Falcon. The Apache Energy Facility is located adjacent to Willcox Playa; along with the SunZia Project, the Apache Energy Facility is likely to impact the population of Sandhill Cranes that fly daily between Willcox Playa and farmland farther north of the Sulphur Springs Valley. The Saguaro Generating Station, located in desertscrub near Red Rock, Arizona, may impact the Tucson Shovel-nosed Snake, the Lesser Long-nosed Bat, and the Cactus Ferruginous Pygmy Owl; these impacts would be cumulative with the proposed Project. All of these power plants would impact vegetation and wildlife other than special-status species.

The Rosemont Copper Mine, located south of Tucson, would have cumulative impacts shared with the proposed Project. The mine, with its associated transmission line and water pipeline, would directly affect the Lesser Long-nosed Bat, Chiricahua Leopard Frog, and the Pima pineapple cactus, and would affect the hydrology of Cienega Creek. This could result in effects to the Mexican Gartersnake, Gila Chub, Gila Topminnow, Huachuca water-umbel, and the high diversity of other wildlife dependent on the Cienega Creek system. In addition, the Santa Rita-Rincon wildlife linkage would be subject to the cumulative effects of the mine and the Project.

In the northwest portion of the Project area, the Pinal Central-Tortolita Transmission Line and the SunZia Transmission Line have the potential to cumulatively affect the Tucson Shovel-nosed Snake and the Sonoran Desert Tortoise, as well as the Southwestern Willow Flycatcher and Yuma Clapper Rail in wet years when water is present in Picacho Reservoir. In the San Pedro River Valley, the San Manuel Interconnect would cross Southwestern Willow Flycatcher critical habitat and may have the potential to cumulatively affect the Sonoran Desert Tortoise and incrementally increase the risk of bird-power line collisions. The Southline Transmission Line Project would cross the Sulphur Springs Valley, increasing the overall risk of collision for wintering Sandhill Cranes and other birds.

Urban expansion may encroach on conservation areas, such as where the City of Tucson borders Saguaro National Park. The Project would contribute to the cumulative loss of undeveloped land surrounding such areas. Several proposed housing developments may have cumulative impacts shared with the proposed Project. In Socorro County, New Mexico, the Willow Springs Ranches residential subdivision is located south of the transmission line, but would not affect the nearby Socorro Springsnail. The Windmill Ranches residential subdivision, south of the SunZia East Substation, likewise would not affect any listed species. In Arizona, the Willow Springs residential subdivision is located in Sonoran desertscrub habitat that may be suitable habitat for the Sonoran Desert Tortoise, the Cactus Ferruginous Pygmy-owl, and may provide foraging habitat for the Lesser Long-nosed Bat, although no known bat roosts would be directly affected by either project. These subdivisions would each have cumulative impacts with the Project on vegetation and wildlife.

Cumulative Effects Analysis, Including Energy Development Scenarios

The proposed Project would begin at the SunZia East Substation, located nearly at the divide between the Tularosa Basin and the Pecos River watershed, a point that marks a transition from vegetation communities associated with the Desert Southwest to those associated with the western Great Plains. As a result, species and vegetation communities affected by wind energy development in central or eastern New Mexico would often be different from those affected by the proposed Project. However, biological resources in desert valleys of western New Mexico and Arizona would be affected by both development of the proposed Project and future solar energy facilities. Impacts to species listed under the ESA could be cumulatively significant; however, future energy development projects would be subject to environmental review on a case-by-case basis, and each project on public land as well as projects funded or permitted by federal agencies would be required to minimize any effects to listed species through consultation under Section 7 of the ESA (BLM 2005). Private and other nonfederal actions are similarly required to minimize effects on listed species through the development of Habitat Conservation Plans (HCP) and other mitigation methods.

Wind Energy

Development and operation of wind energy facilities have several types of impacts in common with construction and operation of the proposed Project. Ground disturbance, maintenance activities, gen-tie transmission lines, the risk of invasive plant colonization, and construction activities are impacts associated with wind energy that are similar to the development of major

transmission lines (BLM 2005). Wind turbines and major transmission lines both create collision hazards for birds. However, the risk posed by transmission lines is relatively dispersed, except where a line would cross major migration corridors. Siting wind energy facilities away from major migration corridors reduces the collision risk to migratory birds, but may still affect resident birds.

Different species groups are also at risk with the two types of development (Erickson et al. 2005). Transmission lines appear to create the highest risk to large wading birds and waterfowl, and secondarily to migratory passerines; while wind turbines, usually sited in open uplands, primarily create the highest risk to passerines and raptors. Improvements in siting and turbine technology have continued to reduce collision risk for birds when compared with older wind energy facilities (Krijgsveld et al. 2009).

Bats can be killed by very low air pressure formed near the tips of moving wind turbine vanes, although wind energy facilities are generally sited in open habitat lacking bat roosts. In addition, both bats and their insect prey avoid windy conditions. The majority of bat mortality at wind facilities is restricted to a handful of migratory bat species (Arnett et al. 2008). Modifying turbine cut-in speeds to avoid operation at low to moderate wind speeds during sensitive seasons can reduce the mortality risk to foraging and migrating bats.

The USFWS has developed draft guidelines to reduce the impact of wind energy development on wildlife, and to assist developers in compliance with the MBTA, BGEPA, and ESA (USFWS 2011a). In part, the USFWS recommends a 3-tiered preconstruction site analysis to eliminate high-risk sites, develop site-specific mitigation, and establish baseline information to allow an assessment of the effects of a project through postconstruction monitoring. Postconstruction monitoring would indicate whether siting, design, and mitigation measures are adequate to eliminate significant effects on wildlife, or whether further mitigation and modification is recommended. Development of an Avian and Bat Protection Plan provides a framework for conducting and reporting these studies. The USFWS also developed draft guidelines to assist in the development of Eagle Conservation Plans for wind energy facilities (USFWS 2010e).

With the exception of bird collisions and bat mortality, the operation of wind energy facilities creates ongoing impacts to wildlife similar to those associated with transmission lines. The habitat between wind turbines is interspersed with access roads, and vegetation management is required around structure bases. However, the greater portion of the ground area remains undisturbed and is suitable for many terrestrial wildlife species. Some species that avoid vertical structures or are threatened by raptor predation, such as certain grassland bird species and prairie dogs, may avoid the vicinity of transmission lines or wind turbines. Nesting bird density can be lower near wind turbines (Pearce-Higgins et al. 2009), and large mammals or those that are sensitive to human presence would avoid the general area of a wind energy facility.

In 2011, the USFWS initiated the process of developing an EIS for a regional HCP in the Midwest, to address mitigation and permitting relating to "take" of ESA-listed and candidate species (USFWS 2011b). The area to be covered in the EIS and HCP was defined around the migration corridor for endangered Whooping Cranes (*Grus americana*) and the range of the candidate Lesser Prairie-chicken (*Tympanuchus pallidicinctus*). The range of the Lesser Prairie-chicken extends into the eastern portion of the wind energy QRA and the cumulative effects

analysis area for the energy development scenario. Lesser Prairie-chickens are a species that responds negatively to wind turbines, transmission lines, and other tall structures. The HCP, if issued, would prescribe mitigation to reduce collision risk and reduce the impacts to sensitive grassland birds.

Solar Energy

Impacts associated with solar development are much more intensive than those associated with wind energy or transmission lines. Solar fields are generally large and contiguous, from tens to hundreds of acres, and often require complete vegetation removal and elimination of all wildlife habitats within a project footprint (BLM and DOE 2010). Engineering constraints require placement of solar fields in large, level areas. Although sensitive montane and riparian habitats are not generally impacted by solar development, a number of species associated with level valley bottoms in the Sonoran Desert are threatened by ongoing urban and agricultural development of those areas. Solar energy development, when not located on previously disturbed land, contributes to the decline of those species.

Conclusion

Development of the proposed Project, in conjunction with other present and future projects, would contribute to the ongoing fragmentation and loss of natural habitats in the Southwest. All Project subroute alternatives, including the BLM preferred alternative, would have similar cumulative impacts. As discussed above, cumulative impacts would be reduced in most cases when linear utilities, including the proposed Project, are colocated. All transmission lines add to the bird collision risk created by existing transmission lines, communications towers, and other structures. Other types of future developments, particularly urban expansion and large-scale solar or wind energy development, are expected to result in the greatest loss of habitat in the region.

4.17.4.7 Wildland Fire Ecology and Management

Cumulative Effects of Increased Fire Risk

The human contribution to the occurrence of fires can be substantial, and can often result in fires occurring outside the natural fire season. Between 1980 and 2003, lightning ignited 1,548 fires and humans caused 1,157 fires on BLM-administered lands in New Mexico (BLM 2004a); and between 1983 and 2002, lightning ignited 426 fires and humans caused 372 fires on BLM-administered lands in Arizona (BLM 2004b). Fires caused by transmission lines are typically a very small percentage of human-caused fires, particularly in grasslands, desertscrub, and similar vegetation communities where plants rarely or never reach conductor height. However, the proposed Project would contribute minor, additive increases in the fire risk during construction and operation, and indirectly through the potential for vegetation change and by increasing access for recreational users. The potential contribution of any single factor to future fire risk cannot be assessed, but ongoing and future actions will continue to create an environment where multiple human-caused fires are expected to occur annually within the study area.

Cumulative Effects on Fire Management Planning

The BLM's four categories of desired fire management are based on the response of an ecosystem to fire and the presence of constraints to the use of fire for management. A single transmission line may not preclude the use of fire, depending on site-specific conditions. However, multiple transmission lines can create large corridors where suppression cannot occur due to the hazard to firefighters, unless the lines are de-energized. This may raise the risk that a controlled fire in that area would expand beyond desired boundaries, or increase beyond the desired intensity. Other types of developments may not create hazards for fire crews, but would further constrain planned fire use. The proposed Project, when considered with past, present, and reasonably foreseeable future actions, would contribute to the trend of an expanding WUI and the creation of a complex landscape where fire use by land managers is becoming increasingly difficult.

Cumulative Effects on Fire Suppression

The proposed Project would result in the addition of major infrastructure to wildlands and existing WUI. Firefighting resources must be allocated to containment of a fire as well as to the protection of life and property. The addition of a double-circuit transmission line would add further infrastructure that may receive fire protection, and would add further complexity to the challenges of fighting a fire in a WUI.

Construction of the proposed Project would result in a cumulative effect by adding hazards to fire suppression primarily where other transmission lines are parallel or nearby. Gas pipelines may require that heavy vehicle use be limited or avoided within the pipeline right-of-way, and valve or meter stations may contain flowing or residual gas in aboveground pipes. However, pipelines do not create linear hazards similar to those associated with transmission lines, such as the flashover risk or flight hazard.

Cumulative Effects Analysis, Including Energy Development Scenarios

Solar and wind energy developments typically share several types of effects relating to fire ecology and management. The risk of a fire igniting as a result of construction activities can exist anywhere internal-combustion engines, blasting, smoking, or metalwork occurs in proximity to flammable vegetation. Disturbed ground enhances the establishment of non-native plants, often those that alter the fire regime. All energy facilities would require additional transmission lines and possibly substations for interconnection with the power grid, with potential effects very similar to those discussed for the proposed Project.

Wind and solar energy facilities can differ in the degree of effects on fire ecology and management during operation. Wind facilities typically leave the majority of vegetation within a site intact, although broken by access roads to each tower. This vegetation could potentially carry a fire through the facility. Mechanical failure of a wind turbine, such as could occur in high winds, can result in a fire ignition as potentially flammable vegetation often surrounds each turbine. Solar facilities are often, but not always, maintained nearly devoid of vegetation. Solar facilities and many wind facilities are typically located on nearly level ground, frequently in vegetation communities with light, fine fuels. However, some wind facilities may be located on

ridgelines, or at higher elevations than is feasible for solar development, and fires of greater intensity may occur in these vegetation communities.

Wildland fire suppression would not typically be needed within a solar facility and would not be affected outside the facility, except near associated transmission lines. Ground suppression within a wind facility can take place with few constraints, as collector lines from each turbine to the facility's substation are typically buried. Aerial suppression may be impeded by the presence of the turbines.

4.17.4.8 Cultural Resources

Cumulative Effects Analysis for SunZia

Impacts to cultural resources consist of the loss of cultural artifacts, features, or sites that could yield important information about the past. Direct effects could occur through the removal of sites, damage to sites, or adding modern facilities to cultural landscapes or historic settings. Indirect effects could occur by providing access to otherwise remote or inaccessible areas, potentially increasing the likelihood of unintentional damage to sites by off-highway vehicles or vandalism. Because cultural resources are limited, finite, and nonrenewable, cumulative effects could occur through the incremental loss of culture-specific artifacts, loss of prehistoric or historic settings, or the incremental addition of information about specific cultural areas.

Mitigation of effects to cultural resources, such as through site avoidance or data recovery, can protect sites from further disturbance or provide opportunities to add important information about history or prehistory. In the Tucson Basin, data recovery projects provided information on cultural resources for which little was previously known (Ciolek-Torrello et al. 1998; Doelle 1984; Doelle and Fish 1988; Gregory et al. 2001; Thiel and Mabry 2006; Whittlesey et al. 1994b). It is reasonable to expect that similar efforts in support of the proposed Project could identify similar information important to our understanding of the past. The identification of new resources and any mitigation of these lesser known culture areas could cumulatively contribute toward the preservation and understanding of their cultural histories.

Cumulative effects for cultural resources would occur over the life of the Project. Past, present, and reasonably foreseeable future actions that were considered for this analysis are described in Table 4-35. Reasonably foreseeable future actions are applicable to all subroutes within each route group. Impacts to reasonably foreseeable future actions outside of the study area are addressed in the energy development scenarios section.

Area of Analysis

The area of analysis for cultural resources is defined as cultural group boundaries derived from archaeological investigations. Given the large scale of the cultural groups (i.e., Ancestral Pueblo includes parts of Arizona, Colorado, and New Mexico), the geographic extent of the area of analysis is the Project study area. The boundaries of the culture groups that inhabited the study area are as follows:

- The Hohokam (Desert and Riverine branches) – west end of the Project study area to the proposed Willow-500 kV Substation
- The Mogollon (San Simon, Mimbres, and Jornada branches) – proposed Willow-500 kV Substation to Truth or Consequences
- The Piro/Tompiro (Mogollon and Ancestral Pueblo) – Truth or Consequences north to the east end of the Project study area

A number of protohistoric and historic groups have occupied the Project study area, such as the Apache, O'odham, Spanish, and the Puebloan groups; many of which are descendants of Ancestral Pueblo and Mogollon cultural traditions. Culture areas are somewhat dynamic and vary chronologically as more information about an area is obtained; however, each culture area occupies a general region. For example, the Hohokam area is located principally around the Phoenix and Tucson areas, but their influence has been found as far away as Safford. The Mogollon area is located in southeastern Arizona and western New Mexico. The Ancestral Pueblo area is located in the Four Corners area; although toward the later part of their occupation, there is evidence for migration along the Rio Grande and into the Safford Area as well as along the San Pedro River. The Apache and other proto-historic tribal groups occupied areas away from historic rural communities, often within the nearby mountainous areas of southeastern Arizona and western New Mexico.

Previously Recorded Cultural Resources within the Project Corridor

The existing environmental conditions, including identification of past and present cultural groups and land uses, are described in Section 3.8. Direct and indirect effects of the Project alternatives are identified and discussed in Section 4.8. Evaluating cumulative effects of the Project involves a review of the known existing cultural resources within the Project corridor, an understanding of the previous development in the cumulative area of analysis, and assessments of reasonably foreseeable future actions.

Although an intensive pedestrian survey has not been completed, the records review has identified 699 known cultural resources within a 0.5-mile-wide corridor for all of the Project alternatives. These include a wide variety of historic districts, prehistoric habitation areas, historic trails, and artifact scatters.

A review of the Class I records indicates that there are 983 cultural resource surveys that were wholly or partially completed within the 0.5-mile-wide cultural study corridor. While some of these surveys were conducted for research purposes, the majority of the surveys were conducted at the request of other Project proponents to fulfill required environmental compliance. Some examples of the past projects similar to the SunZia Project and that are contained, wholly or partially, within the SunZia Class I study corridors include:

- Southern Pacific Pipeline: Hassayampa River to Yuma
- Tucson Gas and Electric 138 kV Transmission Line
- Western Area Power Administration Oracle-Tucson 115 kV Transmission Line
- Cholla-Saguaro Transmission Line Corridor
- AEPCO Project

- CAP – Tucson Aqueduct and Salt-Gila Aqueduct
- All American Pipeline
- Santa Fe Pacific Pipeline: Rillito Loop
- Link 3 of the AT&T NexGen/Core Project
- MCI Fiber Optic Cable Project: Rialto, California, to El Paso, Texas
- Petty-Ray Geophysical Seismic Testing Line
- Pyramid Generating Station and associated transmission lines
- Improvements and maintenance on SR 90 and I-10

Construction

Cumulative effects from impacts associated with the construction phase of the Project would be similar for all alternatives. Cultural resources could be destroyed by construction activities such as cleaning, grading, drilling, substation development, and access road construction. However, the location of projects may impact cultural resources, as the likelihood of encountering such resources increases near existing communities, along transportation corridors, or near sacred areas.

Incremental impacts to cultural resources result from past, present, and reasonably foreseeable future projects. Ground disturbance associated with linear facilities such as transportation corridors (e.g., I-10, UPRR, etc.) has had major incremental cumulative effects because many such corridors follow trails that were historically used. For example, portions of the El Camino Real NHT that parallels I-25 and the historic alignment of the Butterfield/Gila Trail that parallels a portion of US Route 191 may have been partially or wholly destroyed because of the development of transportation corridors. The BLM preferred alternative extends across segments of several historic trails of various levels of significance. Although the proposed transmission line would not physically impact the existing trails, the Project would extend across the trail perpendicularly, segmenting it into smaller components and causing potential visual impacts. While the Project would have a small incremental effect on historic trails as a whole, the cumulative effect of linear projects either crossing or paralleling historic trails would result in incremental degradation to the historic feeling and setting of these trails. Reasonably foreseeable future projects such as the Southline Transmission Line Project also extend across historic trails, potentially adding incremental impacts on cultural resources.

Existing transmission lines and the development of the West-wide Energy Corridor create opportunities in which other features could be colocated, potentially causing additional disturbance to cultural resources as new facilities are developed. Several transmission lines have already been constructed within the study area (APS 115 kV/500 kV Line, El Paso Electric 345 kV, Southwest Transmission Co-op 115 kV/230 kV Line, and Tucson Electric Power Co. 138 kV/345 kV). However, because transmission lines cause less ground disturbance than other linear features such as roads and pipelines, it is possible to avoid cultural resources by having structures span cultural resource sites. In addition, the selective placement of transmission structures provides an opportunity to preserve cultural resource sites from future development impacts within the right-of-way.

Traditional use areas are culturally sensitive areas for tribal groups. During the identification process, tribes will be consulted and invited to participate so that these resources may be

identified and avoided and protected. The Western Apaches consider Mount Graham (within the Pinaleño Mountains) one of their holiest mountains, and it was determined eligible for inclusion to the NRHP. Although none of the Project alternatives would directly impact Mount Graham, the construction of the Project in conjunction with present and future actions could have cumulative effects to the sacred area, given the sensitive issues surrounding the mountain. Other reasonably foreseeable future projects may potentially impact sacred areas, including the Cibola Greenworks Project, which is located near the Laguna del Perro Salt mines, a salt resource used by prehistoric communities.

Through the use of BMPs and selective mitigation measures, impacts to cultural resources and their cumulative effects can be reduced.

Operation

The operation of existing and reasonably foreseeable future projects increases access to remote areas and visually impacts historic viewsheds, which could create additional impacts to cultural resources.

New access roads into remote areas could present new opportunities for vandalism to occur, increase OHV recreation and, in turn, damage cultural resource sites by increasing erosion potential. Several habitation areas located on the east side of the Rio Grande in the Project vicinity have been severely damaged by wind and water erosion.

The expansion and continued use of transportation corridors such as I-10 could have incremental impacts on cultural resources. For example, significant prehistoric cultural resources were identified during the construction of the extra lane along I-10 within the Tucson area. However, while portions of these resources were destroyed, other portions of the sites were saved from future development through protective measures. Prior to their destruction, the adverse impacts to the sites were mitigated through data recovery, the results of which helped to define the current understanding of settlement along the Santa Cruz floodplain, pushing the timeframes for irrigation, ceremonial structures, and cemeteries further back into prehistory than was previously known.

Indirect cumulative effects from the operation of the Project include incremental impacts associated with visual impacts to historic properties. The proposed Project has the potential to visually affect several NRHP-listed properties and a National Monument. For example, several route alternatives were developed based on potential impacts to the Gran Quivira; a 610-acre cultural landscape consisting of ancient pueblo ruins and Spanish mission structures set atop a ridge that provides views and vistas of a landscape relatively unchanged since the Spanish Colonial Period. The incremental effect of the Project would be greater with respect to views to the south of the Gran Quivira. The setting to the North of Gran Quivira has been modified by development in this area, which includes the High Lonesome Mesa Wind project, residences, pipelines, roads, and the visitor center.

Other cultural resources that could be visually affected include several archaeological districts (e.g., Playas Pueblos, Mockingbird Gap, Oak Draw, and Marijilda Canyon Prehistoric), as well as several individual properties, including Sagrada Familia de Lemitar Church, Los Dulces

Nombres; Brown and Fitch Halls; Shakespeare Ghost Town; Hidalgo County Courthouse; Lordsburg-Hidalgo County Library; Bonita Store; Cienega Bridge; and Colossal Cave. In addition, several historic districts and individual properties would be affected by any of the alternatives in the Tucson area.

Portions of Subroute 4C3, within and adjacent to the City of Tucson, are in areas with extensive historic structures and historic districts. These historic features have been significantly impacted by the cumulative effects of modern urban development. The incremental effect of the Project to cultural resources within Tucson would contribute to the disturbance to the historic character or setting of the city.

Possible Mitigation Measures

Mitigation for direct impacts to cultural resources from the construction of the Project or additional transmission projects could include a variety of items, including avoidance of cultural resource sites through line siting, spanning sites with selective structure placement, or mitigation through data recovery of cultural sites that could not be avoided. Limiting entrance to undisturbed areas through Project access roads with locked gates may be an effective method to limit the damage to cultural resources in remote locations. Indirect impacts such as visual impacts to historic trails or other historic properties may be lessened by the modification of the proposed transmission structure type, color, and spacing, if parallel to an existing line. In addition, informational signs and other collaborative interactions with trails associations could provide alternative mitigation measures by providing awareness to sensitive cultural resources.

Cumulative Effects Analysis, Including Energy Development Scenarios

Cumulative effects from potential energy development projects identified as the Energy Development Scenarios could result in cumulative impacts to cultural resources. Impacts would be associated with the areas of development identified below.

Construction

The construction of new renewable energy projects could have cumulative effects to cultural resources depending on the types of renewable energy proposed, the anticipated amount of acreage for the project, and location of the project area. In general, wind resource projects include large dispersed areas of land with associated access roads, allowing for the potential to avoid impacting cultural resources. Solar resource projects generally include large block areas that have a greater potential for impacting sites since there are fewer opportunities for avoidance. In general, there is a direct relationship between the amount of project acreage, the location of the project, and the potential for impacting cultural resources.

Energy development scenario Option B involves the construction of one AC and one DC transmission line that would be constructed with a combined 4,500 MW of transfer capability, and represents the option with the greatest potential ground disturbance. Based on Option B, wind energy development in NM-EA QRA and solar energy development within NM-SW, NM-SO, and AZ-SO QRAs could total approximately 40,270 acres. Existing cultural resources are

known within the NM-EA, NM-SW, NM-SO, and AZ-SO QRAs, and include prehistoric habitation areas (rockshelters, pit houses, and roomblocks); artifact scatters with hearths, roasting pits, rock piles, or bedrock mortars; prehistoric lithic quarries; pictographs/petroglyphs; protohistoric Tohono O'odham villages; the Shuni Village; historic railroads and associated facilities; historic mining facilities; historic irrigation features; and trash scatters associated with historic structures.

Reasonably foreseeable future energy projects such as New Solar Ventures/Solar Torque and Gestamp Solar are located in culture areas that have limited information. The construction of these projects would provide opportunities to add to the cultural resources knowledge base.

Operation

Renewable energy projects would increase access to undeveloped areas. This increased access could present new opportunities for vandalism to occur.

Renewable energy projects such as wind are frequently located on mountaintops or ridges. Mountain ranges in the Southwest are often associated with areas of traditional cultural properties of the tribal groups in the area. The development of these types of projects may cause cumulative impacts to these sensitive resources.

Renewable energy projects such as geothermal, solar, and wind farm also have visual impacts on the landscape. Such projects could contribute to the incremental degradation of historical integrity to historic properties for which setting and feeling are a significant factor to a site's NRHP eligibility. An example of this includes the reasonably foreseeable EnXco Development project, located west of the Rio Grande, which has the potential to visually impact the Butterfield, General Cooke's Wagon Road/Mormon Battalion, and Gila trails. Two qualified resource zones for wind energy development are located to the west and east of Gran Quivira. Given the visual impact from the existing High Lonesome Mesa Wind Project, the development of additional wind generation would have a substantial impact on the cultural landscape of Gran Quivira.

Conclusions

Based on information obtained from the Class I cultural resource and land use inventories for the Project, the addition of the proposed Project is within an environment that has been previously disturbed through the development of other pipeline and transmission line projects. The cumulative effect of a new transmission line project in an area with several other linear facilities would be minimal.

Development of the proposed Project, in conjunction with other present and reasonably foreseeable future projects, could contribute to the loss of archaeological context and historical integrity of setting for sites located in these areas. Other types of large-scale block developments, such as solar and wind energy, are expected to result in greater loss to archaeological and historic resources. In order to locate and evaluate what types of significant sites might be present, intensive pedestrian surveys would need to be completed.

4.17.4.9 Visual Resources

Cumulative effects to visual resources relate to the modification of landscape scenery and the viewsheds associated with public viewing areas. Cumulative effects to visual resources could result from: (1) the incremental modification of landscape character in natural areas, and (2) altering the viewsheds associated with public viewing locations based on the construction and operation of the Project in context with past, present, and reasonably foreseeable future actions. Cumulative effects for visual resources would occur over the life of the Project. Past, present, and reasonably foreseeable future actions that were considered for this analysis are described in Table 4-35.

Cumulative Effects Analysis for SunZia

The visual resources section of Chapter 3 provides an overview of the existing landscape setting (scenery) and the potentially affected viewing locations and KOPs. Direct cumulative effects would occur if activities associated with the construction and operation of the Project and any of the reasonably foreseeable actions were to occur simultaneously within the area of analysis.

Area of Analysis

The geographical extent for the visual resource direct cumulative effects analysis for SunZia was generally associated with a 6-mile-wide corridor centered on the proposed Project reference centerline. Based on the occurrence of renewable energy development areas (QRA) for both wind and solar, the extent of the indirect cumulative effects study area was extended beyond the area of analysis for direct cumulative effects, as appropriate, to account for potential large-scale energy development. Direct and indirect cumulative effects were assessed for both construction and operation activities associated with the Project and energy development scenarios.

Construction and Operation

Generally, construction activities associated with the Project include: upgrading or construction of access roads, clearing and grading activities for the right-of-way, excavating and installation of foundations, assembling structures with temporary and permanent pad sites, stringing conductors and shield wires, and clean-up and reclamation of affected areas. Some activities associated with construction, such as access roads, pad sites, and staging areas (as identified in the POD), would be temporary. Areas disturbed by temporary construction activities (i.e., access roads, staging areas, temporary pad or pulling and tensioning sites) would not be required for routine maintenance activities during operation. These temporary areas will be identified in the POD and restored at the end of construction. Temporary construction activities would result in cumulative effects that would contribute incrementally from the reasonably foreseeable actions. Operation activities associated with the Project would be ongoing and long-term, and would occur along the right-of-way for the life of the Project. The proposed transmission line structures, substations, and associated long-term access would be permanent and require routine maintenance. Operation of the reasonably foreseeable actions would permanently alter the landscape and change the viewsheds associated with public viewing locations for the life of the Project.

Reasonably foreseeable actions that would likely have direct cumulative effects to visual resources during the construction of the proposed Project include residential development, agricultural development, airport and military infrastructure development, and transportation corridor development. Construction would require grading and/or removal of vegetation, which would introduce landscape contrast into the study area. These developments, when added to direct effects of the proposed Project (i.e., 6-mile-wide corridor centered on the proposed Project reference centerline), would incrementally convert the natural landscape into a developed or urban landscape that would adversely affect the scenery over time. Specific projects that would alter landscape scenery within the study area include the residential subdivision of Willow Springs Ranches (New Mexico), Windmill Ranches (New Mexico), SaddleBrooke Ranch (Arizona), and Willow Springs (Arizona). Other types of reasonably foreseeable actions within the study corridor that are more industrial include mining and mineral development, utility development such as HVTLs, power generation stations, and substations. These developments, when added to direct effects of the proposed Project, would incrementally convert natural landscapes into industrial landscapes, which overtime would adversely affect landscape scenery. In the context of the proposed Project, cumulative effects to visual resources occur based on the industrialization of naturally appearing landscapes and the modification of views from moderate to high concern viewing locations.

Specific projects that would have the greatest effect on landscape scenery include the Southline Transmission Line Project and the Pinal Central 500 kV Transmission Line Project. These projects would potentially be constructed in the same corridor as the proposed Project, and therefore would contribute to the modification of natural landscapes located within the study area. Cumulative effects during construction could be reduced if structure spans were matched (where feasible), potential right-of-way distance minimized, and restoration of temporary construction areas (i.e., access roads).

In addition to transmission line projects, power generation facilities located or proposed within the SunZia cumulative effects visual study area would contribute to cumulative impacts. Specifically, wind, solar, and conventional energy projects were identified within the 6-mile-wide study area and are described below.

The existing and proposed Macho Springs Wind Project, Saguaro Solar Power Plant/Solargenix, SOLON Solar Project, and Bowie Power Station Project would all contribute to the modification of the landscape in context with the proposed Project. Reasonably foreseeable actions within the SunZia study area that could contribute to cumulative effects include the Avra Valley Solar Project, Red Horse Wind 2, UA Tech Park Thermal Storage Demonstration Project, and Fotowatio Solar Project. These projects would result in construction modifications that would adversely affect landscape scenery by introducing numerous vertical and geometric structures within a largely flat and horizontal landscape. In addition to effects on scenery, the introduction of the proposed Project in context with these other projects would have a cumulative effect on viewers using local travel routes and recreation areas. The intensity of cumulative effect would vary based on distance from the viewer to the facility, presence of man-made features in the landscape, and Project visibility.

Other past, present, and reasonably foreseeable projects such as mines, transportation corridors, rail, fiber optic lines, and other land disturbing projects would result in adverse cumulative

effects to both landscape scenery and viewers. Cumulative effects could possibly be reduced by consolidating, to the extent practicable, like facilities and sharing access wherever possible.

Cumulative Effects Analysis, Including Energy Development Scenarios

Cumulative effects to visual resources also considered the potential for renewable energy development in the vicinity of the proposed Project. Figure 4-1 illustrates wind and solar resource development areas that were evaluated to disclose cumulative effects for visual resources. Although the visual influence of the proposed Project would not necessarily encompass the entirety of the renewable energy development areas (i.e., direct effects), the typical scale of renewable energy projects requires a large area of effect, as compared to transmission line projects. Therefore, it is reasonable to assess the potential renewable energy development zones in context with the Project from a cumulative effects aspect. Following are cumulative effects for construction and operation based on potential wind and solar energy development.

Construction and Operation

The majority of potential wind development (QRA) that could contribute to cumulative effects of the proposed Project occurs in New Mexico, to the northeast of the SunZia East Substation. This area is anticipated to generate up to 11,290 MW of power, which would require additional transmission lines beyond the proposed Project to transport the energy to market. If this area was built out (including associated transmission line), substantial cumulative effects to landscape scenery would occur. Because of the large footprint of such facilities and the large scale of wind turbines, cumulative effects would remain through decommissioning. Viewers in the vicinity of SunZia East would also be adversely affected by the potential wind development area. Other anticipated cumulative effects resulting from wind facilities per the Final Wind PEIS (BLM 2005) include effects to night skies associated with FAA illumination requirements (aircraft warning lights), landscape disturbance required for construction and operation of the wind turbines, and effects to viewsheds from sensitive public viewing locations.

Potential solar development could occur in both New Mexico and Arizona in the vicinity of the proposed Project (although the majority of potential solar development would occur in New Mexico). These types of development typically require surface disturbance that result in strong visual contrast. Based on current solar technology, vegetation would be removed within the footprint of potential solar facilities, which adversely effects landscape scenery. Over time, each additional solar facility (and associated transmission line) would incrementally convert the character of affected landscapes from natural to industrial. In addition, cumulative effects to viewers within the vicinity of the solar development areas would occur based on what type of solar technology would get implemented. PV technology has a relatively low profile, such that viewer impacts are reduced. Concentrating Solar Trough, or "Power Tower," technologies have components that are typically high profile and increase potential impacts to viewers. Other anticipated cumulative effects resulting from potential solar facilities, per the Draft Solar PEIS (BLM and DOE 2010), include: effects to night skies associated with illumination requirements for maintenance and nighttime operation; effects to sensitive viewsheds, based on the introduction of glint and glare, depending on the type of solar technology developed; and effects to landscape setting, based on the formal geometric shapes associated with industrial-scale facilities.

4.17.4.10 Land Use and Recreation Resources

Cumulative Effects Analysis for SunZia

Area of Analysis

Cumulative land use impacts may occur as result of the construction and operation of the Project and other reasonably foreseeable projects listed in Table 4-35. The development of generation projects would impact land uses within the cumulative area of analysis. The cumulative area of analysis for land use and recreation resources includes all land uses identified within the Project study area, as well as within intersecting QRAs or within 100 miles of a Project subroute. Currently, there are no reasonably foreseeable future wind development projects planned within or near the study area; but approximately 37,500 acres of solar development are planned within or near the study area. (Land uses that make up the Project study area are detailed in Table 4-43.) The proposed Project and reasonably foreseeable future projects are located on federal, state, private, and other entities; with military lands accounting for approximately 15.5 percent of the study area, and six major cities and towns for approximately 1 percent of the study area. Existing linear facilities, including transmission lines, pipelines, roads, highways, and railroads, make up approximately 1 percent of the study area. According to the Energy Development Forecast, between 10,000 and 40,000 acres of land could be developed within the area of analysis.

Table 4-43. Land Uses in Study Area (acres)

Study Area[1]	16,700,000
Proposed SunZia Project	
Right-of-Way (400') and Substations	22,600
Existing Utilities[2]	
Transmission Lines (115 kV and greater)	42,000
Pipelines (6" in diameter and greater)	18,900
Existing Roads, Highways and Railroads[2]	144,200
Agricultural Areas[3]	327,000
Developed Areas[3]	246,800
Military[4]	2,600,000
Major Towns or Cities	178,000
Las Cruces, New Mexico	33,300
Socorro, New Mexico	9,200
Deming, New Mexico	10,394
Tucson, Arizona	124,200
Safford, Arizona	5,100

[1] Study area includes portions of 14 counties in NM and AZ as indicated in Figure 1-1 (Chapter 1)
[2] Includes estimated average size rights-of-way for existing facilities
[3] Source: 2006 USDA Forest Service Landfire existing vegetation dataset
[4] Includes WSMR (2,041,000 acres), Ft. Bliss (504,000 acres), and other military lands (54,000).

Construction

Cumulative direct and indirect impacts to land use and recreation resources may occur as a result of the construction of the Project, as well as from reasonably foreseeable future projects that could include development of new and temporary access roads, staging yards, and impacts to military operations. In addition to the actual construction activities, impacts to local jurisdictions could occur due to the onset of construction crews. Table 4-44 displays the reasonably foreseeable future projects in the area of analysis for land use, including any potential impacts resulting from construction and operation.

In addition to the existing features in the area, federal, state, and local plans were reviewed to research any planned or future development that may occur, including renewable energy developments. Planned residential subdivisions have been identified within the Project study area, including the Windmill Ranches to the southwest of the SunZia East Substation; Willow Springs Ranches residential subdivision located to the south-southeast of Link A161b; and Willow Springs residential subdivision located to the north of Link C691, which includes 4,600 noncontiguous acres. Increased traffic could occur near these subdivisions as they are populated and construction of the Project is occurring, causing strain on local road infrastructure and traffic in these areas.

Conservation initiatives and programs, described in detail in Chapter 3, may provide funding for multiple types of conservation projects. These projects can include, but are not limited to the acquisition of property for conservation easements; habitat restoration; vegetation removal; retirement of agricultural land; invasive species treatment; and educational uses. Potential impacts could include a reduction in agricultural uses along the river corridors, and an increase in recreational and educational uses in conservation areas.

Direct impacts to the area would result from the construction of access roads. Several existing transmission lines that cross through the analysis area are concentrated along I-10, and proceed north to the west of Tucson. These areas may already have existing access roads that could be upgraded and utilized during the construction and operation of the Project. This would also be true for the existing pipelines that traverse the analysis area, with concentrated areas in the northern portion of the Project, west of the planned SunZia East Substation and along I-10 proceeding north towards San Manuel, Arizona and to the west of Tucson. Reasonably foreseeable future projects that could also use these existing access routes and/or could share access with the Project include: (1) the Pinal Central to Tortolita 500 kV transmission line, between the Tortolita Substation and planned Pinal Central Substation to the east of Eloy, Arizona, and west of links C820, C830, C840, and C850; (2) the Bowie Power Station 345 kV transmission line; (3) the Southwest Transmission Co-op San Manuel Interconnect Project, located to the north of San Manuel, Arizona; and (4) the Southline transmission line, located in the southern portion of the study area.

New access roads adjacent to recreation areas have the potential to increase OHV use by enabling additional area access. If the route north of Lordsburg is chosen (Subroute 3A), there is a potential for increased impacts from the subroute crossing the Hot Well Dunes OHV Recreation Area. A portion of Subroute 3A, (Link B160b) crosses the southern edge of the recreation area. Any new access roads would open up previously closed areas to OHV use.

Indirect impacts could occur with other resources as well; particularly biological and cultural, with right-of-way maintenance causing habitat loss for wildlife or the introduction of invasive species and impacts to scenic viewsheds.

In addition to potential impacts from new access, the loss of land used for ranching and grazing, as well as other lands used for agricultural purposes, may result in impacts as well. Staging areas, housing camps, and temporary access roads would take a minimal amount of the land previously used for these activities. Once construction activities have commenced, reclamation can be performed to restore these areas to their previous use(s). In relation to the area of analysis, a minimal portion of land would be affected.

The cumulative effects to military operations and other air facilities during construction would be minor. Link E90, northeast of Socorro, New Mexico, is within 0.5 mile of LC 94. While there is no expected impact to the launch facility itself, there is a possibility that damage could occur during Project construction should there be a catastrophic failure of a missile shortly after launch. If the subroute near the cruise missile launch facility were selected, proper procedures would be followed to protect construction crews from potential injury from a catastrophic event.

Increased jobs, infrastructure, and economic development would also be considered indirect impacts from construction. A temporary economic boom in communities near the Project could occur during the construction phase, due to the onset of construction crews. Transportation infrastructure may be stressed and increased traffic could occur, requiring local jurisdictions to increase funding to manage these areas of their community.

Table 4-44. Reasonably Foreseeable Future Projects

Project	Potential Impacts
Substations and Power Stations	
Pinal Central Substation	Pinal Central Substation will be the terminus for the Project; the expansion for this facility is unknown
Bowie Power Station	Approximately 500 acres for a 1,000 MW natural gas fired power station in Cochise County.
Willow-345 kV Switchyard	Willow-345 kV Substation will be part of the Bowie 345 kV transmission line project; it will be located to the south of the proposed Willow-500 kV Substation, which is part of the Project
Transmission Projects	
Bowie 345 kV Transmission Line	Approximately 44 acres of new right-of-way access would need to extend from where the planned Bowie Substation site, east of Willcox, AZ to the north to connect into the Project alternative.
Tucson Electric Power Co. Pinal Central Substation to Tortolita Substation 500 kV Transmission Line	This 500 kV line could tie into the Project at either existing Tortolita Substation or planned Pinal Central Substation. Existing right-way access could be utilized with minimal additional access if needed.
Southwest Transmission Co-op Inc., 230 kV San Manuel Interconnect Project	Approximately 17 acres of new right-of-way access would need to extend the 230 kV line to tie to the Project
Southline 345 kV Transmission Line Project	Approximately 700 acres of new right-of-way would be constructed in addition to facilities constructed within existing right-of-way.

Table 4-44. Reasonably Foreseeable Future Projects	
Project	**Potential Impacts**
Solar Projects	
enXco Development Corporation	Approximately 73 acres of new right-of-way access with an additional transmission line to connect to the Project to the east of Deming
Lordsburg Mesa, Iberdrola Renewable	Approximately 20 acres of new right-of-way access with an additional transmission line to connect to the Project, west of the Lordsburg Substation, northwest of Lordsburg
New Solar Ventures/Solar Torque	Approximately 12 acres of new right-of-way access with an additional transmission line to connect to the Project west of Deming
Avra Valley Solar Project	Approximately 29 acres of new right-of-way access with an additional transmission line to connect to the Project, northwest of Tucson, north of Tucson Mountain Park. Shared access could occur if the Fotowatio Renewable Ventures Project also connected
UA Tech Park Thermal Storage Demonstration Project; Bell Independent Power Corp.	Approximately 12 acres of new right-of-way access with an additional transmission line to connect to the Project, southwest of Tucson
Fotowatio Renewable Ventures	Approximately 29 acres of new right-of-way access with an additional transmission line to connect to the Project, northwest of Tucson, north of Tucson Mountain Park. Shared access could occur if the Avra Valley Solar Project also connected
Gestamp Solar	Approximately 182 acres of new right-of-way access with an additional transmission line to connect to the Project, northeast of the planned SunZia East Substation

Operation

Cumulative direct and indirect impacts that could occur with the operation of the Project and reasonably foreseeable future projects could include permanent loss of land to physical structures, increased use, and traffic on local infrastructure and transportation systems; especially along transmission access roads, with potential for increased OHV use. Abandonment of structures built in communities to accommodate construction crews could also occur if local economies cannot support the facility. In addition, public lands could be removed permanently from users that may have traditionally used the area for recreation. This would be the same for private lands that would not be removed from development other than energy based. These impacts would last the life of the Project.

Permanent access roads could allow for increased OHV use in areas that may not have been used for this purpose in the past. In addition, permanent access could generate more movement in areas that would not have previously been accessible. Impacts from this permanent infrastructure could be minimized by having new facilities grouped in a way that allows for shared access roads and less disturbance to the area.

Agricultural fields and rangeland crossed by the Project would have impacts from permanent structure pad locations and structures, reducing the amount of crop land available for farming operations, or lands that were previously used for grazing. Depending on conditions unique to the individual grazing operation, reductions in permitted grazing would adversely affect the economic value of ranches. The areas removed would be for structure foundations (which would

vary), access roads approximately 24 feet wide, areas to be used for solar arrays (which would vary), and future substation sites that would be approximately 40 to 80 acres. This impact would affect the San Pedro River Valley and the Sulfur Springs Valley in Arizona, and along the Rio Grande in New Mexico, where existing agricultural plots occur. However, the amount of permanent disturbance and loss of agriculture and rangeland production associated with these projects would not be significant in the context of the region. Existing and future conservation easements may also be impacted, potentially reducing the amount of land currently being conserved; and depending on the final Project design, may fragment linear conservation easements in areas along the San Pedro River and the Rio Grande.

There are no expected impacts to military facilities, but LC 94 is located near Link E90. While there is no expected impact to the launch facility itself, should there be a catastrophic failure of a missile shortly after launch, there is a possibility that damage could occur to the Project from falling debris or blast destruction of the missile. The Project could impede low-level flight training operations within MOAs.

Cumulative Effects Analysis, Including Energy Development Scenarios

In addition to cumulative effects from the construction and operation of the Project as well as from other reasonably foreseeable future projects, cumulative effects of construction and operation of future energy development scenarios were examined. Projects that are being proposed include transportation, transmission, solar, and wind.

Construction

Direct and indirect impacts from construction of future projects would be similar to what is described above. The greatest difference is the potential scatter and density of projects, magnifying the impacts from construction. This would mean greater miles of access roads allowing for more OHV use; larger amount of lands developed for energy projects and less to be used for other development, such as recreation (both public and private); impacts to military and other air facilities; and increased impacts to local jurisdictions, especially transportation infrastructure.

Operation

As described in the section above, direct and indirect impacts from operation of these future projects, in addition to the SunZia Project, would be determined by the number of projects developed and how the facilities are grouped. This would include impacts from permanent access, which could be reduced if projects are grouped to allow for shared access. Impacts to military and air facilities would also be a consideration during the operation phase of any future projects, due to the visibility impacts that solar facilities can generate, and the possibility of collision with and damage to wind facility equipment and military aircraft, should low-level flight paths be located near potential wind development facilities. Another impact would be to local jurisdictions in the form of job creation during the operations phase. This could either help to stimulate local economies or stress infrastructure if there is no room to accommodate these additional workers.

Cumulative effects for the Project and cumulative effects analysis, including energy development scenarios in regards to land use, are expected to be similar between all subroutes, including the BLM preferred alternative, due to the interconnection points being the same for all routes.

4.17.4.11 Special Designations

Cumulative Effects Analysis for SunZia

Area of Analysis

The special designations area of analysis would be the Project study area.

Construction

Cumulative impacts to special designation areas during the construction phase of the Project and reasonably foreseeable future projects would be on a case-by-case basis, based on the type of designation held by area under construction, the proximity of construction, and potential mitigation to reduce these impacts. Specific impacts to special designations have not been identified, because there are no known projects that would affect the status of special designations within the Project study area.

Operation

Cumulative impacts to special designation areas resulting from the operation of the Project and other reasonably foreseeable future projects would also be on a case-by-case basis. For example, access roads could be minimized if facilities were to share infrastructure, resulting in fewer disturbances near or within a specially designated area. Mitigation measures, such as placing gates to limit access to Project roads, could be put in place at the commencement of construction in order to reduce impacts.

Cumulative Effects Analysis, Including Energy Development Scenarios

In addition to cumulative effects resulting from the construction and operation of the Project and other reasonably foreseeable future projects, cumulative effects of construction and operation of future energy development scenarios were evaluated. Proposed projects include transportation, transmission, solar, and wind.

