United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

TAKE PRIDE IN AMERICA

July 2012

In Reply Refer To:
1610 (300)

Dear Reader:

Attached is the Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States (Arizona, California, Colorado, Nevada, New Mexico, and Utah) (FES 12-24; DOE/EIS-0403). This document was prepared by the Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE) as co-lead agencies (Agencies). The BLM and DOE prepared this document in consultation with cooperating agencies and in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality, DOE, and Department of the Interior regulations implementing NEPA (40 CFR Parts 1500–1508, 10 CFR Part 1021, 43 CFR Part 46); and the Federal Land Policy and Management Act of 1976, as amended.

On December 17, 2010, the Agencies published a Notice of Availability (NOA) for the Draft Programmatic EIS for Solar Energy Development in Six Southwestern States. Public comments were accepted through May 2, 2011. More than 80,500 comments were received. The public, as well as many cooperating agencies, offered suggestions on how the Agencies could increase the utility of the document, strengthen the proposed BLM Solar Energy Program, and increase certainty regarding solar energy development on BLM-administered lands.

On October 28, 2011, the Agencies published a Supplement to the Draft PEIS for Solar Energy Development in Six Southwestern States. Public comments were accepted through January 27, 2012. Approximately 131,000 comments were received. The BLM and DOE considered all comments received on both the Draft PEIS and the Supplement to the Draft PEIS, and the Final PEIS reflects that consideration. Volume 7 of this Final Solar PEIS presents summaries of comments received on the Draft PEIS and the Supplement to the Draft PEIS, and responses to those comments prepared by the BLM and DOE.

Through the Final PEIS, the BLM is evaluating actions that will facilitate utility-scale solar energy development on public lands. Multiple Federal orders and mandates establish requirements for the Department of the Interior related to renewable energy development. Through the PEIS, the BLM is considering replacing certain elements of its existing solar energy policies with a comprehensive Solar Energy Program that would allow the permitting of future solar energy development projects on public lands to proceed in a more efficient, standardized, and environmentally responsible manner.

DOE is considering actions to develop new guidance that will further facilitate utility-scale solar energy development and maximize the mitigation of associated environmental impacts. DOE would consider this guidance, including recommended environmental practices and mitigation measures, in its investment and deployment strategies and in its decision-making processes. This guidance would provide DOE with a tool for making more informed, environmentally sound decisions on DOE-supported solar projects.

The Agencies have decided to prepare a condensed Final PEIS in order to reduce the length of the document and facilitate an efficient review by Cooperating Agencies and the public. Several key sections of the Draft PEIS have been revised extensively and are presented in full in this Final PEIS (Chapters 1, 2, 6, 7, 15, and 16, and Appendices A, B, C, and J). Other sections of this Final PEIS are presented as updates to the Draft PEIS (Chapters 3 through 5, 8 through 14, Appendices D through I, and Appendices K through N). There is one new appendix (Appendix O), and a separate volume for responses to comments. The Draft PEIS is being distributed electronically with the Final PEIS to provide the complete set of analyses.

Publication of a Notice of Availability (NOA) of a Final PEIS does not trigger a formal public comment period. An agency (the BLM or DOE for this EIS), however, may choose to review any comments submitted following the publication of a NOA of a Final EIS and use them to inform the agency's Record of Decision (ROD). Those individuals wishing to submit comments are asked to do so through the Solar PEIS project Web site (http://solareis.anl.gov). Individuals should note that the BLM and DOE will consider such comments only to the extent practicable and will not respond to comments individually.

On the basis of the analyses presented in this Final PEIS, the BLM anticipates amending land use plans in the six-state study area to adopt those elements of the new Solar Energy Program that pertain to land use planning. Pursuant to the BLM's land use planning regulations at 43 CFR 1610.5-2, any person who participated in the land use planning process for the Solar PEIS and has an interest that is or may be adversely affected by the land use planning decisions may protest the proposed planning decisions contained in the Final PEIS. The regulations specify the required elements of your protest. A protest may raise only those issues that were submitted for the record during the land use planning process. The protest must be in writing and must be filed with the BLM Director. The protest must be filed within 30 days of the date the U.S. Environmental Protection Agency publishes its NOA of the Final PEIS in the *Federal Register*.

A protest must 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 land use plan or amendment being protested;
(iv) A copy of all documents addressing the issue or issues that were submitted during the land use 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 decision is believed to be wrong.

Take care to document all relevant facts. As much as possible, reference or cite the PEIS or available land use planning records (e.g., meeting minutes or summaries, correspondence). Valid protest issues are limited to allegations that finalizing the proposed land use plan amendment would violate an applicable statute, regulation, or BLM policy. Statements that merely reflect disagreement, express opinions, or make demands or allegations without the support of a concise statement as to why the BLM's decision is wrong will be treated as comments rather than as valid protest issues.

E-mailed 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 e-mailed 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 e-mailed protests to bhudgens@blm.gov.

All protests, including the follow-up letter to e-mails 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

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

Before including your address, phone number, e-mail address, or other personal identifying information in your protest, be advised that your entire protest—including your personal identifying information—may be made publicly available at any time. While you can ask us in your protest to withhold from public review your personal identifying information, we cannot guarantee that we will be able to do so.

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 will be the final decision of the Department of the Interior. Responses to protest issues will be compiled and formalized in a Director's Protest Resolution Report that will be available publicly.

Upon the BLM's review of comments, to the extent practicable, and its resolution of any protests, the BLM will issue a ROD approving the land use plan amendments. The ROD and approved land use plan amendments will be available electronically to all who participated in the PEIS process and will be available to all parties through the "Planning" page on the BLM national Web site (http://www.blm.gov/planning) or by mail upon request.

Requests for additional information about this PEIS, including requests for copies of the document, should be directed to: Shannon Stewart, BLM Washington Office, e-mail: scstewar@blm.gov, phone: (202) 912-7219; or Jane Summerson, DOE Solar PEIS Document

Manager, e-mail: jane.summerson@ee.doe.gov, phone: (202) 287-6188. You may also visit the Solar PEIS Web site at http://solareis.anl.gov. The Final PEIS is available on the project Web site (http://solareis.anl.gov) and on the DOE NEPA Web site (http://energy.gov/nepa). Copies of the Final PEIS are also for public inspection in reading rooms at BLM state, district, and field offices in the six-state study area.

For general information about the DOE NEPA process, please contact: Ms. Carol Borgstrom, Director, Office of NEPA Policy and Compliance (GC-54), U.S. Department of Energy, 1000 Independence Avenue SW, Washington, D.C. 20585, telephone (202) 586-4600, or leave a message at 1-800-472-2756.

Thank you for your continued interest in the PEIS for Solar Energy Development in Six Southwestern States.

Sincerely,

for Michael D. Nedd
Assistant Director
Minerals and Realty Management

FES 12-24 • DOE/EIS-0403

Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States

Volume 1
Executive Summary
Chapters 1–7, 14–16

July 2012

Bureau of Land Management
U.S. Department of Energy

Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States (FES 12-24; DOE/EIS-0403)

Responsible Agencies: The U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE) are co-lead agencies. Nineteen cooperating agencies participated in the preparation of this PEIS: U.S. Department of Defense; U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service; U.S. National Park Service; U.S. Environmental Protection Agency, Region 9; U.S. Army Corps of Engineers, South Pacific Division; Arizona Game and Fish Department; California Energy Commission; California Public Utilities Commission; Nevada Department of Wildlife; N-4 Grazing Board, Nevada; Utah Public Lands Policy Coordination Office; Clark County, Nevada, including Clark County Department of Aviation; Doña Ana County, New Mexico; Esmeralda County, Nevada; Eureka County, Nevada; Lincoln County, Nevada; Nye County, Nevada; and Saguache County, Colorado.

Locations: Arizona, California, Colorado, Nevada, New Mexico, and Utah.

Contacts: *For further information about this PEIS, contact:* Shannon Stewart, BLM Washington Office, e-mail: shannon_stewart@blm.gov, phone: (202) 912-7219; or Jane Summerson, DOE Solar PEIS Document Manager, e-mail: jane.summerson@ee.doe.gov, phone: (202) 287-6188; or visit the PEIS Web site at http://solareis.anl.gov.