Construction

Direct and indirect impacts to special designation areas resulting from construction of future energy projects would include disturbance to these areas if several projects were being constructed near an area designated for (1) scenic values, (2) recreation use, or (3) use with which construction activities may interfere, or in which the increased activity from the construction prevents the user from experiencing the designated area in its intended way; this can include recreation, visual, noise, and air impacts. Additional access could also allow for uses that

the specially designated area does not typically allow for, thus increasing the need for stringent management of the area during this phase of future projects.

Operation

Direct and indirect impacts from operation of future projects to special designations would include the impacts described above during construction. Operation impacts would also include development of future energy projects, if located near a specially designated area.

4.17.4.12 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics

Cumulative effects to wilderness areas, WSA, and lands with wilderness characteristics relate to the following wilderness characteristic criteria associated with these areas: size, naturalness, solitude, and primitive and unconfined recreation. Direct cumulative effects could result if past, present, future, and reasonably foreseeable future actions would be located on lands within the boundaries of lands with wilderness characteristics inventory units, thus reducing the size of the inventory unit and naturalness of the area by introducing man-made features into the landscape setting. There would be no direct cumulative effects to wilderness areas or WSA, due to their special designation and specific management prescriptions, which include the avoidance or exclusion of some activities or uses (i.e., right-of-way leases or grants) within their boundaries. Indirect cumulative effects could result from the incremental increase of areas within wilderness areas, WSA, and lands with wilderness characteristics, where past, present, future, and reasonably foreseeable future actions would be visible; thereby reducing outstanding opportunities for solitude. Cumulative effects to wilderness areas, WSA, and lands with wilderness characteristics would occur over the life of the Project. Past, present, and reasonably foreseeable future actions that were considered for this analysis are described in Table 4-35.

Cumulative Effects Analysis for SunZia

Area of Analysis

Wilderness areas, WSA, and lands with wilderness characteristics area of analysis is defined as the SunZia Project study area.

Construction and Operation

There would be no direct cumulative impacts to wilderness areas and WSA as a result of the construction and operation of the Project or reasonably foreseeable future projects, as no future actions could be developed within wilderness areas or WSA boundaries due to their special designation and specific management prescriptions. However, there could be direct cumulative impacts to lands with wilderness characteristics from the construction and operation of the Project. Direct impacts would occur where construction activities would take place within the boundaries of lands with wilderness characteristics inventory units. Construction activities associated with SunZia would include: upgrading or construction of new access roads, clearing

and grading activities for the right-of-way, excavation and installation of foundations, assembling structures with temporary and permanent pad sites, stringing conductors and shield wires, and clean-up and reclamation of affected areas. Some activities associated with the construction, such as access roads, pad sites, and staging areas (as identified in the POD), would be temporary. Other direct cumulative direct impacts associated with the construction of the Project could include noise and/or dust generated during construction activities. These impacts would, however, be short-term and mitigation measures could be implemented to reduce impacts to these areas during construction. Operation activities associated with the Project would be ongoing and long-term, occurring along the right-of-way for the life of the Project. The proposed transmission line structures, substations, and associated long-term access would be permanent and require routine maintenance. Operation of the Project would reduce the size of the inventory unit, as areas where the Project would cross would no longer be eligible for wilderness designation. There are no direct cumulative effects as a result of reasonably foreseeable actions, as none of the actions described in Table 4-35 would cross wilderness inventory units within the Project study area.

Indirect impacts would occur where construction activities would be visible from within the wilderness areas, WSA, and lands with wilderness characteristics inventory units, reducing the outstanding opportunities for solitude within these areas. Some activities associated with the construction, such as access roads, pad sites, and staging areas (as identified in the POD), would be temporary.

Indirect impacts would also occur where permanent project components (i.e., transmission line towers, substations, and permanent access roads) would be visible from within wilderness areas, WSA, and lands with wilderness characteristics inventory units. Past, present, future, and reasonably foreseeable projects, when added to the indirect effects of the proposed Project, would incrementally reduce opportunities for solitude within these areas. For example, when existing development (such as transmission lines, agricultural lands, and transportation corridors) located within 3 miles southeast of the Nutt Grassland inventory unit is added to indirect effects of the proposed Project (local alternative links A361 and A430), the outstanding opportunities for solitude may incrementally decrease (i.e., development would be seen from more areas within the inventory unit).

Cumulative Effects Analysis, Including Energy Development Scenarios

Cumulative effects to wilderness areas, WSA, and lands with wilderness characteristics would also result from the potential renewable energy development in the Project study area. Figure 4-1 illustrates resource development areas that were evaluated to identify cumulative effects for wilderness areas, WSA, and lands with wilderness characteristics.

Construction and Operation

There would be no direct cumulative impacts to wilderness areas and WSA as a result of potential wind or solar projects, as none of the actions would cross within their boundaries due to their special designation and specific management prescriptions. Direct cumulative impacts to

lands with wilderness characteristics from potential solar and wind projects would include impacts described above during construction and operation.

Cumulative indirect impacts to wilderness areas, WSA, and lands with wilderness characteristics as a result of potential solar and wind projects would include impacts described above, such as the reduction of opportunities for solitude within these areas. Specific impacts would be determined according to individual project evaluation when more information about such projects is available.

4.17.4.13 Social and Economic Conditions

Cumulative Effects Analysis for SunZia

This section discusses cumulative impacts to social and economic resources within the cumulative area of analysis, which includes all counties that would be affected by the proposed Project, energy development within counties containing QRAs, and other past, present, and reasonably foreseeable future projects.

Cumulative effects that could be expected to impact social and economic resources include the creation of jobs, generation of tax revenues, increases in the demand for local housing, transportation systems, businesses, and public services such as schools, emergency services, and various utilities. Social impacts apply to both areas of analysis presented in this section and are discussed in the summary of impacts due to the similarities of impacts for each area. Because the construction of renewable energy related projects requires a large number of workers compared to the operations phase, cumulative impacts are expected to be highest during construction. The timing of these effects is largely dependent on the construction of individual projects, which is uncertain; thus, impacts could vary greatly, especially if projects are developed simultaneously.

Areas of Analysis

Cumulative impacts to social and economic resources are presented for two areas of analysis. The first area of analysis includes the 13 SunZia study area counties as presented in Section 3.13; the second includes these same 13 counties as well as the surrounding counties that are analyzed in the *SunZia Transmission Line Economic Impact Assessment Supplement: Impacts of Potential Renewable Generation Facilities* study, referred to as the *SunZia Economic Supplement Study* (Charney et al. 2012b). The first area of analysis presents economic impacts that could result from the development of all reasonably foreseeable projects (over the next 10 years). The second area of analysis presents economic impacts expected to result if potential wind and solar generation projects are constructed in Arizona and New Mexico over the life of the SunZia Project (anticipated to be 50 years). The amount of energy that could be generated is based on the potential megawatt total identified for Arizona and New Mexico in the Final Wind PEIS (BLM 2005) and a Draft Solar PEIS (BLM and DOE 2010). For the second area of analysis, cumulative impacts are expected to occur within Cochise, Graham, Greenlee, Pima, and Pinal counties in Arizona; and Chavez, De Baca, Doña Ana, Eddy, Grant, Guadalupe, Hidalgo, Lincoln, Luna, Otero, Sierra, Socorro, and Torrance counties in New Mexico. Increases in the number of jobs and tax revenues are expected to result from renewable energy development in

the form of solar PV, solar thermal, wind, and geothermal resources; but impacts would also result from past, present, and other future developments, and renewable energy projects within the cumulative study area.

For both areas of analysis, the results of the *Economic Impact Assessment Supplement* are used to estimate job creation, labor income, and tax revenue impacts (Charney et al. 2012b). All numbers estimated for construction employment represent 1 year of labor. The number of operations jobs is permanent and expected to last 50 years, beginning at the first day a project begins its operations. All income and revenue amounts indicated are represented in 2010 dollars. Economic impacts for each area of analysis should be considered separately and cannot be added to one another, because some of the reasonably foreseeable future projects may be part of the QRAs first mentioned in Section 4.17.3.3. Other cumulative effects are discussed qualitatively, due to uncertainties associated with the nature of these elements.

Cumulative Effects Analysis, Including Energy Development Scenarios

The *SunZia Economic Supplement* Study forecasted potential energy development scenarios that could tie into the SunZia Project (*ibid*). The results of this study presented a range of economic impacts based on the generation of 3,000 to 4,500 MW of electricity. Construction and operation impacts of energy development scenarios are summarized below.

Construction

Within the the cumulative analysis area, over the next 10 years, a total of 2,500 MW of solar PV energy could be generated in New Mexico, and 50 MW could be generated in Arizona. The construction period for a single 100 MW project is estimated to last 1 year (*ibid*). It is important to note that projects such as SunZia could facilitate the transmission of a portion of power generated by these solar PV projects; however, the amount of energy from these specific projects that would ultimately be transmitted by SunZia is unknown. Other types of renewable energy projects, such as wind and geothermal, are not estimated because PV projects are the only projects forecasted to occur within the study area in the reasonably foreseeable future. Construction and operation impacts for these projects are summarized below.

In New Mexico, up to approximately 28,000 direct (approximately 21,500 construction-related) and 4,280 indirect jobs could be created across Doña Ana, Hidalgo, and Luna counties. Based on New Mexico's statewide total construction employment in the third quarter of 2010 (approximately 47,600), the creation of approximately 2,170 jobs per year represents a potential increase of more than 4.5 percent (University of New Mexico Bureau of Business and Economic Research [UNMBBER] 2010). This increase across three counties is greater than the projected 3 percent annual growth rate that is expected to take place across the entire state between 2013 and 2015 (*ibid*).

Labor income paid out over the next 10 years could total approximately $2.5 billion, or $250 million per year ($62.5 million quarterly) due to construction in Doña Ana, Hidalgo, and Luna counties; whereas the state of New Mexico experienced a $74 million decrease in construction labor income during the second quarter of 2011 (U.S. Bureau of Economic Analysis 2011). Tax

revenues (state and local sales, and property taxes) collected during construction could total approximately $71.9 million.

The construction of 50 MW of solar PV projects in Pima County, Arizona could result in the creation of up to 570 direct and 250 indirect jobs. Labor income paid out during the construction of the Project is expected to be approximately $53.7 million. Total tax revenues (state and local sales, and income taxes) during construction could be approximately $7.8 million. Unlike New Mexico, Arizona does not collect property taxes during the construction of renewable energy projects (Charney et al. 2012b). Based on the large population and economy found in Arizona, along with a smaller number of reasonably foreseeable renewable energy projects, the overall economic impact in Arizona should be less than the economic impacts witnessed in New Mexico. During the 2009 fiscal year, $379.6 million in individual income tax revenues and $5.5 billion in sales-related taxes were collected in Arizona (Arizona Department of Revenue 2011).

Operation

It is estimated that approximately 225 direct and 60 indirect long-term jobs could be created in New Mexico. Labor income paid out could total approximately $19.4 million per year in New Mexico. Total state sales, income, and property taxes collected over the first 10 years of operations could total $791 million ($79.1 million per year).

Pima County is expected to gain five direct and three indirect jobs throughout the operations phases of several solar PV projects. Total labor income paid out for these jobs is expected to be $480,000 annually. Total state sales, income, and property taxes over the first 10 years of operations could equal approximately $10.5 million ($1.05 million per year). Similar to construction impacts, Arizona is expected to experience only a small portion of the economic impacts witnessed in New Mexico during the same period.

Summary

The total cumulative economic impact of potential renewable energy development would be much greater than expected to result from the proposed Project alone. Wind and solar PV energy development would be the primary sources of job creation across New Mexico, while solar PV would be the primary source in Arizona.

Based on the high potential for the development of renewable energy identified as reasonably foreseeable future projects and on the BLM's programmatic studies (see Section 4.17.3.3), increases in jobs, income, and tax revenues are expected far beyond the amount of energy that could be carried by the Project.

In addition, plans for several large transmission projects within the vicinity of the SunZia corridors could serve as transmission paths for additional renewable energy developments, particularly with respect to wind energy in New Mexico and solar energy opportunities in Arizona and New Mexico. The High Plains Express Transmission Project and the Centennial West Clean Line Project are multistate transmission projects that could provide added potential electrical transmission paths originating in central and eastern New Mexico, respectively. The

proposed Southline Transmission Project (345 kV), located between southwestern New Mexico and southeastern Arizona, could transport additional electricity generated from sources in those areas; however, the purpose and need for the Southline project is different than for the SunZia Project. The Southline project's capacity would be limited according to the plan to construct portions of the proposed transmission lines within existing rights-of-way.

As other electrical transmission and generation projects continue to develop throughout the area, impacts to social and economic resources that accompany temporary and permanent population growth will occur. Depending on the timing of construction and location of each project, there would be a potential increase in the demand for local housing, transportation systems, businesses, and public services such as public schools, emergency services, and various utilities. Impacts would be highest during Project construction. Operations are also expected to impact housing and public services, but to a much lesser degree. Compared to the level of demand for these resources, the proposed Project would result in minimal incremental cumulative impacts during construction and operation due to the length of construction and the lower numbers of long-term, operational employment.

Other cumulative socioeconomic impacts could result from utility-scale solar or wind developments on public lands.

Livestock grazing on public lands is a meaningful source of income for many ranchers who use public lands for grazing. There are concerns that significant reductions in permitted grazing due to large-scale solar or wind developments on public lands could adversely affect the economic value of these ranches or may threaten their continued viability.

Cumulative impacts on recreational resources (e.g., hiking, biking, back country driving, hunting, bird watching, OHV use, and camping) could occur as a result of utility-scale solar and wind developments. These developments could preclude recreational uses from areas developed for solar energy production in some areas. In addition, indirect effects resulting in the reduction in recreational opportunities and natural experiences such as changes to the visual landscape, impacts on vegetation, development of roads, and displacement of wildlife species near solar or wind developments could occur.

4.17.4.14 Environmental Justice Conditions

Cumulative Effects Analysis for SunZia

Area of Analysis

Outside of the Tucson metropolitan area, the Project is not expected to have significant direct or indirect effects on environmental justice populations. Cumulative effects may occur or take place in communities within the 18 counties containing projects in proximity to SunZia, most notably in urban areas and particularly in residential areas where transmission lines are incompatible with residential land uses.

Construction

Impacts that could occur near environmental justice populations in these counties include the temporary creation of noise and dust from construction, traffic congestion, and obstruction of scenic views. Other effects could include access to direct and indirect job opportunities, and local tax revenue benefits that may result in infrastructure upgrades. If residential, commercial, or industrial properties could not be avoided through mitigation measures or alternative locations for a project, the taking of additional properties and structures could occur during construction of projects such as the High Plains Express Transmission and the Centennial West Clean Line projects.

Operation

The operation of future projects would result in the creation of direct and indirect employment across New Mexico and Arizona. Impacts that were experienced during construction, such as dust and noise during maintenance, traffic congestion, the obstruction of scenic views, and the taking of properties, could remain during the operation to a lesser degree. For properties that experience degradation of scenic views, devaluation could take place. For those whose properties are taken during construction, the impacts would be permanent. While fair compensation would be awarded, the use of the land would be changed from a previously identified use to a right-of-way for a new use. This occurrence would leave long-term, permanent impacts on neighborhoods and individuals affected.

Summary

The level at which environmental justice populations can be impacted is directly related to the proximity and concentration of the population to the areas that will be developed. The remoteness of most of these sites coupled with standard mitigation measures for land use, visual, cultural, and health and safety resources, is expected to reduce cumulative effects to environmental justice populations. Therefore, in most cases, the Project construction and operation activities would not cause or contribute substantially to cumulative effects with respect to environmental justice populations if standard mitigation measures are employed for future projects within proximity to communities.

4.17.4.15 Health and Safety/Hazardous Materials

Cumulative Effects Analysis for SunZia

Area of Analysis

The area of analysis includes the Project right-of-way and areas that would be affected by noise and electrical effects surrounding the right-of-way.

Construction and Operation

Several public health and scientific organizations have reviewed the research on EMF and health and considered the strengths and limitations of the epidemiologic and laboratory studies. These reviewers have concluded that the overall body of research does not indicate any disease or adverse health effects caused by EMF exposure at levels below the guideline limits. The audible noise levels at the edges of the right-of-way are estimated to be less than 55 dBA, the annual average level outdoor target value published by the EPA. While the proposed transmission line would produce EMF, as do all sources of electricity, EMF at intensity levels that would be produced at the edge of the right-of-way also can be found in an ordinary environment. EMF exposure resulting from the proposed transmission line would be well below exposure limits. With the addition of any future transmission lines or other electrical projects, cumulative effects of audible noise levels and EMF exposures could be additive. If additional transmission lines were built in the same right-of-way, estimates of EMF exposure and noise levels would have to be reevaluated.

Cumulative Effects Analysis, Including Energy Development Scenarios

Construction and Operation

Potential effects on occupational health and safety from construction and operation of reasonably foreseeable future actions would be limited. Nevertheless, with the unique occupational hazards associated with heavy construction and the electric power industry, fatalities and injuries from on-the-job accidents could occur. It is assumed that all projects being constructed in the vicinity of the Project would use BMPs to minimize the potential for impacts to public health and safety. The proposed Project is not anticipated to contribute to cumulative impacts on the health and safety of workers or the public.

Summary

Proper design and implementation of safe material handling programs for the Project would reduce the potential for cumulative impacts from release of hazardous materials on the environment. Renewable energy facilities and mining facilities, in particular, typically store and use hazardous materials onsite. It is assumed that these facilities would comply independently with hazardous materials regulations, depending on their specific circumstances (e.g., nature and quantities of hazardous materials stored and used). In short, Project construction and operation activities would not cause or contribute substantially to significant cumulative impacts with respect to hazardous materials handling from a local or regional perspective.

4.17.5 Cumulative Effects from RMP Amendments

Cumulative effects were evaluated with respect to the plan amendment alternatives (see Section 2.6, Proposed Plan Amendments), which would amend the following affected RMPs:

- Socorro RMP, Socorro Field Office (2010)
- Mimbres RMP, Las Cruces District Office (1993)

- Final Safford District RMP and EIS, Safford District Office (1991)

Three RMP amendment alternatives were evaluated (1) No Action alternative, (2) Corridor–400 feet, and (3) Corridor–2,500 feet. The corridor amendments would include the proposed SunZia transmission line right-of-way, and other future rights-of-way, through BLM right-of-way avoidance and VRM noncompliance areas.

The corridor alternatives were identified in order to evaluate the environmental effects that would result from a reasonable range of plan amendment alternatives. It is assumed for purposes of this analysis that additional transmission lines or pipelines could be built within a common corridor with sufficient separation between facilities. The 400-foot width would allow a nonexclusive right-of-way for the Project as well as other potential rights-of-way within the corridor. The 2,500-foot-wide corridor would accommodate multiple rights-of-way. Any new rights-of-way would be subject to case-by-case evaluation according to future project applications; however, no reasonably foreseeable future projects have been identified.

4.18 ENVIRONMENTAL EFFECTS OF RMP AMENDMENTS

Direct and indirect effects of the Project have been described in the preceding resource sections. This section includes descriptions of the potential environmental impacts resulting from the proposed RMP amendments. Locations of the proposed RMP amendment corridors are identified on figures 2-36 through 2-38, and further description is provided in Table 4-45. As stated, the amendments would include the designation of corridors for conformance with RMPs, and construction and operation of other facilities within these corridors would require separate rights-of-way. However, because no project-specific applications for new rights-of-way (except for the SunZia Project) have been identified within these corridors, case-by-case analyses would be required to analyze the effects of actions that may occur for any future right-of-way grants[1]. Alternative plan amendments include the No Action alternative, a 400-foot-wide corridor, or a 2,500-foot-wide corridor. With the No Action alternative, plan amendments would not be implemented and would not result in any environmental impacts.

It is assumed that the environmental effects of the 400-foot-wide corridor amendment would be similar to the effects described for the Project action alternatives, because no other actions have been identified that would be implemented within the BLM preferred alternative corridor. The following discussion addresses impacts to the 2,500-foot-wide corridor alternative.

4.18.1 Air Quality

The utility corridor plan amendment alternative would not be expected to change the estimated impacts to air quality resulting from construction of the Project. Air quality impacts resulting from transmission line construction are expected to be temporary and localized and the area of impact would move as the transmission line construction progresses. Operation impacts to air quality would be negligible. Air quality impacts from construction of other utilities within the

[1] An alternative route has been identified for the Southline Transmission Project that would be located within the BLM preferred alternative route for the SunZia Project within the Mimbres RMP area.

corridor would be unlikely, because construction of other projects would not likely take place at the same time as the SunZia Project.

4.18.2 Earth Resources

Geological Hazards

One of the three RMP amendment alternatives includes the proposal of a corridor, which would involve amending the affected RMPs to allow a 2,500-foot-wide corridor to incorporate both the SunZia transmission line right-of-way and other future utility rights-of-ways. There would not be any cumulative effects from geological hazards resulting from amendments to the RMPs in the Project area (i.e., Socorro, Mimbres [Las Cruces], and Safford RMPs). Affected RMPs would be amended to allow a 2,500-foot-wide corridor that would include the SunZia transmission line right-of-way, as well as other future utility rights-of-way, through BLM right-of-way avoidance or exclusion areas. The designation of a new transmission right-of-way would not be impacted by geological hazards beyond the scope of the Project.

Mineral Resources

The proposed amendment to the Socorro RMP for a 2,500-foot-wide corridor through BLM right-of-way avoidance or exclusion areas would potentially increase the ground disturbance in these areas and, therefore, have a greater effect on mineral resources. The proposed wider utility corridor to accommodate future utility rights-of-ways would have incremental impacts to mineral resources east and west of San Antonio, where leases and coalfields are present. The proposed amendment to the Mimbres (Las Cruces) RMP for a 2,500-foot-wide corridor would have greater effects to mineral resources northeast of Deming along Link A530, where there is an active mine and an active mining lease. There would also be effects associated with the wider corridor in the Lordsburg area along Link B112, where there are active mines and mining leases. The proposed amendment to the Safford RMP would have no added effects from the 2,500-foot-wide corridor, as there are no mines or leases along the links in this area.

Soil Resources

Both direct and indirect effects to soil resources would result from amendments to RMPs in the SunZia Project area, including the Socorro, Mimbres (Las Cruces), and Safford RMPs. Additional project construction within the corridor would impact soils beyond the scope of the proposed Project and could affect previously undisturbed soil resources. An amendment to the Mimbres (Las Cruces) RMP allowing a 2,500-foot-wide corridor to cross avoidance areas would result in direct and indirect cumulative effects to soil resources that are susceptible to both water and wind erosion, especially in the Animas Valley. An amendment to the Safford RMP allowing a 2,500-foot-wide transmission corridor to cross previously designated avoidance and exclusion areas would result in direct and indirect cumulative effects to soil resources.

4.18.3 Paleontological Resources

The proposed amendment to the Socorro RMP for a 2,500-foot-wide corridor could potentially increase the ground disturbance in these areas with the addition of future projects, which could result in a greater cumulative effect to paleontological resources.

4.18.4 Water Resources

The proposed amendment to the Socorro RMP for a 2,500-foot-wide corridor through BLM right-of-way avoidance areas could potentially increase the ground disturbance in these areas, which could have a greater cumulative effect to water resources. However, direct impacts to rivers or streams would not be likely.

4.18.5 Biological Resources

Biological resources may be affected by plan amendments in four areas within Route Group 1. The San Pedro Proprietary SMA was identified as a utility right-of-way avoidance area to protect habitat for the Fugate's bluestar ACEC (Link A112), which could be affected by construction within the corridor. The Ladron Mountain/Devil's Backbone Complex ACEC is set aside to protect habitat for Desert Bighorn Sheep populations west of the Rio Grande (Local Alternative Link A161b). Expanded right-of-way associated with the corridor plan amendment alternative could affect Desert Bighorn Sheep populations through loss of foraging habitat and disturbance during sensitive seasons, including lambing or migration periods. Two right-of-way avoidance areas are crossed by Link A440, within suitable habitat for the Aplomado Falcon. Additional impacts to the Aplomado Falcon in these areas would occur if future development were to be implemented.

None of the areas requiring plan amendments within Route Group 3 have been designated to protect biological resources. However, an avoidance area is crossed by Link B120b within potential habitat for the Aplomado Falcon, and an avoidance area located at the edge of the Lordsburg Playa (Link B140) may contain sensitive plant populations.

An alternative corridor crosses a portion of the Swamp Springs-Hot Springs Watershed and Muleshoe Ranch CMA ACEC (Link C661), which was designated for ecosystem-level conservation and provides habitat for up to five ESA-listed fish. If additional construction were to take place within this corridor, impacts to important riparian habitat may occur.

Table 4-45. Proposed Resource Management Plan Amendments					
Resource Management Plan	**Subroute**	**Land Use Plan Area of Nonconformance**	**Link Number, Milepost**	**Proposed Amendment**	**Total Acres**
Socorro RMP	1A, 1A1, 1A2 (BLM preferred alternative)	BLM ROW Avoidance Area	E101b (MP 5.2-6.3, 6.8-10.5, 11.6-12.6), E133 (MP 0.2-1.4, 1.6-5.7)	No Action	0
				Corridor–400 feet	538
				Corridor–2,500 feet	3,364
	1A, 1A1, 1A2 (BLM preferred alternative)	BLM ROW Avoidance Area	E211 (1.4-2.4, 3.5-7.0, 8.5-14.1) A161 (MP 0.0-0.1)	No Action	0
				Corridor–400 feet	495
				Corridor–2,500 feet	3,091
	1B3	BLM ROW Avoidance Area	A80 (7.1-10.1)	No Action	0
				Corridor–400 feet	145
				Corridor–2,500 feet	909
	1B1, 1B2, 1B2a, 1B3	BLM ROW Avoidance Area	A111 (MP 4.8-5.4, 5.5-7.0), A112 (MP 0.0-2.3), A140 (MP 0.0-0.4)	No Action	0
				Corridor–400 feet	233
				Corridor–2,500 feet	1,455
	1B1, 1B2, 1B2a, 1B3	BLM ROW Avoidance Area	A160 (MP 1.7-3.0, 3.3-8.0), A161 (MP 0.0-0.1)	No Action	0
				Corridor–400 feet	296
				Corridor–2,500 feet	1,848
	1A, 1A1, 1A2 (BLM preferred alternative)	VRM Noncompliance: Class II and Class III	E101a (MP 5.8-5.9), E101b (MP 0.7-2.8, 2.9-5.0, 5.2-6.3, 6.9-7.6, 8.2-10.6, 11.6-12.6), E133 (MP 0.2-1.4, 1.6-5.0)	No Action	0
				Corridor–400 feet	684
				Corridor–2,500 feet	4,273
	1B1, 1B2, 1B2a	VRM Noncompliance: Class II and Class III	A90 (MP 4.3-5.1), A111 (MP 4.5-7), A112 (MP 0-0.8, 1.5-2.3), A140 (MP 0-0.4)	No Action	0
				Corridor–400 feet	257
				Corridor–2,500 feet	1,606
	Local Alternative for 1A, 1A1, 1A2 (BLM preferred alternative), 1B1, 1B2, 1B2a, 1B3,	BLM ROW Avoidance Area	A161b (MP 0.0-2.1, 2.4-5.2)	No Action	0
				Corridor–400 feet	238
				Corridor–2,500 feet	1,485

Table 4-45. Proposed Resource Management Plan Amendments					
Resource Management Plan	**Subroute**	**Land Use Plan Area of Nonconformance**	**Link Number, Milepost**	**Proposed Amendment**	**Total Acres**
Mimbres RMP	1A, 1A1, 1A2 (BLM preferred alternative), 1B1, 1B2, 1B2a, 1B3	BLM ROW Avoidance Area	A440 (MP 5.6-5.9, 6.2-6.8)	No Action	0
				Corridor–400 feet	44
				Corridor–2,500 feet	273
	1A, 1A1, 1A2 (BLM preferred alternative), 1B1, 1B2, 1B2a, 1B3	BLM ROW Avoidance Area	A440 (MP 11.5-12.4), A530 (MP 0.0-1.9)	No Action	0
				Corridor–400 feet	136
				Corridor–2,500 feet	848
	3A, 3A2 (BLM preferred alternative)	BLM ROW Avoidance Area	B120b (MP 7.6 – 7.9)	No Action	0
				Corridor–400 feet	15
				Corridor–2,500 feet	91
	3B	BLM ROW Avoidance Area	B110a (MP 16.6-16.9)	No Action	0
				Corridor–400 feet	15
				Corridor–2,500 feet	91
	3B	BLM ROW Avoidance Area	B112 (MP 10.2-11.2, 11.5-11.6, 11.9-12.1, 12.5-12.8)	No Action	0
				Corridor–400 feet	78
				Corridor–2,500 feet	485
	3B	VRM Noncompliance: Class II	B112 (MP 10.4-11.2)	No Action	0
				Corridor–400 feet	39
				Corridor–2,500 feet	242
	Crossover for 3A and 3B	BLM ROW Avoidance Area	B140 (MP 0.2-1.2)	No Action	0
				Corridor–400 feet	48
				Corridor–2,500 feet	303
Safford RMP	4C1	BLM ROW Avoidance Area: Swamp Springs and Hot Springs ACECs, within the Muleshoe Ranch CMA	C331 (MP 1.8-2.2), C361 (MP 0.0-1.0)	No Action	0
				Corridor–400 feet	68
				Corridor–2,500 feet	424

4.18.6 Wildland Fire Ecology and Management

The RMP amendments would affect Wildland Fire Ecology and Management if future development were to occur within the corridor. Potential effects are uncertain, but would be dependent on the type of construction and management activities during operation.

4.18.7 Cultural Resources

The corridor RMP amendment alternative would have direct and indirect effects. These corridors extend across two segments of the Butterfield Historic Trail, one segment of the El Camino Real Trail, and the middle portion of the Mockingbird Archaeological District. Known cultural resource sites located within the avoidance areas include 25 sites, excluding the trails and archaeological district.

The indirect effects may include the introduction of new access into areas that were previously unavailable to the public. The new access could allow for inadvertent damage from erosion brought about from OHV use and/or disturbance of sites through possible pot hunting. Additionally, the historic trails and other historic sites may be indirectly impacted by visual intrusions of modern facilities on historic viewsheds.

4.18.8 Visual Resources

Scenic quality impacts associated with the plan amendment corridor would be similar to the cumulative effects of the Project, although no reasonably foreseeable future projects have been identified within the alternative plan amendment corridors subject to VRM. Other linear facilities constructed within the corridor could comply with VRM objectives in the plan amendment area, if they were to be similar to the SunZia Project in form, line, color, and texture. Impacts resulting from the construction of other projects within the corridors could be reduced with shared access between the SunZia Project and other facilities constructed within the corridor.

4.18.9 Land Use and Recreation Resources

The six areas within Route Group 1 that would be subject to plan amendments cross BLM-designated right-of-way avoidance areas. The total area removed from avoidance areas in the Socorro RMP (342,363 acres) would be 12,212 acres; roughly 3.5 percent of the designated avoidance area in the Socorro Field Office. The total area removed from the land designated as avoidance areas in the Mimbres RMP (783,400 acres) would be 1,110 acres (less than 1.0 percent).

The four areas within Route Group 3 that would be subject to plan amendments cross BLM-designated right-of-way avoidance areas. The total removed from avoidance areas in the Mimbres RMP (783,400 acres) would be 669 acres; less than 1.0 percent of the avoidance areas in the Mimbres RMP. An alternative route being considered for the Southline Transmission Line Project also crosses 0.3 mile of an avoidance area (Link B120b), within the existing 345 kV transmission line corridor.

One area within Route Group 4 would be subject to a plan amendment, where alternative Subroute 4C1 crosses a right-of-way avoidance area, designated for the Swamp Springs-Hot Springs Watershed and Muleshoe Ranch CMA ACEC. The total area removed from this avoidance area in the Safford RMP (43,423 combined total acres of ACEC) would be 404 acres (less than 1 percent of the RMP area).

4.18.10 Special Designations

An alternative corridor crosses the San Pedro SMA, which would be subject to an amendment to the Socorro RMP. This SMA is 1,201 acres, and is designated to protect special status plants. The 2,500-foot-wide would displace approximately 24 acres of the SMA.

Plan amendments would not affect special designations within Route Group 3.

An alternative within Route Group 4 would be subject to a plan amendment where Subroute 4C1 crosses the Swamp Springs-Hot Springs Watershed and Muleshoe Ranch CMA ACEC, as described in Section 4.10.5.3.

4.18.11 Wilderness, Wilderness Study Areas, and Lands with Wilderness Characteristics

Rights-of-way are excluded from wilderness areas and WSAs. None of the RMP amendment alternatives would impact wilderness, WSAs, or lands with wilderness characteristics.

4.18.12 Social and Economic Conditions

Direct and indirect socioeconomic impacts to BLM lands are expected to be minimal as a result of the plan amendment corridors. If major utility projects were to be constructed, each state and its counties and communities could experience job creation and tax revenues, as well as increased demand for local housing, transportation systems, businesses, and public services. Impacts to population, housing, and community services would be greatest during construction because new populations would temporarily relocate for work. The construction of additional transmission lines within the plan amendment corridors could facilitate the development of renewable energy and other energy generation projects throughout New Mexico and Arizona. The effects from the development of these projects could create long-term economic benefits associated with job creation.

4.18.13 Environmental Justice Conditions

Environmental justice impacts are not expected to result from the plan amendment corridors in the Socorro, Las Cruces, or Safford RMPs, because BLM lands do not contain residential uses.

4.18.14 Health and Safety/Hazardous Materials

Health and safety impacts resulting from other projects within the plan amendment corridor could occur with construction or operation of those facilities. Mitigation or BMPs could

minimize impacts from noise, EMF, and other potential hazards to public safety, and would ensure that EMF and noise levels remain under the guidelines provided by the EPA.

4.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Resources committed to the proposed Project would be material and nonmaterial, including financial. An irreversible commitment of resources, for the purposes of this section, has been interpreted as resources that, once committed to the proposed Project, would continue to be committed throughout the 50-year life of the Project. An irretrievable commitment of resources has been interpreted as resources used, consumed, destroyed, or degraded during the construction and operation of the proposed Project, and that could not be retrieved or replaced for future use. Irreversible and irretrievable commitments of resources for the Project are summarized in Table 4-46.

Table 4-46. Irreversible and Irretrievable Commitment of Resources

Resource	Type of Commitment/Reason for Commitment	Irreversible	Irretrievable
Air Quality	• Degradation of air quality • Construction activities	No	Construction phase
Soils	• Soil loss and erosion • Construction activities	Yes	Yes
Water	• None (see Construction Materials and Fuels, below)	–	–
Biological	• Disturbance to and/or loss of vegetation, habitat, and wildlife species • Construction and operation	Yes	Project life
Archaeological and Historical Sites	• Disturbance or removal of sites • Construction and operation	Yes	Yes
Important Cultural Sites	• Disturbance or removal of sites, interference with visual setting • Construction and operation	Yes	Project life
Traditional Cultural Places	• Disturbance or removal of sites, interference with visual setting, aural disturbance • Construction and operation	Yes	Project life Construction phase
Paleontological Resources	• Disturbance or removal of fossils • Construction activities	Yes	Yes
Visual Resources	• Degradation of natural scenic quality, viewshed intrusion • Construction and operation	Yes	Project life
Land Use and Recreation Resources	• Disturbance to agriculture and grazing • Exclusion of residential, institutional, and industrial uses • Increased recreational use along new access roads • Increased access construction • Construction and operation	Yes	Project life

Table 4-46. Irreversible and Irretrievable Commitment of Resources			
Resource	**Type of Commitment/Reason for Commitment**	**Irreversible**	**Irretrievable**
Public Health	• Potential adverse electrical effects • Operation	Unknown	Unknown
Noise	• Noise exceeding ambient levels • Construction and operation	No	Construction phase
Social and Economic Conditions	• Increased regional and local employment and revenues • Construction and operation	Yes	Project life
Construction Materials and Fuels (use of:)	• Aggregate	Yes	Yes
	• Water	Yes	Yes
	• Steel	Yes	No
	• Aluminum	Yes	No
	• Concrete	Yes	Yes
	• Wood	Yes	No
	• Fossil fuels	Yes	Yes

CHAPTER 5 – CONSULTATION AND COORDINATION

5.1 INTRODUCTION

Consultation and coordination with federal and intergovernmental agencies, organizations, tribes, and interested groups of individuals are important to ensure that the most appropriate data have been gathered and employed for analyses, and that agency and public sentiment and values are considered and incorporated into decision making. Throughout the preparation of the EIS, formal and informal efforts were made by the BLM to involve these groups in the scoping process and subsequent public involvement activities, formal consultation, and review of the EIS.

This chapter provides a brief description of the consultation and coordination efforts for this EIS.

5.2 SCOPING PROCESS

As required by the NEPA, the BLM conducted scoping in the early stages of the preparation of the EIS with cooperating agencies to encourage public participation and solicit agency and public comments on the scope and significance of the proposed action (40 CFR 1501.7). This scoping process was initiated in May 2009 with the announcement of upcoming public scoping meetings that requested comments or issues that should be addressed in the EIS.

5.2.1 Notice of Intent

The public was notified of the Project and upcoming scoping meetings through an NOI published by the U.S. Department of Interior–BLM in the *Federal Register* on May 29, 2009. The NOI formally initiated a 45-day public scoping period for the Project. Comments were received during this 45-day period, which ended on July 13, 2009. The NOI also provided information, including a description of the proposed facilities, Project location, and a summary of the EIS process, and instructions on how to submit comments. The comment deadline was later extended to August 28, 2009.

In addition to the NOI, the BLM used a variety of other notification methods to announce the public scoping meetings and provide Project information. Concurrent with the release of the NOI, the BLM issued a news release to media in New Mexico and Arizona to announce the meetings. Paid display advertisements were placed in newspapers in New Mexico and Arizona, and radio announcements were made. These notifications are detailed in Section 4 of the Scoping Report.

The BLM NOI letter and comment form were included with the first Project newsletter that was direct-mailed to the initial mailing list on June 3, 2009. This initial list comprised agencies, organizations, and individuals that were compiled by the BLM offices within the study area. Subsequent mailing lists expanded to include interested stakeholders such as agencies, special interest groups, and individuals who attended the public scoping meetings or who provided comments on the Project. Project newsletters and the announcement of scoping meetings were distributed to the mailing list. In addition, a direct mailer was sent out in July 2009 to announce the extension of the comment period (from July 2009 to August 2009). The BLM established a

Project website[1] to provide information, including meeting announcements and public documents. Copies of press releases, display advertisements, and media distributions lists can be found in the Scoping Report, which are also available on the Project website.

5.2.2 Scoping Meetings

Nine formal public scoping meetings were held in New Mexico and Arizona during the first scoping period in June and July 2009 (Table 5-1). These were open-house meetings held to introduce, describe, and explain the purpose and need for the Project. In addition, these meetings addressed the planning and permitting process, and solicited scoping comments.

Table 5-1. Scoping Period 1 Meetings – June and July 2009

Meeting Date	Location	Public in Attendance [1]
Arizona		
June 22, 2009	Santa Cruz Valley Union High School 900 N. Main Street Eloy, AZ	16
June 23, 2009	Oracle Community Center 685 American Avenue Oracle, AZ	39
June 24, 2009	Manor House Convention Center 415 E. Highway 70 Safford, AZ	30
June 29, 2009	Valley Telephone Company 752 E. Maley Willcox, AZ	21
New Mexico		
June 30, 2009	Special Events Center 504 2nd Street Lordsburg, NM	13
July 1, 2009	Mimbres Valley Special Events Center 2300 E. Pine Street Deming, NM	31
July 7, 2009	NM Institute of Mining and Technology 801 Leroy Place Socorro, NM	26
July 8, 2009	Carrizozo Municipal Schools 800 Avenue D Carrizozo, NM	52
July 9, 2009	Elephant Butte Inn 401 Highway 195 Elephant Butte, NM	15
Total Attendees		**243**

[1] For purposes of this report, members of the public exclude Project-related individuals (e.g., BLM resource specialists, Applicant staff and engineers, EIS contractor personnel, and cooperating agency representatives.)

[1] http://www.blm.gov/nm/st/en/prog/more/lands_realty/sunzia_southwest_transmission.html

In response to comments received as a result of Scoping Period 1, the study area was expanded to consider additional potential alternative transmission line routes in the area east of the WSMR. Meetings held during Scoping Period 2 are listed in Table 5-2. These meetings presented the expanded study area and the same information used during Scoping Period 1 to introduce, describe, and explain the purpose and need for the Project.

Table 5-2. Scoping Period 2 Meetings – October 2009

Meeting Date	Location	Public in Attendance [1]
October 26, 2009	Court Youth Center 402 West Court Avenue Las Cruces, NM	29
October 27, 2009	First National Bank 414 Tenth Street Alamogordo, NM	17
October 28, 2009	Chaparral High School 800 County Line Drive Chaparral, NM	12
Total Attendees		**58**

[1] For purposes of this report, members of the public exclude Project-related individuals (e.g., BLM resource specialists, Applicant staff and engineers, EIS contractor personnel, and cooperating agency representatives.)

In response to comments received as a result of Scoping Period 2, the study area was expanded to consider additional potential alternative transmission line routes in New Mexico and Arizona. Meetings held during Scoping Period 3 are listed in Table 5-3. These meetings presented the expanded study area and the same information used during Scoping Period 1 to introduce, describe, and explain the purpose and need for the Project.

Table 5-3. Scoping Period 3 Meetings – April 2010

Meeting Date	Location	Public in Attendance [1]
April 27, 2010	Kelly Hall – Socorro County Fairgrounds 1 Fairgrounds Road Socorro, New Mexico	90
April 29, 2010	Holiday Inn – Airport 4550 S. Palo Verde Road Tucson, Arizona	110
Total Attendees		**200**

[1] For purposes of this report, members of the public exclude Project-related individuals (e.g., BLM resource specialists, Applicant staff and engineers, EIS contractor personnel, and cooperating agency representatives.)

More than 500 people attended meetings during the three scoping periods (see Table 5-1, Table 5-2, and Table 5-3). A full description of the scoping process, including the public scoping meetings, is provided in the Project Scoping Report and Addendum.

5.2.3 Comments Received during Scoping

Comments received during scoping, including the additional scoping periods to address the study area expansions, were analyzed and documented in the Project Scoping Report and Addendum. Comments were reviewed to identify issues that should be addressed in the EIS, and to help

develop a range of reasonable and feasible alternatives to the proposed action. In total, approximately 1,400 comment submittals were received, including more than 600 during Scoping Period 1; 200 during Scoping Period 2 (through November 2009); and more than 500 during Scoping Period 3 (through June 2010). Specific issues and where they are addressed in this EIS are listed in Chapter 1, Table 1-3.

5.2.4 Meetings with Interested Stakeholder Groups, Organizations, and Cooperating Agencies

In addition to the public scoping meetings, the BLM hosted meetings with representatives of interested stakeholder groups or other organizations during the scoping period, as listed in Table 5-4. The BLM also hosted meetings with cooperating agencies during the scoping period (Table 5-5).

Table 5-4. Meetings with Interested Stakeholder Groups and Organizations during Scoping Period

U.S. Bureau of Reclamation – Socorro Field Division, Middle Rio Grande Conservancy District	April 16, 2009
U.S. Bureau of Reclamation – Albuquerque Office	April 16, 2009
University of New Mexico – Long Wavelength Array	October 5, 2009
The Nature Conservancy, Arizona	October 14, 2009
The Nature Conservancy, New Mexico	December 2, 2009
Winkelman Natural Resource Conservation District	January 6, 2010
Natural Resources Defense Council, The Wilderness Society, The Nature Conservancy, Center for Desert Archaeology	January 12, 2010
Pima County, Arizona, U.S. Bureau of Reclamation, National Park Service	April 2, 2010
Winkelman Natural Resource Conservation District	April 13, 2010
City of Tucson, Arizona	April 14, 2010
Redington Natural Resource Conservation District	April 15, 2010
Arizona Army National Guard, Fort Huachuca, Davis-Monthan AFB, U.S. Army Regional Coordinator, Department of Defense Regional Environmental Coordinator Officer	April 29, 2010
Pima County Regional Flood Control District	May 19, 2010
Pima County Administrator, Pima County Regional Flood Control District	July 9, 2010
Redington and Winkelman Natural Resource Conservation Districts Workshop	July 28, 2010

Table 5-5. Meetings with Cooperating Agencies during Scoping Period

Fort Bliss, White Sands Missile Range	September 21, 2009
Holloman AFB	October 6, 2009
U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Fort Bliss, White Sands Missile Range, Holloman AFB	December 2, 2009
Holloman Air Force Base, Fort Bliss, White Sands Missile Range, U.S. Fish and Wildlife Service, New Mexico Air National Guard, other Departments of Defense	February 10, 2010

Table 5-5. Meetings with Cooperating Agencies during Scoping Period	
Holloman AFB, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, White Sands Missile Range, Fort Bliss, Office of Secretary of Defense, and State of New Mexico	February 17, 2010
U.S Fish and Wildlife Service, Arizona Game and Fish Department	March 23, 2010
Holloman AFB, White Sands Missile Range, Kirtland AFB, Naval Research Lab, New Mexico Military Base Planning Commission	April 27, 2010
Arizona Game and Fish Department	May 13, 2010

5.3 CONSULTATION AND COORDINATION

Agencies, tribes, and organizations that have jurisdiction and/or specific interest in the Project were contacted at the beginning of scoping, during the resource inventory, and prior to the publication of this EIS to inform them of the Project, verify the status and availability of existing environmental data, request data and comments, and solicit their input regarding the Project. Additional contact was made throughout the scoping process to clarify or update information provided by the agencies and organizations. This section describes the consultation and coordination efforts that have occurred throughout this EIS process.

5.3.1 Cooperating Agencies

A cooperating agency is any federal, state, or local government agency or tribe that has jurisdiction by law or special expertise regarding environmental impacts of a proposed project. Those entities that chose to contribute to the preparation of this EIS as cooperating agencies are listed in Table 5-6. Numerous meetings with the cooperating agencies were held during the scoping period (see Table 5-5 and Section 5.2) and during the process of preparing the EIS.