Abstract: The BLM and DOE have jointly prepared this PEIS to evaluate actions that the agencies are considering taking to further facilitate utility-scale solar energy development in six southwestern states.[1] For the BLM, this includes the evaluation of a new Solar Energy Program applicable to solar development on BLM-administered lands. For DOE, it includes the evaluation of developing new guidance to further facilitate utility-scale solar energy development and maximize the mitigation of associated potential environmental impacts. This Solar PEIS evaluates the potential environmental, social, and economic effects of the agencies' proposed actions and alternatives in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's regulations for implementing NEPA (Title 40, Parts 1500–1508 of the *Code of Federal Regulations* [40 CFR Parts 1500–1508]), and applicable BLM and DOE authorities.

For the BLM, the Final Solar PEIS analyzes a no action alternative, under which solar energy development would continue on BLM-administered lands in accordance with the terms and conditions of the BLM's existing solar energy policies, and two action alternatives that involve implementing a new BLM Solar Energy Program that would allow the permitting of future solar energy development projects on public lands to proceed in a more efficient, standardized, and environmentally responsible manner. The proposed program would establish right-of-way authorization policies and design features applicable to all utility-scale solar energy development on BLM-administered lands. It would identify categories of lands to be excluded from utility-scale solar energy development and specific locations well suited for utility-scale production of solar energy where the BLM would prioritize development (i.e., solar energy zones or SEZs). The proposed action would also allow for responsible utility-scale solar development on lands outside of priority areas.

1 Utility-scale facilities are defined as projects that generate electricity that is delivered into the electricity transmission grid, generally with capacities greater than 20 megawatts (MW).

For DOE, the Final PEIS analyzes a no action alternative, under which DOE would continue to address environmental concerns for DOE-supported solar projects on a case-by-case basis, and an action alternative, under which DOE would adopt programmatic environmental guidance for use in DOE-supported solar projects.

The BLM and DOE initiated the Solar PEIS process in May 2008. On December 17, 2010, the BLM and DOE published the Draft Solar PEIS. Subsequently, on October 28, 2011, the lead agencies published the Supplement to the Draft Solar PEIS, in which adjustments were made to elements of BLM's proposed Solar Energy Program to better meet BLM's solar energy objectives, and in which DOE's proposed programmatic environmental guidance was presented.

SOLAR PEIS CONTENTS

SOLAR PEIS CONTENTS (Cont.)

VOLUME 6

VOLUME 7

VOLUME 1 CONTENTS

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

FIGURES

FIGURES (Cont.)

TABLES

TABLES (Cont.)

TABLES (Cont.)

This page intentionally left blank.

NOTATION

The following is a list of acronyms and abbreviations, chemical names, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

GENERAL ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	alternating current
ACC	air-cooled condenser
ACEC	Area of Critical Environmental Concern
ADEQ	Arizona Department of Environmental Quality
ACHP	Advisory Council on Historic Preservation
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
AERMOD	AMS/EPA Regulatory Model
AFC	Application for Certification
AGL	above ground level
AIM	Assessment, Inventory and Monitoring
AIRFA	American Indian Religious Freedom Act
AMA	active management area
AML	animal management level
ANHP	Arizona National Heritage Program
APE	area of potential effect
APLIC	Avian Power Line Interaction Committee
APP	Avian Protection Plan
APS	Arizona Public Service
AQCR	Air Quality Control Region
AQRV	air quality–related value
ARB	Air Resources Board
ARRA	American Recovery and Reinvestment Act of 2009
ARRTIS	Arizona Renewable Resource and Transmission Identification Subcommittee
ARS	Agricultural Research Service
ARZC	Arizona and California
ATSDR	Agency for Toxic Substances and Disease Registry
AUM	animal unit month
AVSE	Arlington Valley Solar Energy
AVWS	Audio Visual Warning System
AWBA	Arizona Water Banking Authority
AWEA	American Wind Energy Association
AWRM	Active Water Resource Management
AZDA	Arizona Department of Agriculture
AZGFD	Arizona Game and Fish Department

AZGS	Arizona Geological Survey
BA	biological assessment
BAP	base annual production
BEA	Bureau of Economic Analysis
BISON-M	Biota Information System of New Mexico
BLM	Bureau of Land Management
BLM-CA	Bureau of Land Management, California
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BO	biological opinion
BOR	U.S. Bureau of Reclamation
BPA	Bonneville Power Administration
BRAC	Blue Ribbon Advisory Council on Climate Change
BSE	Beacon Solar Energy
BSEP	Beacon Solar Energy Project
BTS	Bureau of Transportation Statistics
CAA	Clean Air Act
CAAQS	California Air Quality Standards
CAISO	California Independent System Operator
Caltrans	California Department of Transportation
C-AMA	California-Arizona Maneuver Area
CAP	Central Arizona Project
CARB	California Air Resources Board
CAReGAP	California Regional Gap Analysis Project
CASQA	California Stormwater Quality Association
CASTNET	Clean Air Status and Trends NETwork
CAWA	Colorado Agricultural Water Alliance
CCC	Civilian Conservation Corps
CDC	Centers for Disease Control and Prevention
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CDNCA	California Desert National Conservation Area
CDOT	Colorado Department of Transportation
CDOW	Colorado Division of Wildlife (now Colorado Parks and Wildlife)
CDPHE	Colorado Department of Public Health and Environment
CDWR	California Department of Water Resources
CEC	California Energy Commission
CEQ	Council on Environmental Quality
CES	constant elasticity of substitution
CESA	California Endangered Species Act
CESF	Carrizo Energy Solar Farm
CFR	*Code of Federal Regulations*
CGE	computable general equilibrium
CHAT	crucial habitat assessment tool

CIRA	Cooperative Institute for Research in the Atmosphere
CLFR	compact linear Fresnel reflector
CNDDB	California Natural Diversity Database
CNEL	community noise equivalent level
CNHP	Colorado National Heritage Program
Colorado DWR	Colorado Division of Water Resources
CO_2e	carbon dioxide equivalent
CPC	Center for Plant Conservation
CPUC	California Public Utilities Commission
CPV	concentrating photovoltaic
CRBSCF	Colorado River Basin Salinity Control Forum
CREZ	competitive renewable energy zone
CRPC	Cultural Resources Preservation Council
CRSCP	Colorado River Salinity Control Program
CSA	Candidate Study Area
CSC	Coastal Services Center
CSFG	carbon-sequestration fossil generation
CSP	concentrating solar power
CSQA	California Stormwater Quality Association
CSRI	Cultural Systems Research, Incorporated
CTG	combustion turbine generator
CTPG	California Transmission Planning Group
CTSR	Cumbres & Toltec Scenic Railroad
CUP	Conditional Use Permit
CVP	Central Valley Project
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWHRS	California Wildlife Habitat Relationship System

DC	direct current
DEM	digital elevation model
DHS	U.S. Department of Homeland Security
DIMA	Database for Inventory, Monitoring and Assessment
DLT	dedicated-line transmission
DNA	Determination of NEPA Adequacy
DNI	direct normal insulation
DNL	day-night average sound level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DRECP	California Desert Renewable Energy Conservation Plan
DSM	demand-side management
DSRP	Decommissioning and Site Reclamation Plan
DTC/C-AMA	Desert Training Center/California–Arizona Maneuver Area

DWMA	Desert Wildlife Management Area
DWR	Division of Water Resources
EA	environmental assessment
EBID	Elephant Butte Irrigation District
ECAR	East Central Area Reliability Coordination Agreement
ECOS	Environmental Conservation Online System (USFWS)
EERE	Energy Efficiency and Renewable Energy (DOE)
Eg	band gap energy
EIA	Energy Information Administration (DOE)
EIS	environmental impact statement
EISA	Energy Independence and Security Act of 2007
EMF	electromagnetic field
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EQIP	Environmental Quality Incentives Program
ERCOT	Electric Reliability Council of Texas
ERO	Electric Reliability Organization
ERS	Economic Research Service
ESA	Endangered Species Act of 1973
ESRI	Environmental Systems Research Institute
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FRCC	Florida Reliability Coordinating Council
FSA	Final Staff Assessment
FTE	full-time equivalent
FY	fiscal year
G&TM	generation and transmission modeling
GCRP	U.S. Global Climate Research Program
GDA	generation development area
GHG	greenhouse gas
GIS	geographic information system
GMU	game management unit
GPS	global positioning system
GTM	Generation and Transmission Model

GUAC	Groundwater Users Advisory Council
GWP	global warming potential
HA	herd area
HAP	hazardous air pollutant
HAZCOM	hazard communication
HCE	heat collection element
HCP	Habitat Conservation Plan
HMA	herd management area
HMMH	Harris Miller Miller & Hanson, Inc.
HRSG	heat recovery steam generator
HSPD	Homeland Security Presidential Directive
HTF	heat transfer fluid
HUC	hydrologic unit code
HVAC	heating, ventilation, and air-conditioning
I	Interstate
IARC	International Agency for Research on Cancer
IBA	important bird area
ICE	internal combustion engine
ICPDS	Imperial County Planning & Development Services
ICWMA	Imperial County Weed Management Area
IDT	interdisplinary team
IEC	International Electrochemical Commission
IFR	instrument flight rule
IID	Imperial Irrigation District
IM	Instruction Memorandum
IMPS	Iron Mountain Pumping Station
IMS	interim mitigation strategy
INA	Irrigation Non-Expansion Area
IOP	Interagency Operating Procedure
IOU	investor-owned utility
IPCC	Intergovernmental Panel on Climate Change
ISA	Independent Science Advisor; Instant Study Area
ISB	Intermontane Seismic Belt
ISCC	integrated solar combined cycle
ISDRA	Imperial Sand Dunes Recreation Area
ISEGS	Ivanpah Solar Energy Generating System
ISO	independent system operator; iterative self-organizing
ITFR	Interim Temporary Final Rulemaking
ITP	incidental take permit
IUCNNR	International Union for Conservation of Nature and Natural Resources
IUCNP	International Union for Conservation of Nature Pakistan
KGA	known geothermal resources area
KML	keyhole markup language

KOP	key observation point
KSLA	known sodium leasing area
LCC	Landscape Conservation Cooperative
LCCRDA	Lincoln County Conservation, Recreation, and Development Act of 2004
LCOE	levelized cost of energy
L_{dn}	day-night average sound level
LDWMA	Low Desert Weed Management Area
L_{eq}	equivalent sound pressure level
LiDAR	light detection and ranging
LLA	limited land available
LLRW	low-level radioactive waste (waste classification)
LPN	listing priority number
LRG	Lower Rio Grande
LSA	lake and streambed alteration
LSE	load-serving entity
LTMP	long-term monitoring and adaptive management plan
LTVA	long-term visitor area
MAAC	Mid-Atlantic Area Council
MAIN	Mid-Atlantic Interconnected Network
MAPP	methyl acetylene propadiene stabilizer; Mid-Continent Area Power Pool
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MEB	Marine Expeditionary Brigade
MFP	Management Framework Plan
MIG	Minnesota IMPLAN Group
MLA	maximum land available
MOA	military operating area
MOU	Memorandum of Understanding
MPDS	maximum potential development scenario
MRA	Multiple Resource Area
MRI	Midwest Research Institute
MRO	Midwest Reliability Organization
MSDS	Material Safety Data Sheet
MSL	mean sea level
MTR	military training route
MVEDA	Mesilla Valley Economic Development Alliance
MWA	Mojave Water Agency
MWD	Metropolitan Water District
MWMA	Mojave Weed Management Area
NAAQS	National Ambient Air Quality Standard(s)
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission (California)

NAIC	North American Industrial Classification System
NASA	National Aeronautics and Space Administration
NCA	National Conservation Area
NCCAC	Nevada Climate Change Advisory Committee
NCDC	National Climatic Data Center
NCES	National Center for Education Statistics
NDAA	National Defense Authorization Act
NDCNR	Nevada Department of Conservation and Natural Resources
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation
NDOW	Nevada Department of Wildlife
NDWP	Nevada Division of Water Planning
NDWR	Nevada Division of Water Resources
NEAP	Natural Events Action Plan
NEC	National Electric Code
NED	National Elevation Database
NEP	Natural Events Policy
NEPA	National Environmental Policy Act of 1969
NERC	North American Electricity Reliability Corporation
NGO	non-governmental organization
NHA	National Heritage Area
NHD	National Hydrography Dataset
NHNM	National Heritage New Mexico
NHPA	National Historic Preservation Act of 1966
NID	National Inventory of Dams
NLCS	National Landscape Conservation System
NMAC	*New Mexico Administrative Code*
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMDGF	New Mexico Department of Game and Fish
NM DOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMED-AQB	New Mexico Environment Department-Air Quality Board
NMFS	National Marine Fisheries Service
NMOSE	New Mexico Office of the State Engineer
NMSU	New Mexico State University
NNHP	Nevada Natural Heritage Program
NNL	National Natural Landmark
NNSA	National Nuclear Security Administration
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NP	National Park
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPV	net present value

NRA	National Recreation Area
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	*National Register of Historic Places*
NRS	*Nevada Revised Statutes*
NSC	National Safety Council
NSO	no surface occupancy
NSTC	National Science and Technology Council
NTHP	National Trust for Historic Preservation
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
NVCRS	Nevada Cultural Resources Inventory System
NV DOT	Nevada Department of Transportation
NWCC	National Wind Coordinating Committee
NWI	National Wetlands Inventory
NWIS	National Water Information System (USGS)
NWPP	Northwest Power Pool
NWR	National Wildlife Refuge
NWSRS	National Wild and Scenic River System
O&M	operation and maintenance
ODFW	Oregon Department of Fish and Wildlife
OHV	off-highway vehicle
ONA	Outstanding Natural Area
ORC	organic Rankine cycle
OSE/ISC	Office of the State Engineer/Interstate Stream Commission
OSHA	Occupational Safety and Health Administration
OTA	Office of Technology Assessment
PA	Programmatic Agreement
PAD	Preliminary Application Document
PAH	polycyclic aromatic hydrocarbon
PAT	peer analysis tool
PCB	polychlorinated biphenyl
PCM	purchase change material
PCS	power conditioning system
PCU	power converting unit
PEIS	programmatic environmental impact statement
PFYC	potential fossil yield classification
PGH	Preliminary General Habitat
PIER	Public Interest Energy Research
P.L.	Public Law
PLSS	Public Land Survey System
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter of 2.5 µm or less
PM_{10}	particulate matter with a diameter of 10 µm or less

POD	plan of development
POU	publicly owned utility
PPA	Power Purchase Agreement
P-P-D	population-to-power density
PPE	personal protective equipment
PPH	Preliminary Priority Habitat
PSD	Prevention of Significant Deterioration
PURPA	Public Utility Regulatory Policy Act
PV	photovoltaic
PVID	Palo Verde Irrigation District
PWR	public water reserve
QRA	qualified resource area
R&I	relevance and importance
RAC	Resource Advisory Council
RCE	Reclamation Cost Estimate
RCI	residential, commercial, and industrial (sector)
RCRA	Resource Conservation and Recovery Act of 1976
RD&D	research, development, and demonstration; research, development, and deployment
RDBMS	Relational Database Management System
RDEP	Restoration Design Energy Project
REA	Rapid Ecoregional Assessment
REAT	Renewable Energy Action Team
REDA	Renewable Energy Development Area
REDI	Renewable Energy Development Infrastructure
REEA	Renewable Energy Evaluation Area
ReEDS	Regional Energy Deployment System
REPG	Renewable Energy Policy Group
RETA	Renewable Energy Transmission Authority
RETAAC	Renewable Energy Transmission Access Advisory Committee
RETI	Renewable Energy Transmission Initiative
REZ	renewable energy zone
RF	radio frequency
RFC	Reliability First Corporation
RFDS	reasonably foreseeable development scenario
RGP	Rio Grande Project
RGWCD	Rio Grande Water Conservation District
RMP	Resource Management Plan
RMPA	Rocky Mountain Power Area
RMZ	Resource Management Zone
ROD	Record of Decision
ROI	region of influence
ROS	recreation opportunity spectrum
ROW	right-of-way