Table 5-6. Cooperating Agencies	
Federal Agencies	**State Agencies**
U.S. Fish and Wildlife Service National Park Service Bureau of Indian Affairs U.S. Army Corps of Engineers Fort Bliss McGregor Range (U.S. Army) Fort Huachuca (U.S. Army) White Sands Missile Range (U.S. Army) Holloman Air Force Base Department of Defense Siting Clearinghouse	New Mexico State Land Office New Mexico Spaceport Authority Arizona State Land Department Arizona Game and Fish Department Arizona Department of Transportation

Additional meetings with cooperating agencies included the following:

- U.S. Army Corps of Engineers – March 17, 2011
- National Park Service (Salinas Pueblo Missions National Monument) Holloman AFB, White Sands Missile Range – June 22, 2011
- Arizona State Land Department – September 28, 2011
- Arizona Game and Fish Department – October 5, 2011

- National Park Service, Holloman AFB, White Sands Missile Range, U.S. Fish and Wildlife Service, Fort Bliss McGregor Range (U.S. Army), New Mexico State Land Office, New Mexico Spaceport Authority – January 23, 2012
- National Park Service, U.S. Fish and Wildlife Service, Fort Huachuca (U.S. Army), Department of Defense Siting Clearinghouse, Arizona State Land Department, Arizona Game and Fish Department, Arizona Department of Transportation – January 24, 2012
- National Park Service, U.S. Fish and Wildlife Service, Fort Huachuca (U.S. Army), Department of Defense Siting Clearinghouse, Arizona State Land Department, Arizona Game and Fish Department – February 29, 2012
- National Park Service – April 19, 2012

5.3.2 Tribes

In May 2009, the BLM contacted the following federally recognized tribes to notify them of the Project, initiate government-to-government consultation, invite them to participate as cooperating agencies in preparation of the EIS, and to participate in the Section 106 consultation:

- Hopi Tribe
- San Carlos Apache Tribe
- Tohono O'odham Nation
- Salt River Pima-Maricopa Indian Community
- Gila River Indian Community
- Ak-Chin Indian Community
- White Mountain Apache
- Tonto Apache Tribe
- Yavapai-Apache Nation
- Pascua Yaqui Tribe
- Comanche Indian Tribe
- Fort Sill Apache Tribe of Oklahoma
- Kiowa Tribe of Oklahoma
- Apache Tribe of Oklahoma
- Ysleta del Sur Pueblo
- Mescalero Apache Tribe
- Pueblo of Isleta
- Navajo Nation (including Alamo Chapter)
- Pueblo of Acoma
- Pueblo of Laguna
- Zuni Pueblo

A copy of the tribal consultation letter and tribal contact information are included in the Project Scoping Report and Addendum. With the addition of local alternatives north of Gran Quivira, the BLM initiated government-to-government consultation with additional federally recognized tribes to invite them to participate as cooperating agencies in preparation of the EIS. Letters were sent to the following tribes in April 2012:

- Caddo Indian Tribe
- Pueblo of Santo Domingo
- Wichita and Affiliated Tribes
- Pueblo of Taos
- Pueblo of Jemez
- Pueblo of Sandia
- Pueblo of Tesuque
- Jicarilla Apache Nation

In recognition of the tribes' special relationship with the United States government, the BLM will continue to consult with the appropriate tribal governments at an official executive level (government to government), in accordance with the NHPA, EO 13175, and the NEPA. The BLM has provided opportunities for government officials and members of federally recognized tribes to comment on and participate in the preparation of the EIS; and will consider these comments, notify consulted tribes of final decisions, and inform them of how their comments were addressed in those decisions. At a minimum, officials of federally recognized tribal governments will be offered the same level of involvement as state and county officials. Coordination will address consistency with tribal plans, as appropriate; and the observance of specific planning coordination authorities (including Section 101[d][6] of the NHPA, American Indian Religious Freedom Act, EO 13007 [Indian Sacred Sites], and EO 12898 [Environmental Justice]) and Secretarial Order 3206 (American Indian Rights, Federal Tribal Trust Responsibilities and the ESA). Although no tribes requested cooperating agency status for the preparation of this EIS, several tribes are participating in Section 106 consultation, which will continue during the post-EIS phases of Project implementation prior to construction. Table 5-7 shows tribal consultation meetings that have occurred to date.

Table 5-7. Tribal Consultation Meetings

Meeting	Date
Arizona Four Southern Tribes[1]	July 21, 2009
Pueblo of Zuni	August 13, 2009
Pueblo of Isleta	August 25, 2009
Fort Sill, Mescalero, and San Carlos Apache tribes	October 16, 2009
San Carlos Apache and White Mountain Apache tribes	October 4, 2011
Four Southern Tribes Cultural Resource Working Group	July 20, 2012
Pueblo of Zuni	August 28, 2012
Ysleta del Sur Pueblo	October 15, 2012
San Carlos Apache Tribe	October 18, 2012
Pueblo of Isleta	November 9, 2012
Tohono O'odham Nation Cultural Preservation Committee	November 27, 2012
Tohono O'odham Nation Legislative Council	December 6, 2012

[1]Tohono O'odham Nation and the Ak-Chin Indian Community representatives were present, while the Gila River and Salt River Pima-Maricopa Indian communities were not present.

5.3.3 Agency Communications

Communications and meetings with agencies, in addition to the cooperating agencies (Section 5.3.1), have continued throughout the EIS process. Various meetings have been conducted at key milestones during the environmental studies to obtain input or refine alternatives and data prior to detailed analysis. Table 5-8 lists the agencies that have been contacted as part of this EIS process.

In addition to the meetings held during scoping, noted in Table 5-4, the BLM met with the NRCD on June 14 and July 11, 2011, and December 18, 2012. In a letter from the chairpersons of the Redington and Winkelman NRCD to the DOI dated July 28, 2011, the NRCD stated that they declined to participate as a cooperating agency.

Table 5-8. Contacts with Other Agencies

Federal Agencies	
Department of Defense U.S. Air Force – Davis Monthan AFB U.S. Naval Research Laboratory U.S. Army Corps of Engineers	**Department of the Interior** Bureau of Reclamation Bureau of Land Management **U.S. Forest Service** Cibola National Forest Southwestern Regional Office
State Agencies	
New Mexico Economic Development Department Museum of Natural History and Science New Mexico Game and Fish Renewable Energy Transmission Authority New Mexico State Historic Preservation Officer New Mexico State Land Office New Mexico Department of Transportation	**Arizona** Arizona Army Air National Guard Arizona Geological Survey Arizona State Historic Preservation Officer Arizona State Land Department Arizona Department of Transportation Arizona State Museum
Local Agencies	
New Mexico Doña Ana County City of Anthony City of Las Cruces Grant County Hidalgo County City of Lordsburg Lincoln County Luna County City of Deming Otero County City of Alamogordo Sierra County Town of Elephant Butte Town of Truth or Consequences Socorro County City of Socorro Torrance County Valencia County	**Arizona** Cochise County City of Benson City of Willcox Graham County Greenlee County Pima County Pima County Flood Control District Redington Natural Resource Conservation District Winkelman Natural Resource Conservation District

5.3.4 Interest Groups and Other Stakeholders

Local interest groups and stakeholders were also invited to attend the scoping meetings and provide comments (Table 5-9). BLM representatives attended a meeting with representatives of the Natural Resources Defense Council, the Wilderness Society, and TNC on January 12, 2010, and a meeting held by the Cascabel Working Group on January 13, 2010.

Table 5-9. Interest Groups and Other Stakeholders	
Anam, Inc.	Jaguar Habitat Campaign
Apaches of Aravaipa Canyon	Lennar Corporation – Tucson Land Division
Aravaipa Property Owners Association	Mesilla Valley Audubon Society
Arid Lands Resource Sciences	Middle Rio Grande Conservancy District
Arizona Archaeological Council	National Parks Conservation Association – Southwest
Arizona Native Plant Society	National Trust for Historic Preservation
Audubon New Mexico	National Trust for Historic Properties
Blue Goose Alliance	Natural Resources Defense Council
Cascabel Hermitage Association	New Mexico Archeological Council
Cascabel Working Group	New Mexico Gas Company
Center for Biological Diversity	NM Solar Station, LLC
Center for Desert Archaeology	NM Wildlife Federation
Coalition for Sonoran Desert Protection	Regional Office
Community Watershed Alliance	Rio Grande Agricultural Land Trust
Continental Divide Trail Alliance	Saguaro Juniper Corporation
Corona Public Schools	Salt River Project
Duke Energy	Sangre de Cristo Audubon Society
Earth Justice	Sierra Club – Grand Canyon Chapter
Electric Pipeline Corporation	Socorro Electric Cooperative
Electrical District #2	Sonoran Institute
Empire-Fagan Coalition	Southern AZ Hiking Club – Cochise Trails Association
Energy Capital Partners	Southwestern Power Group II
Eureka Springs Property Owner Association	The American Consumer Institute
Freeport Sierrita, Inc.	The Gamez Cemetery
Friends of Saguaro National Park	The Nature Conservancy
Friends of the Aravaipa Region	The Peyote Way Church
Friends of the Bosque del Apache NWR	The Wilderness Society
Frio Ridge Energy Development Association, LLC	Tiede's Line Construction
Frio Ridge Landowner Association	Tierra Grande Improvement Association, Inc.
Geo-Marine, Inc.	University of New Mexico
Gila Conservation Coalition	Willow Springs Ranch Phase I Owners Association, Inc.
Gila Resource Information Project	Windmill Ranches Homeowners Association
J-6/Mescal Community Development Organization	

5.3.5 Applicant Participation

Commensurate with the MOU and the EIS Preparation Plan, the Applicant has provided technical and clarifying information about the Project, attended and participated in meetings, and provided comments on documents prepared for the draft EIS. The Applicant has also reviewed and provided the technical, environmental, and socioeconomic information in its possession.

The Applicant has communicated extensively with representatives of various federal, state, and local government agencies and several stakeholder groups and organizations concerning Project plans. BLM representatives attended a meeting hosted by the Applicant, with representatives of the Cascabel Working Group.

5.4 FORMAL CONSULTATION

The BLM and cooperating agencies are required to prepare an EIS in coordination with any studies or analyses required by the Fish and Wildlife Coordination Act (16 USC Sec 661 et seq.),

ESA (16 USC Sec 1531 et seq.), and NHPA (16 USC Sec 470 et seq.). Other consultations and processes for compliance with federal requirements may be carried out to address other laws and regulations, including the MBTA, BGEPA, Section 358 of the National Defense authorization act, and/or others.

The following sections summarize activities associated with the consultation processes to date for threatened and endangered species and cultural resources.

5.4.1 Section 7 of the Endangered Species Act

Consultation with the USFWS is required under Section 7 of the ESA, when a project that is carried out, funded, or authorized by a federal agency may affect species listed under the ESA. The BLM requested early input from the USFWS to identify ESA-listed species and other sensitive biological resources, and received comments on September 14, 2009. Published lists of ESA-listed species created by the USFWS for all counties crossed by the study corridor were reviewed by the BLM, and included BLM records, USFWS documents, other agency reports, primary literature, and regional references. This information was used in the early development of alternative routes for the Project, and updated to include current status of affected species. As part of formal consultation under Section 7 of the ESA, the BLM submitted a BA to the USFWS to address species with the potential to occur in the area of the BLM preferred alternative for the Project. The USFWS will review the BA and issue a Biological Opinion to complete Section 7 consultation.

5.4.2 Section 106 of the National Historic Preservation Act

The lead federal agency, along with any other federal agency that may be issuing permits or licenses for the Project, has a responsibility under Section 106 of the NHPA to consider the effects of its undertakings on properties listed in or eligible for the NRHP. Eligible properties include a diversity of archaeological, historical, and traditional cultural resources. Implementing regulations for Section 106, Protection of Historic Properties (36 CFR 800), define a process for federal agencies to consult with the SHPOs, ACHP, and other interested parties as they assess the effects of their undertakings.

The Section 106 process is initiated with the establishment of the undertaking (§800.3); in this case, the SunZia Southwest Transmission Project, with the BLM as the lead federal agency. This was done shortly after the BLM published the NOI in May of 2009 for the construction, operation, and maintenance of the Project. The Section 106 process was coordinated with the NEPA process, starting with public scoping. During this period, consulting parties were identified and notified of the Project. These parties include tribes, SHPOs in Arizona and New Mexico (§800.3[c]), ASLD, NMSLO, USACE (Section 404 permit compliance), ACHP, NPS, the Applicant, ASM, ADOT, NMDOT, National Trust for Historic Preservation and Archaeology Southwest (formerly known as the Center for Desert Archaeology), Cascabel Working Group, New Mexico Archaeological Council and the Arizona Archaeological Council, Pima County, El Camino Real de Tierra Adentro Trail Association, WSMR, and the Alliance for Regional Military Support. Compliance with other pertinent laws such as the NAGPRA, Archaeological Resources Protection Act, and American Indian Religious Freedom Act is also being coordinated under the NHPA and NEPA.

Tribal consultation is required under the NHPA and other laws. Tribes are potential consulting parties for the 106 process, and any tribe that "requests in writing shall be one" (§800.3[f][2]). Invitations for government to government and Section 106 consultation were sent to 29 tribes in May of 2009 and April of 2012. Although there have been no written requests to be consulting parties, tribes that have been active in general Project consultation and the Section 106 process include: Tohono O'odham Nation, GRIC, Salt River Pima-Maricopa Indian Community, Ak-Chin Indian Community, Pueblo of Isleta, Pueblo of Ysleta del Sur, Pueblo of Zuni, Mescalero Apache, Fort Sill Apache, San Carlos Apache, and White Mountain Apache.

The Section 106 process entails the identification of historic properties (§800.4). For the SunZia Project, the process began with the review of existing information, commonly referred to as a Class I inventory. This inventory identified gaps in field-inventory coverage across both states. To supplement the Class I inventory, the BLM elected to conduct a sample (Class II) inventory that included areas where cultural resources would likely occur; in particular, survey units were located where the Project alternatives cross rivers and historic trails (El Camino Real de Tierra Adentro NHT and the Butterfield Trail). This information provided a useful indication of cultural resources site density and sensitivity, and informed the selection of the BLM preferred alternative.

In accordance with §800.4 (b)(2), for projects "where alternatives under consideration consist of corridors or large land areas," a phased approach is followed to identify and evaluate historic properties. Further, "the agency official may also defer final identification and evaluation of historic properties if it is specifically provided for in a…programmatic agreement executed pursuant to §800.14(b)." The APE (§800.4[a][1]; §800.16[d]) would be determined during development of the PA. For a project of this scale, an intensive Class III inventory would be conducted after the BLM selects an alternative, issues a ROD, and grants the right-of-way permit.

Typically, the next step of the Section 106 process is to evaluate sites to determine whether they are eligible or not eligible for inclusion on the NRHP; those determined to be eligible are called "historic properties." However, since the identification effort would take place in stages for this Project, identification and evaluation of historic properties for the NRHP would be deferred until after the ROD and right-of-way permit.

The assessment of adverse effects for historic properties (§800.5) is the next step in the Section 106 process. An adverse effect is found "when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association." Due to the scope and complexity of the SunZia Project, and because the "effects on historic properties cannot be fully determined prior to the approval of an undertaking" (§800.14[b][1][ii]), the BLM determined early in the process that the undertaking would have an "adverse effect" on historic properties. In accordance with §800.6(a)(1), the ACHP was notified of the "adverse effect" determination, concurred with the determination, and agreed to participate in consultations to resolve the adverse effects.

Consultations were initiated in 2009 and have taken place in the form of written correspondence, email, and telephone conversations among the parties. The first formal Section 106 consulting

parties meeting took place in October 2012. To resolve the adverse effects, a Project-specific PA is being developed among the consulting parties, a draft of which is provided in Appendix M of this Final EIS.

5.5 PUBLIC REVIEW OF THE EIS

Concurrent with the distribution of the Draft EIS/RMPA, an NOA was published in the *Federal Register,* announcing the availability of the draft document for a 90-day public review and comment period that started on May 25, 2012, and ended on August 22, 2012. The Draft EIS/RMPA was sent to cooperating agencies, agencies with a potential interest in the Project, and others who requested copies. Printed versions of the Draft EIS documents were made available for review at libraries, BLM offices, and public meeting sites, and were also provided in response to individual requests.

The availability of the Draft EIS/RMPA for public review and comment, along with the locations and times of public meetings, was announced in paid newspaper legal notices and advertisements. In addition, Project newsletters were mailed to individuals, agencies, and organizations that requested notification of the availability of the Draft EIS/RMPA. During the 90-day public review period, 10 public open house meetings were held in June and July 2012 for the BLM to provide information and receive public input on the Draft EIS/RMPA (Table 5-10). These meetings were held in Lincoln, Socorro, Sierra, Luna, and Hidalgo counties in New Mexico, and in Cochise, Graham, Pima, and Pinal counties in Arizona.

Table 5-10. Public Meetings – June and July 2012

Meeting Date	Location	Public in Attendance[1]
New Mexico		
June 26, 2012	Corona High School 250 Franklin St. Corona, NM	67
June 27, 2012	NM Institute of Mining and Technology 801 Leroy Place Socorro, NM	70
June 28, 2012	Sierra County Events Center 2953 S. Broadway St. Truth or Consequences, NM	16
July 9, 2012	Mimbres Valley Special Events Center 2300 E. Pine St. Deming, NM	24
July 10, 2012	Dugan-Tarango Middle School 1352 Hardin St. Lordsburg, NM	5
Arizona		
July 11, 2012	Safford High School 1400 W. Bulldog Blvd. Safford, AZ	22
July 12, 2012	Benson School 360 S. Patagonia St. Benson, AZ	41

Table 5-10. Public Meetings – June and July 2012		
Meeting Date	**Location**	**Public in Attendance[1]**
July 17, 2012	Palo Verde Magnet School 1302 S. Avenida Vega Tucson, AZ	77
July 18, 2012	San Manuel High School 711 S. Mcnab Pkwy. San Manuel, AZ	19
July 19, 2012	Eloy Junior High School 404 E. Phoenix Ave. Eloy, AZ	10
Total Attendees		**351**

[1] For purposes of this report, members of the public exclude Project-related individuals (e.g., BLM resource specialists, Applicant staff and engineers, EIS contractor personnel, and cooperating agency representatives.)

5.5.1 Comment Analysis Process

Comments on the Draft EIS/RMPA were submitted in person at the public meetings, electronically through the BLM SunZia Project website, or mailed to the BLM NM State Office. All comments received during the 90-day review period were recorded and compiled in a database, in which each comment was assigned a unique identifying number. The BLM received over 900 comment submittals (letters or other correspondence), including over 2000 individual comments. In compliance with the requirements of the CEQ for implementing the NEPA, the comments were then analyzed and responses to substantive comments were provided. Per the BLM NEPA Handbook H-1790-1, substantive comments do at least one of the following:

- question, with reasonable basis, the accuracy of information in the EIS
- question with reasonable basis, the adequacy of, methodology for, or assumptions used for the environmental analysis
- present new information relevant to the analysis
- present reasonable alternatives other than those analyzed in the EIS
- cause changes or revisions in one or more of the alternatives

Comments not considered substantive include those:

- in favor of or against the proposed action or alternatives without reasoning that meets the BLM's criteria for substantive comments
- only agreeing or disagreeing with BLM policy or resource decisions without justification or supporting data that meet the BLM's definition of substance;
- comments that do not pertain to the Project area or the Project
- comments that take the form of vague open-ended questions

A complete list of individual letters that commented on the Draft EIS is included in Appendix J. Comments identified as "CN" (comment noted) are acknowledged, although detailed responses are not provided. Substantive comment letters on the Draft EIS are reproduced in full and are categorized by cooperating agencies, other agencies and non-governmental organizations, individuals, and Applicant. Substantive comments within each letter are enumerated in the left

margin of the comment letter (some comment letters address multiple topics) and corresponding responses are included adjacent to each enumerated comment.

5.5.2 General Summary of Comments

Comments identified during scoping were addressed in development of the Draft EIS. The key issues and concerns were related to one of the following categories:

- Project purpose and need
- Alternative development – comments indicating another alternative should be evaluated
- Alternative description and mitigation measures – comments suggesting modifications to already defined alternatives to reduce or avoid potential impacts
- Analysis of environmental effects – comments specifying concerns over resource impacts or suggesting that other effects be considered and disclosed

The Draft EIS addressed issues identified during scoping. Comments received during the public review of the Draft EIS related to these issues either raised questions, suggested other alternatives, provided new information, or expressed preferences. In the development of the Final EIS, information was provided in response to the comments. Information has been added to clarify or correct the Draft EIS, and modifications to alternative transmission line descriptions have been made, where warranted, to incorporate new information and requests for additional mitigation.

5.5.3 Responses to Key Issues and Concerns

The following comments (paraphrased and italicized) are representative of key issues and concerns. Summary responses to these comments are also provided below. See Appendix J for detailed responses to the comments.

5.5.3.1 Purpose and Need

It was understood that a purpose of the Project was to provide new transmission to deliver electricity generated by renewable energy resources in New Mexico and Southeastern Arizona to western power markets. Clarify the potential for interconnection with fossil fuel energy generation facilities.

As stated in Chapter 1 of the Final EIS, the BLM's purpose and need for the proposed Project is established by regulatory obligations and directives, and current energy development trends. The purpose and need is used to formulate a reasonable range of alternatives to be considered in the EIS. The need for the BLM's proposed action arises from the FLPMA to consider the Applicant's right-of-way application. The Applicant's objectives as stated in Section 1.4 of the EIS include increasing "available transfer capability in an electrical grid that is currently insufficient to support the development, access, and transport of additional energy-generating resources, including renewable energy, in New Mexico and Arizona." The range of alternatives considered included potential transmission line routes that could provide electrical interconnections with renewable energy resources located primarily within the QRAs for wind

energy in south-central New Mexico, and the QRAs for solar energy located in southwestern New Mexico (e.g., BLM designated Afton Solar Energy Zone) and southeastern Arizona.

Transmission facility services are to be provided without discrimination as to the type of generation requesting interconnection and transmission service. Although FERC rules do not allow for discriminatory preference among generation subscribers to a transmission line, it is the intent of the Applicant to provide infrastructure to increase transfer capability in areas of potential renewable energy generation. Indirect and cumulative impacts associated with construction and operation of generation facilities have been analyzed and documented in Section 4.17 of the EIS.

5.5.3.2 Proposed Action and Alternatives

A preference would be to construct new transmission lines in areas where there are existing utilities and access. Avoid building new transmission lines in the San Pedro River Valley, Aravaipa/Sulphur Springs Valley, Avra Valley and particularly avoid lines crossing riparian areas along the San Pedro River and Rio Grande. Avoid building transmission lines in areas where military operations are conducted.

In order to identify potential locations for the proposed transmission line routes, information was gathered to determine environmental, engineering, and agency/public/political opportunities and constraints within the study area. Potential alternatives were reviewed based on their ability to maximize opportunities to locate the proposed transmission lines within existing corridors, while avoiding areas of higher constraint or sensitivity. Alternative transmission line routes were considered within the I-10 corridor in Arizona; it was found that there is insufficient area available for the proposed right-of-way adjacent to I-10 due to existing residential, commercial, and industrial development.

In response to information received following the Draft EIS, modifications to the alternative transmission line routes were developed and additional analysis was conducted. The alignment of the BLM preferred alternative was modified in response to substantive recommendations that provided additional information. The BLM preferred alternative was selected because it would maximize use of existing utility corridors and infrastructure, minimize impacts to sensitive resources, minimize impacts at river crossings, minimize impacts to residential and commercial uses, and minimize impacts to military operations within the restricted airspace north of the WSMR. Where available, portions of the route would follow existing utilities or other roads that would provide access for construction and maintenance. Approximately 273 miles (53 percent) of the BLM preferred alternative (total length is 515 miles) would be parallel to existing or designated utility corridors.

To what extent have alternative technologies or systems such as underground construction, transmission system upgrades in existing rights-of-way, alternative voltages, demand-side management or distributed generation been considered?

The BLM considered other options, including alternative transmission routes and transmission technologies, but eliminated them from consideration because they would not be practicable and feasible, as described in Section 2.3.3 of the Final EIS.

How is the project being funded?

The proposed action does not require a cost outlay by the federal government. As provided in the Memorandum of Understanding between the Applicant and the BLM, it is the Applicant's responsibility to reimburse the federal government for expenses to process the right-of-way application under a cost recovery agreement. Federal government financing for development and construction of the Project is not a condition of the proposed action.

5.5.3.3 Water and Soil Resources

Construction of transmission facilities across environmentally sensitive lands could result in soil erosion that would affect grasslands, playas, rivers and streams. Previous construction of many pipelines and roads has led to severe erosion where proper controls were not used.

Earth and water resources studies have been completed to identify specific locations of potentially high levels of wind and water soil erosion. Mitigation measures are proposed that would include BMPs and special construction methods where needed to minimize the potential for erosion in those areas.

5.5.3.4 Biological Resources

The proposed Project route and alternatives would cross major migratory bird corridors along the Rio Grande, the San Pedro River. Other areas of concern include the Willcox and Lordsburg playas and Picacho Reservoir area. Each of the alternative routes would cross the Rio Grande in central New Mexico, a migratory corridor for Sandhill Cranes, waterfowl, and other species. The proposed transmission line project would pose a collision risk to birds.

The highest risk occurs when transmission lines are sited near roosts or foraging areas, and collisions may also occur at night or in poor weather. However, the BLM preferred alternative would cross the Rio Grande at a narrow point in the floodplain, minimizing the amount of nearby foraging habitat for wintering birds. The collision risk to migratory birds would be mitigated through the placement of bird diverters or similar devices in high-risk areas, to be specified in an Avian Protection Plan. Monitoring would take place to ensure proper function and effectiveness of the devices. Mitigation for lost productivity or habitat for migratory birds would be developed under the terms of EO 13186 according to the MBTA and in cooperation with the BLM and USFWS.

The Project would result in ground disturbance that may be temporary or permanent for the life of the Project. Ground disturbance causes the direct loss of native vegetation, and may facilitate the spread of invasive plants. Linear utilities can result in wildlife habitat fragmentation, when constructed in a way that provides a physical barrier to wildlife movement or causes changes in the habitat that reduce the movement of wildlife across the utility corridor. This may include the creation of open spaces avoided by certain species, or disturbance and road mortality associated with construction and recreational traffic.

In accordance with the results of the biological resources impact analysis, mitigation measures have been proposed to avoid or minimize the loss of sensitive riparian vegetation, grasslands,

and other sensitive habitats. Habitat fragmentation and loss of native vegetation would be addressed through standard and selective mitigation measures during construction and maintenance, according to stipulations for reducing ground disturbance, avoiding disturbance to wildlife during sensitive seasons, and closing or reclaiming temporary roads. Site-specific mitigation would be provided in the final POD to include a biological resources protection plan, monitoring during construction, control or prevention of the spread of noxious weeds and other invasive plants, reclamation, and other measures.

The San Pedro River Valley is one of the last free-flowing rivers in the Southwest, and a major migratory bird corridor. Portions of the river that support perennial flow often have mature riparian woodlands and mesquite bosques, and tributaries to the river support threatened or endangered fish and other native aquatic species. Major tributaries of concern with perennial flow include Aravaipa, Hot Springs, Redfield, and Buehman canyons. Removal of riparian woodland and mesquite bosque, creation of new access roads, potential effects on water quality through erosion, and the collision risk for birds are noted.

The BLM preferred alternative would cross the San Pedro River at a location without perennial flow or riparian woodlands, where elevated terrain would allow transmission lines to span the floodplain and minimize the need for vegetation management. Mitigation measures have been proposed to minimize the potential for soil erosion and vegetation loss, including reclamation or closure of access roads where necessary and practicable at the discretion of the respective landowner or land management agency.

5.5.3.5 Cultural Resources and Native American Concerns

Impacts to cultural resources could result from a loss of integrity on prehistoric and historic sites. The Project could also indirectly affect traditional cultural properties such as Mt. Graham or other important sites like Gran Quivira. Types of potential impacts to cultural resources may include ground disturbance, visual and auditory intrusions, and disturbances to sites due to changes in public accessibility during and after construction.

Inventories of previously recorded sites along the alternative study corridors have been conducted. Impacts to cultural resources have been evaluated in the EIS according to potential sensitivity of known cultural resources. Intensive pedestrian surveys along the selected route, including access roads, substations, and other facilities, would be conducted prior to construction if the BLM approves an action alternative in the ROD. Direct impacts to significant cultural resources can be effectively minimized, if not eliminated, through mitigation planning. In designated areas, structures would be placed to avoid and or span sensitive cultural resource sites or features.

All cultural and historic resources identified during the inventory will be evaluated for eligibility to the NRHP. Consultation with appropriate land management agencies, tribal governments, and State Historic Preservation Offices is ongoing and will result in a Programmatic Agreement, which establishes a project-specific procedure for complying with the NHPA, including procedures to follow during the execution of the Project.

5.5.3.6 Land Use, Property Values and Right-of-Way Acquisition

How will the SunZia Transmission Project affect property values?

Studies regarding the effects of transmission lines on property values have been reviewed. These studies found that in cases where there is a decrease in property value, the effects would generally be 10 percent or less. The discussion of property value effects is included in Section 4.13.4.5 of the EIS.

Will I be paid for right-of-way acquisition?

On private lands, the Applicant or owners' representative would negotiate the amount and terms of compensation with individual property owners, including market value compensation for residual impacts.

Various agencies and groups fund and/or help manage conservation easements for a variety of conservation purposes, including reclamation, rehabilitation, riparian protection, habitat and species protection, and invasive species removal. The Project could impact existing and proposed conservation plans and easements located throughout the study area, as well as grazing lands that have been identified for conservation purposes in Pima County, Arizona.

There are conservation plans in several locations, including the Pima County SDCP, The Lower Sonoran Conservation Initiative, and multiple conservation initiatives along the Rio Grande. Many of these areas are state trust and private lands used for grazing and other activities (see sections 3.6.7, 3.10.1.3, 3.10.3.3, 4.6.4.5, and 4.10.5). Where these lands are protected by recorded easements or designations, right-of-way would be acquired on a case-by-case basis in compliance with restrictions, conditions, and mitigation requirements. Project alternatives avoid crossing conservation easements, where easements have been identified.

5.5.3.7 Visual and Scenic Resources

Visual resources are an important component of the natural landscape within large portions of the study area. The Project would cause impacts to viewers and scenic resources from locations such as rural residences, travel routes, wilderness, recreation areas and cultural resource sites.

The locations of alternative transmission line routes were identified according to the study of opportunities and constraints, which included avoidance of potential visual impacts where feasible (e.g., placing new transmission lines within existing utility corridors to reduce contrast). With respect to each of the alternatives considered, visual resource impacts have been thoroughly analyzed and mitigation measures have been proposed to minimize impacts to sensitive resources (see sections 3.9 and 4.9, as well as Appendix D). The BLM preferred alternative (Subroute 1A2) was modified in the vicinity of the Salinas Pueblo Missions National Monument – Gran Quivira Unit in order to mitigate impacts to the cultural landscape setting.

5.5.3.8 Public Review and Comment

The public review period should have been extended beyond 90 days with opportunities for additional public meetings or hearings.

The Draft EIS was made available for public review and comment on May 25, 2012. The BLM held 10 public meetings and scheduled a 90-day public comment period that ended on August 22, 2012. A 45-day public comment period is generally the time provided for a Draft EIS; however, the BLM's planning regulations and guidance require a minimum 90-day public comment period for land use plan amendments. Comments were received by the BLM New Mexico State Office during this 90-day review period. In addition, substantive comments that were received through March 2013 were considered in preparation of the Final EIS.

In total, public involvement for the SunZia Project has included 24 public meetings (14 scoping meetings and 10 public meetings following publication of the Draft EIS), and 270 days of public comment (180 days during scoping, and 90 days during Draft EIS public review). In addition, the BLM will provide 30 days for public comment following publication of this Final EIS.

5.6 PREPARERS AND CONTRIBUTORS

A list of preparers and contributors involved throughout the Project, including BLM staff and consultants, is provided in Table 5-11 and Table 5-12.

Table 5-11. BLM SunZia EIS Interdisciplinary Team

Name	Title
BLM New Mexico State Office, Lead BLM State	
Adrian Garcia	Project Manager
Jonathan David Goodman	NEPA Planning Coordinator
James Sippel	National Lands Conservation System Coordinator/Wilderness Coordinator
Roger "Rob" Jaggers	Recreation Planner/Visual Resource Management
Jane Childress	Lead Archaeologist
Marikay Ramsey	Wildlife Biologist (Threatened and Endangered species, lead for ESA Section 7 consultation)
Jeanne Hoadley	Resources Program Lead (air quality)
Adrienne Brumley	Minerals
Billy "Link" Lacewell	Hazardous Materials Coordinator
Roger Cumpian	Range Conservationist
John Selkirk	Fire and Aviation Specialist
Elaine Lopez	Engineer
Al Sandoval	Geographic Information Systems
Management Oversight	
Jesse Juen	New Mexico BLM State Director
Bill Merhege	Deputy State Director, Resources
Las Cruces District Office	
David Legare	Archaeologist
Frances Martinez	Lands and Realty
Corey Durr	Hydrologist

Table 5-11. BLM SunZia EIS Interdisciplinary Team	
Name	**Title**
Jennifer Montoya	NEPA Coordinator
Phil Smith	Range Specialist
Steven Torres	Wildlife Biologist
Mike Smith	Geologist (Minerals)
Joe Sanchez	Visual Resource Management
Mohammad Nash	Soils and Earth Resources
Management Oversight	
Bill Childress	District Manager
Jim McCormick	Assistant District Manager
Ed Guerrero	Associate District Manager, Border Liaison
Ed Seum	Lands/Minerals Supervisor
Tom Phillips	Recreation/Cultural Supervisor
Ray Lister	Supervisory Natural Resource Specialist
Mike Howard	Botanist
Mike Smith	Geologist (Minerals)
Socorro Field Office	
Virginia Alguire	Lands and Realty
Denny Apachito	Wildlife Biologist
Kevin Carson	Recreation Planner
Nathan Combs	Range Specialist
Melissa Goldin	Management – Program Analyst
Bethany Rosales	Natural Resource Specialist – Range
Brenda Wilkinson	Archaeologist
Gus Hoever	Range Specialist
Management Oversight	
Danita Burns	Field Manager
Mark Matthews	Assistant Field Manager
John Brenna	Assistant Field Manager
Arizona State Office	
Eddie Arreola	Renewable Energy Coordination Office Project Manager
Connie Stone	Renewable Energy Coordination Office Cultural Program Lead
Chris Horyza	NEPA/Planning Coordinator
Ken Mahoney	Wilderness Coordinator
Don Applegate	Visual Resource Management
Management Oversight	
Ray Suazo	Arizona State Director
Julie Decker	Deputy State Director (Resources)
Becky Heick	Supervisory Branch Chief (Lands and Minerals)
Gila District Office	
Tom Dabbs	District Manager
Safford Field Office	
Melissa Warren	Lands and Realty (AZ BLM lead point of contact)
Deborah Morris	Recreation Planner (Visual Resource Management and Recreation)
Dan McGrew	Archeologist
Jeff Conn	Natural Resource Specialist
Ann Humphrey	Range Management Specialist

Table 5-11. BLM SunZia EIS Interdisciplinary Team	
Name	**Title**
Chris Morris	Hydrologist (water resources)
Larry Thrasher	Geologist
Heidi Blasius	Fisheries Biologist
Management Oversight	
Scott Cooke	Field Manager
Tom Schnell	Assistant Field Manager
Tucson Field Office	
Linda Dunlavey	Lands and Realty
Amy Sobiech	Archaeologist
Darrell Tersey	Natural Resource Specialist
Francisco Mendoza	Landscape Architect (Visual Resource Management)
Marcia Radke	Wildlife Biologist
Kristen Duarte	Range Management Specialist
Ben Lomeli	Hydrology and Soils
Linda Hughes	NEPA
Daniel Moore	Geologist (minerals)
Management Oversight	
Brian Bellew	Field Manager
Markian Rekshynskyj	San Pedro Riparian National Conservation Area Manager
Laura Olais	Ironwood Forest National Monument Manager (acting)
BLM National Operations Center/Washington Office	
Joshua Sidon	Economist
Carol Spurrier	Range Ecologist
Kate Winthrop	Energy and Landscapes Coordinator
Andrew Strasfogel	Planning and Environmental Analyst
Karla Rogers	Visual Resource Management Specialist
Cooperating Agency Reviewers – Points of Contact	
New Mexico State Land Office	
Don Britt	Assistant Commissioner, Commercial Resources
New Mexico Space Authority	
William Gutman	Technical Director
Arizona State Land Department	
Rueben Ojeda	Right-of-Way Manager
Tim Bolton	Principal Planner
Arizona Game and Fish Department	
John Windes	Wildlife Habitat Specialist
Ginger Ritter	Evaluation Program Specialist
Kristin Terpening	Habitat Specialist
Arizona Department of Transportation	
Bill Harmon	Engineer, Safford ADOT District Office
Todd Emery	Engineer, Tucson ADOT District Office
National Park Service	
John Reber	Intermountain Region Energy Coordinator
Glen Fulfer	Superintendent, Salinas Pueblos/Gran Quivira National Monument
Darla Sidles	Superintendent, Saguaro National Park
Scott Stonum	Saguaro National Park

Table 5-11. BLM SunZia EIS Interdisciplinary Team	
Name	**Title**
U.S. Fish and Wildlife Service	
Thomas Harvey	Refuge Supervisor
William "Bill" Werner	Ecological Services Renewable Energy Coordinator
U.S. Army Corps of Engineers	
Eddie Paulsgrove	Regulatory Division – Albuquerque, NM, District Office
Department of Defense Siting Clearinghouse (Office of the Deputy Secretary)	
H. David Belote	Executive Director (DOD Clearinghouse, Installations/Environment)
White Sands Missile Range	
Daniel Hicks	Chief of Staff
Holloman Air Force Base	
Jim Iken	Deputy Director for Installations and Support
Fort Bliss Army Base	
Eric Wolters	NEPA Coordinator/Specialist
Fort Huachuca Army Base	
Matt Walsh	Chief, Strategic Management Office
Bureau of Indian Affairs	
Amy Heuslein	Branch Chief, Environmental Quality Services

Table 5-12. Consultant Preparers and Contributors		
Name	**Education**	**Involvement**
EPG		
Karen Anderson	BA, Journalism	Document Management/Technical Editor
Garlyn Bergdale	MLA, Landscape Architecture, Environmental Planning BS, Geography	Principal-in-Charge
Elizabeth Bergdale	BA, Photography (in progress)	Visual Simulations
Boyd Coleman	BS, Agriculture	Land Use and Recreation Resources
Lori Davidson	MLA, Landscape Architecture BS, Environmental Studies and Applications	Visual Resources
Dylan Dettmann	BLA, Landscape Architecture	Visual Resources
Kris Dobschuetz	MA, Anthropology BA, Anthropology	Cultural and Historical Resources
Kevin Duncan	BS, Urban Planning	Land Use and Recreation Resources
Nicole Dykert	BS, Geography	Geographic Information Systems
Nate Ferguson	BLA, Landscape Architecture and Environmental Planning	Visual Resources
Chris Garbo	MUEP, Urban and Environmental Planning BS, Regional Development	Socioeconomic Resources
Caree Griffin	AAS, Drafting	Graphics, Visual Simulations
Chris Harris	BLA, Landscape Architecture BS, Environmental Design	Visual Simulations

Table 5-12. Consultant Preparers and Contributors		
Name	**Education**	**Involvement**
Chelsa Johnson	MLA, Landscape Architecture BA, Biology and Environmental Studies	Visual Resources
Sally Jurin	MS, Education BA, English Grammar and Literature	Technical Editor
David Kahrs	MS, Wildlife Conservation and Management BA, Biology	Wildlife Biology and Vegetation Resources
Don Kelly	MUEP, Urban and Environmental Planning BA, Anthropology BA, Philosophy	Project Coordinator; Socioeconomic, Environmental Justice, Health and Safety
Joseph Kliner	MA, Geographic Information Systems BA, Anthropology	Geographic Information Systems
Michael Kirby	PhD, Geology MS, Geology BS, Geology	Earth and Paleontological Resources
Cara Lonardo	BA, Archaeology	Cultural and Historical Resources
Bob Pape	BA, Biology	Wildlife Biology and Vegetation Resources
Michael Pasenko	MS, Paleontology BA, Anthropology	Earth and Paleontological Resources
Jared Raymond	BS, Environmental and Public Planning	Land Use and Recreation Resources
Matt Sauter	MS, Paleontology BA, Geology	Earth and Paleontological Resources
Marc Schwartz	MLA, Landscape Architecture (pending) BS, Forestry	Visual Resources
Barbara Shurtliff	BA, Journalism	Public Involvement, Project Administration, Technical Editing
Mickey Siegel	MCRP, City and Regional Planning BA, Psychology	Project Manager
Mike Skoko	BS, Geography	Geographical Information Systems
Linwood E. Smith	PhD, Zoology and Botany MS, Zoology BA, Zoology/Chemistry	Wildlife Biology and Vegetation Resources
Christopher E. Rayle	BA, Anthropology MA, Anthropology	Cultural and Historical Resources
Dustin Sunderman	BS, Anthropology	Cultural and Historical Resources
Steve Swanson	PhD, Anthropology MA, Anthropology BA, Anthropology	Cultural and Historical Resources
Paul Trenter	BSLA, Landscape Architecture	Project Manager
Nikki Wallenta	BS, Land Use Planning	Land Use and Recreation Resources
Lauren Weinstein	BS, Resource Planning and Management	Public Involvement Manager
Scott Woods	BS, Geography	Geographic Information Systems

Table 5-12. Consultant Preparers and Contributors		
Name	**Education**	**Involvement**
Subconsultants and Other Contributors		
Wind River Environmental Group, LLC		
Martha Hyder	PhD, Earth Science/Bioclimatology MS, Earth Science/Bioclimatology BS, Biology	Air Quality and Clean Air Act Conformity Analysis
University of New Mexico – Museum of Southwestern Biology/Department of Biology		
Satya Maliakal-Witt	PhD, Biological Sciences	Assessment of the Potential Impacts of the SunZia Southwest Transmission Project on Fall-Migrant Birds along the Rio Grande Flyway: a Comparison of Five Sites
Christopher Witt	PhD, Biological Sciences	
University of Arizona – Economic and Business Research Center, Eller College of Management		
Alberta H. Charney	PhD, Senior Research Economist	SunZia Southwest Transmission Project Economic Impact Assessment
Valorie Rice	MLS	
Marshall J. Vest	Director of Economic and Business Research Center	
New Mexico State University – Arrowhead Center Inc.		
Anthony V. Popp	PhD	SunZia Southwest Transmission Project Economic Impact Assessment
James Peach	PhD	
Leo Delgado	MBA	
POWER Engineers		
Name	**Title**	**Involvement**
Mark Etherton	Managing Engineer	Project Description, Technical Data
Jim Hsu	Principal Engineer	Project Description, Technical Data
Arthur Kroese	Principal Engineer	Project Description, Technical Data
Gary Kunick	Principal Engineer	Project Description, Technical Data
Jim Multerer	Principal Engineer	Project Description, Technical Data
Kiewit Corporation		
Name	**Title**	**Involvement**
Neal Parece	Managing Engineer	Project Description, Technical Data
Pierre Adam	Principal Engineer	Project Description, Technical Data
Brent Bedillion	Principal Engineer	Project Description, Technical Data
Kevin Needham	Principal Engineer	Project Description, Technical Data

REFERENCES

Abbott, D.R., D.R. Mitchell, and J.A. Merewether. 1994. Chronology. In *The Pueblo Grande Project: Feature Descriptions, Chronology, and Site Structure*, edited by D.R. Mitchell. Soil Systems Publications in Archaeology No. 20. vol. 2. Soil Systems, Inc., Phoenix.

Acuña, R.F. 1974. *Sonoran Strongman Ignacio Pesqueira and His Times*. University of Arizona Press, Tucson.

Allison, L. 2011. Arizona Geothermal Potential Greater than Perceived., Available at http://arizonageology.blogspot.com/2007/03/arizona-geothermal-potential-greater.html. Accessed June 7, 2011.

Allison, M.L., and T.C. Shipman. 2008. Arizona Geological Survey Earth Fissure Mapping Program 2007 Progress Report, Open File Report 08-02, 12 pages.

Alsop, F.J. III. 2001. Birds of North America, Western Region. DK Publishing, New York, New York. 752 p.

American Wind Energy Association (AWEA). 2011. Wind Energy Facts: New Mexico. Available at www.awea.org/learnabout/publications/upload/4Q10-New-Mexico.pdf. Accessed June 2011.

Anning, D.W., S.A. Thiros, L.M. Bexfield, T.S., McKinney, and J.M. Green. 2009. Southwest principal aquifers regional ground-water quality assessment. United States geological Survey Fact Sheet 2009-301d, 4 pages.

Anyon, R., S. Swanson, M.C. Nelson, and S. Ventre. 2005. Pithouse Villages, Population Dynamics, and Landscape Use in the Southern Mogollon Region, AD 200-900. Paper presented at the 70th Annual Meeting of the Society for American Archaeology, Salt Lake City, UT.

Argonne National Laboratory (Argonne). 2007. J.C. Molburg, J.A. Kavicky, and K.C. Picel. *The Design, Construction, and Operation of Long-Distance High-Voltage Electricity Transmission Technologies*. Argonne National Laboratory, Environmental Science Division, Report ANL/EVS/TM/08-4. Available at www.osti.gov/bridge.

Arizona Daily Star. 2011. Wolves released in Mexico mountains near Arizona. October 18, 2011. Available at http://azstarnet.com/news/local/border/article_4f0197be-f9cd-11e0-9665-001cc4c002e0.html. Accessed September 13, 2012.

Arizona Department of Agriculture (ADA). 2011. Prohibited, regulated, and restricted noxious weeds. Available at www.azda.gov/psd/quarantine5.htm. Accessed October 6, 2011.

REFERENCES

Arizona Department of Commerce. 2009. Arizona County Profiles: Cochise County, Graham County, Greenlee County, Pima County, Pinal County. Available at www.azcommerce.com/SiteSel/Profiles/County+Profiles.htm. Accessed January 30, 2011.

Arizona Department of Economic Security. 2006. Arizona Population Projections by County 2006-2055. Available at www.workforce.az.gov/population-projections.aspx. Accessed January 10, 2011.

Arizona Department of Environmental Quality (ADEQ). 2008a. Upper Gila Watershed. Available at www.azdeq.gov/environ/water/assessment/download/2008/ugw.pdf.

Arizona Department of Environmental Quality (ADEQ). 2008b. Final, Arizona State Implementation Plan, Rillito PM10 Nonattainment Area.

Arizona Department of Environmental Quality (ADEQ). 2009. Waste Program Division GIS shapefiles.

Arizona Department of Environmental Quality (ADEQ). 2010. Water Quality Division. 2006/2008 Impaired Waters List. Available at www.azdeq.gov/environ/water/assessment/assess.html.

Arizona Department of Environmental Quality (ADEQ). 2011a. Air Quality Division: Monitoring. Available at www.azdeq.gov/environ/air/monitoring/index.html. Accessed February 28, 2011.