RPG	renewable portfolio goal
RPS	Renewable Portfolio Standard
RRC	Regional Reliability Council
RSEP	Rice Solar Energy Project
RSI	Renewable Systems Interconnection
RTO	regional transmission organization
RTTF	Renewable Transmission Task Force
RV	recreational vehicle
SAAQS	State Ambient Air Quality Standard(s)
SAMHSA	Substance Abuse and Mental Health Services Administration
SCADA	supervisory control and data acquisition
SCE	Southern California Edison
SCRMA	Special Cultural Resource Management Area
SDRREG	San Diego Regional Renewable Energy Group
SDWA	Safe Drinking Water Act of 1974
SEGIS	Solar Energy Grid Integration System
SEGS	Solar Energy Generating System
SEI	Sustainable Energy Ireland
SEIA	Solar Energy Industrial Association
SES	Stirling Energy Systems
SETP	Solar Energy Technologies Program (DOE)
SEZ	solar energy zone
SHPO	State Historic Preservation Office(r)
SIP	State Implementation Plan
SLRG	San Luis & Rio Grande
SMA	Special Management Area
SMART	specific, measurable, achievable, relevant, and time sensitive
SMP	suggested management practice
SNWA	Southern Nevada Water Authority
SPP	Southwest Power Pool
SRMA	Special Recreation Management Area
SSA	Socorro Seismic Anomaly
SSI	self-supplied industry
ST	solar thermal
STG	steam turbine generator
SUA	special use airspace
SWAT	Southwest Area Transmission
SWIP	Southwest Intertie Project
SWPPP	Stormwater Pollution Prevention Plan
SWReGAP	Southwest Regional Gap Analysis Project
TAP	toxic air pollutant
TCC	Transmission Corridor Committee
TDS	total dissolved solids
TEPPC	Transmission Expansion Planning Policy Committee

TES	thermal energy storage
TRACE	Transmission Routing and Configuration Estimator
TSA	Transportation Security Administration
TSCA	Toxic Substances Control Act of 1976
TSDF	treatment, storage, and disposal facility
TSP	total suspended particulates
UACD	Utah Association of Conservation Districts
UBWR	Utah Board of Water Resources
UDA	Utah Department of Agriculture
UDEQ	Utah Department of Environmental Quality
UDNR	Utah Department of Natural Resources
UDOT	Utah Department of Transportation
UDWQ	Utah Division of Water Quality
UDWR	Utah Division of Wildlife Resources
UGS	Utah Geological Survey
UNEP	United Nations Environmental Programme
UNPS	Utah Native Plant Society
UP	Union Pacific
UREZ	Utah Renewable Energy Zone
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
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
Utah DWR	Utah Division of Water Rights
UTTR	Utah Test and Training Range
UWS	Underground Water Storage, Savings and Replenishment Act
VACAR	Virginia–Carolinas Subregion
VCRS	Visual Contrast Rating System
VFR	visual flight rule
VOC	volatile organic compound
VRHCRP	Virgin River Habitat Conservation & Recovery Program
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WA	Wilderness Area
WECC	Western Electricity Coordinating Council
WECC CAN	Western Electricity Coordinating Council–Canada
WEG	wind erodibility group
Western	Western Area Power Administration
WGA	Western Governors' Association
WGFD	Wyoming Game and Fish Department

WHA	wildlife habitat area
WHO	World Health Organization
WIA	Wyoming Infrastructure Authority
WRAP	Water Resources Allocation Program; Western Regional Air Partnership
WRCC	Western Regional Climate Center
WREZ	Western Renewable Energy Zones
WRRI	Water Resources Research Institute
WSA	Wilderness Study Area
WSC	wildlife species of special concern
WSMR	White Sands Missile Range
WSR	Wild and Scenic River
WSRA	Wild and Scenic Rivers Act of 1968
WWII	World War II
WWP	Western Watersheds Project
YPG	Yuma Proving Ground
ZITA	zone identification and technical analysis
ZLD	zero liquid discharge

CHEMICALS

CH_4	methane	NO_2	nitrogen dioxide
CO	carbon monoxide	NO_x	nitrogen oxides
CO_2	carbon dioxide		
		O_3	ozone
H_2S	hydrogen sulfide		
Hg	mercury	Pb	lead
N_2O	nitrous oxide	SF_6	sulfur hexafluoride
NH_3	ammonia	SO_2	sulfur dioxide
		SO_x	sulfur oxides

UNITS OF MEASURE

ac-ft	acre-foot (feet)	dBA	A-weighted decibel(s)
bhp	brake horsepower		
		°F	degree(s) Fahrenheit
°C	degree(s) Celsius	ft	foot (feet)
cf	cubic foot (feet)	ft^2	square foot (feet)
cfs	cubic foot (feet) per second	ft^3	cubic foot (feet)
cm	centimeter(s)		
		g	gram(s)
dB	decibel(s)	gal	gallon(s)

GJ	gigajoule(s)
gpcd	gallon per capita per day
gpd	gallon(s) per day
gpm	gallon(s) per minute
GW	gigawatt(s)
GWh	gigawatt hour(s)
GWh/yr	gigawatt hour(s) per year
h	hour(s)
ha	hectare(s)
Hz	hertz
in.	inch(es)
J	joule(s)
K	degree(s) Kelvin
kcal	kilocalorie(s)
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
kPa	kilopascal(s)
kV	kilovolt(s)
kVA	kilovolt-ampere(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
kWp	kilowatt peak
L	liter(s)
lb	pound(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mg	milligram(s)
Mgal	million gallons
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mm	millimeter(s)
MMt	million metric ton(s)
MPa	megapascal(s)
mph	mile(s) per hour
MVA	megavolt-ampere(s)
MW	megawatt(s)
MWe	megawatt(s) electric
MWh	megawatt-hour(s)
ppm	part(s) per million
psi	pound(s) per square inch
psia	pound(s) per square inch absolute
rpm	rotation(s) per minute
s	second(s)
scf	standard cubic foot (feet)
TWh	terawatt hour(s)
VdB	vibration velocity decibel(s)
W	watt(s)
yd^2	square yard(s)
yd^3	cubic yard(s)
yr	year(s)
µg	microgram(s)
µm	micrometer(s)

ENGLISH/METRIC AND METRIC/ENGLISH EQUIVALENTS

The following table lists the appropriate equivalents for English and metric units.

Multiply	By	To Obtain
English/Metric Equivalents		
acres	0.004047	square kilometers (km^2)
acre-feet (ac-ft)	1,234	cubic meters (m^3)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
degrees Fahrenheit (ºF) –32	0.5555	degrees Celsius (ºC)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
miles per hour (mph)	1.609	kilometers per hour (kph)
pounds (lb)	0.4536	kilograms (kg)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.9072	metric tons (t)
square feet (ft^2)	0.09290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
yards (yd)	0.9144	meters (m)
Metric/English Equivalents		
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	0.00081	acre-feet (ac-ft)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (ºC) +17.78	1.8	degrees Fahrenheit (ºF)
hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	short tons (tons)
kilometers (km)	0.6214	miles (mi)
kilometers per hour (kph)	0.6214	miles per hour (mph)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
meters (m)	1.094	yards (yd)
metric tons (t)	1.102	short tons (tons)
square kilometers (km^2)	247.1	acres
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)

EXECUTIVE SUMMARY

ES.1 BACKGROUND

The U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and U.S Department of Energy (DOE) have jointly prepared this programmatic environmental impact statement (PEIS) to evaluate actions that the agencies are considering taking to further facilitate utility-scale solar energy development in six southwestern states (Arizona, California, Colorado, Nevada, New Mexico, and Utah).[1] For the BLM, this includes the evaluation of a new Solar Energy Program applicable to solar development on BLM-administered lands. For DOE, it includes the evaluation of developing new guidance to further facilitate utility-scale solar energy development and maximize the mitigation of associated environmental impacts. This Solar PEIS evaluates the potential environmental, social, and economic effects of the agencies' proposed actions and alternatives in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality's regulations for implementing NEPA (Title 40, Parts 1500–1508 of the *Code of Federal Regulations* [40 CFR Parts 1500–1508]), the DOI and DOE regulations for implementing NEPA (43 CFR Part 46 and 10 CFR Part 1021, respectively), and applicable BLM and DOE authorities.