Arizona Department of Environmental Quality (ADEQ). 2011b. Outstanding Arizona Waters. http://lists.azdeq.gov/environ/water/permits/stormwater.html. Accessed August, 2011.

Arizona Department of Revenue (ADOR). 2011. Memorandum: June 2011 Tax Facts, Summary of General Fund Revenues (released 9-30-2011). Available at www.azdor.gov/Portals/0/TaxFacts/0611Taxfact.pdf.

Arizona Department of Transportation (ADOT). 2010. Arizona's Wildlife Linkages Assessment Document webpage. Available at www.azdot.gov/Highways/OES/AZ_WildLife_Linkages/assessment.asp. Accessed September 21, 2010.

Arizona Department of Transportation (ADOT). 2011. Available at www.azdot.gov/Highways/Projects/NorthSouthCorridorStudy/index.asp. Accessed January 2011.

Arizona Department of Water Resources (ADWR). 2009. Arizona Water Atlas Volume 3, Southeastern Arizona Planning Area.

Arizona Department of Water Resources (ADWR). 2010. Arizona Water Atlas Volume 8, Active Management Area Planning. http://lists.azdeq.gov/environ/water/watershed/index.html.

REFERENCES

Arizona Game and Fish Department (AZGFD). 1996. Wildlife of special concern in Arizona. Public review draft. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. 23 p.

Arizona Game and Fish Department (AZGFD). 2001a. *Cyprinodon macularius*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 4 p. Available at www.azgfd.gov/w_c/edits/documents/Cyprmacu.fo_000.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2001b. *Anthus spragueii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 6 p. Available at www.azgfd.gov/w_c/edits/documents/Anthspra.d_000.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2001c. *Pediomelum pentaphyllum*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 5 p. Available at www.azgfd.gov/w_c/edits/documents/Pedipent.fo.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2001d. *Oncorhynchus apache*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 6 p. Available at www.azgfd.gov/w_c/edits/documents/Oncoapac.fo_000.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2001e. Desert Tortoise, *Gopherus agassizii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 10 pp.

Arizona Game and Fish Department (AZGFD). 2002. *Gila intermedia*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 9 p. Available at www.azgfd.gov/w_c/edits/documents/Gilainte.fo_002.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2004a. *Panthera onca*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 7 pp. Available at www.azgfd.gov/w_c/edits/documents/Pantonca.fi.pdf. Accessed: November 17, 2009.

Arizona Game and Fish Department (AZGFD). 2004b. *Herpailurus yaguarondi tolteca*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 4 p. Available at www.azgfd.gov/w_c/edits/documents/Herpyato.d.pdf. Accessed October 6, 2011.

REFERENCES

Arizona Game and Fish Department (AZGFD). 2006. *Rallus longirostris yumanensis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona. 11 p. Available at www.azgfd.gov/w_c/edits/documents/Rallloyu.fi_000.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2009. Quarterly Wolf Location Map. Available at www.azgfd.gov/w_c/es/documents/QuarterlyWolfLocationMap7-09-9-09.pdf. Accessed October 2009.

Arizona Game and Fish Department (AZGFD). 2010. AZGFD Game Development Branch – Habitat Partnership Program. Habitat enhancement and wildlife management proposal for the Bonita Grasslands Restoration Project. Available at www.azgfd.gov/w_c/documents/10-504BonitaRanchPhase1BonitaGrasslandsRestoration.pdf. Accessed October 6, 2011.

Arizona Game and Fish Department (AZGFD). 2011a. Cluff Ranch Wildlife Area. Available at www.azgfd.gov/outdoor_recreation/wildlife_area_cluff.shtml. Accessed January 31, 2011.

Arizona Game and Fish Department (AZGFD). 2011b. Rare Ocelot Observed in Southern Arizona. Available at www.azgfd.net/artman/publish/NewsMedia/Rare-ocelot-observed-in-southern-Arizona.shtml. Accessed March 8, 2011.

Arizona Game and Fish Department and the New Mexico Department of Game and Fish (AZGFD and NMDGF). 2007. Memorandum of Understanding for Jaguar Conservation. 7 p. Available at www.gf.state.az.us/w_c/es/documents/JAGCT.MOU.2007-2011.20070212.Final.pdf. Accessed November 17, 2009.

Arizona Game and Fish Department. (AZGFD). 2012. Aerial locations for Wolves with radio collars (July 1, 2012 – September 30, 2012). Available at www.azgfd.gov/w_c/es/documents/QuarterlyWolfLocationMapBRWRA3rd2012_000.pdf. Accessed September 13, 2012.

Arizona Geological Survey (AZGS). 2000. The Geologic Map of Arizona. Arizona Geological Survey Digital Geologic Map: DGM-17. Available at www.azgs.state.az.us/services_azgeomap.shtml. Recovered July 2009.

Arizona Geological Survey (AZGS). 2011. Mining Districts in Arizona. Available at www.azgs.az.gov/minerals_mining.shtml.

Arizona Interagency Desert Tortoise Team. 2000. Averill-Murray, R.C., ed. Status of the Sonoran Population of the Desert Tortoise in Arizona, an Update. Arizona Interagency Desert Tortoise Team and Arizona Game and Fish Department, Phoenix, Arizona. 48 pp.

REFERENCES

Arizona Land Resource Information System (ALRIS). 2009. Arizona Surface Ownership GIS shapefile. Available at Anthony Maslowicz through a temporary download link on February 22, 2009.

Arizona Land Resource Information System (ALRIS). 2010. Available at www.land.state.az.us/alris. Accessed October 6, 2011.

Arizona Rare Plant Committee. No date. Arizona Rare Plant Field Guide. A collaboration of agencies and organizations including USDA Forest Service, U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Tohono O'odham Nation, University of Arizona, Arizona Native Plant Society, The Nature Conservancy, Desert Botanical Garden, the Arboretum at Flagstaff, Navajo Natural Heritage Program, Arizona Game and Fish Department.

Arizona State Forestry Division. 2008. Fire suppression and prescribed fire policy. 10 pp.

Armstrong, A.K. 1970. Mississippian stratigraphy and geology of the northwestern part of the Klondike Hills, southwestern New Mexico. New Mexico Geological Society 21st Field Conference, pp. 60-63.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fielder, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. The Journal of Wildlife Management 72 (1): 61-78.

Arno, S.F. 2000. Fire in Western forest ecosystems. *In* Brown, J.K, and J.K. Smith, eds. Wildland fire in ecosystems: effects of fire on flora. General Technical Report RMRS-GTR-42 (2). U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 257 pp.

Association of Fish and Wildlife Agencies. 2002. State Wildlife Grants Program. Available at www.teaming.com/funding/state_wildlife_grants.html. Accessed February 24, 2011.

Autrey, Patricia. Town of Mountainair New Mexico Municipal Court. Discussion about emergency medical services in southeast Torrance County. June 16, 2011.

Averill-Murray, R.C., S.J. Bailey, B.E. Martin, and E.B. Wirt. 2002. Activity and Behavior of the Sonoran Desert Tortoise in Arizona. *In* The Sonoran Desert Tortoise: Natural History, Biology, and Conservation. University of Arizona Press, Tucson, Arizona. 388 pp.

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird collisions with power lines: State of the art in 1994. Edison Electric Institute. Washington, DC. 78 pp.

Avian Power Line Interaction Committee (APLIC). 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, California. 207 pp.

Avian Powerline Interaction Committee (APLIC). 2012. Reducing Avian Collisions with Powerlines: the State of the Art in 2012. Edison Electric Institute and APLIC. Washington, DC. 184 pp.

Babb, R.D., D.E. Brown, and J.L. Childs. 2004. On the status of the Opossum (*Didelphis virginiana*) in Arizona. Journal of the Arizona-Nevada Academy of Science 36 (2): 120-126.

Bahr, D., J. Smith, W.S. Allison, and J. Hayden. 1994. *The Short, Swift Time of Gods on Earth: The Hohokam Chronicles*. University of California Press, Berkeley.

Baker, A.J. 2008. Islands in the sky: the impact of Pleistocene climate cycles on biodiversity. Journal of Biology 7: 32.1-32.4.

Bancroft, H.H. 1889. History of Arizona and New Mexico. In *The Works of Hubert Howe Bancroft Volume XVII*. 39 vols. The History Company Publishers, San Francisco.

Barbour, R.W., and W.H. Davis. 1969. Bats of America. The University of Kentucky Press. 286 p.

Barnes, W. C. 1988. *Arizona Place Names*. 3rd ed. University of Arizona Press, Tucson.

Barrett, S.L. 1990. Home range and habitat of the Desert Tortoise (*Xerobates agassizii*) in the Picacho Mountains of Arizona. Herpetologica 46 (2): 202-206.

Bartolino, J.R., and J.C. Cole. 2002. Ground-water resources of the middle Rio Grande basin, New Mexico. U.S. Geological Survey Circular 1222, 132 p.

Basso, K.H. 1971. *Western Apache Raiding and Warfare: From the Notes of Grenville Goodwin.* University of Arizona Press, Tucson.

Basso, K. H. 1983 Western Apache. In *Handbook of North American Indians, Volume 10: Southwest*, edited by A. Ortiz, pp. 462-488. vol. 10, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Baxter, J.O. 1987. *Las Carneradas: Sheep Trade in New Mexico 1700–1860*. University of New Mexico Press, Albuquerque.

Beckett, P.H., and R.S. MacNeish. 1994. The Archaic Chihuahua Tradition of South-Central New Mexico and Chihuahua, Mexico. In *Archaeic Hunter-Gatherer Archaeology in the American Southwest*, edited by B.J. Vierra, pp. 335-371. Contributions in Anthropology 13(1). Eastern New Mexico Press, Portales.

Beier, P., D. Majka, and T. Bayless. 2006. Arizona Missing Linkages: Rincon-Santa Rita-Whetstone Linkage Design. Report to the Arizona Game and Fish Department. School of Forestry, Northern Arizona University. 135 p. + Appendices. Available at http://corridordesign.org/linkages/Arizona. Accessed October 6, 2011.

Beier, P., Garding, E., and D. Majka. 2008. Arizona Missing Linkages: Galiuro-Pinaleño-Dos Cabezas Linkage Design. Report to the Arizona Game and Fish Department. School of Forestry, Northern Arizona University. 96 p. + Appendices. Available at http://corridordesign.org/linkages/Arizona. Accessed October 6, 2011.

Bennet, Pat. 2011. Grant County History. Available at www.grantcountynewmexico.org. Accessed January 30, 2011.

Benson Hospital. 2010. Benson (Arizona) Hospital Website. Available at www.benson hospital.org/index.html. Accessed January 30th, 2011.

Bermudez, F.C., J.N. Stuart, J.K. Frey, and R. Valdez. 1995. Distribution and status of the Virginia Opossum (*Didelphis virginiana*) in New Mexico. The Southwestern Naturalist 40 (3): 336-340.

Berry, C.F., and M.S. Berry. 1986. Chronological and Conceptual Models of the Southwestern Archaic. In *Anthropology of the Desert West Essays in Honor of Jesse D. Jennings*, edited by C.J. Condie and D.D. Fowler. University of Utah Anthropological Papers No. 110. University of Utah, Salt Lake City.

Biota Information System of New Mexico (BISON-M). 2008. New Mexico Department of Game and Fish. Available at www.bison-m.org. Accessed October 6, 2011.

Bland, D. 2010. Geothermal Applications in New Mexico. *Lite Geology*. New Mexico Bureau of Geology & Mineral Resources, a division of New Mexico Tech. Fall 2010. Issue 28. Available at http://geoinfo.nmt.edu/publications/periodicals/litegeology/28/ lite_geo_28fall10.pdf.

Boarman, W.I., and M. Sazaki. 2006. A highway's road effect zone for Desert Tortoises (*Gopherus agassizii*). Journal of Arid Environments 65: 94-101.

Boldurian, A., and J.L. Cotter. 1999. Clovis Revisited: New Perspectives on Paleoindian Adaptations for Blackwater Draw New Mexico. University of Pennsylvania Museum, Philadelphia.

REFERENCES

Bolton, H.E. 1949. *Coronado, Knight of Pueblos and Plains*. University of New Mexico Press, Albuquerque.

Bonneville Power Administration. 2009. Available at http://efw.bpa.gov/environmental_services/Document_Library/Grand_Coulee. Accessed September 21, 2011.

Bonnichsen, R., and K.L. Turmire. 1991. *Clovis: Origins and Adaptions*. Center for the First Americans, Oregon State University, Corvallis.

Bostwick, T.W., D.H. Greenwald and M.-E. Walsh-Anduze. 1996. Exploring the Hohokam to Pima Transition in the Salt River Valley. Paper presented at the 1995 Fall Conference of the Arizona Archaeological Council, Flagstaff.

Bowie Power Station. 2010. Bowie Power Station Class I Permit Application. Submitted to Arizona Department of Environmental Quality.

Braddy, S.J. 1998. An overview of the invertebrate Ichnotaxa from the Robledo Mountains Ichnofauna (lower Permian), southern New Mexico. Pp. 93-98 *In* Lucas, S.G., J.W. Estep, and J.M Hoffer (Eds.) Permian Stratigraphy and Paleontology of the Robledo Mountains, New Mexico. New Mexico Museum of Natural History and Science Bulletin 12.

Brayer, H.O. 1939. *Pueblo Indian Land Grants of the "Rio Abajo," New Mexico*. University of New Mexico Press, Albuquerque.

Brennan, T.C., and A.T. Holycross. 2006. Amphibians and Reptiles in Arizona. Arizona Game and Fish Department. Phoenix, Arizona. 150 p.

Breternitz, D.A. 1959. *Excavations at Nantuck Village, Point of Pines, Arizona*. Anthropological Papers of the University of Arizona No. 1. University of Arizona, Tucson.

Brooks, M.L. 2008. Plant invasions and fire regimes. *In* Zouhar, K., J.K. Smith, S. Sutherland, and M.L. Brooks. Wildland fire in ecosystems: fire and nonnative invasive plants. General Technical Report RMRS-GTR-42 (6). U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 355 pp.

Brooks, M.L., and T. Esque. 2000. Alien grasses in the Mojave and Sonoran deserts. Proceedings of the California Exotic Pest Plant Council Symposium 6: 39-44.

Brown, B.T. 1993. Winter foraging ecology of Bald Eagles in Arizona. The Condor 95 (1): 132-138.

Brown, B.T., W.C. Leibfried, T.R. Huels, and J.A. Olivera. 1991. Prey remains from Bald Eagle nests in Sonora, Mexico. The Southwestern Naturalist 36 (2): 259-262.

Brown, D.E. 1982a. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Brown, D.E. 1982b. Chihuahuan Desertscrub. Pp. 169-179. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Brown, D.E. 1982c. Semidesert Grassland. Pp. 123-131. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Brown, D.E. 1982d. Plains and Great Basin Grasslands. Pp. 115-121. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Brown, D.E. 1982e. Great Basin Conifer Woodland. Pp. 52-57. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Brown, D.E., and C.A. López González. 1999. Jaguarundi (*Herpailurus yagouaroundi*) Not in Arizona or Sonora. Journal of the Arizona-Nevada Academy of Science, Vol. 32, No., 2pp. 155-157.

Bryan, K., and J.W. Gidley. 1926. Vertebrate fossils and their enclosing deposits from the shore of Pleistocene Lake Cochise, Arizona. American Journal of Science, 5th Series 2:477-488.

Bureau of Land Management (BLM). 1978g. Wilderness Inventory Handbook. Available at www.blm.gov/ca/pa/wilderness/wilderness_pdfs/wsa/Wilderness_Inventory.pdf. Accessed March 2011.

Bureau of Land Management (BLM). 1985. Rio Puerco (Albuquerque) Resource Management Plan Revision and Environmental Impact Statement 1985.

Bureau of Land Management (BLM). 1986. Las Cruces Field Office. White Sands Resource Management Plan. October 1986.Available at www.blm.gov/pgdata/etc/medialib/blm/nm/field_offices/las_cruces/las_cruces_planning/white_sands_rmp.Par.85500.File.dat/White%20Sands%20Resources%20Area.pdf.

Bureau of Land Management (BLM). 1987. Safford and Phoenix Districts_ Eastern Arizona Grazing EIS. Available at www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/nepa/library/grazing.Par.3164.File.dat/EasternAzGrazingDEIS.pdf

Bureau of Land Management (BLM). 1988. Desert Tortoise Habitat Management on the Public Lands – a Rangewide Plan. 23 pp.

Bureau of Land Management (BLM). 1988. Phoenix Field Office. Phoenix Resource Management Plan and Final Environmental Impact Statement. December 1988.

Bureau of Land Management (BLM). 1991. Safford District Office. Safford District Resource Management Plan and Environmental Impact Statement. August 1991.

Bureau of Land Management (BLM). 1993. Las Cruces District Office. Mimbres Resource Management Plan. December 1993. Available at http://www.blm.gov/nm/st/en/fo/Las_Cruces_District_Office/mimbres_rmp.html

Bureau of Land Management (BLM). 1997. Roswell Approved Resource Management Plan and Record of Decision. October 1997.

Bureau of Land Management (BLM). 1998a. Gila Box Riparian National Conservation Area Management Plan, Environmental Assessment, and Decision Record. January 1998.

Bureau of Land Management (BLM). 1998b. *Tucson Field Office, Muleshoe Ecosystem Management Plan and Environmental Assessment.* 206 pp.

Bureau of Land Management (BLM). 2003. Tucson Field Office, Las Cienegas Resource Management Plan and Record of Decision. This plan was prepared to manage the 49,000 acres of public land, resources and uses within the Las Cienegas National Conservation Area and Sonoita Valley Acquisition Planning district.

Bureau of Land Management (BLM). 2004a. New Mexico Statewide Resource Management Plan Amendment for Fire and Fuels on Public Land in New Mexico and Texas. 107 pp. Available at www.blm.gov/pgdata/etc/medialib/blm/nm/field_offices/nmso/nmso_planning/fire_and_fuels_mgmt.pdf.

Bureau of Land Management (BLM). 2004b. Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management. 208 pp.

Bureau of Land Management (BLM). 2004c. Safford-Tucson Fire Management Zone: Fire Management Plan. 111 pp.

Bureau of Land Management (BLM). 2005. *Final Programatic Environmental Impact Statement on Wind Energy Development on BLM–Administered Lands in the Western United States.* Washington, DC: Bureau of Land Management.

Bureau of Land Management (BLM). 2006. Las Cruces District Office. McGregor Range Record of Decision and Resource Management Plan Amendment. May 2006. Available at www.blm.gov/pgdata/etc/medialib/blm/nm/field_offices/las_cruces/las_cruces_planning/mcgregor_range.Par.2140.File.dat/Final_ROD_RMPA.pdf.

Bureau of Land Management (BLM). 2008a. BLM NEPA Handbook H-1790-1. National Environmental Policy Act. January 2008.

Bureau of Land Management (BLM). 2008b. Proposed Socorro Field Office Resource Management Plan and Final Environmental Impact Statement. 229 pp + appendices.

Bureau of Land Management (BLM). 2009a. Personal email communication with Darrell Tersey/BLM – Tucson Office on November 3, 2009.

Bureau of Land Management (BLM). 2009b. Wildlife – Aravaipa Canyon Wilderness Area Permit System. Available at www.blm.gov/az/st/en/arolrsmain/aravaipa/wildlife.html. Accessed: January 31, 2011.

Bureau of Land Management (BLM). 2009c. Ironwood Forest National Monument. Available at www.blm.gov/az/st/en/prog/blm_special_areas/natmon/ironwood.html. Accessed February 1, 2011.

Bureau of Land Management (BLM). 2009d. Application of the Visual Resource Management Program to Renewable Energy. Instruction Memorandum No. 2009-167. Bureau of Land Management.

Bureau of Land Management (BLM). 2009e. Back Country Byways. Available at www.blm.gov/wo/st/en/prog/Recreation/recreation_national/byways.html

Bureau of Land Management (BLM). 2009f. New Mexico Surface Ownership GIS shapefile. Available at www.blm.gov/nm/st/en/prog/more/geographic_sciences/spatial_data_metadata.html. Accessed May 11, 2009.

Bureau of Land Management (BLM). 2010a. SunZia Southwest Transmission Project, Scoping Report. April 2010.

Bureau of Land Management (BLM). 2010b. Socorro Field Office. Socorro Resource Management Plan and Record of Decision. August 2010.

Bureau of Land Management (BLM). 2010c. Socorro Field Office. Socorro Resource Management Plan. Available at www.blm.gov/pgdata/etc/medialib/blm/nm/field_offices/socorro/socorro_planning/socorro_rmp_2010.Par.67785.File.dat/RMP_Socorro_2010.pdf.

Bureau of Land Management (BLM). 2010d. Determination of Surface Rights Under Public Law 84-167 (1955). Available at www.blm.gov/mt/st/en/prog/mining/claim_info.html.

Bureau of Land Management (BLM). 2010e. Las Cruces District Office: Fire Management Plan. 95 pp.

Bureau of Land Management (BLM). 2010f. Rio Puerco Field Office: Fire Management Plan. 71 pp.

Bureau of Land Management (BLM). 2010g. Roswell Field Office: Fire Management Plan. 63 pp. Available at www.blm.gov/pgdata/etc/medialib/blm/nm/programs/fire/fire_management_plans/roswell_fmp.Par.13478.File.dat/RoswellFMP_2010_final.pdf

Bureau of Land Management (BLM). 2010h. Socorro Field Office: Fire Management Plan.

Bureau of Land Management (BLM). 2010i. Gila District: Fire Management Plan.

Bureau of Land Management (BLM). 2010j. Fact Sheet on the BLM's Management of Livestock Grazing. Available at www.blm.gov/wo/st/en/prog/grazing.html.

Bureau of Land Management (BLM). 2010k. Bordo Atravesado Herd Management Area. Record of Decision. June 2010

Bureau of Land Management (BLM). 2011a. Land and Mineral Legacy Rehost 2000 System. Pending Solar and Wind Projects. Available at http://www.blm.gov/lr2000. Accessed January 2011.

Bureau of Land Management (BLM). 2011b. Arizona National Scenic Trail. Available at www.blm.gov/az/st/en/prog/blm_special_areas/az-scenic-trail.html. Accessed March 2011.

Bureau of Land Management (BLM). 2011c. National Landscape Conservation System. Available at www.blm.gov/wo/st/en/prog/blm_special_areas/NLCS.html.

Bureau of Land Management and Department of Energy (BLM and DOE). 2010. *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States.* Washington DC.: Bureau of Land Management. Available at http://solareis.anl.gov/documents/dpeis/index.cfm.

California Public Utilities Commission (CPUC). 2011. RPS Program Overview. Available at www.cpuc.ca.gov/PUC/energy/Renewables/overview.htm. Accessed January 11, 2011.

Cannon, M.D., and D.J. Meltzer 2004. Early Paleoindian foraging: examining the faunal evidence for large mammal specialization and regional variability in prey choice. Quaternary Science Reviews 23:1955-1987.

Carondelet St. Joseph's Hospital. 2011. Carondelet St. Joseph's Hospital (Arizona). Available at www.carondelet.org/Portals/0/docs/about/factsheets/CSJ%20Fact%20Sheet%20FY10.pdf. Accessed January 30, 2011.

Carveth, C.J., A. Widmer, S.A. Bonar, and W. Matter. 2005. Estimation of acute upper lethal water temperature tolerances of native Arizona fishes. Report to the University of Arizona Water Resources Research Center. Tucson, Arizona. 19 pp.

Casa Grande Regional Medical Center. 2011. Casa Grande Regional Medical Center (Arizona) website. Available at www.casagrandehospital.com/about. Accessed January 30, 2011.

Cascabel Working Group. 2010a. Draft Environmental Impact Statement Contributions for Proposed SunZia Transmission Line Routes Traversing the middle San Pedro Watershed.

Cascabel Working Group. 2010b. Draft Environmental Impact Statement Contributions for Proposed SunZia Transmission Line Route Traversing the Aravaipa Watershed and Lower San Pedro River Valley.

Cascabel Working Group. 2010c. Draft Environmental Impact Statement Contributions For Proposed SunZia Transmission Line Routes Traversing the San Pedro River Valley. Unpublished MS.

Chalmers, James A., and Frank A. Voorvaart. 2009. High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects. *The Appraisal Journal*. Summer.

Charney, Alberta H., PhD, Anthony V. Popp, PhD, Valorie Rice, MLS, James Peach, PhD, Marshall J. Vest, Director, and Leo Delgado, MBA. 2012a. SunZia Southwest Transmission Project Economic Impact Assessment. Economic and Business Research Center, Eller College of Management University of Arizona; Arrowhead Center, Inc., New Mexico State University.

Charney, Alberta H., PhD, Anthony V. Popp, PhD, Valorie Rice, MLS, James Peach, PhD, Marshall J. Vest, Director, and Leo Delgado, MBA. 2012b. SunZia Southwest Transmission Project Economic Impact Assessment Supplement. Economic and Business Research Center, Eller College of Management University of Arizona; Arrowhead Center, Inc., New Mexico State University.

Chávez, T.E. 2002. *An Illustrated History of New Mexico*. University of New Mexico Press, Albuquerque.

Chenault, M.L. 2000. In Defense of the Polvoron Phase. In *The Hohokam Village Revisited*, edited by D.E. Doyel, S.K. Fish and P.R. Fish, pp. 277-286. Southwest and Rocky Mountain Division of the American Association for the Advancement of Science, Fort Collins, Colorado.

Chew, R.T. 1952. The Geology of the Mineta Ridge Area, Pima and Cochise Counties, Arizona. M.S, Thesis, U. of Arizona, 53 p.

Ciolek-Torrello, R., K. M. Cairns, L. S. Cummings, W. L. Deaver, J. R. Hoffman, J. A. Homburg, B. B. Huckell, L. W. Huckell, C. W. Shaw, R. M. Van Dyke and S. M. Whittlesey. 1998. *Early Farmers of the Sonoran Desert: Archaeological Investigations at the Houghton Road Site, Tucson, Arizona*. Statistical Research Technical Series 72, Tucson, Arizona.

City of Belen. 2003. Belen Comprehensive Land Use Plan.

City of Benson. 2002. City of Benson General Development Plan.

City of Benson. 2011. City Departments. Parks and Recreation. Available at www.cityofbenson.com. Accessed January 2011.

City of Casa Grande. 2010. City of Casa Grande General Plan.

City of Deming. 2003. City of Deming Comprehensive Plan. January.

City of Elephant Butte. 2003. City of Elephant Butte Comprehensive Plan.

City of Las Cruces. 1999. City of Las Cruces Comprehensive Plan. March.

City of Lordsburg. 2001. City of Lordsburg Comprehensive Plan. October.

City of Safford. 2004. City of Safford General Plan.

City of Socorro. 2003. City of Socorro Comprehensive Plan. April.

City of Truth or Consequences. 2007. City of Truth or Consequences Comprehensive Plan. April.

City of Tucson. 2001.City of Tucson General Plan. November

City of Tucson. 2011. Sweetwater Wetlands. Available at http://cms3.tucsonaz.gov/water/sweetwater. Accessed January 2011.

City of Willcox. 2009. City of Willcox General Plan.

Clark, I.G. 1987. *Water in New Mexico*. University of New Mexico Press, Albuquerque.

Cochise County. 2006. Cochise County Comprehensive Plan. February 2011.

Cockrum, E.L. 1991. Seasonal Distributions of Northwestern Populations of the Long-nosed Bats, *Leptonycteris sanborni* Family Phyllostomidae. Anales Inst. Biol. Univ. Nac. Auton. Mexico, Series, Zoological. 62(2): 181-202.

Coes, A., D.J. Gellenbeck, D.C. Towne, and M.C. Freark. 2002. Ground-water quality in the upper Santa Cruz Basin, Arizona, 1998. U.S. Geological Survey Water-resources Investigations Report 00-4117, 34 p.

Colorado Department of Public Health and Environment (CDPHE). 2005. SCREEN3 Stationary Source Modeling Guidance.

Connell, S.D., J.W. Hawley, and D.W. Love. 2005. Late Cenozoic drainage developments in the southeastern Basin and Range of New Mexico, southeasternmost Arizona, and western Texas. Pp. 125 – 150 *In* Lucas, S.G., G.S. Morgan, and K.E. Ziegler (Eds.) New Mexico's Ice Ages. New Mexico Museum of Natural History and Science Bulletin 28.

Cook, C.W., S.G. Lucas, and J.W. Estep. 1998. Stratigraphy of upper Pennsylvanian-lower Permian rocks in New Mexico: An Overview. Pp. 9-27 *In* Lucas, S.G., J.W. Estep, and J.M Hoffer (Eds.) Permian Stratigraphy and Paleontology of the Robledo Mountains, New Mexico. New Mexico Museum of Natural History and Science Bulletin 12.

Cordell, L.S. 1984. *Prehistory of the Southwest*. Academic Press, Inc., Orlando.

Cordell, L.S. 1997. Salado. In *Archaeology of the Southwest*, edited by L.S. Cordell. 2nd ed. Academic Press, New York.

Cordell, L.S., and G.J. Gumerman. 1989. *Dynamics of Southwest Prehistory*. Smithsonian Institute Press, Washington, DC.

Corman, T.E., and C. Wise-Gervais Eds. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque, NM. 636 p.

Corridor Design. 2010. Available at http://corridordesign.org. Accessed September 21, 2010.

Couchman, D.C. 1990. *Cooke's Peak – Pasaron Por Aqui: A Focus on United States History in Southwestern New Mexico*. Bureau of Land Management, Las Cruces District, Mimbres Resource Area, Las Cruces.

Council on Environmental Quality (CEQ). 1997a. Environmental Justice: Guidance under the National Environmental Policy Act. Available at www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf. Accessed February 25, 2011.

Council on Environmental Quality (CEQ). 1997b. *Considering Cummulative Effects Under the National Environmental Policy Act.* Washington, DC: Council on Environmental Quality. Executive Office of the President of the United States of America.

Countess Environmental. 2006. WRAP Fugitive Dust Handbook. Prepared for the Western Governors' Association.

Craig, D.B. 2001. *The Grewe Archaeological Research Project, Volume 1:Project Background and Feature Descriptions*. Northland Research, INC., Flagstaff and Tempe.

Crown, P.L. 1994. *Ceramics and Ideology: Salado Polychrome Pottery*. University of New Mexico Press, Albuquerque.

Crown, P.L., and E.W. Sires. 1984. The Hohokam Chronology and Salt-Gila Aqueduct Research. In *Hohokam Archaeology Along the Salt-Gila Aqueduct, Central Arizona Project, Volume 9: Synthesis and Conclusions*, edited by L.S. Teague and P.L. Crown. Arizona State Museum Archaeological Series 150. University of Arizona, Tucson.

Crown, P.L., and W.J. Judge. 1991. *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest*. School of American Research advanced seminar series. School of American Research Press, Santa Fe

Cummings, B. 1953. *First Inhabitants of Arizona and the Southwest*. Cummings Publication Council, Tucson.

Curtin, A.J., G.R. Zug, and J.R. Spotila. 2009. Longevity and growth strategies of the Desert Tortoise (*Gopherus agassizii*) in two North American deserts. Journal of Arid Environments 73: 463-471.

Davis, S.K. 2004. Area sensitivity in grassland passerines: effects of patch size, patch shape, and vegetation structure on bird abundance and occurrence in southern Saskatchewan. The Auk 121 (4): 1130-1145.

Davis, W.B., and D.J. Schmidly. 1997. The Mammals of Texas – Online Edition. Available at http://www.nsrl.ttu.edu/tmot1/copyrigh.htm. Accessed October 6, 2011.

de Oliveira, T.G. 1998. *Herpailurus yagouaroundi*. Mammalian Species, No. 578, pp. 1-6. American Society of Mammalogists.

DeBano, L.F., D.G. Neary, and P.F. Foliott. 2005. Soil physical properties. *In*: Neary, D.G., K.C. Ryan, and L.F. DeBano, eds. Wildland fire in ecosystems: effects of fire on soils and water. General Technical Report RMRS-GTR-42 (4). U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 250 pp.

Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 431 p.

DeJong, D.H. 1992. "See the New Country:" The Removal Controversy and Pima-Maricopa Water Rights, 1869-1879. *The Journal of Arizona History* 33(4):367-396.

Delaney, Charles J., and Douglas Timmons. 1992. High Voltage Power Lines: Do They Affect Residential Property Value? *The Journal of Real Estate Research*. Vol. 7, Number 3.

Denevan, W.M. 1992. The pristine myth: the landscape of the Americas in 1492. Annals of the Association of American Geographers 82 (3): 369-385.

Department of Energy (DOE). 2008. Programmatic Environmental Impact Statement. Designation of Energy Corridors on Federal Land in the 11 Western States. Available at http://corridoreis.anl.gov/news/index.cfm

Department of Energy (DOE). 2009. National Electric Transmission Congestion Study (NESC). December 2009.

Department of Energy (DOE). 2011. States with Renewable Energy Portfolio Standards. Available at http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm#chart. Accessed January 10, 2011.

Department of Energy and U.S. Department of Interior (DOE/DOI). 2009. Solar Energy Study Areas in new Mexico Map.

Di Peso, C.C., R.E. Gerald and M.V. Gerald. 1953. The Sobaipuri Indians of the Upper San Pedro River Valley, Southeastern Arizona. Amerind Foundation Publication No. 6. Amerind Foundation, Inc., Dragoon.

Diehl, M., and P.A. Gilman. 1996. Implications from the Design of Different Southwestern Architectural Forms. In *Southwestern Diversity: Underlying Principles and Overarching Patterns,* edited by P.R. Fish and J.J. Reid. Anthropological Research Papers No. 48, G.A. Clark, general editor. Arizona State University, Tempe.

Diehl, M., and S.A. LeBlanc. 2001. *Early Pithouse Villages of the Mimbres Valley and Beyond*. Papers of the Peabody Museum of Archaeology and Ethnology 83. Harvard University, Cambridge.

Dimmitt, M. 2011. Cactaceae. Available at www.desertmuseum.org/books/nhsd_cacti.html. Accessed October 11, 2011.

Dobyns, H.F. 1974. The Kohatk: Oasis and Ak-Chin Horticulturalists. *Ethnohistory* 21(4):317-327.

Dobyns, H.F. 1976. Spanish Colonial Tucson, A Demographic History. University of Arizona Press, Tucson.

Doelle, W.H. 1984. The Tucson Basin During the Protohistoric. *Kiva* 49:195-211.

Doelle, W.H., and P. Fish. 1988. Recent Research on Tucson Basin Prehistory: Proceedings of the Second Tucson Basin Conference.

Doelle, W.H., and H.D. Wallace. 1991. The Changing Role of the Tucson Basin in the Hohokam Regional System. In *Exploring the Hohokam: Prehistoric Desert Peoples of the American Southwest*, edited by G.J. Gumerman, pp. 279-345. University of New Mexico Press, Albuquerque

Doña Ana County Historical Society, 2001. History of Doña Ana County. Available at www.donaanacountyhistsoc.org. Accessed January 30, 2011.

Doña Ana County. 1994. Doña Ana County Comprehensive Plan. November. Available at http://donaanacounty.org/development/plans/.

Doña Ana County. 2005. Doña Ana County Land Use Regulations and Zoning Ordinance. February. Available at http://donaanacounty.org/development/regulations/.

Dory-Garduño, J. 2010. Governor Cachupin and the Pueblo Grants. Electronic document, http://www.newmexicohistory.org/filedetails_docs.php?fileID=22389, accessed October 21, 2010. New Mexico Office of the State Historian, Santa Fe.

Downey, J.S. 1968. Late Pliocene Lagomorphs of the San Pedro Valley, Arizona. United States Geological Survey Professional Paper 600-D:169-173.

Downum, C.E., P.R. Fish and S.K. Fish. 1994. Refining the Role of *Cerros de Trincheras* in Southern Arizona Settlement. *The Kiva* 59(3):271-296.

Doyel, D.E. 1991. Hohokam Cultural Evolution in the Phoenix Basin. In *Exploring the Hohokam: Prehistoric Desert People of the American Southwest*, edited by G.J. Gumerman, pp. 231-278. University of New Mexico Press, Albuquerque.

Doyel, D.E., and S.K. Fish. 2000. Prehistoric Villages and Communities in the Arizona Desert. In *The Hohokam Village Revisited* edited by D.E. Doyel, S.K. Fish and P.R. Fish, pp. 1-36. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Fort Collins.

Dozier, E.P. 1983. *The Pueblo Indians of North America*. Waveland Press, Inc., Prospect Heights.

Drewitt, A.L., and R.H.W. Langston. 2008. Collision effects of wind-power generators and other obstacles on birds. Annals of the New York Academy of Science 1134: 233-266.

Driscoll, D.E., R.E. Jackman, W.G. Hunt, G.L. Beatty, J.T. Driscoll, R.L. Glinski, T.A. Gatz and R.I. Mesta. 1999. Status of nesting Bald Eagles in Arizona. Journal of Raptor Research 33:218-226.

Durst, S.L. 2004. Southwestern Willow Flycatcher potential prey base and diet in native and exotic habitats. Unpublished Master's Thesis. Northern Arizona University, Flagstaff, Arizona. 96 pp.

Earls, A.C. 1987. An Archaeological Assessment of Las Huertas, Socorro, New Mexico. Maxwell Museum of Anthropology.

Easterling, D., and T. Karl. 2011. Global Warming: Frequently Asked Questions. Available at www.ncdc.noaa.gov/oa/climate/globalwarming.html. Accessed February 3, 2011.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. The Birder's Handbook, A Field Guide to the Natural History of North American birds. Simon & Schuster, New York. 785 p.

Electronic Proving Ground. 2010. EPG Facility Overview. Available at www.epg.army.mil/Pages/Facilities/EPGFacilityOverview.htm. Accessed March 2011.

Elliott-Smith, E., and S.M. Haig. 2004. Piping Plover (*Charadrius melodus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/002. Accessed October 6, 2011.

Environmental Protection Agency (EPA). 1998. *Exhaust Emission Factors for Nonroad Engine Modeling —Compression-Ignition* (NR-009A).

Environmental Protection Agency (EPA). 1999. *Exhaust Emission Factors for Nonroad Engine Modeling —Spark Ignition* (NR-010b).

Environmental Protection Agency (EPA). 2001. Procedures Document for National Emission Inventory, Criteria Air Pollutants, 1985-1999 (EPA-454/R-01-006).

Environmental Protection Agency (EPA). 2003. User's Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model (EPA 420-R-03-010).

Environmental Protection Agency (EPA). 2004a. Understanding the Safe Drinking Water Act. 4 pages. Available at http://water.epa.gov/lawsregs/guidance/sdwa/upload/2009_08_28_sdwa_fs_30ann_sdwa_web.pdf.

Environmental Protection Agency (EPA). 2004b. User's Guide for the AERMOD Meteorological Preprocessor (AERMET) (EPA-454/B-03-002).

Environmental Protection Agency (EPA). 2005a. *Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition* (EPA 420-R-05-019; NR-010e).

Environmental Protection Agency (EPA). 2005b. *Compilation of Air Pollutant Emission Factors* (AP-42), Chapter 11.12 Concrete Batching.

Environmental Protection Agency (EPA). 2008. *Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from Mobile Combustion Sources* (EPA 430-K-08-004).

Environmental Protection Agency (EPA). 2009. EPA Renewable Portfolio Standards Fact Sheet. Available at www.epa.gov/chp/state-policy/renewable_fs.html. Accessed June 8, 2011.

Environmental Protection Agency (EPA). 2010a. What is nonpoint source pollution? Available at http://water.epa.gov/polwaste/nps/whatis.cfm.

Environmental Protection Agency (EPA). 2010b. *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression-Ignition* (NR-009d).

Environmental Protection Agency (EPA). 2010c. *Technical Support Document, Pinal County, Arizona, Area Redesigation for the 1987 24-hour PM_{10} NAAQS*. Available at http://pinalcountyaz.gov/Departments/AirQuality/Documents/Other%20EPA%20Regulatory%20Actions/20100921_Pinal%20PM10%20NPR_TSD_final.pdf.

Environmental Protection Agency (EPA). 2011a. National Ambient Air Quality Standards. Available at www.epa.gov/air/criteria.html. Accessed January 31, 2011.

Environmental Protection Agency (EPA). 2011b. Arizona Class I Areas. Available at www.epa.gov/region9/air/maps/az_clss1.html. Accessed February 28, 2011.

Environmental Protection Agency (EPA). 2011c. Technical Support Document for 2008 Ozone NAAQS Designations, Arizona, Area Designations for the 2008 Ozone National Ambient Air Quality Standards.

Environmental Protection Agency (EPA). 2011d. AQS Data Mart. Available at www.epa.gov/ttn/airs/aqsdatamart. Accessed February 2011.

Environmental Protection Agency (EPA). 2011e. Sole Source Aquifer Protection Program. Available at http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/solesourceaquifer.cfm.

Environmental Protection Agency (EPA). 2011f. Watershed Assessment, Tracking & Environmental Results. Available at www.epa.gov/waters/index.html.

Environmental Protection Agency (EPA). 2011g. CERCLIS Public Access Database. Available at http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm. Accessed February 28, 2011.

EPG, Inc. 2011. SunZia Southwest Transmission Project – Analysis of Potential Avian Collisions with Transmission Lines at Four Locations on the Rio Grande in New Mexico.

Erickson, W.P., G.D. Johnson, and D.P. Young. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. USDA Forest Service, Pacific Southwest Research Station. General Technical Report PSW-GTR-191: 1029-1042.

Esque, T.C., C.R. Schwalbe, L.A. DeFalco, R.B. Duncan, and T.J. Hughes. 2003. Effects of desert wildfires on Desert Tortoise (*Gopherus agassizii*) and other small invertebrates. The Southwestern Naturalist 48 (1): 103-111.

Ezell, P. 1983. History of the Pima. In *Southwest*, edited by A. Ortiz. Handbook of North American Indians. vol. 10, W.C. Sturtevant, general editor. Smithsonian Institution, Washington DC.

Farish, T.E. 1915. Early Spanish Explorations. In *History of Arizona*. vol. 1. The Filmer Brothers Electrotype Company, San Francisco.

Federal Energy Regulatory Commission (FERC). 2005. Docket No. RM05-25-000;18 CFR Chapter 1. September 16, 2005.

Federal Office of Civil Aviation. 2009. *Guidance on the Determination of Helicopter Emissions*. Edition 1.

Fenneman, N.M. 1931. Physiography of the Western United States. McGraw Hill, Book Company Inc. New York and London. 714 pages.

Fierro, R. 2012. Personal Communication via email with Ramon Fierro, Grazing Lease Administrator, Arizona State Land Department on October 24, 2012.

Fire Department Directory. 2011. Fire department search by Arizona county (Graham, Greenlee, Cochise, Pima, and Pinal) and New Mexico county (Doña Ana, Grant, Hidalgo, Lincoln, Luna, Otero, Sierra, Socorro, Torrance). Available at www.firedepartmentdirectory.com. Accessed January 10, 2011.

Fish, S.K., and P.R. Fish. 2006. The Hohokam Millennium. In *The Hohokam Millennium*, edited by S.K. Fish and P.R. Fish. School for Advance Research Press, Santa Fe.

Fish, S.K., P.R. Fish and J.H. Madsen. 1992. Evidence for Large-scale Agave Cultivation in the Marana Community. In *The Marana Community in the Hohokam World*, edited by S.K. Fish, P.R. Fish and J.H. Madsen, pp. 73-87. Anthropological papers of the University of Arizona; no. 56. University of Arizona Press, Tucson.

Flesch, A.D. 2003. Perch-site selection and spatial use by Cactus Ferruginous Pygmy-owls in south-central Arizona. The Journal of Raptor Research 37 (2): 151-157.

Flesch, A.D., and R.J. Steidl. 2002. Nest-site selection by Cactus Ferruginous Pygmy-owls in northern Sonora Mexico. Report to the U.S. Fish and Wildlife Service. Tucson, Arizona. 14 pp.

Flint, R., and S.C. Flint. 2005. Documents of the Coronado Expedition, 1539–1542: "They Were Not Familiar with His Majesty, nor Did They Wish to Be His Subjects. Southern Methodist University Press, Dallas.

Fontana, B.L. 1974. Man in Arid Lands: The Piman Indians of the Sonoran Desert. *Desert Biology* 2:489-528.

Fontana, B.L. 1983. History of the Papago. In *Southwest*, edited by A. Ortiz. Handbook of North American Indians. vol. 10, W.C. Sturtevant, general editor. Smithsonian Institution, Washington DC.

Forbes, J.D. 1959. Unknown Athapaskans: The Identification of the Jano, Jocome, Jumano, Manso, and Suma, and other Indian Tribes of the Southwest. *Ethnohistory* 6(2).

Forbes, J. D. 1960. *Apache, Navaho, and Spaniard*. University of Oklahoma Press, Norman.

Fowler, A. 1990. Archaeological Studies along the Arizona Interconnection Project Transmission Line Corridor.

Frison, G.C. 1991. *Prehistoric Hunters of the High Plains*. 2nd ed. Academic Press, New York.

Frisvold, G.W. 2009. *Arizona Solar Energy & Economics Outlook.* Arizona Solar Energy and Economic Summit.

Gabel, N.E. 1931. Martinez Hill Ruins: An Example of Prehistoric Culture of the Middle Gila. Unpublished Master's thesis, Department of Anthropology, University of Arizona, Tucson, Arizona.

Galusha, T., N.M. Johnson, E.H. Lindsay, N.D. Opdyke, and R.H. Tedford. 1984. Biostratigraphy and magnetostratigraphy, late Pliocene rocks, 111 Ranch Arizona. Geological Society of America Bulletin 95:714-722.

Garland, T., and W.G. Bradley. 1984. Effects of a highway on Mohave Desert rodent populations. The American Midland Naturalist 111 (1): 47-56.

Gazin, C.L. 1942. The late Cenozoic vertebrate faunas from the San Pedro Valley, Arizona. Proceedings of the United States National Museum 92(3155):475-518.

GeoMAC. 2011. Fire perimeters (2000-2010). GIS database retrieved from: http://rmgsc.cr.usgs.gov/outgoing/GeoMAC/historic_fire_data/us_hist_fire_perimeters_dd83.zip. Accessed January 26, 2012.

GeoMAC. 2012. Fire perimeters (2011). GIS database retrieved from: http://rmgsc.cr.usgs.gov/outgoing/GeoMAC/2011_fire_data/2011_all_states/perimeters_dd83.zip. Accessed January 26, 2012.

Gerald Champion Regional Medical Center. 2011. Gerald Champion Regional Medical Center website (New Mexico). Available at www.gcrmc.org. Accessed January 30, 2011.