The BLM and DOE initiated the Solar PEIS process in May 2008. Since that time, the agencies have engaged extensively with their cooperating agencies, key stakeholders, and the general public to obtain input on the scope and objectives of their proposed actions. On the basis of this input, as appropriate, the agencies have incrementally refined their proposed actions, alternatives, and analyses. On December 17, 2010, the BLM and DOE published the *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* (BLM and DOE 2010); the Notice of Availability (NOA) was published in the *Federal Register*, Volume 75, page 78980. During the comment period, the public, as well as many cooperating agencies and key stakeholders, offered suggestions on how the BLM and DOE could increase the utility of the analysis, strengthen elements of the BLM's proposed Solar Energy Program, and increase certainty regarding solar energy development on BLM-administered lands. Subsequently, on October 28, 2011, the lead agencies published the Supplement to the Draft Solar PEIS (BLM and DOE 2011), in which adjustments were made to elements of the proposed Solar Energy Program and to guidance for facilitating utility-scale solar energy development to better meet BLM and DOE's solar energy objectives. The NOA for the Supplement to the Draft Solar PEIS was published in the *Federal Register*, Volume 76, page 66958.

ES.2 BLM PROPOSED ACTION

The BLM proposes to develop a new Solar Energy Program to further support utility-scale solar energy development on BLM-administered lands in the six-state study area. The

[1] Utility-scale facilities are defined as projects that generate electricity that is delivered into the electricity transmission grid, generally with capacities greater than 20 megawatts (MW)

proposed Solar Energy Program would replace certain elements of BLM's existing solar energy policies with a comprehensive program that would allow the permitting of future solar energy development projects on public lands to proceed in a more efficient, standardized, and environmentally responsible manner. The proposed program would establish right-of-way (ROW) authorization policies and design features applicable to utility-scale solar energy development on BLM-administered lands. It would identify categories of lands to be excluded from utility-scale solar energy development and identify specific locations well suited for utility-scale production of solar energy where the BLM would prioritize development (i.e., solar energy zones, or SEZs). The proposed action would also allow for responsible utility-scale solar development on lands outside of priority areas.

ES.2.1 BLM Purpose and Need

The BLM has identified a need to respond in a more efficient and effective manner to the high interest in siting utility-scale solar energy development on public lands and to ensure consistent application of measures to mitigate the potential adverse impacts of such development.

The BLM is therefore considering replacing certain elements of its existing solar energy policies with a comprehensive Solar Energy Program. While the proposed Solar Energy Program will further BLM's ability to meet the mandates of Executive Order (E.O.) 13212,"Actions to Expedite Energy-Related Projects" (*Federal Register,* Volume 66, page 28357, May 22, 2001), and the Energy Policy Act of 2005, it also has been designed to meet the requirements of DOI Secretarial Order 3285SA1 (Secretary of the Interior 2010) related to identifying and prioritizing specific locations best suited for utility-scale solar energy development on public lands (see Section 1.1 of this Final Solar PEIS for a discussion of these and other applicable federal orders and mandates).

The objectives of BLM's proposed Solar Energy Program include the following:

- Facilitate near-term utility-scale solar energy development on public lands;
- Minimize potential negative environmental impacts;
- Minimize social and economic impacts;
- Provide flexibility to the solar industry to consider a variety of solar energy projects (location, facility size, technology, etc.);
- Optimize existing transmission infrastructure and corridors;
- Standardize and streamline the authorization process for utility-scale solar energy development on BLM-administered lands; and
- Meet projected demand for solar energy development.

The elements of BLM's proposed Solar Energy Program include the following:

1. Commitment to process pending applications for utility-scale solar energy development that meet due diligence and siting provisions under existing land use plans and other policies and procedures;

2. Identification of lands to be excluded from utility-scale solar energy development in the six-state study area;

3. Establishment of a process to identify new or expanded SEZs;

4. Identification of priority areas (i.e., SEZs) that are well suited for utility-scale production of solar energy in accordance with the requirements of Secretarial Order 3285A1 and the associated authorization procedures for applications in these areas;

5. Establishment of a process that allows for responsible utility-scale solar energy development outside of SEZs (i.e., variance process);

6. Establishment of design features for solar energy development on public lands to ensure the most environmentally responsible development and delivery of solar energy; and

7. Amendment of BLM land use plans in the six-state study area to adopt those elements of the new Solar Energy Program that pertain to planning.

ES.2.2 BLM Scope of Analysis

The geographic scope of the PEIS for the BLM includes all BLM-administered lands in the six-state study area. The scope of the impact analysis includes an assessment of the potential environmental, social, and economic impacts of utility-scale solar facilities and required transmission connections from these facilities to the existing electricity transmission grid and other associated infrastructure such as roads over an approximately 20-year time frame (i.e., until about 2030).

The scope of this analysis is limited to utility-scale solar energy development. For the purposes of the Solar PEIS and associated decision making, utility-scale solar energy development is defined as any project capable of generating 20 megawatts (MW) or more. As a result, BLM's new Solar Energy Program would apply only to projects of this scale; decisions on projects that are less than 20 MW would continue to be made in accordance with existing land use plan requirements,[2] current applicable policy and procedures, and individual site-specific NEPA analyses. Viable utility-scale solar technologies considered likely to be deployed over the next 20 years and analyzed as part of the Solar PEIS include parabolic trough, power tower, dish engine systems, and photovoltaic (PV) systems.

The Solar PEIS considers the potential direct, indirect, and cumulative effects of establishing broad Solar Energy Program elements and strategies across the six-state study area. This programmatic analysis considers potential environmental effects over a broad geographic and time horizon and, as a result, it is fairly general, focusing on major impacts in a qualitative manner. In addition to the programmatic analysis, the Solar PEIS also provides in-depth data collection and environmental analysis for the proposed SEZs. The primary purpose of this more rigorous SEZ-specific analysis is to provide documentation from which the BLM can tier future project authorizations, thereby limiting the required scope and effort of project-specific NEPA analyses.

ES.2.3 Applications for Solar Energy Development on BLM Lands

As of May 31, 2012, the BLM had approved 11 utility-scale solar projects on public lands and 5 linear ROWs that enabled development of projects on private lands (See Table B-1 of Appendix B of this Final Solar PEIS). As stated in the Supplement to the Draft Solar PEIS and reaffirmed in this Final Solar PEIS, the BLM is committed to continued processing of all pending[3] solar energy applications that meet due diligence and siting requirements under existing land use plans and other policies and procedures that the BLM has adopted or might adopt. Pending applications will *not* be subject to any new program elements adopted by the Solar PEIS ROD. All new[4] applications, however, will be subject to the program elements adopted by the Solar PEIS ROD.

ES.2.4 BLM Alternatives

As discussed in Chapter 2, through this PEIS, the BLM is evaluating three alternatives for managing utility-scale solar energy development on BLM-administered lands in the six-state study area. These alternatives include two action alternatives—a solar energy development program alternative and an SEZ program alternative—and a no action alternative. The solar energy development program alternative is BLM's preferred alternative.

---

[2] Co-generation projects involving a mix of solar energy technologies and other energy technologies (e.g., natural gas, wind, and hydropower) would be subject to the requirements of the new Solar Energy Program if the solar energy component is 20 MW or greater.

[3] The BLM defines "pending" applications as any applications (regardless of place in line) filed within proposed variance and/or exclusion areas before the publication of the Supplement to the Draft Solar PEIS (October 28, 2011), and any applications filed within proposed SEZs before June 30, 2009.

[4] The BLM defines "new" applications as any applications filed within proposed SEZs after June 30, 2009, and any applications filed within proposed variance and/or exclusion areas after the publication of the Supplement to the Draft Solar PEIS (October 28, 2011).

The alternatives are summarized in the following sections. Table ES.2-1 identifies the estimated amount of land that would be available for ROW application under each alternative by state. Figures ES.2-2 through ES.2-7, provided after Section ES.2.4.7, show the approximate locations of those lands proposed for exclusion, lands available for solar ROW applications, and priority SEZs.

ES.2.4.1 Program Elements Common to Both BLM Action Alternatives

Under BLM's proposed action alternatives, the Solar Energy Program would include comprehensive ROW authorization policies; requirements for monitoring, adaptive management and mitigation, and programmatic design features that would avoid, minimize, and/or mitigate the potential adverse effects of solar energy development. These elements, which are summarized below, are described in detail in Section 2.2.1 of this Final Solar PEIS.

ES.2.4.1.1 ROW Authorization Policies

The BLM proposes a number of ROW authorization policies that would be applicable to solar energy ROWs on all BLM-administered lands. These include, but are

TABLE ES.2-1 Summary of Potentially Developable BLM-Administered Land under the No Action Alternative, the Solar Energy Development Program Alternative, and the SEZ Program Alternative[a]

State	Total State Acreage	BLM-Administered Lands Constituting No Action Alternative (acres)	BLM-Administered Lands Constituting Solar Energy Development Program Alternative (acres)[b,c]	BLM-Administered Lands Constituting SEZ Program Alternative (acres)
Arizona	72,700,000	9,181,179	3,380,877	5,966
California	100,200,000	10,815,285	766,078	153,627
Colorado	66,500,000	7,282,258	95,128	16,308
Nevada	70,300,000	40,760,443	9,076,145	60,395
New Mexico	77,800,000	11,783,665	4,184,520	29,964
Utah	52,700,000	18,098,240	1,809,759	18,658
Total	440,200,000	97,921,069	19,312,506	284,918

a To convert acres to km^2, multiply by 0.004047.

b The acreage estimates were calculated on the basis of the best available geographic information system (GIS) data. GIS data were not available for the entire set of exclusions; thus the exact acreage could not be calculated. Exclusions that could not be mapped would be identified during the ROW application process.

c Values shown include areas of less than 247 acres (1 km^2).

not limited to, policies addressing competing applications, terms, ROWs, and changes to terms; ROW renewal; cost-recovery payments; valid existing rights; rental fees; due diligence and applicant qualifications; plans of development; notification to livestock grazing operators; performance and reclamation bonds; notice to proceed; administrative appeal; air navigation hazards;, cadastral survey policies; diligent development; operating standards; access to records; upgrades or changes to facility design or operation; 10-year reviews; and transfers or assignments requiring BLM approval. The BLM is undertaking rulemaking to establish a competitive process for offering public lands for solar as well as wind energy development within designated leasing areas (i.e., SEZs). When established, the rule may supersede some of the authorization policies described in the Final Solar PEIS.

ES.2.4.1.2 Monitoring, Adaptive Management, and Mitigation

The BLM has committed to developing and incorporating a monitoring and adaptive management plan into its Solar Energy Program to ensure that data and lessons learned about the impacts of solar energy projects will be collected, reviewed, and, as appropriate, incorporated into BLM's Solar Energy Program in the future. The long-term solar monitoring and adaptive management plan (Solar LTMP) will be based on BLM's Assessment, Inventory and Monitoring (AIM) Strategy developed in 2011. It will also take advantage of and augment other AIM efforts, including Rapid Ecoregional Assessments, the national landscape monitoring framework, greater sage-grouse habitat analysis, and an array of local, management-driven monitoring efforts.

BLM's proposed Solar Energy Program under both action alternatives will employ a mitigation hierarchy to address potential impacts—avoidance, minimization, and offset of unavoidable impacts. Avoidance will be achieved through siting decisions and the identification of priority SEZs. Minimization will be achieved through the application of design features and adherence to applicable federal, state, and local laws and regulations such as the Endangered Species Act (ESA). For those impacts that cannot be avoided or minimized, the BLM will determine, in consultation with affected stakeholders, if measures to offset or mitigate adverse impacts would be appropriate. To help accomplish this goal, the BLM proposes to establish regional mitigation plans that will facilitate development in SEZs. As envisioned, these regional mitigation plans will simplify and improve the mitigation process for future projects in SEZs.

ES.2.4.1.3 Programmatic Design Features

The BLM has established a set of proposed programmatic design features that would be required for all utility-scale solar energy development on BLM-administered lands under both action alternatives. Design features are mitigation requirements that have been incorporated into the proposed action or alternatives to avoid or reduce adverse impacts. The proposed design features were derived from comprehensive reviews of solar energy development activities, published data regarding solar energy development impacts, existing relevant mitigation guidance, and standard industry practices.

ES.2.4.2 Solar Energy Development Program Alternative (BLM Preferred Alternative)

Under the solar energy development program alternative (referred to as the "program alternative"), the BLM proposes categories of lands to be excluded from utility-scale solar energy development and identifies specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM proposes to prioritize development. The program alternative emphasizes and incentivizes development within SEZs and proposes a collaborative process to identify additional SEZs. To accommodate the flexibility described in the BLM's program objectives, the program alternative allows for responsible utility-scale solar development in variance areas outside of SEZs in accordance with the proposed variance process. The program alternative also establishes programmatic authorization policies and design features for utility-scale solar energy development on BLM-administered lands. The elements of the new Solar Energy Program would be implemented through amendment of the land use plans within the six-state study area (see Appendix C of this Final Solar PEIS).

ES.2.4.2.1 Proposed Right-of-Way Exclusion Areas

Under the program alternative, the BLM proposes to exclude specific categories of land from utility-scale solar energy development. Right-of way exclusion areas are defined as areas that are not available for location of ROWs under any conditions (BLM Land Use Planning Handbook, H-1601-1 [BLM 2005]). On the basis of input received from the public, stakeholders, cooperating agencies, and tribes on the Supplement to the Draft Solar PEIS, the list of proposed exclusions has been modified and now totals approximately 79 million acres (319,072 km^2), including some state-specific exclusions (see Table ES.2-2 and Figure ES.2-1).

The identification of exclusion areas allows the BLM to support the highest and best use of public lands by avoiding potential resource conflicts and reserving for other uses public lands that are not well suited for utility-scale solar energy development. Due to the size and scale of utility-scale solar energy development (typically involving a single use of public lands), the BLM is proposing to exclude a broader set of categories than would be identified in a land use plan for other types of ROWs. For the purposes of the Solar PEIS and its associated NEPA analysis, the BLM has mapped and estimated the acreage for all proposed exclusions in the aggregate based on best available existing information. The identification of any additional exclusion areas for utility-scale solar energy development would involve planning-level decisions and require the BLM to amend applicable land use plans.

ES.2.4.2.2 Proposed Solar Energy Zones

An SEZ is defined by the BLM as an area within which the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development. SEZs should be relatively large areas that provide highly suitable locations for utility-scale solar development: locations where solar development is economically and technically feasible, where there is good potential for connecting new electricity-generating

TABLE ES.2-2 Exclusions under BLM's Solar Energy Development Program Alternative

1. Lands with slopes greater than 5% determined through geographical information system (GIS) analysis using digital elevation models.[a]

2. Lands with solar insolation levels less than 6.5 kWh/m^2/day determined through National Renewable Energy Laboratory solar radiation GIS data (http://www.nrel.gov/rredc/solar_data.html).

3. All Areas of Critical Environmental Concern (ACECs) identified in applicable land use plans (including Desert Wildlife Management Areas [DWMAs] in the California Desert District planning area).

4. All designated and proposed critical habitat areas for species protected under the Endangered Species Act (ESA) of 1973 (as amended) as identified in respective recovery plans (http://ecos.fws.gov/tess_public/TESSWebpageRecovery?sort=1).