Gettings, M.E., and B. Houser. 1997. Basin geology of the upper Santa Cruz Valley, Pima and Santa Cruz counties, southeastern Arizona. U.S. Geological Survey Open File Report 97-676, 39 p.

Gidley, J.W. 1926. Fossil Proboscidea and Edentata of the San Pedro Valley, Arizona. U.S. Geological Survey Professional paper 140-B.

Gila Regional Medical Center. 2006. Gila Regional Medical Center website (New Mexico). Available at www.grmc.org. Accessed January 30, 2011.

Gila River Indian Community. 2003. Education Initiative. Moving Towards the San Carlos Project – Pima-Maricopa Irrigation Project. Pp. 51-55. Available at www.gilariver.com/lessons/sancarloslesson33.pdf. Accessed: February 2, 2011.

Gilman, P.A. 1983. Changing Architectural Forms in the Prehistoric Southwest. PhD Dissertation, Anthropology, University of New Mexico, Albuquerque.

Gilman, P.A. 1987. Architecture as Artifact: Pit Structures and Pueblos in the American Southwest. *American Antiquity* 52:538-564.

Gilman, P.A. 1997. *Wandering Villagers: Pit Structures, Mobility and Agriculture in Southeastern Arizona*. Department of Anthropology Arizona State University, Tempe, Arizona.

Gilpin, D.A., and D.A. Phillips. 1998. *The Prehistoric to Historic Transition Period in Arizona, circa A.D. 1519–1692*. State Historic Preservation Office, Arizona State Parks Board, Phoenix.

Gladwin, H.S., E.W. Haury, N. Gladwin and E.B. Sayles. 1937. *Excavations at Snaketown*. Medallion papers. Priv. print. for Gila pueblo, Globe, Ariz.

Gladwin, W., and H.S. Gladwin. 1935. The Eastern Range of the Red-on-buff Culture. *Medallion Papers* 16.

Glass, J.K. 1972. Feeding behavior of the Western Shovel-nosed Snake, *Chionactis occipitalis klauberi*, with special reference to scorpions. The Southwestern Naturalist 16 (3/4): 445-447.

Glinski, R.L. 1998. Golden Eagle. *In*: The Raptors of Arizona. R.L. Glinski, ed. The University of Arizona Press, Tucson, Arizona. 220 p.

Goodwin, G. 1935. The Social Divisions and Economic Life of the Western Apache. *American Anthropologist* 37(1):55-64.

Goodwin, G. 1942. *The Social Organization of the Western Apache*. University of Chicago Press, Chicago.

Graham County. 1996. Graham County Comprehensive Plan.

Graham County. 2005. Graham County Community Wildfire Protection Plan. 66 pp.

Graham County. 2008. General Plan. August.

Grant County. 2004. Grant County Comprehensive Plan.

Grant County. 2006. Grant County Community Wildfire Protection Plan. 389 pp.

Greenlee County. 2003. Greenlee County Comprehensive Plan. March.

Gregory, D.A. 1984. Excavations at the Siphon Draw Site. In *Hohokam Archaeology along the Salt-Gila Aqueduct, Central Arizona Project: Prehistoric Occupation of the Queen Creek Delta*, edited by L.S. Teague and P.L. Crown, pp. 15-218. Arizona State Museum Archaeological Series No. 150. vol. 4. University of Arizona, Tucson.

Gregory, D.A., J.L. Adams, M. Diehl, A. Ferg, D.A. Gregory, J.M. Heidke, L. Lincoln-Babb, P.D. Minturn, M.S. Shackley, R.J. Silva, A.W. Vokes, J.A. Waters and H. Woecherl. 2001. *Excavations in the Santa Cruz River Floodplain: The Early Agricultural Period Component at Los Pozos.* Anthropological Papers No. 21. Center for Desert Archaeology Tucson.

Griffen-Pierce, T. 2010. *The Columbia Guide to American Indians of the Southwest*. Columbia University Press, New York.

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

Guido, Z. 2010. Warmer Means Drier: Comparing the 2000s Drought to the 1950s Drought. Available at www.climas.arizona.edu/feature-articles/february-2010. Accessed January 9, 2012.

Gutiérrez, R.J., A.B. Franklin, and W.S. Lahaye. 1995. Spotted Owl (*Strix occidentalis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/179. Accessed October 6, 2011.

Gutzler, D.S. 2004. New Mexico's Changing Climate. Natural Resources Journal 45:277:282.

Hackenberg, R.A. 1983. Pima and Papago Ecological Adaptations. In *Southwest*, edited by A. Ortiz, pp. 161-177. Handbook of North American Indians. vol. 10, W.C. Sturtevant, general editor. Smithsonian Institution, Washington DC.

Haines, A.M., L.E. Grassman, M.E. Tewes, and J.E. Janečka. 2006. First Ocelot (*Leopardus pardalis*) monitored with GPS telemetry. European Journal of Wildlife Research 52: 216-218.

Haney, J. 2005. The Lower San Pedro River-Hydrology and Flow Restoration for Biodiversity Conservation. Pp. 311-315. In: USDA Forest Service Proceedings RMRS-P-36. Available at www.fs.fed.us/rm/pubs/rmrs_p036/rmrs_p036_311_315.pdf. Accessed: February 2, 2011.

Hanson, R.T., J.S. McLean, and R.S. Miller. 1994. Hydrogeologic framework and preliminary simulation of ground-water flow in the Mimbres Basin, southwestern New Mexico. U.S. Geological Survey Water-Resources Investigations Report 94-4011, 118 p.

Harris, A.H. 2005. Caves as unique resources for Pleistocene vertebrate faunas. New Mexico's Ice Ages. New Mexico Museum of Natural History and Science Bulletin 28:249-253.

Harveson, P.M., M.E. Tewes, G.L. Anderson, L.L. Laack. 2004. Habitat use by Ocelots in south Texas: implications for restoration. Wildlife Society Bulletin 32 (3): 948-954.

Haury, E.W. 1936. *The Mogollon Culture of Southwestern New Mexico.* Medallion Papers. Priv. print. for the Medallion, Gila Pueblo, Globe, Arizona.

Haury, E.W. 1950. *The Stratigraphy and Archaeology of Ventana Cave, Arizona*. University of Arizona Press, Tucson.

Haury, E.W. 1976. *The Hohokam, Desert Farmers and Craftsmen: Excavations at Snaketown, 1964-1965*. University of Arizona Press, Tucson.

Haury, E.W. 1985. *Mogollon Culture in the Forestdale Valley, East-central Arizona*. University of Arizona Press, Tucson

Haury, E.W., and E.B. Sayles. 1947. *An Early Pit House Village of the Mogollon Culture, Forestdale Valley, Arizona*. Social Science Bulletin. University of Arizona, Tucson.

Haury, E.W., E. Antevs, and J.F. Lance. 1953. Artifacts with mammoth remains, Naco, Arizona. American Antiquity 19(1):1-24.

Haury, E.W., E.B. Sayles, and W.W. Wasley. 1959. The Lehner mammoth site, southeastern Arizona. American Antiquity 25(1): 2-30.

Hawley, J.W. 2001. Hydrogeologic framework of the middle Rio Grande Basin, New Mexico, with emphasis on Kirk Bryan's contribution to conceptual-model development. Geological Society of America Bulletin, Annual Meeting, abstract.

Hawley, J.W., B.J. Hibbs, J.F. Kennedy, B.J. Creel, M.D. Remmenga, M. Johnson, M.M. Lee, and P. Dinterman. 2000. Trans-International boundary aquifers in southwestern New Mexico. Technical Completion Report, New Mexico Water Resources Research Institute.

Hayden, J. 1982. Ground Figures of the Sierra Pinacate, Sonora, Mexico. In *Hohokam and Patayan: Prehistory of Southwestern Arizona*, edited by R.H. McGuire and M.B. Schiffer, pp. 581-588. Academic Press, New York.

Hayes, A.C. 1981. *Excavation of Mound 7, Gran Quivira National Monument, New Mexico*. Publications in Archeology No. 16. National Park Service, Washington, DC.

Haynes, C.V. Jr. 1970. Geochronology of Man-Mammoth Sites and Their Bearing on the Origin of the Llano Complex. In *Pleistocene and Recent Environments of the Central Great Plains*, edited by W. Dort and J.K. Jones. Department of Geology Special Publication No. 3. University Press of Kansas Lawrence.

Haynes, C.V. Jr. 2007. Clovis Investigations in the San Pedro Valley. Pp. 1-15 *In* Haynes, C.V. Jr., and B. Huckell (Eds.). Murray Springs A Clovis Site with Multiple Activity Areas in the San Pedro Valley, Arizona. University of Arizona press, Tucson.

Headquarters West LTD. 2011. Three Links Farm – Cochise County, Arizona. Available at www.headquarterswest.com/listings/threelinks/index.htm. Accessed January 31, 2011.

Hegmon, M., and M.C. Nelson. 2003. The Archaeology and Meaning of Mimbres. *Archaeology Southwest* 17(4).

Hemmings, E.T., and C.V. Haynes. 1969. The Escapule mammoth and associated projectile points. Journal of the Arizona Academy of Science 5(3):184-188.

Henderson, T.K., and M.R. Hackbarth. 2000. What is going on at the Hohokam Village? A Fourteenth and Fifteenth Century Perspective. In *The Hohokam Village Revisited* edited by D.E. Doyel, S.K. Fish and P.R. Fish, pp. 287-316. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Fort Collins.

Hendricks, D.M. 1985. Arizona Soils. College of Agriculture, University of Arizona, Tucson, Az. 244 p. + Map.

Hidalgo County. 2004. Hidalgo County Comprehensive Plan.

Hidalgo County. 2009. Hidalgo County Community Wildfire Protection Plan. 74 pp.

Hidalgo County. 2010. County homepage. Available at www.hidalgocounty.org. Accessed January 30, 2011.

Hoffmeister, D.F.1986. Mammals of Arizona. The University of Arizona Press, Tucson, Arizona. 602 p.

Hogan, P.F. 2006. Southeastern New Mexico Regional Research Design and Cultural Resource Management Strategy. Office of Contract Archaeology, University of New Mexico.

Houser, B.B., P.A. Pearthree, J.A. Homburg, and L.C. Thrasher. 2004. Quaternary stratigraphy and tectonics, and late prehistoric agriculture of the Safford Basin (Gila and San Simon River valleys), Graham County, Arizona. United States Geological Survey Open File Report 2004-1062.

Howard, J.B. 1985. Courtyard Groups and Domestic Recycling: A Hypothetical Model of Growth. *Proceedings of the 1983 Hohokam Conference*. Phoenix.

Howard, M. 2011. SunZia Southwest Transmission Project Administrative Draft EIS comments; Mike Howard/Bureau of Land Management/Las Cruces Field Office.

Hoyt, R.A., J.S. Altenbach., and D.J. Hafner. 1994. Observations of Long-nosed Bats (*Leptonycteris*) in New Mexico. The Southwestern Naturalist. Vol. 39, No. 2. Pp. 175-179.

Huckell, B.B. 1984. *The Archaic Occupation of the Rosemont Area, Northern Santa Rita Mountains, Southeastern Arizona*. Arizona State Museum Archaeological Series No. 147. University of Arizona, Tucson.

Huckell, B.B. 1988. Late Archaic Archeology of the Tucson Basin: A Status Report In *Recent Research on Tucson Basin Prehistory: Proceedings of the Second Tucson Basin Conference*, edited by W.H. Doelle and P.R. Fish. Institute for American Research Anthropological Papers No. 10, Tucson.

Huckell, B.B. 1995. *Of Marshes and Maize: Preceramic Agricultural Settlements in the Cienega Valley Southeastern Arizona.* University of Arizona Anthropological Papers No. 59. University of Arizona Press, Tucson.

Huckell, B.B., L.W. Huckell and M.S. Shackley. 1999. McCuen Cave. *Archaeology Southwest* 13(1):12.

Huff, G.F. 2005. Simulation of ground-water flow in the basin-fill aquifer of the Tularosa Basin, south-central New Mexico, predevelopment through 2040. United States geological Survey Scientific Investigations Report 2004-5197, 98 pages.

Hughes, J.M. 1999. Yellow-billed Cuckoo (*Coccyzus americanus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/418. Accessed October 6, 2011.

Hunt, W.G. 1998. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Raptors of Arizona, R.L. Glinski, ed. The University of Arizona Press. Tucson, Arizona. 220 pp.

Hunt, W.G., D.E. Driscoll, E.W. Bianchi and R.E. Jackman. 1992. Ecology of Bald Eagles in Arizona. Report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis, Inc., Santa Cruz, California.

Institute of Electrical and Electronics Engineers (IEEE). 2010. Website regarding National Electric Transmission Congestion Study (NESC). Available at http://standards.ieee.org/about/nesc. Accessed Oct. 21, 2011.

Intermountain West Joint Venture. 2005. Coordinated Implementation Plan for Bird Conservation in Western New Mexico. 49 p.

International Commission on Non-Ionizing Radiation Protection (ICNIRP). 1998. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics. Vol. 74:494-522. Available at http://www.icnirp.de/documents/emfgdl.pdf.

Irwin-Williams, C. 1973. *The Oshara Tradition: Origins of Anasazi Culture*. Contributions in Anthropology 5(1). Eastern New Mexico University, Portales.

Jackson, Thomas, and Jennifer Pitts. 2010. The Effects of Electric Transmission Lines on Property Values: A Literature Review. Journal of Real Estate Literature. Volume 18, Number 2.

Jackson, Thomas. 2010. Electrical Transmission Lines: Is There an Impact on Rural Land Values. Right Of Way. November/December.

Jackson, V.L., L.L. Laack, and E.G. Zimmerman. 2005. Landscape metrics associated with habitat use by Ocelots in south Texas. Journal of Wildlife Management 69 (2): 733-738.

Jacobs, L.L. 1977. Rodents of the Hemphillian age Redington local fauna, San Pedro Valley, Arizona. Journal of Paleontology 51(3):505-519.

Jacobson, S.L. 2005. Mitigation measures for highway-caused impacts to birds. USDA Forest Service, Pacific Southwest Research Station. General Technical Report PSW-GTR-191: 1043-1050.

Johanson, V., D. Moore, and D. Ahler. 2006. 2006 Yellow-billed Cuckoo Study Results. San Marcial, New Mexico. United States Department of the Interior, Bureau of Reclamation, Fisheries and Wildlife Resources Group, Denver, Colorado. 21 p. Available at www.usbr.gov/pmts/fish/Reports/JohansonYellowBilledCuckooReport2006.pdf. Accessed October 6, 2011.

Johnson, M.J., J.A. Holmes, C. Calvo, I Samuels, S. Krantz, and M.K. Sogge. 2007. Yellow-billed Cuckoo distribution, abundance, and habitat use along the lower Colorado and tributaries, 2006 annual report. U.S. Geological Survey Open File Report 2007-1097. 219 pp.

Johnson, R.R., J.E. Cartron, L.T. Haight, R.B Duncan, and K.J. Kingsley. 2000. A historical perspective on the population decline of the Cactus Ferruginous Pygmy-owl in Arizona. *In* Cartron, J. E., and D.M. Finch, eds. Ecology and conservation of the Cactus Ferruginous Pygmy-owl in Arizona. General Technical Report RMRS-GTR-43. U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 68 pp.

Johnson, R.R., J.E. Cartron, L.T. Haight, R.B. Duncan, and K.J. Kingsley. 2003. Cactus Ferruginous Pygmy-owl in Arizona, 1872-1971. The Southwestern Naturalist 48 (3): 389-401.

Johnson, T.B., W.E. Van Pelt, and J.N. Stuart. 2009. Jaguar Conservation Assessment for Arizona, New Mexico, and Northern Mexico. Final draft public review document. 87 p. Available at www.azgfd.com/w_c/es/documents/JAGCTConservationAssessment.20090316. DraftFinal18.PublicReview.pdf. Accessed November 17, 2009.

Judge, W.J. 1989. Chaco Canyon – San Juan Basin. In *Dynamics of Southwest Prehistory*, edited by L.S. Cordell and G.J. Gumerman, pp. 209-261. School of American Research Advanced Seminar Book. Smithsonian Institution Press, Washington, DC.

Julyan, B. 1996. *Place Names of New Mexico* Revised ed. University of New Mexico Press, Albuquerque.

Keddy-Hector, D.P. 2000. Aplomado Falcon (*Falco femoralis*). The Birds of North America Online. Ithaca: Cornell Lab of Ornithology. Available at http://bna.birds.cornell.edu/bna/species/549. Accessed October 6, 2011.

Kepner, W.G., C.J. Watts, C.M. Edmunds, J.K. Maingi, S.E. Marsh, and G. Luna. 2000. A landscape approach for detecting and evaluating change in a semi-arid environment. Environmental Monitoring and Assessment 64:179-195.

Kessell, J.L. 2002. Spain in the Southwest: A Narrative History of Colonial New Mexico, Arizona, Texas, and California. University of Oklahoma Press, Norman.

Kino University Physicians Hospital. 2006. Kino University Physicians Hospital (Tucson, Arizona) website. Available at www.uph.org/Hospitals/UPHHospitalatKinoCampus/tabid/84/Default.aspx. Accessed January 30, 2011.

Kintigh, K.W. 1996. The Cibola Region in the Post-Chacoan Era. In *The Prehistoric Pueblo world, A.D. 1150-1350*, edited by M.A. Adler, pp. 131-144. University of Arizona Press, Tucson.

Klauber, L.M. 1951. The Shovel-nosed Snake, *Chionactis*, with descriptions of two new subspecies. Transactions of the San Diego Society of Natural History 9 (9): 141-204.

Knechtel, M.M. 1938. Geology and groundwater resources of the valley of Gila River and San Simon Creek, Graham County, Arizona. U.S. Geological Survey Water-Supplement Paper 796-F: 181-222.

Krijgsveld, K.L., K. Akershoek, F. Schenk, F. Dijk, and S. Dirksen. 2009. Collision risk of birds with modern large wind turbines. Ardea 957 (3): 357-366.

Kruse, C.G., and Christman, B. 2007. General Distribution and Abundance of Chiricahua Leopard Frogs on the Ladder Ranch Including Prevalence of Chytrid Fungus. Available at www.wildlife.state.nm.us/conservation/share_with_wildlife/documents/07KruseFnl.pdf. Accessed October 6, 2011.

Kruse, K.L. 2010. Central Flyway harvest and population survey data book. U.S. Fish and Wildlife Service. Denver, Colorado. 86 pp.

Kruse, K.L., D.E. Sharp, and J.A. Dubovsky. 2010. Status and harvest of Sandhill Cranes: Mid-continent, Rocky Mountain, and Lower Colorado River Valley populations. U.S. Fish and Wildlife Service administrative report. Denver, Colorado. 11 pp.

Kunzmann M.R., A. Rybak, and P.S. Bennett. 2000. Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) habitat identification factors using GPS and GIS analysis techniques. In Proceedings of the 2000 Environmental Systems Research Institute (ESRI) Twentieth Annual User Conference. June 26-30, 2000. San Diego, California.

Lammers, G.E. 1970. The late Cenozoic Benson and Curtis Ranch faunas from the San Pedro Valley, Cochise County, Arizona. Unpublished Ph.D. dissertation, University of Arizona, 193 pages.

Lavender, D. 1980. *The Southwest*. University of New Mexico Press, Albuquerque.

Lavin, P. 2001. *Arizona: An Illustrated History*. Hippocrene Books, Inc., New York.

Laymon, S.A. 1998. Yellow-billed Cuckoo (Coccyzus americanus). *In* The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. Available at www.prbo.org/calpif/htmldocs/ riparian.html. Accessed October 6, 2011.

Laymon, S.A., and M.D. Halterman. 1989. A proposed habitat management plan for Yellow-billed Cuckoos in California. U.S. Department of Agriculture, Forest Service General Technical Report PSW-110: 272-277.

Lee, D.S., C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina Biological Survey – North Carolina State Museum of Natural History, Raleigh, North Carolina. 867 p.

Lekson, S.H. 1991. Settlement Patterns and the Chaco Region. In *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest*, edited by P.L. Crown and W.J. Judge, pp. 31-56. School of American Research Press, Santa Fe.

Lekson, S.H. 2006. *Archaeology of the Mimbres Region, Southwestern New Mexico, USA*. British Archaeological Reports International Series, Oxford.

Leonard, R.D. 1998. Cibola Branch. In *Archaeology of Prehistoric Native America: An Encyclopedia*, edited by G. Gibbon. Gibbon. Garland Publishing, Inc., New York.

Levine, F. 1999. What is the Significance of a Road: Cultural Change and Cultural Exchange along El Camino Real. In *El Camino Real de Tierra Adentro*, edited by J. Piper. vol. 2. Bureau of Land Management, New Mexico State Office, Santa Fe.

Lilley, M.B., and J. Firestone. 2008. Wind power, wildlife, and the Migratory Bird Treaty Act: a way forward. Environmental Law 38: 1167-1214.

Lincoln County Medical Center. 2011. Lincoln County Medical Center website (New Mexico). Available at www.phs.org/PHS/hospitals/hospitals/ruidoso/index.htm. Accessed January 30, 2011.

Lincoln County. 2007. Lincoln County Comprehensive Plan. August.

Lindsay, E.H. 1984. Fossils of the San Pedro Valley. Fieldnotes from the Arizona Bureau of Geology and mineral Technology 14(4):1-12.

Lindsay, E.H., and N.T. Tessman. 1974. Cenozoic vertebrate localities and faunas in Arizona. Journal of the Arizona Academy of Science 9(1):3-28.

Lindsay, E.H., G.A. Smith, C.V. Haynes, and N.D. Opdyke. 1990. Sediments, geomorphology, magnetostratigraphy, and vertebrate paleontology in the San Pedro Valley, Arizona. Journal of Geology 98:605-619.

Littell, J.S., D. McKenzie, D.L. Peterson, and A.L. Westerling. 2009. Climate and wildfire area burned in western U.S. ecoprovinces, 1916-2003. Ecological Applications 19 (4): 1003-1021.

Lockhart, B. 1997. Protohistoric Confusion: A Cultural Comparison of the Manso, Suma, and Jumano Indians of the Paso del Norte Region. *Journal of the Southwest* 39(1):113-149.

Logan Simpson Design. 2005. Greenlee County Community Wildfire Protection Plan for At-Risk Communities of the Apache National Forest in Greenlee County. 113 pp.

Logan Simpson Design. 2006. Cascabel Community Wildfire Protection Plan. 74 pp.

Logan Simpson Design. 2009. Pinal County Community Wildfire Protection Plan. 163 pp.

Lowe, C.H. 1964. (1980 Printing) The Vertebrates of Arizona. The University of Arizona Press. 270 p.

Lowery, S.F., S.T. Blackman, and D. Abbate. 2009. Urban Movement patterns of Lesser Long-nosed bats (*Leptonycteris curasoae*): Management Implications for the Habitat Conservation Plan within the City of Tucson and the Town of Marana. Research Branch, Arizona Game and Fish Department, Phoenix, Arizona.

Lucas, S.G., A.B. Heckert, and R.M. Sullivan. 2000. Cretaceous dinosaurs in New Mexico. Pp. 83-90 *In* Lucas, S.G., A.B. Heckert (Eds.) Dinosaurs of New Mexico. New Mexico Museum of Natural History and Science Bulletin 17.

Lucas, S.G., A.B. Heckert, J.W. Estep, A.P. Hunt, and O.J. Anderson. 1998. Stratigraphy, paleontology, and depositional environments of the lower Permian Robledo Mountains Formation of the Hueco Group, Robledo Mountains, New Mexico. Pp. 29-41 *In* Lucas, S.G., J.W. Estep, and J.M Hoffer (Eds.) Permian Stratigraphy and Paleontology of the Robledo Mountains, New Mexico. New Mexico Museum of Natural History and Science Bulletin 12.

Lucas, S.G., A.P. Hunt, A.B. Heckert, and H. Haubold. 1995. Vertebrate paleontology of the Robledo Mountains Member of the Hueco Formation, Doña Ana Mountains, New Mexico. Pp. 269-277 *In* Lucas, S.G., and A.B. Heckert (Eds.) Early Permian footprints and facies. New Mexico Museum of Natural History and Science Bulletin 6.

Lucas, S.G., and A.B. Heckert. 2005. Distribution and correlation of Cretaceous fossil vertebrates from Arizona. Vertebrate Paleontology in Arizona. New Mexico Museum of Natural History and Science Bulletin 29:105-110.

Lucas, S.G., and G.S. Morgan. 1999. The oldest *Mammut* (Mammalia: Proboscidea) from New Mexico. New Mexico Geology 21:10-12.

Lucas, S.G., and G.S. Morgan. 2005. Paleogene vertebrate fossils from Arizona. Vertebrate Paleontology in Arizona. New Mexico Museum of Natural History and Science Bulletin Number 29: 114.

Lucas, S.G., and J.W. Estep. 1998. Lithostratigraphy and biostratigraphy of the lower-middle Cretaceous Bisbee Group, southwestern New Mexico, USA. Pp. 39-55 *In* Lucas, S.G., J.I. Kirkland, and J.W. Estep. (Eds.) Lower and Middle Cretaceous Terrestrial Ecosystems. New Mexico Museum of Natural History and Science Bulletin 14.

Lucas, S.G., and T.E. Williamson. 1993. Eocene vertebrate and late Laramide stratigraphy of New Mexico. New Mexico Museum of Natural History Bulletin 3:145-158.

Lucas, S.G., K. Krainer, J.A. Spielmann, K.E. Ziegler, and A.P. Hunt. 2005. The Permian of south-central New Mexico: Albuquerque to the Joyita Hills, Derry Hills, Las Cruces and Robledo Mountains. Pp. 1-15 *In* Lucas, S.G., K.E. Ziegler, and J.A. Spielmann (Eds.) The Permian of central New Mexico. New Mexico Museum of Natural History and Science Bulletin 31.

Lucas, S.G., R.M. Schoch, E. Manning, C. Tsentas. 1981. The Eocene biostratigraphy of New Mexico. Geological Society of America Bulletin, Part I, 92:651-967.

Luna County, New Mexico. 2011. History of Luna County, New Mexico. Available at http://lunacountynm.us/index.html. Accessed January 30, 2011.

Luna County. 2010. Luna County Community Wildfire Protection Plan. 75 pp.

Mabry, J.B. 2000. The Red Mountain Phase and the Origins of the Hohokam Villages. In *The Hohokam Village Revisited*, edited by D.E. Doyel, S.K. Fish and P.R. Fish, pp. 1-28. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Glenwood Springs.

Mabry, J.B. 2008. Chronology. In *Las Capas: Early Irrigation and Sedentism in a Southwestern Floodplain*, edited by J.B. Mabry, pp. 55-76. Anthropological Papers No. 28. Center for Desert Archaeology, Tucson.

Macias-Duarte, A., A.B. Montoya, W.G. Hunt, A. Lafon-Terrazas, and R. Tafanelli. 2004. Reproduction, prey, and habitat of the Aplomado Falcon (*Falco femoralis*) in desert grasslands of Chihuahua, Mexico. The Auk 121 (4): 1081-1093.

Macias-Garcia, C., and H. Drummond. 1988. Seasonal and ontogenetic variation in the diet of the Mexican Garter Snake, *Thamnophis eques*, in Lake Tecocomulco, Hidalgo. Journal of Herpetology 22 (2): 129-134.

Manville, A.M. II., 2009. Towers, turbines, power lines, and buildings – steps being taken by the U.S. Fish and Wildlife Service to avoid or minimize take of migratory birds at these structures. *In* Ralph, C.J., and T.D. Rich, eds. Proceedings of the 4th International Partners in Flight Conference. February 2008, McAllen, Texas.

Marshall, M.P., and H.J. Walt. 1984. *Rio Abajo: The Prehistory and History of a Rio Grande Province*. New Mexico Historic Preservation Division.

Martin, P.S., and J.B. Rinaldo. 1947. The SU Site Excavations at a Mogollon Village, Western New Mexico, Third Season, 1946. Field Museum Press, Chicago.

Martin, P.S., and J.B. Rinaldo. 1960. Excavations in the Upper Little Colorado Drainage, Eastern Arizona. *Fieldiana: Anthropology* 51 (1).

Massing, G.L. 1977. Baca Formation. New Mexico Bureau of Geology and Mineral Resources Open File Report-94.

Mauldin, R. 1993. The Relationship Between Ground Stone and Agricultural Intensification in Western New Mexico. *The Kiva* 58(2):317-330.

May, B.C., D.B. Webster, C.M. Britton, T. Bryson. 2008. Macro- and micro-habitat characteristics of Kuenzler's Hedgehog Cactus, *Echinocereus fendleri* var. *kuenzleri*. Haseltonia 14: 170-175.

McCain, E.B., and J.L. Childs. 2008. Evidence of resident Jaguars (*Panthera onca*) in the southwestern United States and the implications for conservation. Journal of Mammalogy 89 (1): 1-10.

McCord, R., L.C. Thrasher, R.S. White, B.J. Tegowski, A. Skaff, G. McCullough, and E. Schirtzinger. 2002. New fossil records from the Blancan 111 Ranch beds, Graham County, Arizona: Results of cooperative efforts by a federal agency, public and private museums and the amateur community. Mesa Southwest Bulletin 8:113-120.

McCord, R.D. 1997. An Arizona Titanosurid sauropod and revision of the late Cretaceous Adobe Canyon Fauna. Journal of Vertebrate Paleontology 17(3):620-622.

McCormack, J.E., Bowen, B.S., and Smith, T.B. 2008. Integrating paleoecology and genetics of bird populations in two sky island archipelagos. BMC Biology. Vol. 6: 28.

McDonald, J. 2007. Electric Power Substations Engineering, Second Edition, Edited by John D. McDonald, Boca Raton, Florida.

McGarvin, T.G. 1987. The 1887 Sonoran Earthquake: It Wasn't Our Fault. Arizona Bureau of Geology and Mineral Technology Fieldnotes Vol. 17 No. 2.

McGregor, R., S. Derrane, D. Bender, and L. Fahrig. 2003. The effect of traffic volume on translocated small mammal movement. *In*: Irwin, C.L., P. Garrett, and K.P. McDermott, Eds. Proceedings of the 2003 International Conference on Ecology and Transportation. North Carolina State University, Raleigh, NC. pp. 394-396.

McGuire, R. 2001. Ideologies of Death and Power in the Hohokam Community of La Ciudad. In *Ancient Burial Practices in the American Southwest: Archaeology, Physical Anthropology, and Native American Perspectives*, edited by D. Mitchell and J. Brunson-Hadley, pp. 27-44. University of New Mexico Press, Albuquerque.

McLaughlin, S.P., and J.E. Bowers. 1982. Effects of wildfire on a Sonoran Desert plant community. Ecology 63 (1): 246-248.

McLemore, V.T., G.K. Hoffman, M. Mansell, G.R. Jones, C.B. Krueger, and M. Wilks. 2005. Mining Districts in New Mexico. New Mexico Bureau of Geology and Mineral Resources Open File Report-494.

Mead, J.I., N.J. Czaplewski, L.D., and Agenbroad. 2005. Rancholabrean (Late Pleistocene) mammals and localities of Arizona. Vertebrate Paleontology of Arizona. Mesa Southwest Museum Bulletin Number 11:139-180.

Mech, L.D. 1981. The Wolf: The ecology and behavior of an endangered species. University of Minnesota Press. Minneapolis, Minnesota. 384 pp.

Mehringer, P.J., and V.C. Haynes. 1965. The Pollen Evidence for the Environment of Early Man and Extinct Animals at the Lehner Mammoth Site, Southeastern Arizona. *American Antiquity* 31:17-23.

Memorial Medical Center. 2011. Memorial Medical Center website (New Mexico). Available at www.mmclc.org/services.html. Accessed January 30, 2011.

Middle Rio Grande-Albuquerque Reach Watershed Group. 2008. Middle Rio Grande-Albuquerque Reach Watershed Restoration Action Strategy, 30 pages, 7 appendices.

Midwest Research Institute. 2005. Analysis of the Fine Fraction of Particulate Matter in Fugitive Dust: Final Report. Prepared for the Western Governors' Association, Western Regional Air Partnership (WRAP). (MRI Project No. 110397)

Mimbres Memorial Hospital. 2009. Mimbres Memorial Hospital website (New Mexico). Available at www.mimbresmemorial.com/Pages/home.aspx. Accessed January 30, 2011.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department. Sims Printing Company, Inc. Phoenix, Arizona. 293 p.

Minckley, W.L., and Brown, D.E. 1982. Riparian Scrublands, pp. 255-256. *In*: Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Minckley, W.L., and P.C. Marsh. 2009. Inland Fishes of the Greater Southwest: chronicle of a vanishing biota. University of Arizona Press, Tucson, Arizona. 425 pp.

Minnis, P.E. 1985. *Social Adaptation to Food Stress: A Prehistoric Southwestern Example*. Prehistoric Archaeology and Ecology. University of Chicago Press, Chicago.

Mitchell, D. 2003. Burial and Society. In *Centuries of Decline During the Hohokam Classic Period at Pueblo Grande*, edited by D. Abbott, pp. 107-127. University of Arizona Press, Tucson.

Moore, R., and H.W. Miller. 1960. A dinosaur-bearing section of Cretaceous rocks in the Empire Mountains, Pima County, Arizona. Arizona Geological Society Digest 3:57-61.

Morgan, G.S., and R.S. White, Jr. 2005. Miocene and Pliocene vertebrates from Arizona. Pp. 115-136 *In* Heckert, A.B., and S.G. Lucas (Eds.) Vertebrate Paleontology in Arizona. New Mexico Museum of Natural History and Science Bulletin 29.

Morgan, G.S., and S.G. Lucas. 2003. Mammalian biochronology of Blancan and Irvingtonian (Pliocene and early Pleistocene) faunas from New Mexico. Bulletin of the American Museum of Natural History, Number 270, Chapter 12, pages 269-320.

Morgan, G.S., E.B. Lander, C. Cikoski, R.M. Chamberlin, D.W. Love, and L. Peters. 2009. The oreodont *Merychyus major major* (Mammalia: Artiodactyla: Oreodontidae) from the Miocene Popotosa Formation, Bosque del Apache National Wildlife Refuge, Socorro County, central New Mexico. New Mexico Geology 31(4): 91-103.

Morgan, G.S., S.G. Lucas, and J.W. Estep. 1998. Pliocene (Blancan) vertebrate fossils from the Camp Rice Formation near Tonuco Mountain, Doña Ana County, southern New Mexico. New Mexico Geological Society Guidebook, 49th Field Conference, Las Cruces County, pages 237-249.

Morgan, S.S., P.L. Sealey, and S.G. Lucas. 2011. Pliocene and Early Pleistocene (Blancan) vertebrates from the Palomas Formation in the vicinity of Elephant Butte Lake and Caballo Lake, Sierra County, southwestern New Mexico. Pp. 664-736. *In* Sullivan, R.M. Sullivan, S.G. Lucas, and J.A. Spielmann (Eds.) Fossil Record 3. New Mexico Museum of Natural History and Science Bulletin 53.

Morrison, J.L. 1990. The Meadow Jumping Mouse in New Mexico: habitat preferences and management recommendations. *In* Proceedings of the symposium on Managing Wildlife in the Southwest: 136-141. Phoenix, Arizona chapter of The Wildlife Society.

Mosk, S.A. 1942. The Influence of Tradition on Agriculture in New Mexico. *The Journal of Economic History* 2(Supplement: The Tasks of Economic History):34-51.

MountainView Regional Medical Center. 2010. MountainView Regional Medical Center website (New Mexico). Available at www.mountainviewregional.com/Pages/home.aspx. Accessed January 30, 2011.

Mt. Graham Regional Medical Center. 2010. Mt. Graham (Arizona) Regional Medical Center website. Available at www.mtgraham.org. Accessed January 30, 2011.

Murphy, R.W., K.H. Berry, T. Edwards, A.E. Leviton, A. Lathrop, and J.D. Riedle. 2011. The dazed and confused identity of Agassiz's land tortoise, *Gopherus agassizii* (Testudines, Testudinidae) with the description of a new species, and its consequences for conservation. ZooKeys 113: 39-71.

Murray, J.L., and G.L. Gardner. 1997. *Leopardus pardalis*. Mammalian Species 548. The American Society of Mammalogists. 10 pp.

Myrick, D.F. 1990. *New Mexico's Railroads: A Historical Survey*. University of New Mexico Press, Albuquerque.

Nash, G.D. 1987. Reshaping Arizona's Economy: A Century of Change. In *Arizona at Seventy-Five*, edited by B. Luey and N.J. Stowe. Arizona State University Public History Program and the Arizona Historical Society. University of Arizona Press, Tucson.

National Audubon Society. 2011. Arizona's Important Bird Areas Program. Available at http://iba.audubon.org/iba/viewSiteProfile.do?siteId=3040&navSite=state. Accessed February 1, 2011.

National Climatic Data Center. 2011. Climate Normals 1981-2010. Available at shttp://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/. Accessed January 9, 2012.

National Geographic Society (NGS). 2002. Field Guide to Birds of North America. Fourth edition. National Geographic Society, Washington, DC. 480 p.

National Park Service (NPS). 2007. Saguaro National Park Available at www.nps.gov/sagu/naturescience/index.htm. Accessed February 1, 2011.

National Park Service (NPS). 2010a. Tumacácori National Historical Park. National Park Service.

National Park Service (NPS). 2010b. Cultural Landscapes Inventory: Gran Quivira, Salinas Pueblo Missions National Monument. National Park Service, Mountainair, NM.

National Park Service (NPS). 2010c. National Trails System. Available at www.nps.gov/nts.

Neely, J. 2004. Paleoclimatic and Archaeological Contexts. In *Safford Valley Grids: Prehistoric Cultivation in the Southern Arizona Desert*, edited by W.E. Doolittle and J. Neely, pp. 18–30. Anthropological Papers of the University of Arizona. The University of Arizona, Tucson.

Nelson, M.C. 1999. Mimbres During the Twelfth Century: Abandonment, Continuity, and Reorganization. University of Arizona Press, Tucson.

New Mexico Bureau of Mines and Mineral Resources/USGS. 2009. New Mexico Mineral Map. Accessed January 2011.

New Mexico Department of Agriculture. 2009. New Mexico noxious weed list update. New Mexico State University. Available at http://nmdaweb.nmsu.edu/quick-reference/New%20Mexico%20Noxious%20Weed%20List%20Update.html. Accessed October 6, 2011.

New Mexico Energy. 2011a. *Renewable Energy: Wind*. Available at www.emnrd.state.nm.us/ECMD/RenewableEnergy/wind.htm. Accessed June 7, 2011.

New Mexico Energy. 2011b. *Renewable Energy: Solar*. New Mexico Energy, Minerals and Natural Resources Department. Available at www.emnrd.state.nm.us/ECMD/RenewableEnergy/solar.htm. Accessed June 8, 2011.

New Mexico Environment Department (NMED). 2011. New Mexico Atlas GIS shapefiles.

New Mexico Environment Department (NMED). 2011a. NMED Air Monitoring Website. Available at http://air.state.nm.us. Accessed February 28, 2011.

New Mexico Environment Department (NMED). 2011b. Dispersion Modeling Section: Class I Areas. Available at www.nmenv.state.nm.us/aqb/modeling/class1areas.html. Accessed February 28, 2011.

New Mexico Environment Department (NMED). 2011c. Outstanding National Resource Waters. Available at www.nmenv.state.nm.us/swqb/ONRW. Accessed August, 2011.

New Mexico Environment Department Surface Water Quality Bureau. 2010. 2010-2012 State of New Mexico Clean Water Act §303(d)/§305(b) Integrated Report.

New Mexico Office of the State Historian (NMOSH). 2010a. Don Juan de Oñate Takes Possession of New Mexico. Electronic document. Available at http://www.newmexicohistory.org/filedetails_docs.php?fileID=305. Accessed October 6, 2010. New Mexico Office of the State Historian, Santa Fe.

New Mexico Office of the State Historian (NMOSH). 2010b. Pedro de Peralta. Available at http://www.newmexicohistory.org/filedetails_docs.php?fileID=421. Accessed October 6, 2010. New Mexico Office of the State Historian, Santa Fe.

New Mexico Ornithological Society. 2007. NMOS Field Notes Database. Natural Heritage New Mexico (database designer/server), Albuquerque, New Mexico. Available at http://nhnm.unm.edu/partners/NMOS. Accessed on January 25, 2013.

New Mexico State University, Office of Policy Analysis at Arrowhead Center. 2009 (reports revised 2011). The Economic Base of Doña Ana County, Grant County, Hidalgo County, Lincoln County, Luna County, Otero County, Sierra County, Socorro County (multiple studies), total land area (square miles). Available at http://arrowheadcenter.nmsu.edu/content/county-map. Accessed January 24, 2011.

New Mexico Water Resources Research Institute. 2010a. Available at http://wrri.nmsu.edu/publish/otherrpt/swnm/pdf/chap8.pdf.

New Mexico Water Resources Research Institute. 2010b. Available at http://river.nmsu.edu/website/jornada.

Noftsker, C. 2005. New Mexico Office of the State Engineer Underground Water Basins in New Mexico. Office State Engineer Water Resource Allocation Program.

Norris, K.S., and J.L. Kavanau. 1966. The burrowing of the Western Shovel-nosed Snake, *Chionactis occipitalis*, and the undersand environment. Copeia 4: 650-664.

Northern Arizona University (NAU). 2010. The Tohono O'odham. Available at http://www.cba.nau.edu/caied/tribepages/Tohono.asp. Accessed October, 21, 2010. Northern Arizona University, Flagstaff.

Northern Arizona University (NAU). 2011. Wind Sustainable Energy Solutions. Available at www.wind.nau.edu/maps. Accessed June 7, 2011.

Northern Cochise Community Hospital. 2011. Northern Cochise Community Hospital website. Available at www.ncch.com/getpage.php?name=index. Accessed January 30, 2011.

Northwest Fire. 2009. Northwest Fire/Rescue District website. Available at www.northwestfire.org. Accessed January 30, 2011.

Northwest Hospital. 2010. Northwest Hospital (Tucson, Arizona) website. Available at www.northwestmedicalcenter.com. Accessed January 30, 2011.

O'Laughlin, T.C. 2001. Long Lessons and Big Surprises: Firecracker Pueblo. In *Following Through: Papers in Honor of Phyllis S. Davis*, edited by R.N. Wiseman, T.C. O'Laughlin and C.T. Snow, pp. 115-131. Archaeological Society of New Mexico, Albuquerque.

Oakes, Y. R. 1996. Expanding Chronometric Boundaries in West-Central New Mexico. In *La Jornada Papers in Honor of William F. Turney Archaeological Society of New Mexico Papers No. 22*, edited by M. S. Duran and D. T. Kirkpatrick, pp. 139-149. Archaeological Society of New Mexico Papers No. 22. Archaeological Society of New Mexico Alburquerque.

Obama, President Barack. 2009. Remarks of President Barack Obama, Weekly Address: Saturday, January 24th, 2009. Available at www.whitehouse.gov/president-obama-delivers-your-weekly-address. Accessed January 17, 2011.

Ortega-Huerta, M.A., and K.E. Medley. 1999. Landscape analysis of Jaguar (*Panthera onca*) habitat using sighting records in the Sierra de Tamaulipas, Mexico. Environmental Conservation 26 (4): 257-269.

Otero County. 2005. Otero County Comprehensive Plan. October.

Owen, G. 2008. Drought and the Environment. Available at www.southwestclimatechange.org/impacts/land/drought. Accessed January 9, 2012.

Pase, C.P., and D.E. Brown. 1982a. Interior Chaparral. Pp. 95-99. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Pase, C.P., and D.E. Brown. 1982b. Rocky Mountain (Petran) and Madrean Montane Conifer Forests. Pp. 43-48. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

Pasenko, M.R. 2007. *Rhynchotherium falconeri* (Proboscidea, Gomphotheriidae) from 111 Ranch, southeastern Arizona with a discussion of the genus. Journal of Vertebrate Paleontology 27(1):195-203.

Pasenko, M.R. 2011. New mastodont and mammoth remains from Pleistocene deposits in southeastern Arizona. Submitted manuscript to the Journal of the Arizona-Nevada Academy of Science.

Paysen, T.E., R.J. Ansley, J.K. Brown, G.J. Gottfried, S.M. Haase, M.G. Harrington, M.G. Narog, S.S. Sackett, and R.C. Wilson. 2000. Fire in western shrubland, woodland, and grassland ecosystems. *In* Brown, J.K, and J.K. Smith, eds. Wildland fire in ecosystems: effects of fire on flora. General Technical Report RMRS-GTR-42 (2). U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 257 pp.

Pearce-Higgins, J.W., L. Stephen, R.H.W. Langston, I.P. Bainbridge, and R. Bullman. 2009. The distribution of breeding birds around upland wind farms. Journal of Applied Ecology 46: 1323-1331.

Peregrine Fund. 2009. Aplomado Falcon Press Release – July 7, 2009. Available at www.peregrinefund.org/news-release/159. Accessed October 6, 2011.

Peterson, M.D., A.D. Frankel, S.C. Harmsen, C.S. Mueller, K.M. Haller, R.L. Wheeler, R.L. Wesson, Y. Zeng, O.S. Boyd, D.M. Perkins, N. Luco, E.H. Field, C.J. Wills, and K. Rukstales. 2008. Documentation for the 2008 update of the United States National Seismic Hazard Maps. United States Geological Survey Open File Report 2008-1128, 61 pages.

Phillips, A.R., J. Marshall and G. Monson. 1964. The Birds of Arizona. University of Arizona Press. Tucson, Arizona. 220 p.

Pike, D. 2004. *Roadside New Mexico: A Guide to Historical Markers*. University of New Mexico Press, Albuquerque.

Pima County. 2004. Draft Pima County multi species conservation plan appendices, Section C. Priority vulnerable species: analysis and review of the species proposed for the SDCP. 368 pp. + Appendices.

Pima County. 2007. Pima County Comprehensive Plan.

Pima County. 2010a. Multi-species Conservation Plan: Administrative Draft. Submitted to the U.S. Fish and Wildlife Service, Tucson, Arizona. 151 p.

Pima County. 2010b. Natural Resources, Parks and Recreation. Available at www.pima.gov/nrpr/parks/maps.htm. Accessed January 2011.

Pima County. 2011a. A7 Ranch. Available at www.pima.gov/nrpr/parks/nrparks/A7RA_access_flyer.pdf. Accessed October 6, 2011.

Pima County. 2011b. Cienega Creek. Available at www.pima.gov/nrpr/apps/permits.htm. Accessed January 31, 2011.

Pinal County. 2009. Pinal County Comprehensive Plan. November. Available at http://pinalcountyaz.gov/Departments/PlanningDevelopment/ComprehensivePlanUpdate/Documents/Pinal%20County%20Comprehensive%20Plan.pdf.

Pinal County. FY 2011-2012 Tentative Budget Facts and Figures. Available at www.pinal countyaz.gov/Departments/BudgetOffice/Documents/Downloads/FY%202011%20Budget%20Fact%20Sheet.pdf.Accessed July 24, 2011.

Plog, S. 1997. *Ancient Peoples of the American Southwest*. Thames and Hudson Ltd, London.

Porath, M.T., H.B. Blasius, J.A. Conn, and K. . Young. 2010. Evaluating Translocation of the Apache Trout (*Oncorhynchus apache*) to Nonhistorical Renovated Streams. The Southwestern Naturalist, 55(2): 229-239.

Powell, S., and F.E. Smiley. 2002. The First Black Mesa Farmers: The White Dog and Lolomai Phases. In *Prehistoric Culture Change on the Colorado Plateau: Ten Thousand Years on Black Mesa,* edited by S. Powell and F.E. Smiley, pp. 37-66. University of Arizona Press, Tucson.

Prince, L.B. 1883. Historical Sketches of New Mexico from the Earliest Records to the American Occupation. Leggat Brothers, New York.

Pritzker, B. 2000. A Native American Encyclopedia: History, Culture, and Peoples. Oxford University Press, New York.

Prothero, D.R., J.A. Ludtke, and S.G. Lucas. 2004. Magnetic stratigraphy of the middle Eocene (Duchesnean) Baca Formation, west-central New Mexico. Pp. 55-58. *In* Lucas, S.G., K.E. Ziegler, and P.E. Kondrashov (Eds.) Paleogene Mammals. New Mexico Museum of Natural History and Science Bulletin 26.

Quintana, D. 2004. Fire management in a southeastern Arizona riparian area. BLM Safford-Tucson Fire Management Zone. 38 pp.

Raftovich, R.V., K.A. Wilkins, K.D. Richkus, S.S. Williams, and H.L. Spriggs. 2010. Migratory bird hunting activity and harvest during the 2008 and 2009 hunting seasons. U.S. Fish and Wildlife Service Department of Migratory Bird Management. Laurel, Maryland. 63 pp.

Rambler, T. 2012. San Carlos Apache Tribe's First Comment Letter on the SunZia Draft EIS Issued on May 25, 2012. San Carlos Apache Tribe, San Carlos.

Rare Plant Technical Council (RPTC). 1999. *Pediomelum pentaphyllum*. New Mexico Rare Plants. Albuquerque, NM: New Mexico Rare Plants Home Page. Available at http://nmrareplants.unm.edu. Accessed October 6, 2011.

Ravesloot, J. C. and S. M. Whittlesey. 1987. Inferring the Protohistoric Period in Southern Arizona. In *The Archaeology of the San Xavier Bridge Site (AZ BB:13:14) Tucson Basin, Southern Arizona*, edited by J. C. Ravesloot, pp. 81-98. Arizona State Museum Archaeology Series No. 171. Arizona State Museum, University of Arizona, Tucson.

Redington NRCD. 2010. Redington NRCD Plan. Available at http://redingtonnrcd.org/attachments/Long_range_plan_20102016.pdf.

Reeder, H.O. 1957. Ground water in Animas Valley, Hidalgo County, New Mexico. United States Geological Survey Technical Report Number 11, 101 pages.

Reid, J.J. 1989. A Grasshopper Perspective on the Mogollon of the Arizona Mountains. In *Dynamics of Southwestern Prehistory*, edited by L. Cordell and G.J. Gumerman. Smithsonian Institution Press, Washington, DC.

Reid, J.J., and S.M. Whittlesey. 1997. *The Archaeology of Ancient Arizona*. The University of Arizona Press, Tucson.

Reid, J.J., and S.M. Whittlesey. 1999. *Grasshopper Pueblo: A Story of Archaeology and Ancient Life*. University of Arizona Press, Tucson.

Remick, W.H. 1989. Maps showing ground-water conditions in the Duncan-Virden Valley Basin, Greenlee and Cochise Counties, Arizona and Hidalgo and Grant Counties, New Mexico. State of Arizona, Department of Water Resources Hydrologic Map Series Report Number 16, Sheets 1 & 2, scale 1:125,000.

Rice, G.E. 1980. An Analytical Overview of the Mogollon Tradition. In *Studies in the Prehistory of the Forestdale Region, Arizona*, edited by C.R. Stafford and G.E. Rice, pp. 9-40. No. 1 ed. Arizona State University Anthropology Papers. Arizona State University, Tempe, Arizona.

Richardson, S. 2009. Personal communication with Scott Richardson/USFWS-Tucson Office on July 21, 2009.

Riley, C. T. 1987. *The Frontier People: The Greater Southwest in the Protohistoric Period*. University of New Mexico Press, Albuquerque.

Riley, S.P.D., J.P. Pollinger, R.M. Sauvajot, E.C. York, C. Bromley, T.K. Fuller, and R.K. Wayne. 2006. A southern California Freeway is a physical and social barrier to gene flow in carnivores. Molecular Ecology 15: 1733-1741.

Rinne, J.N. 1991. Habitat use by Spikedace, *Meda fulgida* (Pisces: Cyprinidae) in Southwestern streams with reference to probable habitat competition by Red Shiner, *Notropis lutrensis* (Pisces: Cyprinidae). The Southwestern Naturalist 36 (1): 7-13.

Robbins, M.B., and B.C. Dale. 1999. Sprague's Pipit (*Anthus spragueii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/439. Accessed October 6, 2011.

Roberts, C.A., and S.A. Roberts. 2006. *New Mexico*. University of New Mexico, Albuquerque.

Roberts, D. 1996. In Search of the Old Ones: Exploring the Anasazi World of the Southwest. Simon & Schuster, New York.

Robson, S.G., and E.R. Banta. 1995. Ground water atlas of the United States Arizona, Colorado, New Mexico, Utah. U.S. Geological Survey HA 730-C.

Rogers, M.J. 1939. Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum Papers No. 3. San Diego Museum of Man, San Diego.

Rogers, M.J. 1966. *Ancient hunters of the far west*. Ed. Richard F. Pourade. San Diego: Copley Press.

Rojas-Martinez, Valiente-Banuet, A., del Coro Arizmendi, M., Alcantara-Eguren, A., and Arita, H.T. 1999. Seasonal Distribution of the Long-Nosed Bat (*Leptonycteris curasoae*) in North America: Does a Generalized Migration Pattern Really Exist? Journal of Biogeography, Vol. 26, No. 5, pp. 1065-1077.

Rosen, P.C. 2003. Avra Valley Snakes: Marana Survey Report for Tucson Shovel-nosed Snake (*Chionactis occipitalis klauberi*). Final Report on Shovel-nosed Snake Prepared for Town of Marana. University of Arizona, Tucson, Arizona. 23 pp.

Rosen, P.C., S.S. Sartorius, C.R. Schwalbe, P.A. Holm, and C.H. Lowe. 1998. Herpetology of the Sulphur Springs Valley, Cochise County, Arizona. *In* Tellman, B, D.M. Flinch, C. Edminster, and R. Hamre (eds.). The Future of Arid Grasslands: Identifying Issues, Seeking Solutions. Rocky Mountain Research Station, Fort Collins, CO. 392 pp.

Rothman, H.K. 1991. Navajo National Monument: A Place and Its People: An Adminstrative History. National Park Service, Division of History, Southwest Cultural Resources Center Professional Papers No. 40, Santa Fe.

Ruhler, M. 1998. The Origin of the Na-Dene. Proceedings of the National Academy of Sciences of the United States of America 95:13994-13996.

S.J. Swanson and C. Rayle (Editors). 2012. A Class I Records Review and Class II Cultural Resource Survey of Alternatives Under Analysis for the SunZia Southwest Transmission Project.

Salazar, Ken. 2010. Renewable Energy Development by the United States Department of the Interior, Secretarial Order 3285A1. Amended February 22, 2010. Available at http://elips.doi.gov/elips/0/doc/151/Page1.aspx. Accessed April 2013.

Sandberg, D.V., R.D. Ottmar, J.L. Peterson, J. Core. 2002. Wildland fire on ecosystems: effects of fire on air. General Technical Report RMRS-GTR-42 (5). U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 79 pp.

Sandoval, D. 2012. Personal Communication via email with Danny Sandoval, Management Analyst-Surface Division, New Mexico State Land Office on October 24, 2012.

Saunders, J.J. 1970. The distribution and taxonomy of *Mammuthus* in Arizona. MS Thesis, U. of Arizona.

Sayles, E.B. 1945. Material Culture. In *The San Simon Branch: Excavations at Cave Creek in the San Simon Valley*. Medallion Papers No. 34. Gila Pueblo, Globe.

Sayles, E.B., and E. Antevs. 1941. Archaeology of the Cochise Culture. In *The Cochise Culture*. Medallion Papers 29. Gila Pueblo, Globe.

Sayles, E.B., E. Antevs, E.W. Haury, T.L. Smiley, R.H. Thompson and W.W. Wasley. 1983. *The Cochise Cultural Sequence in Southeastern Arizona*. Anthropological Papers of the University of Arizona Number 42. University of Arizona Press, Tucson.

Schmidly, D.J. The Bats of Texas. 1991. Texas A & M University Press, College Station, Texas. 188 p.

Schoenherr, A.A. 1977. Density dependent and density independent regulation of reproduction in the Gila Topminnow, *Poeciliopsis occidentalis* (Baird and Girard). Ecology 58 (2): 438-444.

Scholle, P.A. 2003. Geological map of New Mexico. New Mexico Bureau of Geology and Mineral Resources, 1:500,000.

Schroeder, A. H. 1974a. Apache Indians, Part I. In *American Indian Ethnohistory: Indians of the Southwest*. vol. 4. Garland Publishing, New York.

Schroeder, A. H. 1974b. Apache Indians, Part IV. In *American Indian Ethnohistory: Indians of the Southwest*. vol. 4. Garland Publishing, New York.

Schroeder, A. H. 1974c. Apache Indians, Part V. In *American Indian Ethnohistory: Indians of the Southwest*. vol. 4. Garland Publishing, New York.

Seymour, D. J. 2008. Despoblado or Athapaskan Heartland: A Methodological Perspective on Ancestral Apache Landscape Use in the Safford Area. In *Crossroads of the Southwest: Culture, Ethnicity, and Migration in Arizona's Safford Basin*, edited by D. E. Purcell, pp. 121-162. Cambridge Scholars Press, New York.

Seymour, D.J. 2009a. The Canutillo Complex: Evidence of Protohistoric Mobile Occupants in the Southern Southwest. *Kiva* 74(4):421-446.

Seymour, D.J. 2009b. Evaluating Eyewitness Accounts of Native Peoples along the Coronado Trail from the International Border to Cibola. *New Mexico Historical Review* 84(3):399-435.

Seymour, D. J. 2012a. When Data Speak Back: Resolving Source Conflict in Apache Residential and Fire-Making Behavior. *International Journal of Historical Archaeology*. December.

Seymour, D. J. 2012b. Isolating a Pre-Differentiation Athapaskan Assemblage in the Southern Southwest: The Cerro Rojo Complex. In *From the Land of Ever Winter to the American Southwest: Athapaskan Migrations, Mobility, and Ethnogenesis*, edited by Deni J. Seymour, pp. 90-123. University of Utah Press, Salt Lake City.

Seymour, D. J. 2012c. Horse Herd Size and the Role of Horses among the Mescalero Apache: A Response to Osborn. Papers of the Archaeological Society of New Mexico. In honor of Regge Wiseman, edited by Carol Condie and Helen Crotty. Archaeological Society of New Mexico, Albuquerque.

Seymour, D. J. 2013a. Apache Platform Cave-Cache Encampments: Implications for Mobility Strategies and the Earliest Athabascans. Journal of Field Archaeology 38(2).

Seymour, D. J. 2013b. Coronado Expedition Contributions to Early Historic Cocomaricopa [*Kavelychidom Piipaash*] Agricultural Practices.

Seymour, D. J. n.d. Documentary Clarification of the Gila River Sobaipuri-Pima in Kino's Time. Submitted to *Journal of the Southwest*.

Seymour, D. J. n.d. An Ethno-Geographic Evaluation of the Santa Cruz River Pima and Their Principle Great Settlement of San Xavier del Bac. Submitted to *Kiva*.

Sheppard, P.R., A.C. Comrie, G.D. Packin, K. Angersbach, and M.K. Hughes. 1999. The Climate of the Southwest, CLIMAS Report Series CL1-99. Institute for the Study of Planet Earth, Tucson, Arizona.

Sheridan, T.E. 1995. *Arizona: A History*. University of Arizona Press, Tucson.

Sierra County Community Wildfire Protection Plan Team. 2012. Sierra County Community Wildfire Protection Plan. 92 pp.

Sierra County. 2006. Sierra County Comprehensive Plan. January.

Sierra Vista Regional Health Center. 2011. Sierra Vista Regional Health Center website. Available at www.svrhc.org. Accessed January 30, 2011.

Simmons, M. 1977. *New Mexico: A History*. The States and the Nation Series. W.W. Norton and Company, Inc., New York.

Sinclair, J.L. 1985. Santa Rita – The Town that Vanished Into Thin Air. In *New Mexico*. New Mexico Magazine Santa Fe.

Sires, E. 1984. Hohokam Architecture and Site Structure. In *Hohokam Archaeology along the Salt-Gila Aqueduct, Central Arizona Project: Synthesis and Conclusions*, edited by L.S. Teague and P.L. Crown, pp. 115-140. Arizona State Museum Archaeological Series No. 150. vol. 9. University of Arizona, Tucson.

Sires, E.W., Jr. 1983. Archaeological Investigations at Los Fosas (AZ U:15:19) A Classic Period Settlement on the Gila River. In *Hohokam Archaeology along the Salt-Gila Aqueduct, Central Arizona Project: Habitation Sites on the Gila River*, edited by L.S. Teague and P.L. Crown, pp. 493-658. Arizona State Museum, Archaeological Series vol. 16. Arizona State Museum, Tucson.

Sky Island Alliance. 2005. Aravaipa Ecosystem Management Plan. Management Recommendations. Tucson, Arizona. 52 p. + Attachments. Available at www.skyislandalliance.org/media/Aravaipa.pdf. Accessed October 6, 2011.

Sky Island Alliance. 2010. Sky Island Alliance, Patagonia, and Freedom to Roam in partnership document first live ocelot in Arizona!. Sky Island Alliance Available at www.skyislandalliance.org. Accessed June 23, 2010.

Smith, L., D. Smith, and S. Smallhouse. 2006. Final Report Lower San Pedro Watershed Assessment Project. Arizona Water protection Fund Grant #00-109.

Society of Vertebrate Paleontology (SVP). 1995. Assessment and mitigation of adverse impacts to nonrenewable paleontologic resources: standard guidelines. Society of Vertebrate Paleontology News Bulletin 163:22-27.

Society of Vertebrate Paleontology (SVP). 2009. Available at www.vertpaleo.org/society/polstatconformimpactmigig.cfm. Accessed September 29, 2009.

Socorro County Chamber of Commerce. 2011. History of Socorro. Available at www.socorro-nm.com/History.htm. Accessed January 30, 2011.

Socorro County. 2006. Socorro County Community Wildfire Protection Plan. 22 pp.

Socorro General Hospital. 2011. Socorro General Hospital website (New Mexico). Available at www.phs.org/PHS/careers/locations/socorro/index.htm. Accessed January 30, 2011.

Sogge, M.K. 2000. Breeding season ecology. *In* Finch, D.M., and S.H. Stoleson, editors. Status, Ecology, and Conservation of the Southwestern Willow Flycatcher. General Technical Report RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station. Ogden, Utah. 131 pp.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. *In* Finch, D.M., and S.H. Stoleson, editors. Status, Ecology, and Conservation of the Southwestern Willow Flycatcher. General Technical Report RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station. Ogden, Utah. 131 pp.

Sogge, M.K., R.M. Marshall, S.J. Sferra and T.J. Tibbitts. 1997. A Southwestern Willow Flycatcher Natural History Summary and Survey Protocol. Technical Report NPS/NAUCPRS/NRTR-97/12. U.S. Department of the Interior, National Park Service, Colorado Plateau Research Station. 35 pp. + Appendices.

Sonnichsen, C.L. 1958. *The Mescalero Apaches*. The Civilization of the American Indian. University of Oklahoma Press, Norman.

Sonoran Desert. 1999. Sonoran Desert Conservation Plan.

Southwest Area Transmission (SWAT). 2006. Project Zia Transmission Planning Workshop, PowerPoint presentation given on August 17, 2006, by Bob Smith, Arizona Public Service Company. Available at http://westconnect.com/filestorage/swat_project_zia_081706.pdf. Accessed October 10, 2012.

Spicer, E.H. 1962. *Cycles of Conquest: The Impact of Spain, Mexico, and the United States on the Indians of the Southwest, 1533-1960*. University of Arizona Press, Tucson.

Spielmann, J.A., and S.G. Lucas. 2006. Late Cretaceous marine reptiles (Mosasauridae and Plesiosauria) from New Mexico and their biostratigraphic distribution. Pp. 217 – 221 *In* Lucas, S.G., and R.M. Sullivan (Eds.) Late Cretaceous vertebrates from the Western Interior. New Mexico Museum of Natural History and Science Bulletin 35.

Spielmann, J.A., and S.G. Lucas. 2009. Triassic stratigraphy and biostratigraphy in Socorro County, New Mexico. New Mexico Geological Society Guidebook, 60th Field Conference, Geology of the Chupadera Region. Pp. 213-226.

Sredl, M.J., and R.D. Jennings. 2005. *Rana chiricahuensis* Platz and Mecham 1979, Chiricahua Leopard Frog. *In* Lannoo, Michael, Amphibian Declines. University of California Press, Berkeley, CA. 1094 pp.

Stromberg, J.C. 1993. Riparian mesquite forests: a review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 27 (1): 111-124.

Stuart, D.E., and R.P. Gauthier. 1981. *Prehistoric New Mexico: Background for Survey*. University of New Mexico Press, Albuquerque.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The Fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 393 p.

Sullivan, B.K. 2009. Arizona Striped Whiptail: *Aspidoscelis arizonae* (Van Denburgh, 1896). *In* L.L.C. Jones, and R.E. Lovich (eds). Lizards of the American Southwest: a photographic field guide. Rio Nuevo Publishers. Tucson, Arizona. 567 pp.

Sullivan, B.K., P.S. Hamilton, and M.A. Kwiatkowski. 2005. The Arizona Striped Whiptail: past and present. USDA Forest Service Proceedings RMRS-P-36 (2005): 145-148.

SunZia Transmission, LLC. 2010. SunZia Southwest Transmission Project: Proponent's Purpose and Need Statement. December 2010.

SunZia Transmission, LLC. 2011. SunZia Southwest Transmission Project Underground Technology and Cost Analysis. Unpublished manuscript.

SWCA Environmental Consultants, and Arid Land Innovation. 2008. Claunch-Pinto Soil and Water Conservation District Community Wildfire Protection Plan. 285 pp.

SWCA Environmental Consultants. 2007. Middle Rio Grande Bosque Community Wildfire Protection Plan appendices. 111 pp.

SWCA Environmental Consultants. 2008. Torrance County Community Wildfire Protection Plan. 256 pp.

Sweeney, E.R. 1992. *Merejido Grijalva: Apache Scout: Army Scout*. The University of Texas at El Paso Southwestern Studies Series No. 96. Texas Western Press, El Paso.

Taylor, D.W. 1987. Fresh-water Mollusks from New Mexico and Vicinity. Bulletin 116. New Mexico Bureau of Mines and Mineral Resources. Socorro, NM. 50 p.

Teague, L.S. 1993. Prehistory and the Traditions of the O'odham and Hopi. *The Kiva* 58(4):435-455.

Tedford, R.H. 1981. Mammalian biochronology of the late Cenozoic basins of New Mexico. Geological Society of America Bulletin, Part 1, 92:1008-1022.

Tegowski, B.J., and R.S. White. 2000. Proboscidean fossils from the San Simon River Valley, Graham and Cochise Counties, Arizona. Pp. 101-111 In McCord, R.D., and D. Boaz (Eds.) Southwest Paleontological Symposium, Proceedings 2000. Mesa Southwest Museum Bulletin Number 7.

Terres, J.K. 1980. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf, New York. 1109 p.

The Agape Center. 2010. New Mexico Hospitals. Available at www.theagapecenter.com/Hospitals/New-Mexico.htm#H. Accessed January 30, 2011.

The Nature Conservancy. 2010. Relocating Desert Fish Species by Helicopter. Available at www.nature.org/wherewework/northamerica/states/arizona/features.

The Nature Conservancy. 2011. Muleshoe Ranch CMA. Available at www.nature.org/wherewework/northamerica/states/arizona/preserves/art22004.html. Accessed January 31, 2011.

Thiel, J.H., and J.B. Mabry (editors). 2006. Rio Nuevo Archaeology Program, 2000–2003: Investigations at the San Agustín Mission and Mission Gardens, Tucson Presidio, Tucson Pressed Brick Company, and Clearwater Site. Center for Desert Archaeology, Tucson.

Thrasher, L. 2007. Fossil tracks and trackways from the Bowie zeolite mines, Graham County, Arizona. Cenozoic vertebrate tracks and traces. New Mexico Museum of Natural History and Science Bulletin Number 42:269-273.

Titus, J.H., and P.J. Titus. 2008. Seedbank of Bingham Cienega, a spring-fed marsh in southeastern Arizona. The Southwestern Naturalist 53 (3): 393-399.

Todd, R.L. 1986. A saltwater marsh hen in Arizona: a history of the Yuma clapper rail (*Rallus longirostris yumanensis*). Completion report, Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix, Arizona. 290 p.

Tomida, Y. 1987. Small mammal fossils and correlation of continental deposits, Safford and Duncan Basins, Arizona, USA. National Science Museum, Tokyo, 141 p.

Toms, D., and T. Roop. 2006. LA 120 – Gran Quivira Determination of Eligibility. National Park Service, Mountainair, NM.

Torrance County. 2010. About Us: Torrance County. Available at www.torrancecountynm.org/index.php?page=about-us. Accessed June 15, 2011.

Torrez, R. 2010a. New Mexico in the 18th Century. Available at www.newmexicohistory.org/filedetails_docs.php?fileID=21410. Accessed October 6, 2010. New Mexico Office of the State Historian, Santa Fe.

Torrez, R. 2010b. Spanish and Mexican Land Grants. Available at www.newmexicohistory.org/filedetails_docs.php?fileID=21447. Accessed October 6, 2010. New Mexico Office of the State Historian, Santa Fe.

Toulouse, J.H. Jr. 1943. *History of the Salinas Province*. Gran Quivira National Monument, Gran Quivira, NM.

Town of Carrizozo. 2008. Town of Carrizozo Comprehensive Plan. August.

Town of Marana. 2007. Town of Marana General Plan Update.

Towne, D.C., and L. Rowe. 2004. Ambient groundwater quality of the San Simon sub-basin of the Safford basin: A 2002 Baseline Study. Arizona Department of Environmental Quality Open File Report 2004-02, 44 p.

Towne, D.C., and L.W. Stephenson. 2002. Ambient groundwater quality of the lower San Pedro Basin: A 1999-2000 Baseline Study. Arizona Department of Environmental Quality Open File Report 2002-01, 39 p.

Towne, D.C., M.C. Freark, and L.W. Stephenson. 2001. Ambient groundwater quality of the Willcox Basin: A 1999 Baseline Study. Arizona Department of Environmental Quality Open File Report 2001-09, 36 p.

Towne, D.C., S. Calloway, and J.A. Rodine. 2008. Ambient groundwater quality of the Pinal Active Management Area: A 2005-2006 Baseline Study. Arizona Department of Environmental Quality Open File Report 08-01, 74 p.

Trimble, M. 1989. *Arizona: A Cavalcade of History*. Treasure Chest Publications, Tucson.

Tucson Medical Center. 2011. Tucson (Arizona) Medical Center website. Available at www.tmcaz.com/TucsonMedicalCenter. Accessed January 30, 2011.

Tuggle, H.D., J.J. Reid and J. Cole, Robert C. 1984. Fourteenth Century Mogollon Agriculture in the Grasshopper Region of Arizona. In *Prehistoric Agricultural Strategies in the Southwest*, edited by S.K. Fish and P. Fish, pp. 101-110. Anthropological Research Papers. vol. No. 33. Arizona State University, Tempe, Arizona.

Turner, R.M. 1982. Sonoran Desertscrub. Pp. 181-221. *In*: Brown, D.E. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants. Vol. 4 (Nos. 1-4). 342 p.

United States Bureau of Economic Analysis. 2001-2008. Total employment by sector, Arizona, Cochise County, Graham County, Greenlee County, Pima County, Pinal County. Available at www.bea.gov/regional/docs/footnotes.cfm?tablename=CA25N. Accessed January 24, 2011.

United States Bureau of Economic Analysis. 2011. *Box: Gross Product Originating: Definition and Relationship to Gross Domestic Product"*. Available at www.bea.gov/scb/account_articles/national/0398gpo/box1.htm. Accessed July 24, 2011.

United States Bureau of Economic Analysis. 2011. News Release: State Personal Income: Second Quarter 2011 (released 9/22/2011). Available at www.bea.gov/newsreleases/regional/spi/2011/pdf/spi0911.pdf.

United States Bureau of Labor Statistics. 2010. Unemployment rates, Not seasonally adjusted. United States, Arizona, Cochise County, Graham County, Greenlee County, Pima County, Pinal County, New Mexico, Doña Ana County, Grant County, Hidalgo County, Lincoln County, Luna County, Otero County, Sierra County, Socorro County. Available at www.bls.gov/data/#unemployment. Accessed January 19, 2011.

United States Census Bureau. 2000. Total population, Persons per square mile, United States, Arizona, New Mexico. Available at http://quickfacts.census.gov/qfd/states/35000.html. Accessed February 2, 2011.

United States Census Bureau. 2006. County Business Patterns. Number of employees and average annual wage by county, New Mexico. Available at www.census.gov/econ/cbp/index.html. Accessed January 24, 2011.

United States Census Bureau. 2007. County Business Patterns. Number of employees and average annual wage by county, Arizona. Available at www.census.gov/econ/cbp/index.html. Accessed January 24, 2011.

United States Census Bureau. 2011a. American Community Survey (ACS). 5-year estimates (2005 to 2009), Arizona and New Mexico counties. Available at http://factfinder2.census.gov. Accessed October 24, 2011.

United States Census Bureau. 2011b. Census 2010, Arizona and New Mexico counties. Available at http://factfinder2.census.gov. Accessed March 20, 2013.

United States Census Bureau. American Community Survey (ACS). 2011c. Briefs, Poverty: 2009 and 2010. Available at www.census.gov/hhes/www/poverty. Accessed January 24, 2011.

United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2011. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana. Available at http://plants.usda.gov. Accessed January 26, 2011.

United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2010. Federal Noxious Weed List. Available at www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist-2010doc.pdf. Accessed: May 25, 2011.

United States Department of Agriculture (USDA). 2011. Soil Survey Handbook, Part 622 – Ecological and Interpretive Groups, Section 04 – Prime Farmland Soils. Available at http://soils.usda.gov/technical/handbook/contents/part622.html. Accessed December 6, 2011.

United States Department of Housing and Urban Development. 1994. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Available at http://portal.hud.gov/hudportal/HUD?src=/program_offices/fair_housing_equal_opp/FHLaws/EXO12898. Accessed January 10, 2011.

United States Department of the Interior. 1995. DOI Manual – Part 609: Weed Control Program. Available at http://elips.doi.gov/elips/release/3042.htm. Accessed January 27, 2011.

United States Energy Information Administration (EIA). 2011a. U.S. Energy-Related Carbon Dioxide Emissions, 2010. Available at www.eia.gov/environment/emissions/carbon. Accessed August 25, 2011.

United States Energy Information Administration (EIA). 2011b. Emissions of Greenhouse Gases in the U.S., 2009. Available at www.eia.gov/environment/emissions/ghg_report. Accessed August 25, 2011.

United States Fish and Wildlife Service (USFWS). 1982. Mexican Wolf Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 103 pp.

United States Fish and Wildlife Service (USFWS). 1990. Listed cats of Texas and Arizona Recovery Plan (with emphasis on the Ocelot). Albuquerque, New Mexico. 131 pp.

United States Fish and Wildlife Service (USFWS). 1994a. Lesser Long-nosed Bat Recovery Plan. USFWS, Phoenix, Arizona, May 1994. 55 p.

United States Fish and Wildlife Service (USFWS). 1994b. Socorro and Alamosa Springsnail Recovery Plan. New Mexico Ecological Services State Office, Albuquerque, New Mexico, August 1994. 24 pp.

United States Fish and Wildlife Service (USFWS). 1995. Birds of Bosque del Apache National Wildlife Refuge. U.S. Fish and Wildlife Service. Unpaginated. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available at www.npwrc.usgs.govbosque.htm. (Updated July 1999). Accessed January 28, 2011.

United States Fish and Wildlife Service (USFWS). 1998. Establishment of a Nonessential Experimental Population of the Mexican Gray Wolf in Arizona and New Mexico. *Federal Register*. Vol. 63, No. 7: 1,752-1,772.

United States Fish and Wildlife Service (USFWS). 2001a. Todsen's Pennyroyal (*Hedeoma todsenii*) Revised Recovery Plan. U.S. Fish and Wildlife Service. Albuquerque, New Mexico. 37 pp.

United States Fish and Wildlife Service (USFWS). 2001b. Wildlife Conservation and Restoration Program. Available at www.federalgrantswire.com/wildlife-conservation-and-restoration.html. Accessed February 24, 2011.

United States Fish and Wildlife Service (USFWS). 2001c. Jaguarundi (*Felis yagouaroundi tolteca*). Arizona Ecological Services Field Office. Phoenix, Arizona. 1 p.

United States Fish and Wildlife Service (USFWS). 2002a. Southwestern Willow Flycatcher Recovery Plan. Albuquerque, New Mexico. 210 pp. + appendices.

United States Fish and Wildlife Service (USFWS). 2002b. News Release: Arizona's first private endangered species bank approved. U.S. Fish and Wildlife Service, Arizona Ecological Field Services Office. Phoenix, Arizona. 2 pp.

United States Fish and Wildlife Service (USFWS). 2003a. Desert Pupfish Recovery Plan. Phoenix, Arizona. 67 p.

United States Fish and Wildlife Service (USFWS). 2003b. Mexican Wolf Recovery Program: Progress Report 5. New Mexico Ecological Services Field Office. Albuquerque, New Mexico.

United States Fish and Wildlife Service (USFWS). 2005a. Biological Opinion. Formal Consultation Pursuant to Section 7 of the Endangered Species Act on the Effects of Existing Land Management Practices on Reestablished Populations of Gila Topminnow and Desert Pupfish in the Aravaipa Creek Watershed.

United States Fish and Wildlife Service (USFWS). 2005b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*); Final Rule. Vol. 70, No. 201: 60,886-60,934.

United States Fish and Wildlife Service (USFWS). 2005c. Biological Opinion: Intra-service Biological Opinion regarding the proposed issuance of an Incidental Take Permit and approval of a Safe Harbor Agreement for Gila Topminnow and Desert Pupfish for the Arizona chapter of The Nature Conservancy. Arizona Ecological Field Services Office. Phoenix, Arizona. 33 pp.

United States Fish and Wildlife Service (USFWS). 2006. Yuma Clapper Rail 5-year review. U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Phoenix, Arizona.

United States Fish and Wildlife Service (USFWS). 2007a. Chiricahua Leopard Frog (*Rana chiricahuensis*) Recovery Plan. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM. 148 pp. + appendices.

United States Fish and Wildlife Service (USFWS). 2007b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Spikedace (*Meda fulgida*) and the Loach Minnow (*Tiaroga cobitis*); Final Rule. *Federal Register*. Vol. 72, No. 54: 13,355-13,422.

United States Fish and Wildlife Service (USFWS). 2008a. Mexican Wolf Conservation Assessment. USFWS, Albuquerque, New Mexico. 82 pp.

United States Fish and Wildlife Service (USFWS). 2008b. Endangered and Threatened Wildlife and Plants; 90-day finding on a petition to list the Tucson Shovel-nosed Snake (*Chionactis occipitalis klauberi*) as Threatened or Endangered with Critical Habitat. *Federal Register* Vol. 73 (146): 43,905-43,910.

United States Fish and Wildlife Service (USFWS). 2008c. Socorro Springsnail (*Pyrgulopsis neomexicana*) 5-year review: summary and evaluation. USFWS, Albuquerque, New Mexico. 10 pp.

United States Fish and Wildlife Service (USFWS). 2008d. Designation of critical habitat for *Helianthus paradoxus* (Pecos Sunflower). FR 73 (63): 17762-17807.

United States Fish and Wildlife Service (USFWS). 2010a. Ocelot Recovery Plan (*Leopardus pardalis*) draft first revision. USFWS, Albuquerque, New Mexico. 170 pp.

United States Fish and Wildlife Service (USFWS). 2010b. Bosque del Apache National Wildlife Refuge. Available at www.fws.gov/refuges/profiles/index.cfm?id=22522. Accessed February 2011.

United States Fish and Wildlife Service (USFWS). 2010c. 12-month finding on a petition to list Sprague's Pipit as endangered or threatened throughout its range. FR 75 (178): 56028-56050.

United States Fish and Wildlife Service (USFWS). 2010d. Waterfowl population status. U.S. Fish and Wildlife Service Department of Migratory Bird Management. Laurel, Maryland. 79 pp.

United States Fish and Wildlife Service (USFWS). 2010e. Draft Eagle Conservation Plan Guidance. U.S. Fish and Wildlife Service Department of Migratory Bird Management. Laurel, Maryland. 106 pp.

United States Fish and Wildlife Service (USFWS). 2011a. 12-month finding on a petition to list the Cactus Ferruginous Pygmy-owl as Threatened or Endangered with Critical Habitat. FR 76 (193): 61856-61894.

United States Fish and Wildlife Service (USFWS). 2011b. Sevilleta National Wildlife Refuge. Available at www.fws.gov/southwest/REFUGES/newmex/sevilleta/index.html. Accessed January 28, 2011.

United States Fish and Wildlife Service (USFWS). 2011c. Bosque del Apache NWR. Available at www.fws.gov/southwest/refuges/ newmex/bosque/about.html. Accessed January 28, 2011.

United States Fish and Wildlife Service (USFWS). 2011d. Sevilleta National Wildlife Refuge. Available at www.fws.gov/refuges/profiles/index.cfm?id=22522.

United States Fish and Wildlife Service (USFWS). 2011e. Bosque del Apache National Wildlife Refuge. Available at www.fws.gov/refuges/profiles/index.cfm?id=22522. Accessed February 2011.

United States Fish and Wildlife Service (USFWS). 2011f. U.S. Fish and Wildlife Service land-based wind energy guidelines. U.S. Fish and Wildlife Service. Washington, DC 127 pp.

United States Fish and Wildlife Service (USFWS). 2011g. Draft Environmental Impact Statement and Habitat Conservation Plan for commercial wind energy developments within nine states. FR 76 (135): 41510-41513.

United States Fish and Wildlife Service (USFWS). 2012a. Designation of critical habitat for Jaguar. FR 77 (50214-50242).

United States Fish and Wildlife Service (USFWS). 2012b. Listing and designation of critical habitat for the Chiricahua Leopard Frog. FR 77 (54): 16324-16424.

United States Fish and Wildlife Service (USFWS). 2012c. Endangered status and designations of critical habitat for Spikedace and Loach Minnow. FR 77 (36): 10810-10932.

United States Fish and Wildlife Service (USFWS). 2012d. Determination of endangered status for the Chupadera Springsnail and designation of critical habitat. FR 77 (134): 41088-41106.

United States Fish and Wildlife Service (USFWS). 2012e. 12-month finding for the Lemmon Fleabane, endangered status for the Acuña Cactus and the Fickeisen Plains Cactus and designation of critical habitat, proposed rule. FR 77 (192): 60510-60579.

United States Fish and Wildlife Service (USFWS). 2013. Designation of critical habitat for the Southwestern Willow Flycatcher. FR 78 (2): 344-534.

United States Forest Service (USFS). 1985. Cibola National Forest Land and Resource Management Plan (LRMP). 1985. Available at www.fs.usda.gov/Internet/ FSE_DOCUMENTS/stelprdb5277871.pdf.

United States Forest Service (USFS). 1986a. Lincoln National Forest Land and Resource Management Plan (amended 2009). Available at: www.fs.usda.gov/Internet/ FSE_DOCUMENTS/fsbdev7_014272.pdf.

United States Forest Service (USFS). 1986b. Coronado National Forest Plan (amended 2005). June 2005. Available at www.fs.usda.gov/Internet/FSE_DOCUMENTS/ fswdev7_018649.pdf.

United States Forest Service (USFS). 2011. Draft Environmental Impact Statement for the Rosemont Copper Project: A Proposed Mining Operation, Coronado National Forest, Pima County, Arizona, Volume 1. Available at www.rosemonteis.us/draft-eis. Accessed November 15, 2011.

United States Geological Survey (USGS). 2009. National Hydrography Dataset from the United States Geological Survey. http://nhd.usgs.gov.

United States Geological Survey (USGS). 2010 Earthquake Hazards Program. Available at http://earthquake.usgs.gov. Accessed August 2010.

United States Office of Management and Budget. 1997. Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity. Available at www.whitehouse.gov/omb/fedreg/1997standards.html. Accessed June 24, 2011.

United States Travel Association. 2010. Travel as an Economic Engine, New Mexico and Arizona. Available at http://www.ustravel.org/research/economic-research. Accessed on December 15, 2011.

University of Arizona Medical Center. 2011. University of Arizona (Arizona) Medical Center website. Available at www.azumc.com. Accessed January 30, 2011.

University of Arizona. 2008. Bingham Cienega Natural Preserve, a Remote Location. Arroyo (Winter 2008). Newsletter of the Water Resources Research Center, College of Agriculture and Life Sciences. 12 pp.

University of Georgia. 2011. Center for Invasive Species and Ecosystem Health – Early detection and distribution mapping system. Available at www.invasiveplantatlas.org/index.html. Accessed May 26, 2011.

University of New Mexico (UNM), Bureau of Business and Economic Research (BBER). 2001-2009. Total employment by sector, New Mexico, Doña Ana County, Grant County, Hidalgo County, Lincoln County, Luna County, Otero County, Sierra County, Socorro County. Available at http://bber.unm.edu/bber_data.html. Accessed January 24, 2011.

University of New Mexico (UNM), Bureau of Business and Economic Research (BBER). 2010. The FOR-UNM Bulletin: A Quarterly Economic Forecast of the New Mexico Economy, Winter 2010, Vol. 21, No. 4. Available at http://bber.unm.edu/pubs/BULLSAMP.pdf.

University of New Mexico (UNM). 2010. Resource Geographic Information System (RGIS). Available at http://rgis.unm.edu.

Van Devender, T.R., R.C. Averill-Murray, T.C. Esque, P.A. Holm, V.M. Dickinson, C.R. Schwalbe, E.B. Wirt, and S.L. Barrett. 2002. Grasses, Mallows, Desert Vine, and More: diet of the Desert Tortoise in Arizona and Sonora. *In* The Sonoran Desert Tortoise: Natural History, Biology, and Conservation. University of Arizona Press, Tucson, Arizona. 388 pp.

Village of Hatch. 2007. Village of Hatch Comprehensive Plan.

Vlasich, J.A. 2005. *Pueblo Indian Agriculture*. University of New Mexico Press, Albuquerque.

Walsh Environmental Scientists And Engineers. 2008. Lincoln County Community Wildfire Protection Plan. 76 pp.

Warshall, P. 1994. The Madrean Sky Island archipelago: a planetary overview. *In* Biodiversity and Management of the Madrean Archipelago: the Sky Islands of Southwestern United States and Northwestern Mexico. USDA Forest Service General Technical Report RM-GTR-264: 6-18.

Waters, M.R. 1986. *The Geoarchaeology of Whitewater Draw*. University of Arizona Anthropological Papers No. 45. University of Arizona, Tucson.

Welch, J. 1991. Mogollon V. In *From Horticulture to Agriculture in the Late Prehistory of the Grasshopper Region, Arizona*, edited by P.H. Beckett, pp. 75-92. COAS Publishing, Las Cruces.

Wells, C.E. 2006. From Hohokam to O'odham: The Protohistoric Occupation of the Middle Gila River Valley, Central Arizona. Gila River Indian Community Anthropological Research Papers 3. Gila River Indian Community Cultural Resource Management Program, Sacaton, Arizona.

Welsh, S.L., and M. Licher. 2010. *Pediomelum* Rydberg (Leguminosae) in Arizona and Two Previously Undescribed Species. Western North American Naturalist. Vol. 70 (1), pp. 9-18.

WestConnect. 2011. Links to Generator Interconnection Queues. Available at www.westconnect .com/init_trans_provider.php. Accessed September 15, 2011.

Western Area Power Administration. 2005. Electric and Magnetic Fields Facts. Available at www.wapa.gov/newsroom/pdf/EMFbook.pdf. Accessed February 14, 2011.

Western Governors' Association (WGA) and Department of Energy (DOE). 2009. *Western Renewable Energy Zones – Phase I Report*. June 2009. Available at www.westgov.org/wga/publicat/WREZ09.pdf.

Western Regional Air Partnership (WRAP). 2009. Paved and Unpaved Road Dust Calculators. Available at www.wrapair.org/forums/dejf/fdh/index.html. Accessed October 2, 2009.

Western Regional Climate Center (WRCC). 2010. Available at http://wrcc.dri.edu/index.html. Accessed July, 2, 2010.

Western Regional Climate Center (WRCC). 2011a. Climate of New Mexico. Available at www.wrcc.dri.edu/narratives/NEWMEXICO.htm. Accessed January 28, 2011.

Western Regional Climate Center (WRCC). 2011b. Climate of Arizona. Available at www.wrcc.dri.edu/narratives/arizona.htm. Accessed January 28, 2011.

Western Regional Climate Center (WRCC). 2011c. Western U.S. Climate Historical Summaries. Available at www.wrcc.dri.edu/Climsum.html. Accessed February 28, 2011.

West-wide Energy Corridor Programmatic EIS. 2009. Available at http://corridoreis.anl.gov/ news/index.cfm.

Wheat, J.B. 1954. *Crooked Ridge Village (Arizona W:10:15)*. University of Arizona Social Science Bulletin, No. 24. University of Arizona, Tucson.

Wheeler, B.K. 2003. Raptors of Western North America. Princeton University Press. Princeton, New Jersey. 544 p.

White Sands Military Range. Final EIS for Development and Implementation of Range-Wide Mission and Major Capabilities (FEIS WSMR). 2009. Reviewed March 2011.

White, D.A. 2004. *Hohokam Palettes* Arizona State Museum Archaeological Series No. 196. Arizona State Museum, Tucson.

Whiteley, P.M. 1988. Deliberate Acts: Changing Hopi Culture through the Oraibi Split. University of Arizona Press, Tucson.

Whittlesey, S.M., R. Ciolek-Torrello and M.A. Sterner. 1994a. Prehistory of the San Pedro River Valley. In *Southern Arizona The Last 12,000 Years: A Cultural-Historic Overview for the Western Army National Guard Aviation Training Site*. Statistical Research Institute Technical Services No. 48, Tucson.

Whittlesey, S.M., R. Ciolek-Torrello and M.A. Sterner. 1994b. The Transition to History: Native Americans and the Spanish, 1539–1821. In *Southern Arizona: The Last 12,000 Years*. Statistical Research, Inc. Technical Series 48. Statistical Research, Inc., Tucson.

Wilcox, D.R. 1991. The Mesoamerican Ballgame in the American Southwest. In *The Mesoamerican Ballgame*, edited by V.L. Scarborough and D.R. Wilcox, pp. 101-125. University of Arizona Press, Tucson.

Wilcox, D. R. and W. B. Masse. 1981. A History of Protohistoric Studies in the North American Southwest. In *The Protohistoric Period in the North American Southwest, A.D. 1450–1700*, edited by D. R. Wilcox and W. B. Masse. Anthropological Research Papers No. 24. Arizona State University, Tempe.

Wilcox, D.R., and C. Sternberg. 1983. *Hohokam Ballcourts and their Interpretation*. Cultural Resource Management Division Arizona State Museum University of Arizona, Tucson, Arizona.

Wilcox, D.R., T.R. McGuire and C. Sternberg. 1981. *Snaketown Revisited*. Arizona State Museum Archaeological Series No. 160, Tucson.

WildEarth Guardians 2008. Petition to List the Chihuahua Scurfpea (*Pediomelum pentaphyllum*) Under the U.S. Endangered Species Act. October 9, 2008. Available at www.wildearthguardians.org/site/DocServer/petition_scurfpea.pdf?docID=624&AddInterest=1103. Accessed October 6, 2011.

Wildland Fire Leadership Council. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy.

Williams, J.L. (editor). 1986. *New Mexico in Maps*. 2nd ed. University of New Mexico Press, Albuquerque.

Williams, A., and B. Gregory. 2010. *Feasibility Study for 500 kV AC Underground Cables for Use in the Edmonton Region of Alberta, Canada. Technical Report No. ER 381*. CCI for Alberta Electric System Operator. Available at http://www.aeso.ca/transmission/20001.html.

Wills, W.H. 1988. *Early Prehistoric Agriculture*. School of American Research Press, Santa Fe.

Wills, W.H. 1991. Organizational Strategies and the Emergence of Prehistoric Villages in the American Southwest. In *Between Bands and States*, edited by S.A. Gregg. Center for Archaeological Investigations, Occasional Paper No. 9. Southern Illinois University, Carbondale.

Wills, W.H. 1995. Archaic Foraging and the Beginning of Food Production in the American Southwest. In *Last Hunters, First Farmers*, edited by T. Price and A. Gebauer, pp. 215-244. School of American Research Press, Santa Fe.

Wilson, T.B., R.H. Thompson, and L. Thomas. 2001. Mechanisms of range expansion and removal of mesquite in desert grasslands of the southwestern United States. General Technical Report RMRS-GTR-81. U.S. Forest Service Rocky Mountain Research Station. Ogden, Utah. 23 pp.

Winkelman NRCD. 2009. Winkelman Land Management Plan. Available at www.wnrcd.org/uploads/WNRCD_Land_Managerment_Plan.pdf

Winter, J.C. 1973. Cultural Modifications of the Gila Pima: AD 1697-AD 1846. *Ethnohistory* 20(1):67-77.