5. All areas for which an applicable land use plan establishes protection for lands with wilderness characteristics.

6. Developed recreational facilities, special-use permit recreation sites (e.g., ski resorts and camps), and all Special Recreation Management Areas (SRMAs) identified in applicable land use plans, except for those in the State of Nevada and a portion of the Yuma East SRMA in Arizona.[b]

7. All areas where the BLM has made a commitment to state agency partners and other entities to manage sensitive species habitat, including but not limited to sage grouse core areas, nesting habitat, and winter habitat; Mohave ground squirrel habitat; flat-tailed horned lizard habitat; and fringe-toed lizard habitat.

8. Greater sage-grouse habitat (currently occupied, brooding, and winter habitat) as identified by the BLM in California, Nevada, and Utah, and Gunnison's sage-grouse habitat (currently occupied, brooding, and winter habitat) as identified by the BLM in Utah.[c]

9. All areas designated as no surface occupancy (NSO) in applicable land use plans

10. All right-of-way (ROW) exclusion areas identified in applicable land use plans.

11. All ROW avoidance areas identified in applicable land use plans.

12. In California, lands classified as Class C in the California Desert Conservation Area (CDCA) planning area.

13. In California and Nevada, lands in the Ivanpah Valley.

14. In Nevada, lands in Coal Valley and Garden Valley.

15. All Desert Tortoise translocation sites identified in applicable land use plans, project-level mitigation plans or Biological Opinions.

16. All Big Game Migratory Corridors identified in applicable land use plans.

17. All Big Game Winter Ranges identified in applicable land use plans.

18. Research Natural Areas identified in applicable land use plans.

TABLE ES.2-2 (Cont.)

19. Lands classified as Visual Resource Management (VRM) Class I or II (and, in Utah, Class III[d]) in applicable land use plans.

20. Secretarially designated National Recreation, Water, or Side and Connecting Trails and National Back Country Byways (BLM State Director approved) identified in applicable BLM and local land use plans (available at http://www.americantrails.org/NRTDatabase), including any associated corridor or lands identified for protection through an applicable land use plan.

21. All units of the BLM National Landscape Conservation System, congressionally designated National Scenic and Historic Trails (National Trails System Act [NTSA], P.L. 90-543, as amended), and trails recommended as suitable for designation through a congressionally authorized National Trail Feasibility Study, or such qualifying trails identified as additional routes in law (e.g., West Fork of the Old Spanish National Historic Trail), including any trail management corridors identified for protection through an applicable land use plan. Trails undergoing a congressionally authorized National Trail Feasibility Study will also be excluded pending the outcome of the study.[e]

22. National Historic and Natural Landmarks identified in applicable land use plans, including any associated lands identified for protection through an applicable land use plan.

23. Lands within the boundaries of properties listed in the *National Register of Historic Places* (NRHP) and any additional lands outside the designated boundaries identified for protection through an applicable land use plan.

24. Traditional cultural properties and Native American sacred sites as identified through consultation with tribes and recognized by the BLM.

25. Wild, Scenic, and Recreational Rivers designated by Congress, including any associated corridor or lands identified for protection through an applicable river corridor plan.

26. Segments of rivers determined to be eligible or suitable for Wild or Scenic River status identified in applicable land use plans, including any associated corridor or lands identified for protection through an applicable land use plan.

27. Old Growth Forest identified in applicable land use plans.

28. Lands within a solar energy development application area found to be inappropriate for solar energy development through an environmental review process that occurred prior to finalization of the Draft Solar PEIS.[f]

29. Lands previously proposed for inclusion in SEZs that were determined to be inappropriate for development through the NEPA process for the Solar PEIS (limited to parts of the Brenda SEZ in Arizona; the previously proposed Iron Mountain SEZ area and parts of the Pisgah and Riverside East SEZs in California; parts of the De Tilla Gulch, Fourmile East, and Los Mogotes East SEZs in Colorado; and parts of the Amargosa Valley SEZ in Nevada).

30. In California, all lands within the proposed Mojave Trails National Monument[g] and all conservation lands acquired outside of the proposed Monument through donations or use of Land and Water Conservation Funds.

31. In California, BLM-administered lands proposed for transfer to the National Park Service with the concurrence of the BLM.[h]

TABLE ES.2-2 (Cont.)

32.	Specific areas identified since the publication of the Supplement to the Draft Solar PEIS by the BLM based on continued consultation with cooperating agencies and tribes to protect sensitive natural, visual, and cultural resources (total of 1,066,497 acres [4,316 km^2]; see Figure ES.2-1. Note there are some overlapping exclusions). Data and finer scale maps will be made available through the Solar PEIS project Web site (http://solareis.anl.gov). Note that in some cases, the description of these areas will be withheld from the public to ensure protection of the resource.

[a] Applications may include some lands with up to 10% slope where higher slopes inclusions meet all of the following: (1) are proximate to variance lands in the application, (2) are not otherwise excluded from development, (3) allow for the avoidance or minimization of resource conflicts, and (4) do not create any significant new or additional conflicts. In such cases, a land use plan amendment would have to be adopted as part of the project-specific analysis to permit the slope exception.

[b] In Nevada, many designated SRMAs are located on semi-degraded lands that might be appropriate for solar development. Decisions on solar ROW applications within Nevada SRMAs will be made on a case-by-case basis. A portion of the Yuma East SRMA was identified as a variance area rather than as an exclusion area based on its designation as VRM Class III and as a rural developed recreation setting, both of which allow for modifications to the natural environment.

[c] In April 2010, the USFWS published its listing for the greater sage-grouse as “Warranted but Precluded.” Inadequacy of regulatory mechanisms was identified as a major threat in the USFWS finding on the petition to list the greater sage-grouse. The USFWS has identified the principal regulatory mechanism for the BLM as conservation measures in RMPs. On the basis of the identified threats to the greater sage-grouse and the USFWS’s time line for making a listing decision on this species, the BLM has initiated action to incorporate explicit objectives and adequate conservation measures into RMPs (including PEISs and project EISs) within the next 3 years in order to conserve greater sage-grouse and avoid a potential listing under the ESA. To meet the objectives of BLM’s sage-grouse conservation policy, the Solar PEIS has excluded specifically identified sage-grouse habitat (currently occupied, brooding, and winter habitat) located on BLM public lands in Nevada and Utah. These exclusions will be subject to change based on the outcome of the BLM’s sage grouse planning efforts and resulting plan amendments.

[d] In Utah, VRM Class III lands have also been removed due to the high sensitivity and location proximity to Zion, Bryce, Capital Reef, Arches, and Canyonlands National Parks, and to significant Cultural Resource Special Management Areas (in southeast Utah).

[e] National Scenic Trails are comprised of extended pathways located for recreational opportunities and the conservation and enjoyment of the scenic, historic, natural, and cultural qualities of the areas through which they pass (NTSA Sec. 3(a)(2)).

National Historic Trails are comprised of Federal Protection Components and/or high-potential historic sites and high-potential route segments, including original trails or routes of travel, developed trail or access points, artifacts, remnants, traces, and the associated settings and primary uses identified and protected for public use and enjoyment (NTSA Sec. 3(a)(3)) and may include associated auto tour routes (NTSA Sec. 5(b)(A) and 7(c)). National Historic Trails or other types of historic trails may also contain properties listed or eligible for listing on the NRHP or National Historic Landmarks. National Historic Trails are protected and identified as required by law (NTSA Sec. 3(a)(3)), through BLM inventory and planning processes.

[f] For example, lands considered non-developable in the environmental analyses completed for the Genesis Ford Dry Lake Solar Project, Blythe Solar Project, and Desert Sunlight Solar Project, and some lands previously within the Pisgah and Brenda proposed SEZs.

Footnotes continued on next page

TABLE ES.2-2 (Cont.)

[g] As described in Senate Bill 138, California Desert Protection Act of 2011, introduced in the 112th Congress.