Wood, P.A. 1962. Pleistocene fauna from 111 Ranch area, Graham County, Arizona. PhD Dissertation, University of Arizona. 121 p.

Wood, S.R., and J.S. Richardson. 2010. Evidence for ecosystem engineering in a lentic habitat by tadpoles of the Western Toad. Aquatic Science 72: 499-508.

Wright, J.W., and C.H. Lowe. 1965. The rediscovery of *Cnemidophorus arizonae* Van Denburgh. Journal of the Arizona Academy of Science 3 (3): 164-168.

Young, K.E., B.C. Thompson, A. Lafon-Terrazas, A.B. Montoya, and R. Valdez. 2004. Aplomado Falcon abundance and distribution in the northern Chihuahuan Desert of Mexico. The Journal of Raptor Research 38 (2): 107-117.

Zenone, P. Solving the Puzzle: conservationists, partners help secure a bright future for the Pecos sunflower. USFWS Endangered Species Bulletin, September-October 2012. Available at http://www.fws.gov/endangered/news/episodes/bu-09-2012/story2/index.html. Accessed September 24, 2012.

GLOSSARY

100-year Flood – A flood with a magnitude that may occur once every 100 years. A 1-in-100 chance of a certain area being inundated during any year.

Access (road) – Road used for passage to and along transmission line for purposes of construction and maintenance.

Adequacy (electrical system) – Having sufficient resources to provide customers with a continuous supply of electricity at the proper voltage and frequency, virtually all of the time. "Resources" refers to a combination of electricity generating and transmission facilities, which produce and deliver electricity; and "demand-response" programs, which reduce customer demand for electricity.

Advisory Council on Historic Preservation (ACHP) – An independent federal agency that advises the President and Congress on historic preservation matters and oversees the review of projects under Section 106 of the National Historic Preservation Act.

Aeolian – Wind-blown sand or silt material, which when deposited forms dunes or small sandy ridges.

Affected Environment – (1) A geographic area and the associated natural, human, and cultural resources that could be influenced by a proposed action. (2) The chapter in an environmental impact statement that describes the existing condition of the environment.

Aggregation – The natural deposition of sediments in a river channel, gradually building up the slope or level of the riverbed.

Air Quality Classes – Classifications established under the Prevention of Significant Deterioration portion of the Clean Air Act that limit the amount of air pollution considered significant within an area. Class I applies to areas where almost any change in air quality would be significant, Class II applies to areas where the deterioration normally accompanying moderate well-controlled growth would be permitted, and Class III applies to areas where industrial deterioration would generally be allowed.

Alignment – The specific, surveyed route of a transmission line.

Alluvial Fan – A gradually sloping mass of alluvium (sand, clay, etc., deposited by moving water) that widens out like a fan from the place where a stream issues from a narrow mountain valley upon a plain or broad valley.

Alluvium – A general term for clay, silt, sand, gravel, or similar consolidated material deposited during a comparatively recent geologic time by a stream or other body of running water in the bed of a stream, river, or floodplain, or as a cone or fan at the base of a mountain slope.

Ambient Air – Any unconfined portion of the atmosphere: open air, surrounding air.

GLOSSARY

American Indian tribe – A legal term meaning an American Indian or Alaska Native tribal entity that is recognized as having a government-to-government relationship with the United States, with the responsibilities, powers, limitations, and obligations attached to that designation. A federally recognized tribe is eligible for funding and services from the Bureau of Indian Affairs, is given certain inherent rights of self-government (i.e., tribal sovereignty), and is entitled to receive certain federal benefits, services, and protections because of their special relationship with the United States.

Aquifer – A stratum of permeable rock, sand, etc., that contains water. Water source for a well.

Archaeology – The science that investigates the history of peoples by studying the material remains of past societies.

Archival – Pertaining to or contained in documents or records that preserve information about an event or individual.

Area of Critical Environmental Concern (ACEC) – A Bureau of Land Management (BLM) designation for an area within public lands where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values; fish and wildlife resources or other natural systems or processes; or to protect life from natural hazards.

Arroyo – A dry gully or a stream in a dry region.

Artifact – Any object showing human workmanship or modification, especially from a prehistoric or historic culture.

Assessment (environment) – An evaluation of existing resources and potential impacts to those resources from a proposed act or change to the environment.

Attainment Area – An area considered to have air quality as good as or better than the National Ambient Air Quality Standards, as defined in the Clean Air Act. An area may be an attainment area for one pollutant and a nonattainment area for others.

A-Weighted Sound Level – Sound that is measured with a sound-level meter using the A-weighted response filter built into the meter circuitry. The A-weighted filter simulates the frequency response to the human ear.

Background – The portion of the visual landscape lying from the outer limit of the middleground to infinity. Color and texture are subdued in this area, and visual sensitivity analysis is primarily concerned with the two-dimensional shape of landforms against the sky.

Background Concentrations – Essential part of the total air quality concentration to be considered when determining source impacts. Background air quality includes pollutant concentrations due to (1) natural sources, (2) nearby sources other than those currently under consideration, and (3) unidentified sources.

GLOSSARY

Base Load – The minimum load of a utility over a given period of time.

Batch Plant – An area used for concrete mixing, temporary field office facility, material storage, and stations for equipment maintenance during construction of a transmission line. The area usually covers approximately 2 acres.

Bundle – Two or more conductors combined to form a phase.

Butte – A steep hill standing alone in a plain.

Caliche – Cemented deposit of secondary calcium carbonate found in layers or disseminated throughout the horizon of certain soils in arid to semiarid regions.

Candidate Species – Any species included in the *Federal Register*'s Notice of Review being considered for listing as threatened or endangered by the U.S. Fish and Wildlife Service.

Capacity – The maximum load that can be generated or transmitted by generation or transmission facilities for a given period of time without exceeding approved limits of temperature or stress.

Carbon Monoxide (CO) – A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion. One of the six criteria pollutants.

Centerline – A line along the approximate middle of a transmission line right-of-way.

Circuit – A complete, closed conducting path over which electric current may flow.

Clean Air Act (CAA) – A federal law defining the Environmental Protection Agency's (EPA's) responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The last major changes in the law, the CAA Amendments of 1990, were enacted by Congress in 1990. Legislation passed since then has made several minor changes. The CAA was incorporated into the United States Code as Title 42, Chapter 85.

Conductor – The wire cable strung between transmission line towers through which the electrical current flows.

Construction, Operation, and Maintenance Plan – A detailed plan depicting engineering, access, construction, environmental, and reclamation that is prepared prior to construction and operation of a proposed action.

Contrast – The effect of a striking difference in the form, line, color, or texture of an area being viewed.

GLOSSARY

Contrast Rating – A method of determining the extent of visual impact for an existing or proposed activity that would modify any landscape feature (land and water form, vegetation, and structures).

Corona – The discharge of energy from an energized transmission line that occurs when the voltage gradient exceeds the breakdown strength of air.

Corridor – A continuous strip of land, of defined width, through which a linear utility route (or routes) passes.

Council on Environmental Quality (CEQ) – An advisory council to the President of the United States established by the National Environmental Policy Act of 1969. This council reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Counterpoise – Conductive cable buried in the ground at a transmission line tower to lower the resistance of the ground to conduct electricity.

Criteria Pollutant – The 1970 amendments to the Clean Air Act required the EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. The EPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide. The term "criteria pollutants" derives from the requirement that the EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Cultural Resource – Any resource associated with the human cultural environment; examples include artifacts and historic objects, archaeological sites, historic sites, historic properties, and traditional cultural properties.

Cumulative Effect – The effect on the environment that results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Dead-end Structure – Transmission line tower structures that are more robust than tangent structures, used (1) to add longitudinal strength to the line, (2) at turning points (angles), (3) for added safety at crossings of other utilities, such as other transmission lines and roads, and (4) to interrupt long distances of suspension structures that would otherwise provide more exposure to catastrophic line failure over long distances.

Degradation – The wearing down, or away, and general lowering or reduction of the earth's surface by the processes of weathering and erosion.

GLOSSARY

Design Features – Standard corporate practices and procedures for environmental protection and design features addressing specific environmental policies and regulatory requirements incorporated by the Proponent as part of the proposed action that are applied/used generally to the entire Project to reduce adverse impacts on a non-specific basis.

Devonian – A geologic period during the Paleozoic Era, spanning in time between 410 and 360 million years ago, marked by an abundance of fish and the appearance of the first land plants and amphibians.

Dip Slope – The downward slope of geologic strata.

Direct Effect – Effects caused by the action (i.e., construction) and occur at the same time and place (see Indirect Effect).

Direct Impact – Effects that are caused by the action (i.e., construction) and occur at the same time and place (see Indirect Impact).

Distance Zone – A visibility threshold distance where visual perception changes. The zones are usually defined as foreground, middleground, and background.

Distributed Generation – A method of generating electricity from multiple small energy sources very near to where the electricity is actually used.

Drainage Basin – The region or area bounded peripherally by a drainage divide or occupied by a river system.

Duct Bank – Containment system for underground transmission lines.

Economic Base – An area's economic base comprises industries that are primarily responsible for bringing outside income into the local economy. Economic base analysis measures the relative importance of industries for a particular area by comparing employment and income levels to a reference area (e.g., the United States).

Economy Energy – Energy produced and supplied from a more economical source in one system and substituted for that being produced or capable of being produced by a less economical source in another system.

Ecosystem – A complex system composed of a community of plants and animals, and that system's chemical and physical environment.

Ecotone – A transitional zone between two adjacent communities.

Edge Effect – The forest edge is the zone where different plant and animal communities and successional stages meet. Widening of the right-of-way would increase the edge effect by further changing the composition of the biotic communities.

GLOSSARY

Effects – In this realm, considered the cause and effect of an action or the projected degree of change caused by a process (see also Impact).

Electric and Magnetic Field (EMF) – A space or region within which magnetic forces are present around an electrical current (also referred to as electromagnetic field).

Electric Field – Electric effect resulting from the voltage on a transmission line. Measured as volts per meter or kilovolts per meter.

Electric System Losses – Total electric energy losses in an electric system as a result of transmission, transformation, and distribution. Electric energy is lost primarily due to heating of transmission and distribution elements.

Electrostatic Field – Pertaining to a space or region within which atmospheric electricity at rest interferes with radar, radio, or television reception.

Emergent (vegetation) – Vegetation with all or part of their vegetative and reproductive parts above the water.

Endangered Species – A plant or animal species whose prospects for survival and reproduction are in immediate jeopardy, as designated by the Secretary of the Interior. It is further defined by the Endangered Species Act of 1973, as amended.

Endemic – Plants or animals that are native to a particular region or country.

Energy Conservation – A means of saving energy.

Environment – The surrounding conditions, influences, or forces that affect or modify an organism or an ecological community and ultimately determine its form and survival.

Environmental Impact Statement (EIS) – A detailed written statement, as required by Section 102(2)(C) of the National Environmental Policy Act, when an agency proposes a major federal action significantly affecting the quality of the human environment.

Environmental Justice – The pursuit of equal justice and equal protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, and/or socioeconomic status. Federal agencies must incorporate environmental justice as part of their mission by identifying and addressing the effects of programs, policies, and activities to ensure the opportunity for full and fair participation by affected communities in the decision-making process; and avoid, minimize, or mitigate disproportionately high and adverse health and environmental effects on minority and low-income populations.

Eocene – The epoch of the Tertiary period spanning the time between 55.5 and 33.7 million years ago.

GLOSSARY

Ephemeral – Present only during a portion of the year. Generally refers to water courses.

Erosion – The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface.

Escarpment – A steep slope or cliff formed by erosion or, less often, by faulting.

Ethnography – The study and systematic recording of human cultures. Also the descriptive body of work produced from such research.

Extirpate – To destroy completely.

Extraction – The act of drawing a substance out of the earth (e.g., mining).

Fault – A fracture or fracture zone in the earth's surface along where there has been displacement of the sides, relative to one another and parallel to the fracture.

Fauna – The wildlife or animals of a specified region or time.

Federal Energy Regulatory Commission (FERC) – The agency primarily responsible for ensuring adequate energy supplies at just and reasonable rates and providing regulatory incentives for increased productivity, efficiency, and competition.

Federal Land Policy and Management Act of 1976 (FLPMA) – Public Law 94-579 of October 21, 1976. This law is often referred to as the BLM's Organic Act, which provides the majority of the BLM's legislated authority, direction, policy, and basic management guidance.

Floodplain – That portion of a river or stream valley, adjacent to the river channel, which is built of sediments and is inundated with water when the stream overflows its banks.

Foreground – The visible area from a viewpoint or use area out to a distance of 0.5 mile. The ability to perceive detail in a landscape is greatest in this zone.

Foreground-Middleground – The area visible from a travel route, residence, or other use area to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where texture and form of individual plants are no longer apparent in the landscape. Vegetation is apparent only in patterns or outline.

Fossil – The remains or traces of an organism or assemblage of organisms preserved by natural processes in the earth's crust; exclusive of organisms buried since the beginning of historical time.

GLOSSARY

Fuel Cells – Power generating systems that produce DC electricity by combining hydrogen and oxygen in an electrochemical reaction. Compared with traditional generating technologies that use combustion processes first to convert fuel to heat and mechanical energy, fuel cells convert the chemical energy of a fuel to electric energy directly.

Fugitive Dust – Dust put into the atmosphere by the wind blowing over plowed fields, dirt roads, or desert or sandy areas with little or no vegetation. Also caused by mechanically generated particulate matter emissions put into the air by reason of vehicles or equipment moving soil or driving over unpaved roads (or dirty paved roads) and dusty areas.

Fugitive Emissions – Fugitive emissions are air pollutant emissions from facilities or activities that could not reasonably pass through a stack, chimney, vent, or other equivalent opening.

Generation source – A facility generating electrical power.

Geologic Formations – A rock unit distinguished from adjacent deposits by some common character, such as its composition, origin, or the type of fossil associated with the unit.

Geology – The science that relates to the earth, the rocks of which it is composed, and the changes the earth has undergone or is undergoing.

Geothermal Resource – Heat found in rocks and fluids at various depths that can be extracted by drilling or pumping for use as an energy source. This heat may be residual heat, friction heat, or a result of radioactive decay.

Grazing Potential – The potential of an area to support livestock grazing; measured by the number of acres of land required to support one animal unit for a month.

Groundwire – Two wires installed along the transmission line at the top of the tower structures to protect the conductors from lightning strikes by transferring the energy from the lightning through the ground wires and structures into the ground below.

Habitat – The region where a plant or animal naturally grows or lives. A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and home range.

Habitat Fragmentation – A reduction in area of undisturbed, continuous habitat. Often affects interior forest species that depend on unbroken expanses of mature coniferous forest.

Hazardous Air Pollutants – Air pollutants not covered by ambient air quality standards, but that, as defined in the Clean Air Act, may present a threat of adverse human health effects or adverse environmental effects.

Herbaceous – Of, or having the nature of, an herb or herbs, as distinguished from woody plants.

GLOSSARY

Historic property – Any district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (maintained by the Secretary of the Interior [36 CFR 800]).

Homogenous – Having similarity in structure because of similarity in descent.

Hydrology – The science that relates to the water of the earth.

Impact – Modification in the status of the environment brought about by a proposed action.

Indirect Effects – Caused by the action later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth-rate, and related effects on air and water and other natural systems, including ecosystems.

Indirect Impact – Effects caused by the action and occur later in time or are farther removed, but are still reasonably foreseeable (see Direct Impact).

Infrastructure – The basic facilities on which a community depends, such as schools, power plants, or transportation and communication systems.

Insulator – A device resistant to electrical conduction used for isolating and supporting conductors.

Intermittent – A river or stream that flows for a period of time, usually seasonally during rainy periods, and stops during dry periods. In arid regions, dry periods may be interrupted by occasional flash floods from brief but intense rain storms.

Jurisdictions – The limits or territory within which authority may be exercised.

Kilovolt – 1,000 volts (a volt is a measure of electrical potential difference which would cause a current of ampere to flow through a conductor whose resistance is 1 ohm).

Kilovolts per Meter (kV/m) – A unit measure of electric field strength.

Kilowatt (kW) – A unit of power equivalent to 1,000 watts.

Lacustrine – Lakes and ponds that have more than 2 acres in surface area.

Landform – A term used to describe the many types of land surfaces that exist as a result of geologic activity and weathering (e.g., plateaus, mountains, plains, and valleys).

Link – A segment of a route alternative sharing common endpoints with adjacent links. Endpoints of a link are determined by the location of intersections with other segments (links) of other routes.

Loam – A rich soil composed of clay, silt, sand, and some organic matter.

Magnetic Field – Electric effect resulting from an electric current flowing in a conductor. Unit of measurement is a Gauss.

Megawatt (MW) – 1,000 kilowatts or 1 million watts (a watt is a unit of electrical power equal to 1/756th horsepower).

Mesa – An isolated, nearly level land mass, formed of nearly horizontal rocks, standing above the surrounding country and bounded with steep sides.

Migratory – Birds, animals, or people that migrate or move from one region or country to another.

Milligauss (mG) – A unit of measurement for magnetic fields.

Mineral Resources – Any inorganic or organic substance occurring naturally in the earth that has a consistent and distinctive set of physical properties. Examples of mineral resources include coal, nickel, gold, silver, and copper.

Miocene – The epoch of the Tertiary period spanning the time between 23.8 and 5.3 million years ago.

Mississippian – A period of the Paleozoic Era, spanning in time from about 345 to 320 million years ago.

Mitigate – To alleviate, reduce, or render less intense or severe.

National Ambient Air Quality Standards (NAAQS) – The Clean Air Act requires the EPA to set NAAQS (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 has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants.

National Emissions Standards for Hazardous Air Pollutants – Emission standards set by the EPA for an air pollutant not covered by National Ambient Air Quality Standards.

National Environmental Policy Act of 1969 (NEPA) – Public Law 91-190. An Act that encourages productive and enjoyable harmony between man and his environment, promotes efforts to prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of man, enriches the understanding or the ecological systems and natural resources important to the nation, and establishes the CEQ.

National Historic Preservation Act of 1966 (NHPA) – Public Law 89-665; 16 U.S.C. 470 et seq. A law authorizing the Secretary of the Interior to expand and maintain a National Register of Historic Places and directing federal agencies to take into account the effects of their actions on historic properties and provide the ACHP a reasonable opportunity to comment.

National Register of Historic Places (NRHP) – A list of districts, sites, buildings, structures, and objects maintained by the National Park Service (NPS), each determined by NPS to be of historic, cultural, architectural, archaeological, or engineering significance at the local, state, or national level, established by the Historic Preservation Act of 1966.

Native Vegetation – Natural vegetation originating in a certain region or country.

Nonattainment Area – Area that does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.

Nonspecular Conductors – Conductors treated to reduce reflection, rendering the conductor less shiny and noticeable.

Ozone (O_3) – A form of oxygen produced when an electric spark is passed through oxygen or air. One of six criteria pollutants.

Paleontology – The science that deals with the life of past geological ages through the study of the fossil remains of organisms.

Paleozoic – The geologic era between the Precambrian and Mesozoic eras covering the time between 570 million and 225 million years ago. The era was characterized by the development of the first fish, amphibians, reptiles, and land plants.

Palustrine – A marsh or marsh-like environment.

Particulate Matter/Particulates – Minute, separate particles, such as dust or other air pollutants. PM_{10} is a measure of particles in the atmosphere with a diameter of less than, or equal to, a nominal 10 micrometers aerodynamic equivalent diameter. $PM_{2.5}$ is a measure of particles in the atmosphere with a diameter of less than, or equal to, a nominal 2.5 micrometers aerodynamic equivalent diameter. These are criteria pollutants.

Per capita income – Calculated by dividing total income in a specified area (e.g., county) by the area's population.

Physiographic Province – An area characterized by distinctive topography, geologic structure, climate, drainage patterns, and other features and phenomena of nature.

Pithouse – A prehistoric dwelling partially constructed beneath the earth's surface.

Playa – The shallow central basin of a desert plain where water gathers after a rain and is evaporated.

Primitive – An area that is not developed; a pristine natural area.

Quaternary – The second period of the Cenozoic era spanning 1.8 (recently refined to 2.6) million years ago to the present. This is the period of glaciations in the northern hemisphere.

Quaternary Fault – A fault that has been active or has had displacement during the Quaternary Period, between 1.8 million years ago and the present.

Range – A large, open expanse in which livestock harvest natural vegetation.

Raptor – A bird of prey.

Rare – A plant or animal restricted in distribution. May be locally abundant in a limited area, or few in number over a wide area.

Reactive Compensation – Provides transmission system voltage stability and facilitates power transfers. Reactive compensation is provided by reactors and capacitors located within substations or transition stations.

Reclamation – Returning disturbed lands to a form and productivity that will be ecologically balanced.

Recontouring – Returning a surface to, or near to, its original form through some type of action, such as grading.

Record of Decision (ROD) – A document separate from, but associated with, an environmental impact statement that publicly and officially discloses the responsible official's decision on the proposed action.

Reference Centerline – For purposes of assessing impacts and recommending mitigation, a centerline is assigned that may be slightly adjusted during engineering design.

Region – A large tract of land generally recognized as having similar character types and physiographic types.

Reliability (electrical system) – In the context of the bulk power system, the National Electric Reliability Council defines reliability as the ability to meet the electricity needs of end-use customers, even when unexpected equipment failures or other factors reduce the amount of available electricity.

Renewable Resource – Any natural resource that can replenish itself naturally over time.

GLOSSARY

Residual Impact – The impact of an action remaining after application of mitigation.

Revegetation – The reestablishment and development of self-sustaining plant cover. On disturbed sites, this normally requires human assistance, such as reseeding.

Right-of-way – A strip of land acquired by legal means, over which the power line and access roads would pass.

Riparian – An aquatic or terrestrial ecosystem associated with bodies of water, such as streams, lakes, or wetlands, or is dependent upon the existence of perennial, intermittent, or ephemeral surface or subsurface water drainage. Riparian areas are usually characterized by dense vegetation and an abundance and diversity of wildlife.

Riverine – Relating to, or within the limits of, river or stream channels.

Roadless Area – Areas identified by the U.S. Forest Service (USFS) to establish prohibitions on road construction, road reconstruction, and timber harvesting pursuant to the Roadless Area Conservation Rule of 2001.

Route – A transmission route is the general path of a transmission line and associated facilities.

Scenic Byway – A specially designated road that travels through an area of natural beauty.

Scenic Quality Rating Unit (SQRU) – A portion of the landscape that displays primarily homogeneous visual characteristics of the basic landscape features (landform, water, vegetation, and structures and modifications), which separate it from the surrounding landscape.

Security (electrical system) – The ability of the bulk power system to withstand sudden, unexpected disturbances such as short circuits, or unanticipated loss of system elements due to natural or man-made causes

Sediment – Solid fragmental material, either mineral or organic, transported or deposited by air, water, gravity, or ice.

Seismicity – The likelihood of an area being subject to earthquakes. The phenomenon of earth movements.

Selective Mitigation – Measures or techniques developed to reduce adverse impacts on a case-by-case or selective basis.

Semi-arid – A climate or region characterized by little yearly rainfall and by the growth of a number of short grasses and shrubs.

Sensitivity – The state of being readily affected by the actions of external influence.

Sensitivity Level Rating Unit (SLRU) – The designation (high, medium, or low) assigned to a landscape area to indicate the concern of the public to changes in the landscape (BLM designation).

Shield Wire – (see Ground Wire)

Significant (Impact) – "Significant" has been used in this document to describe any impact that would cause a substantial adverse change or stress to one or more environmental resources. In general, all potential high impacts were considered to be significant.

Simulations – The use of a computer to calculate the effect of a given physical process.

Site – In archaeology, any locale showing evidence of human activity.

Solar Energy – Energy derived from the sun in the form of solar radiation.

Spanning – Placing tower structures so the transmission line extends across a sensitive area or resource

Species – A group of individuals of common ancestry that closely resemble each other structurally and physiologically, and in nature interbreed producing fertile offspring.

Staging Area – A designated area where vehicles, supplies, and construction equipment are positioned for use and access to a construction site.

Standard Mitigation – Measures, techniques, or practices applied/used generally to reduce adverse impacts on a non-specific basis.

Study Area – A given geographical area delineated for specific research.

Subsidence (soil) – The sinking of the earth's surface because of the withdrawal of water or mineral resources.

Subspecies – Any natural subdivision of a species that exhibits small, but persistent morphological variations from other subdivisions of the same species living in different geographical regions or times.

Substation – An assemblage of equipment, enclosed by a fence, occurring at points along a transmission line. A facility in an electrical transmission system with the capability to route and control electrical power, and to transform power to a higher or lower voltage. Equipment includes transformers, circuit breakers, and other equipment for switching, changing, or regulating the voltage of electricity.

Substrates – Sediment that lies beneath the surface of the earth.

Sulfur Dioxide (SO_2) – A pungent, colorless, gas formed primarily by the combustion of fossil fuels. One of the six criteria pollutants.

Tangent Structure – Typical transmission line structure. Can be one of several types, placed four to five per mile in linear position.

Technical Report – Documentation of detailed studies summarized in the Draft Environmental Impact Statement.

Terminal – (see Substation)

Threatened Species – Any plant or animal species defined under the Endangered Species Act as likely to become endangered within the foreseeable future throughout all or a significant portion of its range; listings are published in the *Federal Register*.

Traditional Cultural Property (TCP) – Any built or natural locations, areas, or features considered sacred or culturally significant by a group or people because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.

Transfer capability – The measure of the ability of interconnected electric systems to move or transfer power in a reliable manner from one area to another over all transmission lines (or paths) between those areas under specified system conditions. The units of transfer capability are in terms of electric power, generally expressed in megawatts (MW).

Undeveloped Area – An area identified by the USFS containing wilderness characteristics and roadless qualities pursuant to the National Forest System Land Resource Management Planning Rule of 2000, amended 2009. These areas can overlap with inventoried roadless areas.

Use Volume – The total volume of visitor use that each segment of a travel route or use-area receives.

Utility Corridor – A route used by a utility for pipelines, cables, and transmission lines.

Vegetation Communities – A combination of dominant plant species which live together in the same region or on the same landform.

Viewshed – Visible portion of the specific landscape seen from a specific viewpoint, normally limited by landform, vegetation, distance, and existing cultural modifications.

Visual Management Objectives – The term used in this study to generally define Visual Resource Management (BLM) or Scenic Integrity Objective levels (USFS).

Visual Quality Objective – Classification of landscape areas, according to the types of structures and changes that are acceptable to meet established visual goals (Forest Service designation).

Visual Resource Inventory (VRI) Classes – Classification of landscape areas composed of scenic quality, sensitivity level rating units, and distance zones for inventory purposes (BLM).

Visual Resource Management (VRM) Classes – Classification of landscapes according to the kinds of structures and changes acceptable to meet established visual goals (BLM).

Volatile Organic Compound (VOC) – Any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA as having negligible photochemical reactivity.

Waters of the United States – All waters currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including adjacent wetlands and tributaries to waters of the United States, and all waters by which the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce.

Wetlands – Those areas that are inundated by surface or groundwater with a frequency sufficient to support vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wilderness – A congressionally designated area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation that is protected and managed to preserve its natural conditions, as described in Section 2A of the Wilderness Act of 1964.

Wilderness Characteristics – Key characteristics of wilderness listed in section 2 (c) of the Wilderness Act of 1964 and used by Bureau of Land Management in conducting wilderness inventories. These characteristics are features of the land associated with the concept of wilderness that specifically deals with naturalness and opportunities for solitude and primitive and unconfined recreation. These characteristics may be considered in land use planning when Bureau of Land Management determines that those characteristics are reasonably present, of sufficient value (condition, uniqueness, relevance, importance), and need (trend, risk), and are practical to manage (from IM-2003-275, Change 1, Considerations of Wilderness Characteristics in LUP, Attachment 1).

Wilderness Study Area – A roadless area or island of undeveloped federal land that has been inventoried and found to possess wilderness characteristics described under Title VI, Section 603 of Federal Land Policy and Management Act and Section 2C of the Wilderness Act of 1964. These characteristics are: (1) generally appears to have been affected mainly by the forces of nature, with human imprints substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres or is large enough to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

Wind Energy – Form of energy conversion in which turbines convert the kinetic energy of wind into mechanical or electrical energy that can be used for power.

INDEX

AAAQS (Arizona Ambient Air Quality Standards), 3-5
AAC (Arizona Administrative Code), 1-25, 1-26, 1-28, 3-6, 3-67, 4-15, 4-16, 4-17, 4-18, 4-257
access road, 1-10, 1-11, 1-27, 2-10, 2-33, 2-51, 2-62, 2-63, 2-64, 2-65, 2-73, 2-74, 2-76, 2-77, 2-79, 2-81, 2-82, 2-87, 2-90, 2-93, 2-95, 2-96, 2-98, 2-103, 2-105, 2-108, 2-113, 2-115, 3-2, 3-33, 3-247, 4-1, 4-2, 4-3, 4-4, 4-7, 4-8, 4-12, 4-20, 4-25, 4-27, 4-28, 4-29, 4-30, 4-49, 4-54, 4-55, 4-56, 4-57, 4-62, 4-64, 4-65, 4-72, 4-76, 4-77, 4-82, 4-84, 4-85, 4-86, 4-92, 4-96, 4-97, 4-99, 4-103, 4-109, 4-112, 4-113, 4-118, 4-121, 4-122, 4-123, 4-124, 4-126, 4-133, 4-145, 4-146, 4-150, 4-152, 4-158, 4-165, 4-166, 4-170, 4-174, 4-179, 4-180, 4-181, 4-183, 4-184, 4-185, 4-188, 4-191, 4-193, 4-196, 4-200, 4-213, 4-259, 4-266, 4-270, 4-297, 4-314, 4-315, 4-317, 4-319, 4-320, 4-322, 4-323, 4-324, 4-327, 4-329, 4-332, 4-333, 4-334, 4-336, 4-337, 4-340, 4-341, 4-342, 4-343, 4-344, 4-346, 4-360, 5-17
ACEC (area of critical environmental concern), 2-9, 2-31, 2-105, 2-113, 2-118, 2-119, 3-127, 3-209, 3-212, 3-214, 3-215, 3-222, 3-228, 3-230, 3-239, 3-242, 3-286, 3-287, 3-290, 3-291, 3-293, 3-294, 4-156, 4-161, 4-172, 4-182, 4-216, 4-225, 4-227, 4-355, 4-357, 4-359
  Aravaipa Watershed ACEC, 3-286
  Bear Springs Badlands ACEC, 3-228, 3-286, 3-291, 4-182
  Desert Grasslands RNA ACEC, 3-287, 3-291, 3-294
  Ladron Mountain/Devil's Backbone Complex ACEC, 2-31, 3-209, 3-212, 3-214, 3-215, 3-286, 3-290, 3-291, 4-156, 4-161, 4-172
  Mockingbird Gap Proprietary ACEC, 3-286
  Northern Peloncillo Mountains ACEC, 3-222
  San Pedro ACEC, 3-221
  South Rim ACEC, 3-286
  Swamp Springs-Hot Springs Watershed ACEC, 2-9, 2-118, 3-242, 3-286, 3-291, 4-216, 4-227, 4-355, 4-359
  Table Mountain RNA ACEC, 3-228, 3-230, 3-287, 3-291, 3-293
  Turkey Creek ACEC, 3-88, 3-99, 3-105, 3-127, 3-287, 3-291, 3-293, 4-83, 4-86, 4-88, 4-109
  Uvas Valley ACEC, 3-118, 3-124, 3-125, 3-206, 3-215, 3-221, 3-286, 3-291, 4-37, 4-99, 4-172, 4-312, 4-321
ACHP (Advisory Council on Historic Preservation), 3-149, 3-150, 3-151, 3-151, 3-153, 3-154, 5-10, 5-11
Active Management Area, *see* AMA, 3-66
ADA (Arizona Department of Agriculture), 3-76, 3-83, 4-89
ADEQ (Arizona Department of Environmental Quality), 1-26, 1-28, 3-3, 3-7, 3-13, 3-58, 3-60, 3-62, 3-63, 3-66, 3-67, 3-75, 3-341, 3-342, 3-345, 3-346, 4-16, 4-19, 4-257, 4-307
adequacy, 5-13
ADOT (Arizona Department of Transportation), 1-1, 1-12, 1-20, 1-23, 1-26, 3-115, 3-256, 3-273, 3-274, 3-284, 5-10, 5-21
Advisory Council on Historic Preservation, *see* ACHP, 1-23, 3-149
ADWR (Arizona Department of Water Resources), 3-28, 3-58, 3-60, 3-61, 3-62, 3-65, 3-66
ALRIS (Arizona Land Resource Information System), 3-74, 3-79, 3-312
AMA (active management area), 3-66
amphibians, 3-87, 3-107, 3-290, 4-66, 4-75, 4-267, 4-325
APE (area of potential effect), 3-153, 4-122, 4-123, 4-124, 5-11

INDEX

aquifer, 2-121, 3-28, 3-57, 3-58, 3-60, 3-64, 3-65, 3-66, 3-68, 3-70, 3-71, 3-72, 4-56, 4-57, 4-60, 4-62, 4-63, 4-76, 4-266, 4-320
aquifers
  Basin and Range Aquifer, 3-60, 3-64
  Rio Grande Aquifer, 3-60, 3-64
  Santa Cruz Sole Source Aquifer, 3-66, 3-70
  Sole Source Aquifer Program, 3-60
  Tucson Sole Source Aquifer, 2-121, 3-58
area of critical environmental concern, *see* ACEC, 2-9
area of potential effect, *see* APE, 2-91, 3-153
Arizona Administrative Code, *see* AAC, 1-28, 3-6
Arizona Ambient Air Quality Standards, *see* AAAQS, 3-7, 4-23
Arizona Department of Agriculture, *see* ADA, 1-26, 3-76, 3-92, 3-109
Arizona Department of Environmental Quality, *see* ADEQ, 1-28, 3-3
Arizona Department of Transportation, *see* ADOT, 1-1, 1-20, 5-5, 5-6, 5-8, 5-21
Arizona Department of Water Resources, *see* ADWR, 3-28, 3-60
Arizona Game and Fish Department, *see* AZGFD, 1-1, 3-253, 5-5, 5-6, 5-21
Arizona Land Resource Information System, *see* ALRIS, 3-74
Arizona Native Plant Law, 3-76
Arizona Pollutant Discharge Elimination System, *see* AZPDES, 1-26, 3-59
Arizona Revised Statute (ARS), 1-28, 3-6
Arizona State Land Department, *see* ASLD, 1-1, 3-247, 3-253, 5-5, 5-6, 5-8, 5-21
Arizona State Museum, 1-26, 3-45, 3-46, 5-8
Arizona Upland Subdivision, 3-80, 3-118
ASLD (Arizona State Land Department), 1-1, 1-12, 1-17, 1-26, 2-105, 3-25, 3-77, 3-113, 3-153, 3-247, 5-10
AZGFD (Arizona Game and Fish Department), 1-1, 1-12, 1-26, 2-36, 2-118, 3-73, 3-74, 3-76, 3-88, 3-92, 3-94, 3-95, 3-96, 3-97, 3-100, 3-101, 3-103, 3-107, 3-109, 3-110, 3-111, 3-112, 3-115, 3-117, 3-127, 3-256, 3-286, 3-312, 4-68, 4-79, 4-80, 4-91, 4-110
AZPDES (Arizona Pollutant Discharge Elimination System), 3-59, 3-75
AZSITE – Arizona's Cultural Resource Inventory, 3-147, 3-182
Bald and Golden Eagle Protection Act, *see* BGEPA, 1-14, 2-88, 3-89, 3-92
Basin and Range Province, 3-25, 3-26, 3-49, 3-50, 3-51, 3-60, 3-77, 3-206, 3-207
BCC (Birds of Conservation Concern), 3-90, 3-92, 3-108
BGEPA (Bald and Golden Eagle Protection Act), 1-23, 1-28, 2-88, 2-93, 3-74, 3-75, 3-89, 3-90, 3-92, 4-68, 4-76, 4-327, 5-10
BHCA (Bird Habitat Conservation Area), 2-113, 3-117, 3-118, 3-120, 3-121, 3-125, 4-99, 4-101, 4-104, 4-105, 4-107
biological resource conservation areas, 4-91
biomes, 3-77, 3-79, 3-81, 3-82, 3-83, 3-85, 3-86, 3-110, 3-114
Biota Information System of New Mexico, *see* BISON-M, 3-73
Bird Conservation Region (BCR), 3-108
Bird Habitat Conservation Area, *see* BHCA, 3-117, 4-99

INDEX

birds
migratory, 1-10, 1-23, 2-10, 2-48, 2-88, 2-89, 2-93, 2-102, 2-113, 3-77, 3-78, 3-86, 3-110, 3-113, 3-118, 3-119, 3-120, 3-126, 4-74, 4-82, 4-91, 4-94, 4-99, 4-101, 4-102, 4-105, 4-111, 4-262, 4-273, 4-321, 4-324, 4-327, 5-16, 5-17
of Conservation Concern, *see also* BCC, 3-108
passerines, 2-102, 3-120, 4-66, 4-75, 4-94, 4-327
raptors, 3-97, 4-64, 4-65, 4-75, 4-94, 4-99, 4-323, 4-324, 4-327
shore, 3-117, 3-118, 3-119, 3-126, 3-287, 4-65, 4-75, 4-100
wading, 4-65, 4-327
waterfowl, 1-10, 2-10, 2-102, 3-110, 3-111, 3-117, 3-118, 3-120, 3-127, 3-129, 3-133, 3-287, 4-74, 4-81, 4-82, 4-91, 4-92, 4-98, 4-100, 4-102, 4-103, 4-105, 4-114, 4-116, 4-262, 4-268, 4-323, 4-327, 5-16
BISON-M (Biota Information System of New Mexico), 3-73, 3-93, 3-98, 3-100
BLM District Offices
Las Cruces, 1-15, 3-254, 3-260, 3-327
Safford, 3-46, 3-85, 3-328
BLM Field Offices
Phoenix, 3-245
Roswell, 1-12, 1-16, 3-139, 4-211
Safford, 1-12, 1-16, 3-46, 3-85, 3-223, 3-224, 3-226, 3-229, 3-230, 3-232, 3-233, 3-238, 3-245, 3-254, 3-301, 3-328, 4-212, 4-213, 4-214, 4-215, 5-20
Socorro, 1-12, 1-16, 1-21, 2-130, 2-131, 3-139, 3-210, 3-213, 3-216, 3-221, 3-245, 3-253, 3-254, 3-288, 3-301, 3-327, 4-157, 4-162, 4-164, 4-169, 4-173, 4-209, 4-210, 4-211, 4-287, 4-353, 4-358, 5-20
Tucson, 1-12, 1-17, 3-139, 3-203, 3-230, 3-232, 3-233, 3-238, 3-239, 3-240, 3-245, 3-246, 3-253, 3-254, 3-260, 3-301, 3-328, 4-215, 4-216, 4-217, 4-219, 5-21
Bonita Grasslands Restoration Project, 3-111, 4-92
BOR (Bureau of Reclamation), 1-14, 1-15, 1-19, 1-20, 1-23, 2-36, 2-37, 2-48, 2-78, 2-81, 2-88, 2-105, 2-111, 2-112, 2-115, 2-117, 3-248, 3-255, 3-259, 3-260, 3-311, 3-312, 4-5, 4-207
Bosque del Apache National Wildlife Refuge, 1-10, 2-9, 2-113, 3-110, 4-91
Buffalo Soldier Electronic Proving Ground, 1-10, 1-11, 1-15, 2-106, 2-118, 3-253, 3-258, 3-279, 4-222, 4-224, 4-225, 4-286
Bureau of Land Management, see BLM District Offices and BLM Field Offices, 1-1, 3-108, 3-253, 3-342, 5-8
Bureau of Reclamation, *see* BOR, 1-14, 1-19, 3-253, 4-287, 5-4, 5-8
California Public Utilities Commission, *see* CPUC, 1-7
CAP (Central Arizona Project), 1-14, 1-19, 1-20, 2-25, 2-26, 2-27, 3-117, 3-127, 3-132, 3-237, 3-261, 4-98, 4-109, 4-199, 4-208, 4-324, 4-332
Carlson Foley Act, 3-75
cave and karst resources, 2-93, 3-86, 3-88, 3-119, 3-135, 4-78, 4-100, 4-101
CDNST (Continental Divide National Scenic Trail), 2-104, 3-200, 3-205, 3-222, 3-224, 3-225, 3-226, 3-297, 4-175, 4-178, 4-179
CDTS (Continental Divide Trail Society Route), 3-209, 3-212, 3-214, 4-156, 4-175, 4-176
CEC (Certificate of Environmental Compatibility), 3-247, 3-291, 3-293

INDEX

Cenozoic, 3-25, 3-51, 3-54
Central Arizona Project, *see* CAP, 1-14, 3-253
CEQ (Council on Environmental Quality), 1-13, 1-14, 1-21, 1-23, 2-10, 3-333, 3-334, 4-271, 4-272, 5-13
Certificate of Environmental Compatibility, *see* CEC, 1-25, 3-247
Chihuahuan Desertscrub, 2-7, 2-74, 3-79, 3-80, 3-82, 3-120, 3-122, 3-123, 3-124, 3-125, 3-126, 3-129, 3-131, 3-132, 3-134, 3-135, 3-140, 3-142, 4-70
CIC (Compliance Inspection Contractor), 2-88, 2-91, 2-98, 4-145
Clean Water Act of 1977, *see* CWA, 1-13, 1-28, 2-47
CMA (cooperative management area), 2-9, 2-26, 3-112
  Muleshoe Ranch CMA, 2-9, 2-34, 2-118, 2-119, 3-105, 3-112, 3-232, 3-235, 3-236, 3-237, 3-238, 3-239, 3-242, 3-251, 3-286, 3-291, 3-303, 4-91, 4-93, 4-187, 4-189, 4-190, 4-192, 4-194, 4-202, 4-216, 4-227, 4-355, 4-357, 4-359
CNF (Coronado National Forest), 2-25, 2-26, 3-127, 3-143, 3-144, 3-200, 3-228, 3-230, 3-231, 3-235, 3-246, 3-251, 3-303, 3-322, 4-100, 4-186, 4-191
Code of Federal Regulations (CFR), 1-5
Compliance Inspection Contractor, *see* CIC, 2-88
Construction, Operation, and Maintenance Plan, *see* COM Plan, 4-58
Continental Divide National Scenic Trail, *see* CDNST, 2-104, 3-289
Continental Divide Trail Society Route, *see* CDTS, 3-209
cooperative management area, *see* CMA, 2-9
Coronado National Forest, *see* CNF, 1-11, 2-25, 3-246, 3-253, 4-282
Council on Environmental Quality, *see* CEQ, 1-13
CPUC (California Public Utilities Commission), 1-7, 4-260
critical habitat, 1-23, 2-6, 2-88, 2-102, 2-105, 2-108, 2-113, 2-120, 3-67, 3-73, 3-89, 3-95, 3-99, 3-100, 3-101, 3-103, 3-104, 3-105, 3-106, 3-107, 3-110, 3-112, 3-120, 3-121, 3-122, 3-124, 3-128, 3-129, 3-130, 3-131, 3-132, 3-133, 3-135, 3-248, 3-287, 4-68, 4-83, 4-86, 4-87, 4-88, 4-95, 4-103, 4-106, 4-109, 4-111, 4-113, 4-114, 4-115, 4-116, 4-266, 4-267, 4-326
CWA (Clean Water Act), 1-24, 1-25, 1-26, 1-28, 2-47, 2-88, 3-58, 3-59, 3-60, 3-66, 3-74, 3-341, 4-55, 4-58, 4-261, 4-266
Department of Defense, *see* DOD, 1-1, 3-253, 5-4, 5-5, 5-6, 5-8, 5-22
Department of Energy, *see* DOE, 1-6
Department of the Army, *see* DOA, 1-1, 1-12, 1-20, 1-25, 2-28, 2-31, 2-33, 3-253
designated utility corridor, 2-23, 2-24, 2-25, 2-26, 2-27, 2-99, 2-107, 2-112, 2-115, 2-117, 3-244, 3-279, 3-280, 3-281, 4-149, 4-221, 4-287, 5-15
dispersed recreation, 3-236, 3-255, 3-270, 3-271, 3-272, 4-155, 4-161, 4-186, 4-189, 4-191
distance zones, 3-200, 3-202, 3-203, 3-210, 3-213, 3-216, 3-221, 3-223, 3-224, 3-226, 3-229, 3-230, 3-232, 3-238
distinct population segment, *see* DPS, 3-103
DOD (Department of Defense), 1-1, 1-12, 1-14, 1-15, 1-25, 2-11, 2-32, 2-33, 2-89, 2-104, 2-106, 2-111, 2-112, 2-113, 2-115, 2-117, 3-243, 3-244, 3-250, 3-258, 3-277, 3-278, 3-311, 3-312, 4-221, 4-222, 4-223, 4-224, 5-22

INDEX

DOE (Department of Energy), 1-6, 1-7, 1-8, 1-15, 2-4, 2-41, 2-43, 2-101, 3-204, 3-259, 3-260, 3-279, 3-280, 4-154, 4-160, 4-170, 4-177, 4-287, 4-298, 4-299, 4-300, 4-310, 4-311, 4-320, 4-328, 4-338, 4-348
DPS (distinct population segment), 3-90, 3-91, 3-92, 3-103
earthquake, 3-22, 3-28, 3-33
Electronic Proving Ground, *see* Buffalo Soldier Electronic Proving Ground, 2-106, 3-258, 4-222, 4-224, 4-225, 4-286
Endangered Species Act of 1973, *see* ESA, 1-12, 1-13, 1-14, 3-89, 3-92, 5-10
Energy Policy Act of 2005, *see* EPAct, 1-5, 4-287
EO (executive order), 1-13, 1-14, 1-23, 1-24, 1-25, 2-47, 2-88, 3-59, 3-74, 3-76, 3-151, 3-333, 4-57, 4-248, 5-7, 5-16
EPA (U.S. Environmental Protection Agency), 1-11, 1-22, 1-24, 1-27, 1-28, 2-38, 3-4, 3-5, 3-6, 3-7, 3-8, 3-11, 3-12, 3-13, 3-16, 3-17, 3-18, 3-19, 3-58, 3-59, 3-60, 3-66, 3-67, 3-75, 3-341, 3-342, 3-345, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-12, 4-13, 4-14, 4-18, 4-19, 4-21, 4-56, 4-260, 4-262, 4-300, 4-306, 4-311, 4-352, 4-360
EPAct (Energy Policy Act), 1-5, 1-6, 1-8, 1-9, 1-15, 2-4, 3-260, 4-297
ESA (Endangered Species Act), 1-12, 1-13, 1-17, 1-23, 2-88, 2-93, 2-106, 2-120, 3-73, 3-74, 3-75, 3-76, 3-77, 3-79, 3-85, 3-88, 3-89, 3-92, 3-107, 3-108, 3-109, 3-111, 3-112, 3-113, 3-114, 3-119, 3-125, 3-249, 4-67, 4-68, 4-69, 4-76, 4-77, 4-91, 4-96, 4-101, 4-266, 4-268, 4-323, 4-326, 4-327, 4-355, 5-7, 5-10, 5-19
executive order, *see* EO, 1-13
Farmland Protection Policy Act of 1981, *see* FPPA, 3-24
fault, 2-43, 3-28, 3-36, 3-37, 3-41, 3-42, 3-43, 3-63, 4-25, 4-31
Federal Emergency Management Agency, *see* FEMA, 3-29
Federal Energy Regulatory Commission, *see* FERC, 1-8
Federal Land Policy and Management Act of 1976, *see* FLPMA, 1-1, 1-14, 1-18
Federal Water Pollution Control Act, *see* CWA, 1-26, 3-58, 3-74, 3-75
FEMA (Federal Emergency Management Agency), 3-29, 3-33, 3-36, 3-37
FERC (Federal Energy Regulatory Commission), 1-8, 1-9, 1-25, 4-303, 5-15
fish, 1-10, 1-17, 1-18, 1-26, 2-120, 3-52, 3-73, 3-74, 3-75, 3-76, 3-83, 3-87, 3-88, 3-91, 3-96, 3-102, 3-103, 3-104, 3-105, 3-107, 3-109, 3-112, 3-113, 3-114, 3-160, 3-162, 3-163, 3-249, 3-250, 3-286, 3-290, 3-311, 4-66, 4-76, 4-81, 4-86, 4-87, 4-88, 4-95, 4-109, 4-267, 4-298, 4-325, 4-330, 4-355, 5-5, 5-8, 5-9, 5-17
Fish and Wildlife Coordination Act, 1-26, 3-74, 3-75, 5-9
fissure, 3-28, 3-43
flooding, 3-11, 3-27, 3-29, 3-111, 3-115, 4-24, 4-25, 4-31, 4-37, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-47, 4-48, 4-66, 4-309, 4-311, 4-312
FLPMA (Federal Land Policy and Management Act), 1-1, 1-5, 1-6, 1-13, 1-15, 1-21, 1-23, 1-24, 3-24, 3-74, 3-75, 3-204, 3-286, 3-300, 3-301, 3-306, 5-14
fossil, 2-114, 3-45, 3-46, 3-47, 3-48, 3-51, 3-52, 3-53, 3-55, 3-56, 3-57, 4-49, 4-51, 4-53, 4-54, 4-265, 4-272, 4-308, 4-310, 4-314, 4-316, 4-318, 4-319, 5-14
FPPA (Farmland Protection Policy Act), 3-24
geocommunicator, 3-22
geographic information system, *see* GIS, 3-74, 5-19, 5-22, 5-23

INDEX

geological hazards, 2-114, 2-121, 3-22, 3-26, 3-27, 3-33, 3-35, 3-36, 3-37, 3-38, 3-39, 3-41, 3-42, 3-43, 4-24, 4-25, 4-26, 4-31, 4-32, 4-33, 4-34, 4-35, 4-37, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-47, 4-48, 4-311, 4-312, 4-354
geology, 2-95, 3-1, 3-22, 3-26, 3-46, 3-79, 4-311, 5-23
geothermal, 3-22, 3-24, 3-25, 3-29, 3-30, 3-257, 4-26, 4-27, 4-298, 4-299, 4-300, 4-303, 4-313, 4-314, 4-318, 4-335, 4-348
GHG (greenhouse gas), 3-13, 4-6, 4-8, 4-11, 4-13, 4-14, 4-18, 4-20, 4-22, 4-23, 4-262, 4-308, 4-309, 4-310
Gila Box Riparian National Conservation Area Management Plan, 1-16, 3-245
GIS (geographic information system), 2-5, 3-22, 3-23, 3-28, 3-29, 3-46, 3-73, 3-74, 3-95, 3-147, 3-203, 4-149, 4-151, 4-228, 4-273
Gran Quivira, *see* national monuments, Salinas Pueblo Missions National Monument – Gran Quivira, 1-12, 2-23, 2-32, 2-102, 2-107, 2-113, 2-114, 3-36, 3-54, 3-55, 3-68, 3-120, 3-146, 3-178, 3-179, 3-180, 3-185, 3-186, 3-199, 3-200, 3-205, 3-209, 3-210, 3-212, 3-214, 3-215, 3-217, 3-218, 3-220, 3-250, 3-256, 3-264, 3-278, 3-289, 3-296, 4-34, 4-37, 4-50, 4-59, 4-107, 4-123, 4-129, 4-130, 4-131, 4-133, 4-146, 4-147, 4-148, 4-158, 4-159, 4-161, 4-162, 4-163, 4-164, 4-169, 4-170, 4-171, 4-173, 4-223, 4-333, 4-335, 5-6, 5-17, 5-21
grazing, 1-11, 1-17, 2-10, 2-105, 2-108, 2-118, 3-32, 3-80, 3-81, 3-94, 3-113, 3-140, 3-141, 3-205, 3-207, 3-208, 3-243, 3-244, 3-249, 3-250, 3-251, 3-254, 3-262, 3-266, 3-267, 3-268, 3-269, 3-282, 3-283, 3-284, 3-285, 3-286, 4-29, 4-130, 4-208, 4-209, 4-210, 4-211, 4-212, 4-213, 4-214, 4-215, 4-216, 4-217, 4-219, 4-220, 4-245, 4-275, 4-314, 4-324, 4-341, 4-343, 4-350, 4-360, 5-18
Great Basin Conifer Woodland, 2-6, 3-81
greenhouse gas, *see* GHG, 3-13
groundwater pollution prevention section, *see* GWPPS, 3-75
harvest restricted, 3-76
hazardous air pollutant, *see* HAP, 3-3, 3-6
Heritage Data Management System, *see* HDMS, 3-73
highly safeguarded, 3-76, 3-92, 3-109
Historic Properties Treatment Plan, *see* HPTP, 2-48, 2-93
HPTP (Historic Properties Treatment Plan), 2-48, 2-91, 2-93, 3-154, 4-145, 4-146
IBA (Important Bird Area), 3-118, 3-119, 4-100
Important Bird Area, *see* IBA, 3-118, 4-100
Interior and Sonoran Riparian Scrubland, 3-82
Interior and Sonoran Riparian Woodland, 3-82
interior chaparral, 2-7, 3-79, 3-81, 3-127, 3-128
invertebrates, 2-104, 3-52, 3-55, 3-88, 3-102, 3-103, 3-105, 3-107, 3-126, 4-67, 4-76, 4-100, 4-108, 4-268
key observation point, 3-200, 3-201
K_w, 3-31, 4-29
lands with wilderness characteristics, 3-299, 3-301, 3-305, 4-227, 4-228, 4-233, 4-345, 4-359
locatable minerals, 3-29, 3-257
Lower Colorado River Valley Subdivision, 3-79

mammals
large, 3-94, 4-64, 4-65, 4-73, 4-119, 4-327
small, 3-95, 3-102, 4-65, 4-73, 4-80, 4-322, 4-323
MBTA (Migratory Bird Treaty Act), 1-23, 1-28, 2-88, 2-93, 3-74, 3-75, 4-75, 4-85, 4-327, 5-10, 5-16
Memorandum of Understanding, *see* MOU, 5-16
Mesozoic, 3-26, 3-52, 3-54, 3-55, 4-51, 4-53
Migratory Bird Treaty Act, *see* MBTA, 1-14, 1-28, 2-88
military operations, 1-15, 2-32, 2-102, 2-107, 4-221, 4-222, 4-223, 4-224, 4-340, 4-341, 4-343, 5-15
mineral, 2-98, 3-22, 3-24, 3-25, 3-29, 3-30, 3-33, 3-36, 3-39, 3-42, 3-43, 3-65, 3-157, 3-177, 3-257, 3-276, 4-24, 4-26, 4-27, 4-31, 4-32, 4-34, 4-35, 4-36, 4-37, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-48, 4-312, 4-313, 4-314, 4-337, 4-354
MOU (Memorandum of Understanding), 3-243, 3-254, 3-258, 5-9
Muleshoe Ecosystem Management Plan, 1-17, 3-139, 3-246
NAAQS (National Ambient Air Quality Standards), 3-4, 3-6, 3-7, 3-11, 3-12, 3-13, 4-13, 4-18, 4-19, 4-21, 4-23
National Ambient Air Quality Standards, *see* NAAQS, 3-4
National Emission Standards for Hazardous Air Pollutants, *see* NESHAP, 3-6
National Environmental Policy Act of 1969, *see* NEPA, 1-1, 1-14, 3-151, 4-272
national forests
Cibola National Forest, 2-28, 2-31, 3-67, 3-207, 3-209, 3-212, 3-214, 3-215, 3-218, 3-220, 3-246, 4-155, 4-156, 4-161, 4-164, 5-8
Coronado National Forest, 1-11, 2-25, 3-246, 3-253, 4-282
Gila National Forest, 3-67, 3-94, 3-111, 3-125, 3-222, 3-253, 3-322, 4-79
Lincoln National Forest, 3-106, 3-246
National Historic Preservation Act of 1966, *see* NHPA, 1-12, 1-14, 3-151, 5-10
national historic trails, *see* NHT, 2-32, 2-113, 3-184, 3-190, 3-197
national monuments, 1-12, 3-8, 3-18, 3-106, 3-114, 3-116, 3-179, 3-180, 3-202, 3-214, 3-252, 3-256, 3-278, 3-288, 3-296, 3-309, 3-322, 4-98, 4-130, 4-158, 4-159, 4-287, 4-333, 5-21
Salinas Pueblo Missions National Monument – Gran Quivira, 1-12, 2-23, 2-32, 2-102, 2-107, 2-113, 2-114, 3-36, 3-54, 3-55, 3-68, 3-120, 3-146, 3-147, 3-178, 3-179, 3-180, 3-185, 3-186, 3-199, 3-200, 3-205, 3-209, 3-210, 3-212, 3-214, 3-215, 3-217, 3-218, 3-220, 3-250, 3-253, 3-256, 3-264, 3-278, 3-289, 3-296, 4-34, 4-37, 4-50, 4-59, 4-107, 4-123, 4-129, 4-130, 4-131, 4-133, 4-146, 4-147, 4-148, 4-158, 4-159, 4-161, 4-162, 4-163, 4-164, 4-169, 4-170, 4-171, 4-173, 4-223, 4-333, 4-335, 5-5, 5-6, 5-17, 5-18, 5-21
National Park Service (NPS), *see* national parks, 1-1, 3-253, 5-4, 5-5, 5-6, 5-21
national parks
NPS (National Park Service), 1-1, 1-12, 1-14, 1-15, 2-102, 2-107, 3-114, 3-147, 3-153, 3-175, 3-178, 3-179, 3-180, 3-205, 3-288, 3-289, 3-300, 3-311, 3-312, 4-91, 4-130, 5-10
Saguaro National Park (East and West), 2-27, 2-36, 3-8, 3-114, 3-193, 3-200, 3-232, 3-237, 3-241, 3-242, 3-251, 3-252, 3-253, 3-262, 4-91, 4-96, 4-142, 4-186, 4-194, 4-199, 4-287, 4-288, 4-326, 5-9, 5-21
National Pollutant Discharge Elimination System, *see* NPDES, 1-24, 1-26, 1-27, 3-59

INDEX

National Register of Historic Places, *see* NRHP, 2-106
national scenic trails
Arizona National Scenic Trail, 2-119, 3-200, 3-228, 3-230, 3-232, 3-236, 3-237, 3-238, 3-242, 3-289, 3-298, 4-182, 4-193, 4-199, 4-202
Continental Divide National Scenic Trail (CDNST), 2-104, 3-200, 3-205, 3-222, 3-224, 3-225, 3-226, 3-289, 3-297, 4-175, 4-178, 4-179
National Weather Service, *see* NWS, 3-3, 3-9, 3-11
National Wildlife Refuge, *see* NWR, 2-31, 3-290, 3-299
Natural Resource Conservation District, *see* NRCD, 3-249, 5-4
Natural Resources Conservation Service, *see* NRCS, 3-23
NEP (nonessential experimental population), 3-89, 3-90, 3-92, 3-94, 4-79
NEPA (National Environmental Policy Act), 1-1, 1-13, 1-14, 1-18, 1-19, 1-20, 1-21, 1-23, 2-10, 2-11, 2-27, 2-64, 2-88, 2-89, 3-24, 3-74, 3-153, 3-154, 3-204, 3-250, 3-300, 3-301, 3-306, 4-1, 4-21, 4-30, 4-68, 4-149, 4-208, 4-257, 4-272, 4-274, 4-276, 5-1, 5-7, 5-10, 5-13, 5-19, 5-20, 5-21, 5-22
NESC (National Electric Safety Code), 2-42, 2-44, 2-45, 2-50, 2-60, 2-73, 2-78, 2-82, 2-99, 4-72, 4-80, 4-83, 4-94
NESHAP (National Emission Standards for Hazardous Air Pollutants), 3-6
New Mexico Administrative Code, 1-28, 3-6
New Mexico Ambient Air Quality Standards, *see* NMAAQS, 3-7, 4-21, 4-23
New Mexico Bureau of Geology and Mineral Resources, *see* NMBGMR, 3-22
New Mexico Cultural Resources Information System, *see* NMCRIS, 3-147
New Mexico Department of Game and Fish, *see* NMDGF, 1-28, 3-73, 3-92
New Mexico Endangered Plant Species Act, 3-76
New Mexico Environment Department, *see* NMED, 1-28, 3-3
New Mexico Pollutant Discharge Elimination System, *see* NMPDES, 3-59
New Mexico State Land Office, *see* NMSLO, 1-1, 3-253, 5-5, 5-6, 5-8, 5-21
New Mexico Statutes Annotated, *see* NMSA, 1-28, 3-6
New Mexico Water Quality Control Commission, *see* NMWQCC, 3-60
New Mexico Wildlife Conservation Act of 1978, 3-76
NHPA (National Historic Preservation Act), 1-12, 1-13, 1-23, 3-149, 3-151, 3-152, 3-153, 4-123, 5-7, 5-10, 5-11, 5-17
NHT (national historic trails), 2-32, 3-150, 3-180, 3-185, 3-186, 3-187, 4-129, 4-131, 4-132, 4-141
El Camino Real de Tierra Adentro National Historic Trail, 3-146, 3-149, 3-178, 3-200, 3-289, 4-147, 4-332, 5-11
Juan Bautista de Anza National Historic Trail, 2-119, 3-200, 3-228, 3-237, 3-241, 3-289, 3-298
NMBGMR, 3-22, 3-28
NMCRIS (New Mexico Cultural Resources Information System), 3-147, 3-148, 3-181, 3-182
NMDGF (New Mexico Department of Game and Fish), 1-27, 1-28, 3-73, 3-74, 3-76, 3-95, 3-109, 3-111, 3-115, 3-117, 3-286, 4-68
NMED (New Mexico Environment Department, *see*), 1-27, 1-28, 3-3, 3-6, 3-8, 3-12, 3-67, 3-75, 3-341, 3-342, 3-345, 4-257

NMPDES (New Mexico Pollutant Discharge Elimination System), 3-59
NMSA (New Mexico Statutes Annotated), 1-27, 1-28, 3-6, 3-24, 3-60, 3-76, 3-152, 3-342
NMSLO (New Mexico State Land Office), 1-1, 1-12, 1-27, 3-24, 3-48, 3-153, 5-10
NMWQCC (New Mexico Water Quality Control Commission), 3-60
NOI (Notice of Availability), 1-11, 1-22, 5-12
NOI (Notice of Intent), 1-9, 1-21, 2-8, 4-16, 4-17, 5-1, 5-10
nonessential experimental population, *see* NEP, 3-92, 3-94, 4-79
Notice of Availability, *see* NOI, 1-11
Notice of Intent, *see* NOI, 1-9, 5-1
NPDES (National Pollutant Discharge Elimination System), 3-59
NRCD (Natural Resource Conservation District), 1-17, 1-18, 3-243, 3-249, 3-250, 3-255, 3-263, 5-8
  Redington, 1-17, 3-23, 3-249, 4-208, 5-4, 5-8
  Winkelman, 3-249, 3-250, 5-4, 5-8
NRCS (Natural Resources Conservation Service), 3-23, 3-31, 3-32, 3-112, 3-249, 4-29
NRHP (National Register of Historic Places), 2-106, 3-146, 3-147, 3-149, 3-150, 3-151, 3-151, 3-152, 3-153, 3-180, 3-184, 4-122, 4-125, 4-126, 4-333, 4-335, 5-10, 5-11, 5-17
NWR (National Wildlife Refuge), 2-9, 2-23, 2-28, 2-31, 2-37, 2-101, 2-102, 3-7, 3-51, 3-93, 3-97, 3-98, 3-105, 3-107, 3-110, 3-111, 3-113, 3-120, 3-121, 3-122, 3-185, 3-200, 3-207, 3-209, 3-210, 3-212, 3-213, 3-214, 3-218, 3-219, 3-244, 3-248, 3-250, 3-253, 3-261, 3-266, 3-267, 3-282, 3-290, 3-293, 3-299, 3-328, 4-74, 4-78, 4-90, 4-91, 4-92, 4-93, 4-102, 4-154, 4-155, 4-156, 4-159, 4-160, 4-161, 4-167, 4-202, 4-220, 4-286, 4-290, 5-9
  Bosque del Apache National Wildlife Refuge, 1-10, 2-9, 2-113, 3-110, 4-91
  Sevilleta National Wildlife Refuge, 2-113, 3-110, 4-91
OATT (Open Access Transmission Tariffs), 1-8
Occupational Safety and Health Administration, *see* OSHA, 2-73, 3-341
Open Access Transmission Tariffs, *see* OATT, 1-8
OSHA (Occupational Safety and Health Administration), 2-73, 3-341, 3-342, 4-258, 4-261
paleontological, 1-24, 2-48, 2-65, 2-89, 2-92, 2-93, 2-114, 2-121, 3-1, 3-2, 3-45, 3-46, 3-47, 3-48, 3-49, 3-50, 3-51, 3-52, 3-54, 3-286, 4-48, 4-49, 4-50, 4-51, 4-52, 4-53, 4-54, 4-145, 4-265, 4-266, 4-273, 4-316, 4-317, 4-318, 4-355, 4-360, 5-23
Paleozoic, 3-26, 3-27, 3-49, 3-50, 3-51, 3-52, 3-54, 3-119, 4-100
perennial, 2-92, 2-95, 2-121, 3-58, 3-60, 3-61, 3-62, 3-65, 3-66, 3-67, 3-68, 3-69, 3-70, 3-71, 3-72, 3-78, 3-80, 3-84, 3-87, 3-96, 3-97, 3-103, 3-105, 3-112, 3-113, 3-114, 3-118, 3-130, 3-180, 3-222, 3-233, 3-234, 4-54, 4-56, 4-57, 4-58, 4-59, 4-60, 4-61, 4-62, 4-86, 4-88, 4-90, 4-92, 4-93, 4-94, 4-95, 4-96, 4-146, 4-266, 4-319, 4-320, 4-325, 5-17
PFYC (Potential Fossil Yield Classification), 3-46, 3-49, 3-53, 3-54, 3-55, 3-57, 4-48, 4-49, 4-50, 4-51, 4-53, 4-266
Plains and Great Basin Grassland, 2-6, 3-81
Plains Riparian Wetlands, 3-82
Plan of Development, *see* POD, 1-17, 2-47, 4-3
POD (Plan of Development), 1-17, 1-18, 2-48, 2-51, 2-62, 2-64, 2-73, 2-74, 2-76, 2-78, 2-80, 2-81, 2-87, 2-88, 2-89, 2-92, 4-3, 4-4, 4-5, 4-48, 4-54, 4-56, 4-63, 4-68, 4-69, 4-72, 4-73, 4-75, 4-81, 4-83, 4-118, 4-123, 4-145, 4-245, 4-261, 4-336, 4-346, 5-17

Potential Fossil Yield Classification, *see* PFYC, 3-46, 3-48, 3-54
prime or unique farmland, 3-22, 3-30, 3-31, 3-32, 3-34, 3-35, 3-36, 3-37, 3-38, 3-39, 3-40, 3-41, 3-42, 3-43, 3-44, 4-24, 4-28, 4-29, 4-30, 4-31, 4-32, 4-34, 4-36, 4-37, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-265
priority conservation area, *see* PCA, 3-147
Quaternary, 3-22, 3-25, 3-27, 3-28, 3-33, 3-37, 3-38, 3-39, 3-41, 3-42, 3-43, 3-46, 3-49, 3-50, 4-24, 4-25, 4-26, 4-31, 4-32, 4-34, 4-35, 4-37, 4-41, 4-48, 4-50, 4-52
rangeland, 1-11, 3-31, 3-118, 3-120, 3-121, 3-254, 3-309, 4-343
Rare Plant Technical Council, *see* RPTC, 3-107
Record of Decision, *see* ROD, 1-16, 1-19, 2-2, 3-245, 3-246
recreation area (*see* also SRMA), 1-11, 2-95, 2-97, 2-104, 2-119, 3-200, 3-201, 3-209, 3-212, 3-214, 3-218, 3-240, 3-285, 4-151, 4-172, 4-175, 4-176, 4-194, 4-207, 4-218, 4-219, 4-246, 4-337, 4-341, 5-18
  Hot Well Dunes Recreation Area, 2-24, 2-25, 2-104, 2-108, 2-115, 3-226, 3-229, 4-175, 4-176, 4-341
  The Box Recreation Area, 1-16, 2-118, 3-106, 3-116, 3-246, 3-327, 3-330
Regional Flood Control District, *see* RFCD, 3-114, 5-4
reliability, 1-6, 2-7, 2-37, 2-38, 2-42, 2-44, 2-46, 2-78, 4-297
renewable energy, 1-6, 1-7, 1-8, 1-9, 2-3, 2-41, 2-42, 3-199, 3-259, 4-272, 4-273, 4-275, 4-295, 4-296, 4-297, 4-298, 4-299, 4-300, 4-303, 4-304, 4-305, 4-309, 4-310, 4-312, 4-313, 4-314, 4-315, 4-316, 4-318, 4-321, 4-334, 4-336, 4-338, 4-340, 4-346, 4-347, 4-348, 4-349, 4-350, 4-359, 5-14, 5-15
renewable portfolio standard, *see* RPS, 1-6
reptiles, 3-49, 3-51, 3-87, 3-107, 3-290, 4-66, 4-76, 4-267, 4-325
research natural area, *see* RNA, 2-5, 3-127, 3-287, 3-292
resource management plan, *see* RMP, 1-1, 1-5, 3-203
RMP (resource management plan), 1-5, 1-6, 1-12, 1-15, 1-16, 1-19, 1-21, 1-23, 2-2, 2-8, 2-33, 2-101, 2-103, 2-105, 2-112, 2-115, 2-117, 2-129, 2-130, 2-131, 3-138, 3-144, 3-200, 3-204, 3-242, 3-243, 3-245, 3-254, 3-261, 3-262, 3-282, 4-120, 4-152, 4-201, 4-203, 4-204, 4-205, 4-207, 4-220, 4-221, 4-238, 4-249, 4-273, 4-274, 4-287, 4-353, 4-354, 4-357, 4-358, 4-359
  Las Cienegas RMP, 3-246
  Mimbres RMP, 1-16, 2-135, 3-139, 3-245, 4-354, 4-355
  Phoenix RMP, 1-16, 2-117, 3-245, 4-204
  Rio Puerco (Albuquerque) RMP, 1-16, 3-245
  Roswell RMP, 1-16
  Safford RMP, 2-117, 2-137, 3-262, 4-354, 4-357, 4-359
  Socorro RMP, 1-16, 1-21, 2-112, 2-130, 2-131, 2-133, 3-139, 3-245, 3-261, 4-203, 4-205, 4-220, 4-353, 4-354, 4-355, 4-356, 4-358, 4-359
  White Sands RMP, 1-16
RNA (research natural area), 3-127
  Desert Grasslands RNA, 3-287, 3-291, 3-294
  Lordsburg Playa RNA, 3-287, 3-293
  Table Mountain RNA, 3-228, 3-230, 3-287, 3-291, 3-293
ROD (Record of Decision), 1-19, 1-22, 1-23, 2-2, 2-64, 2-65, 3-154, 5-11, 5-17

RPS (renewable portfolio standard), 1-6, 1-7, 1-8, 1-9, 2-41, 4-297
Safe Drinking Water Act, *see* SDWA, 1-14, 3-60
Salt River Project, *see* SRP, 1-2, 4-288, 5-9
salvage assessed, 3-76
salvage restricted, 3-76
scenery, 2-103, 2-104, 2-105, 2-113, 2-115, 2-119, 3-199, 3-200, 3-201, 3-203, 3-204, 3-208, 3-209, 3-211, 3-212, 3-213, 3-214, 3-216, 3-217, 3-222, 3-223, 3-225, 3-227, 3-229, 3-231, 3-233, 3-234, 3-239, 3-240, 3-241, 4-148, 4-149, 4-150, 4-153, 4-154, 4-158, 4-159, 4-160, 4-163, 4-165, 4-166, 4-169, 4-170, 4-174, 4-176, 4-177, 4-179, 4-180, 4-181, 4-183, 4-184, 4-185, 4-187, 4-188, 4-190, 4-191, 4-192, 4-193, 4-195, 4-196, 4-201, 4-269, 4-336, 4-337, 4-338
scenic quality rating unit, *see* SQRU, 3-201, 4-205
scenic routes
  El Camino Real National Byway, 3-210, 3-213, 3-216, 4-157
  Geronimo Trail National Scenic Byway, 3-209, 3-212, 3-214, 4-157
  Lake Valley Back Country Byway, 3-209, 3-210, 3-212, 3-213, 3-214, 3-215, 3-216, 3-218, 3-219, 4-157, 4-202
  Patagonia-Sonoita Scenic Road (SR 83), 3-237
  Quebradas Back Country Byway, 2-113, 3-209, 3-212, 3-214, 3-215, 3-218, 3-219, 3-288, 3-291, 3-292, 3-295, 3-296, 4-156, 4-162, 4-167, 4-202
  Salt Missions Trail Scenic Byway, 3-209, 3-212, 3-220, 4-159, 4-164, 4-202
SDCP (Sonoran Desert Conservation Plan), 1-17, 3-110, 3-113, 3-119, 3-205, 3-248, 4-95, 5-18
SDWA (Safe Drinking Water Act), 3-60
security, 1-5, 1-6, 3-258
seismicity, 3-27, 3-28, 3-33
semidesert grassland, 2-7, 3-78, 3-79, 3-80, 3-82, 3-86, 3-95, 3-106, 3-114, 3-120, 3-123, 3-124, 3-125, 3-126, 3-127, 3-128, 3-129, 3-130, 3-131, 3-132, 3-134, 3-142, 3-144, 3-206, 3-207, 3-217, 3-225, 4-70, 4-78, 4-107, 4-110
sensitivity level rating unit, *see* SLRU, 3-202, 3-203, 3-210, 3-213, 3-216, 3-221, 3-223, 3-224, 3-226, 3-229, 3-230, 3-232, 3-233, 3-238, 3-240, 4-205
Sevilleta National Wildlife Refuge, 2-113, 3-110, 4-91
SGCN (species of greatest conservation need), 3-89, 3-90, 3-91, 3-92, 3-109, 3-110
SHPO (State Historic Preservation Officer), 1-23, 1-26, 1-28, 3-146, 3-147, 3-150, 3-152, 3-153, 3-180, 4-123, 5-10
Sikes Act, 3-74, 3-75
SMA (special management area), 2-112, 3-243, 3-261, 3-287, 3-294, 4-105, 4-355, 4-359
Society of Vertebrate Paleontology, *see* SVP, 3-47
soil, 1-10, 1-17, 1-18, 2-4, 2-60, 2-65, 2-74, 2-76, 2-78, 2-79, 2-95, 2-98, 2-103, 2-104, 2-108, 3-22, 3-23, 3-24, 3-30, 3-31, 3-32, 3-33, 3-36, 3-39, 3-43, 3-44, 3-102, 3-142, 3-249, 3-287, 3-309, 4-17, 4-24, 4-28, 4-29, 4-30, 4-31, 4-32, 4-34, 4-35, 4-36, 4-37, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-48, 4-55, 4-64, 4-72, 4-90, 4-92, 4-258, 4-265, 4-309, 4-314, 4-315, 4-316, 4-319, 4-354, 5-16, 5-17
Soil Survey Geographic, *see* SSURGO, 3-23
solar energy, 3-259, 3-260, 4-298, 4-304, 4-326, 4-329, 4-334, 4-338, 4-350, 5-15

Sonoran Desert Conservation Plan, *see* SDCP, 1-17, 3-248, 3-263
Sonoran Desertscrub, 2-6, 2-7, 3-79, 3-80, 3-93, 3-99, 3-101, 3-102, 3-106, 3-114, 3-118, 3-127, 3-129, 3-130, 3-132, 3-134, 3-135, 3-136, 3-137, 3-141, 3-142, 4-326
Southwest Area Transmission, *see* SWAT, 1-8
special management area, *see* SMA, 2-5, 3-243, 3-287, 3-294
special recreation management area, *see* SRMA, 2-6, 3-200, 3-288, 3-295
species
  native, 2-81, 2-93, 3-75, 3-76, 3-82, 3-83, 3-87, 3-88, 3-100, 3-104, 3-112, 3-113, 3-114, 3-115, 3-127, 3-131, 3-132, 3-140, 3-141, 3-142, 3-144, 3-155, 3-166, 3-170, 3-172, 3-173, 3-174, 3-179, 3-286, 4-17, 4-64, 4-66, 4-71, 4-73, 4-75, 4-83, 4-86, 4-88, 4-90, 4-96, 4-99, 4-102, 4-109, 4-119, 4-120, 4-309, 4-322, 4-329, 5-16, 5-17
  of concern, 2-93, 2-98, 3-7, 3-22, 3-45, 3-73, 3-108, 3-146, 3-198, 3-200, 3-202, 3-239, 3-241, 3-242, 4-31, 4-32, 4-34, 4-35, 4-36, 4-37, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-69, 4-99, 4-123, 4-152, 4-168, 4-175, 4-176, 4-178, 4-273, 5-16, 5-17
  of economic and recreational importance, 3-109
  sensitive, 1-11, 1-13, 1-23, 2-2, 2-6, 2-74, 2-78, 2-79, 2-93, 2-95, 2-96, 2-97, 2-98, 2-104, 2-107, 2-116, 2-121, 3-6, 3-46, 3-74, 3-75, 3-76, 3-88, 3-92, 3-108, 3-110, 3-115, 3-119, 3-126, 3-138, 3-144, 3-146, 3-148, 3-149, 3-153, 3-344, 4-29, 4-49, 4-51, 4-52, 4-53, 4-54, 4-58, 4-60, 4-63, 4-67, 4-68, 4-79, 4-80, 4-84, 4-100, 4-101, 4-103, 4-108, 4-109, 4-110, 4-111, 4-120, 4-121, 4-137, 4-146, 4-151, 4-180, 4-192, 4-194, 4-196, 4-197, 4-199, 4-238, 4-259, 4-264, 4-321, 4-322, 4-327, 4-328, 4-332, 4-334, 4-335, 4-338, 4-355, 5-10, 5-15, 5-16, 5-17, 5-18
  special status, 1-23, 1-26, 2-4, 2-5, 2-10, 2-120, 3-1, 3-73, 3-74, 3-75, 3-85, 3-88, 3-89, 3-111, 3-112, 3-114, 3-115, 3-118, 3-119, 3-134, 3-202, 3-287, 4-2, 4-63, 4-64, 4-67, 4-68, 4-69, 4-72, 4-73, 4-76, 4-77, 4-95, 4-101, 4-104, 4-108, 4-110, 4-111, 4-112, 4-113, 4-114, 4-115, 4-116, 4-126, 4-268, 4-325, 4-359
species of greatest conservation need, *see* SGCN, 3-109
SRMA (special recreation management area, *see* also recreation area), 3-200, 3-209, 3-210, 3-212, 3-214, 3-215, 3-243, 3-244, 3-286, 3-288, 3-295, 3-296, 4-155, 4-158, 4-161, 4-163, 4-175, 4-176, 4-225
  Hot Dunes Recreation Area – SRMA, 3-224
  Johnson Hill SRMA, 2-113, 3-209, 3-211, 3-212, 3-213, 3-214, 3-215, 3-216, 3-269, 3-288, 3-295, 4-155, 4-158, 4-161, 4-163, 4-202, 4-226
  Quebradas Back Country Byway SRMA, 2-113, 3-209, 3-212, 3-214, 3-215, 3-218, 3-219, 3-288, 3-291, 3-292, 3-295, 3-296, 4-156, 4-162, 4-167, 4-202
  Socorro Nature Area, 3-144, 3-288, 3-295
  The Box, 3-209, 3-210, 3-212, 3-214, 3-215, 3-288, 3-295, 4-155, 4-161
SRP (Salt River Project), 1-2, 2-63, 3-259
SSURGO (Soil Survey Geographic), 3-23, 3-31, 4-29
State Historic Preservation Officer, *see* SHPO, 1-28, 3-146, 3-151, 5-8, 5-17
State Soil Geographic, *see* STATSGO, 3-23
STATSGO (State Soil Geographic), 3-23
subsidence, 3-27, 3-28, 4-24, 4-31, 4-37, 4-312, 4-320
SVP (Society of Vertebrate Paleontology), 3-47, 3-48

SWAT (Southwest Area Transmission), 1-8
Tertiary, 3-25, 3-26, 3-50, 3-51, 4-52
The Nature Conservancy, *see* TNC, 2-31, 2-34, 5-4, 5-9
threatened and endangered, 1-27, 2-6, 2-98, 2-118, 3-67, 3-76, 3-83, 3-107, 3-286, 5-10, 5-19
TNC (The Nature Conservancy), 2-34, 3-88, 3-105, 3-107, 3-112, 3-113, 3-114, 3-127, 3-132, 3-134, 3-242, 3-251, 4-91, 5-8
transfer capability, 1-5, 1-6, 1-7, 1-8, 1-9, 2-36, 2-40, 2-41, 2-42, 2-43, 2-44, 2-45, 2-46, 2-47, 4-297, 4-303, 4-318, 4-334, 5-14, 5-15
transportation, 1-18, 2-4, 2-73, 2-129, 3-33, 3-150, 3-175, 3-180, 3-184, 3-185, 3-188, 3-189, 3-190, 3-191, 3-192, 3-208, 3-211, 3-216, 3-217, 3-222, 3-223, 3-225, 3-227, 3-229, 3-231, 3-234, 3-243, 3-244, 3-249, 3-250, 3-253, 3-256, 3-260, 3-272, 3-273, 3-274, 3-309, 3-310, 3-311, 3-329, 3-330, 3-331, 3-341, 4-208, 4-275, 4-282, 4-319, 4-332, 4-333, 4-337, 4-342, 4-343, 4-344, 4-346, 4-347, 4-350, 4-359
U.S. Army Corps of Engineers, *see* USACE, 1-1, 5-4, 5-5, 5-8, 5-22
U.S. Department of Agriculture, *see* USDA, 3-23, 3-83, 3-253
U.S. Environmental Protection Agency, *see* EPA, 1-11
U.S. Fish and Wildlife Service, *see* USFWS, 1-1, 3-253, 3-328, 5-4, 5-5, 5-6, 5-22
U.S. Forest Service, *see* USFS, 1-14, 3-92, 3-108, 3-245, 3-246, 3-253, 4-340, 5-8
U.S. Geological Survey, *see* USGS, 3-22
Union Pacific Railroad, *see* UPRR, 2-25, 4-280
United States Code (USC), 1-1
UPRR (Union Pacific Railroad), 2-25, 2-34, 2-35, 3-116, 3-117, 3-244, 3-273, 4-97, 4-98, 4-332
USACE (U.S. Army Corps of Engineers), 1-1, 1-12, 1-20, 1-25, 1-26, 2-88, 3-59, 3-153, 3-248, 3-255, 4-55, 4-56, 5-10
USDA (U.S. Department of Agriculture), 3-23, 3-31, 3-74, 3-83, 3-85, 3-107, 3-249, 3-255, 3-311, 4-340
USFS (U.S. Forest Service), 1-14, 1-15, 2-6, 3-23, 3-58, 3-74, 3-108, 3-112, 3-117, 3-137, 3-246, 3-251, 3-286, 3-300, 3-311, 3-312, 4-91, 4-150
USFWS (U.S. Fish and Wildlife Service), 1-1, 1-12, 1-14, 1-15, 1-23, 1-26, 2-48, 2-88, 2-89, 2-93, 2-102, 2-113, 2-118, 3-58, 3-73, 3-74, 3-75, 3-88, 3-92, 3-94, 3-95, 3-97, 3-99, 3-100, 3-101, 3-102, 3-104, 3-105, 3-106, 3-107, 3-108, 3-109, 3-110, 3-112, 3-117, 3-119, 3-248, 3-249, 3-255, 3-288, 3-290, 3-300, 3-311, 3-312, 3-327, 4-68, 4-76, 4-79, 4-80, 4-82, 4-84, 4-85, 4-88, 4-89, 4-91, 4-267, 4-323, 4-327, 5-10, 5-16
USGS (U.S. Geological Survey), 3-22, 3-27, 3-28, 3-33, 3-45, 3-58, 3-61, 3-65, 3-66, 3-67, 3-73, 3-113, 3-257, 4-25
utility corridors
  designated, 2-23, 2-24, 2-25, 2-26, 2-27, 2-99, 2-107, 2-112, 2-115, 2-117, 3-244, 3-279, 3-280, 3-281, 4-149, 4-221, 4-287, 5-15
viewing locations, 3-199, 3-200, 3-201, 3-209, 3-211, 3-214, 3-215, 3-217, 3-218, 3-220, 3-221, 3-222, 3-224, 3-225, 3-227, 3-229, 3-231, 3-234, 3-236, 3-237, 3-238, 3-239, 3-240, 3-241, 4-148, 4-149, 4-150, 4-151, 4-152, 4-153, 4-154, 4-160, 4-164, 4-166, 4-168, 4-170, 4-171, 4-174, 4-176, 4-177, 4-180, 4-181, 4-184, 4-186, 4-189, 4-191, 4-193, 4-197, 4-201, 4-270, 4-336, 4-337, 4-338
visual resource inventory, *see* VRI, 3-199, 3-202, 3-203, 4-151, 4-205

visual resource management, *see* VRM, 1-21, 3-202, 3-203, 3-204, 4-152, 4-157, 4-173, 4-185, 4-205, 5-19, 5-20, 5-21
VRI (visual resource inventory), 3-200, 3-202, 3-203, 3-204, 3-210, 3-213, 3-215, 3-216, 3-220, 3-221, 3-223, 3-224, 3-226, 3-228, 3-229, 3-230, 3-232, 3-233, 3-238, 3-239, 3-240, 3-241, 4-151, 4-205
VRM (visual resource management), 1-21, 2-6, 2-101, 2-103, 2-104, 2-112, 2-115, 2-117, 2-129, 2-130, 3-149, 3-199, 3-200, 3-201, 3-202, 3-203, 3-204, 3-211, 3-213, 3-216, 3-220, 3-221, 3-222, 3-223, 3-224, 3-226, 3-229, 3-230, 3-233, 3-239, 3-240, 3-241, 3-242, 3-261, 3-262, 4-148, 4-149, 4-150, 4-151, 4-152, 4-153, 4-157, 4-158, 4-162, 4-163, 4-164, 4-165, 4-169, 4-173, 4-174, 4-175, 4-177, 4-178, 4-179, 4-180, 4-183, 4-187, 4-190, 4-194, 4-201, 4-202, 4-203, 4-205, 4-220, 4-353, 4-356, 4-357, 4-358
water erosion, 3-31, 3-34, 3-35, 3-36, 3-37, 3-39, 3-40, 3-41, 3-42, 3-43, 3-44, 4-29, 4-34, 4-37, 4-38, 4-41, 4-42, 4-43, 4-45, 4-46, 4-47, 4-64, 4-265, 4-333
Water Quality Control Commission, *see* WQCC, 3-60, 3-75
watershed, 1-11, 3-60, 3-61, 3-62, 3-63, 3-65, 3-68, 3-87, 3-103, 3-104, 3-105, 3-127, 3-128, 3-287, 3-288, 4-86, 4-88, 4-319, 4-320, 4-325, 4-326, 5-9
weeds
  invasive, 1-17, 3-73, 3-76, 3-83, 3-99, 3-140, 3-142, 3-144, 3-249, 3-255, 4-55, 4-64, 4-66, 4-72, 4-73, 4-75, 4-76, 4-89, 4-91, 4-96, 4-99, 4-105, 4-118, 4-119, 4-266, 4-322, 4-326, 4-340, 4-341, 5-16, 5-17, 5-18
  noxious, 1-10, 1-17, 2-87, 2-89, 2-93, 2-95, 3-75, 3-83, 3-85, 3-249, 4-69, 4-72, 4-73, 4-74, 4-81, 4-83, 4-85, 4-89, 4-91, 4-92, 4-93, 4-96, 4-145, 4-322, 5-17
WEG (wind erodibility group), 3-31, 4-29
Western Governors' Association, *see* WGA, 1-8, 4-299
Western Regional Climate Center, *see* WRCC, 3-3
WGA (Western Governors' Association), 1-8, 2-41, 3-9, 3-11, 4-299, 4-300
White Sands Missile Range, *see* WSMR, 1-1, 1-11, 3-253, 4-286, 5-4, 5-5, 5-6, 5-22
wilderness, 1-11, 2-4, 2-105, 3-2, 3-6, 3-112, 3-169, 3-207, 3-250, 3-286, 3-290, 3-299, 3-300, 3-301, 3-302, 3-303, 3-305, 3-306, 3-322, 4-178, 4-225, 4-227, 4-228, 4-229, 4-230, 4-231, 4-233, 4-234, 4-235, 4-236, 4-273, 4-345, 4-346, 4-347, 4-359, 5-18
wilderness area
  Aravaipa Canyon Wilderness, 3-228, 3-230, 3-303, 4-182, 4-230
  Chupadera Wilderness, 3-209, 3-212, 3-214, 3-218, 4-156, 4-161, 4-167
  Galiuro Wilderness, 1-10, 1-11, 2-106, 2-120, 3-8, 3-26, 3-40, 3-52, 3-62, 3-65, 3-73, 3-78, 3-81, 3-88, 3-98, 3-99, 3-101, 3-103, 3-104, 3-112, 3-115, 3-116, 3-127, 3-130, 3-142, 3-200, 3-207, 3-208, 3-227, 3-231, 3-233, 3-235, 3-251, 3-300, 3-303, 4-41, 4-42, 4-82, 4-97, 4-109, 4-180, 4-230
  Indian Well Wilderness, 3-209, 3-212, 3-214, 4-156, 4-161
  Peloncillo Mountains Wilderness, 2-108, 3-222, 3-302, 3-303, 4-175, 4-176, 4-178, 4-236
  Redfield Canyon Wilderness, 2-119, 3-235, 3-303, 4-189, 4-230
  Rincon Mountain Wilderness, 3-144, 3-237, 3-239, 3-241, 3-251, 3-303, 4-83, 4-199, 4-230, 4-231
  Santa Teresa Wilderness, 3-228, 3-230, 3-303, 4-182, 4-230

Wilderness Study Area, *see* WSA, 2-5, 2-31, 3-2, 3-299, 3-300, 3-304, 4-225, 4-227, 4-231, 4-274, 4-345, 4-359
wildlife linkages, 3-115, 4-96
wildlife management area, *see* WMA, 3-111, 4-92
wildlife refuges, *see* NWR
  Bosque del Apache National Wildlife Refuge, 1-10, 2-9, 2-113, 3-110, 4-91
  Sevilleta National Wildlife Refuge, 2-113, 3-110, 4-91
wildlife species of concern, *see* WSC, 3-109
wind erodibility group, *see* WEG, 3-31, 4-29
wind erosion, 3-30, 3-31, 3-34, 3-35, 3-36, 3-37, 3-38, 3-39, 3-40, 3-41, 3-42, 3-43, 3-44, 4-29, 4-30, 4-35, 4-36, 4-38, 4-39, 4-40, 4-41, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-265, 4-355
WMA (wildlife management area), 3-111, 3-127, 4-91, 4-92
WQCC (Water Quality Control Commission), 3-75
WRCC (Western Regional Climate Center), 3-3, 3-7, 3-8, 3-10, 3-21, 3-78
WSA (Wilderness Study Area), 2-31, 2-33, 3-209, 3-211, 3-212, 3-213, 3-214, 3-215, 3-216, 3-218, 3-243, 3-300, 3-304, 4-156, 4-158, 4-161, 4-163, 4-227, 4-228, 4-231, 4-232, 4-233, 4-345, 4-346, 4-347
  Peloncillo Mountains WSA, 3-222, 3-304, 3-305, 4-233, 4-236
  Presilla WSA, 3-304, 4-232, 4-236
  Sierra de las Canas WSA, 3-218, 3-304
  Stallion WSA, 2-113, 3-209, 3-211, 3-212, 3-213, 3-214, 3-216, 3-218, 3-301, 3-304, 3-305, 4-154, 4-155, 4-159, 4-161, 4-167, 4-202, 4-231, 4-232, 4-233, 4-236
  Veranito WSA, 2-113, 3-144, 3-209, 3-212, 3-214, 3-216, 3-304, 4-155, 4-158, 4-161, 4-163, 4-202, 4-232, 4-236
WSC (wildlife species of concern), 3-89, 3-90, 3-91, 3-92, 3-109
WSMR (White Sands Missile Range), 1-1, 1-10, 1-12, 1-15, 1-20, 2-9, 2-10, 2-24, 2-28, 2-31, 2-32, 2-33, 2-89, 2-102, 2-107, 2-113, 3-31, 3-62, 3-106, 3-117, 3-178, 3-209, 3-210, 3-212, 3-213, 3-214, 3-215, 3-216, 3-217, 3-244, 3-250, 3-256, 3-257, 3-258, 3-261, 3-266, 3-267, 3-277, 3-278, 3-304, 4-156, 4-158, 4-162, 4-163, 4-169, 4-202, 4-221, 4-222, 4-223, 4-224, 4-286, 4-340, 5-3, 5-10, 5-15
xeroriparian scrubland, 3-82, 3-117, 4-72