[h] Three specific geographic areas described as (1) the narrow strip of BLM-administered lands between Fort Irwin and Death Valley National Park, (2) an area of public lands on the northeastern side of Mojave National Preserve adjacent to the California and Nevada border, and (3) an area along the northern boundary of Joshua Tree National Park.

plants to the transmission distribution system, and where there is generally low resource conflict. ROWs for utility-scale solar energy development in SEZs would be given priority over all other ROWs. The BLM may decide to authorize ROWs for other uses that are found to be compatible with utility-scale solar energy development such as shared access roads and transmission lines. The BLM will consider the processing of pending ROW applications in identified SEZs on a case-by-case basis.

Through the Draft Solar PEIS, the BLM conducted SEZ-specific analysis for 24 SEZs (approximately 677,000 acres [2,741 km^2]) and discovered some potentially significant impacts on various resources and resource uses that could result from solar energy development in these areas. Based on this analysis, the BLM decided to eliminate some SEZs from further consideration and reduce the area of other SEZs. The BLM has carried 17 SEZs forward for analysis in the Final Solar PEIS. These SEZs total approximately 285,000 acres (1,153 km^2) of land potentially available for development (see Table ES.2-3). Chapters 8 through 13 of the Draft and Final Solar PEIS include assessments of the affected environment and potential environmental impacts of solar energy development in each of the SEZs. This SEZ-specific analysis provides documentation from which the BLM will tier future project authorizations, thereby limiting the required scope and effort of additional project-specific NEPA analyses. The extent of tiering will vary from project to project, as will the necessary level of NEPA documentation.

The BLM will require that utility-scale solar energy projects in SEZs be developed in compliance with NEPA and other applicable laws, including, but not limited to the ESA and the National Historic Preservation Act (NHPA), and applicable regulations and policies. The BLM has already undertaken ESA consultation, NHPA Section 106 consultation, and tribal consultation for the SEZs that will further limit the level of effort required to authorize projects in SEZs in the future.

The BLM developed action plans for each of the 17 SEZs as part of the Supplement to the Draft Solar PEIS (Appendix C of the Supplement). These action plans described additional data that could be collected for individual SEZs and proposed data sources and methods for the collection of those data. Through implementation of these action plans, the BLM is committed to obtaining additional SEZ-specific resource data and conducting additional analysis in order to more effectively facilitate future development in SEZs.

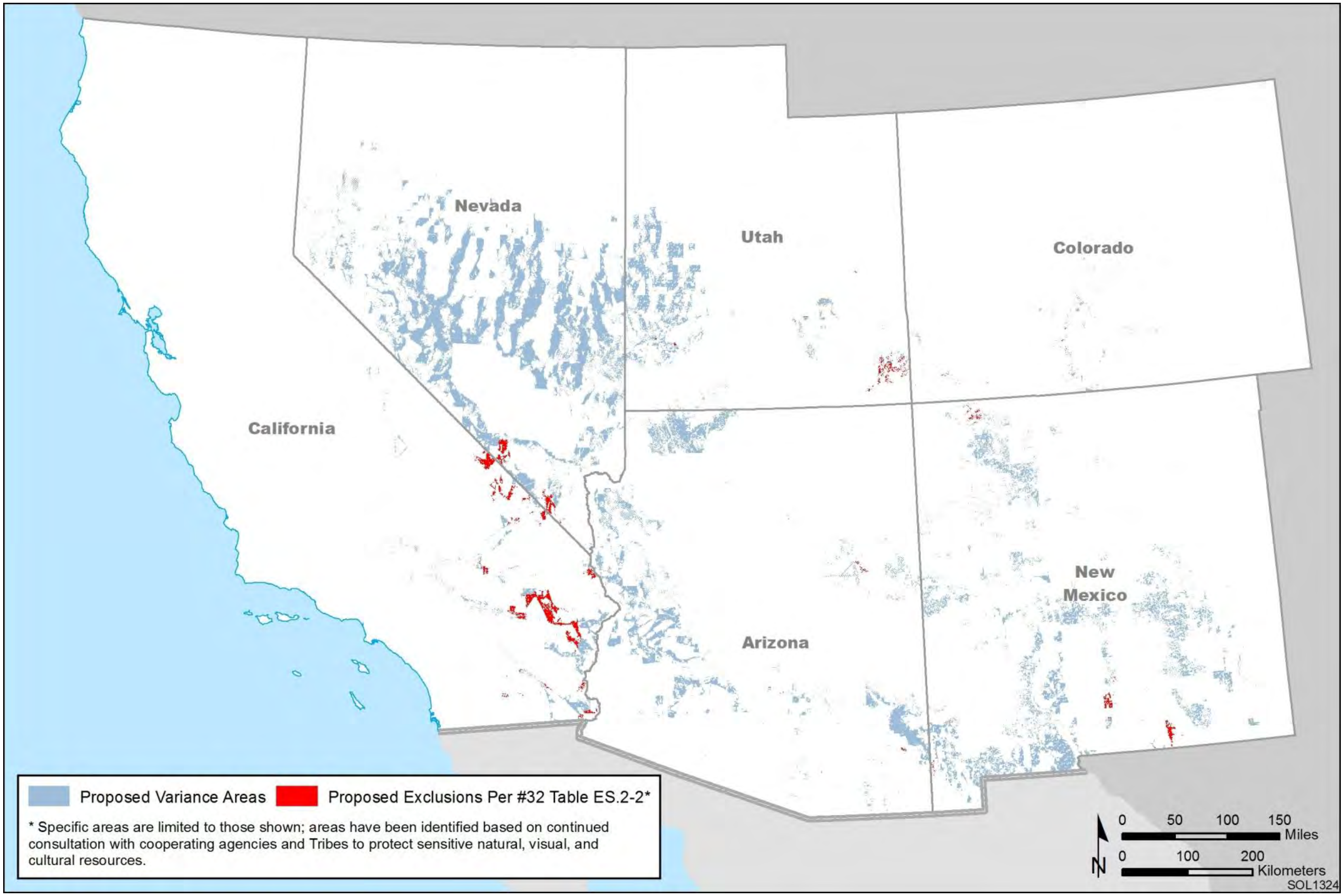


FIGURE ES.2-1 Areas Proposed for Exclusion Since Publication of the Supplement to the Draft Solar PEIS Based on Continued Consultation with Cooperating Agencies and Tribes

TABLE ES.2-3 Proposed SEZs and Approximate Acreage by State[a]

Proposed SEZ (BLM Office/County)	Approximate Acreage
Arizona	
Brenda (Lake Havasu/La Paz)	3,348
Gillespie (Lower Sonoran/Maricopa)	2,618
Total	5,966
California	
Imperial East (El Centro/Imperial)	5,717
Riverside East (Palm Springs–South Coast/Riverside)	147,910
Total	153,627
Colorado	
Antonito Southeast (La Jara/Conejos)	9,712
De Tilla Gulch (Saguache/Saguache)	1,064
Fourmile East (La Jara/Alamosa)	2,882
Los Mogotes East (La Jara/Conejos)	2,650
Total	16,308
Nevada	
Amargosa Valley (Southern Nevada/Nye)	8,479
Dry Lake (Southern Nevada/Clark)	5,717
Dry Lake Valley North (Ely/Lincoln)	25,069
Gold Point (Battle Mountain/Esmeralda)	4,596
Millers (Battle Mountain/Esmeralda)	16,534
Total	60,395
New Mexico	
Afton (Las Cruces/Dona Ana)	29,964
Total	29,964
Utah	
Escalante Valley (Cedar City/Iron)	6,533
Milford Flats South (Cedar City/Beaver)	6,252
Wah Wah Valley (Cedar City/Beaver)	5,873
Total	18,658
Total	284,918

[a] To convert acres to km^2, multiply by 0.004047.

The BLM has proposed an authorization process for utility-scale solar energy projects proposed in SEZs. It intends to offer lands in SEZs through a competitive process and has initiated rulemaking to establish this process.

The BLM has taken a number of important steps through the Solar PEIS to facilitate future development in SEZs in a streamlined and standardized manner. Through the Solar PEIS ROD, the BLM will amend land use plans in the six-state study area to adopt those elements of the new Solar Energy Program that pertain to planning. No additional plan amendments are expected to be required to approve projects in identified SEZs.

In addition to the efforts described above to facilitate development in SEZs, the BLM is proposing to undertake a variety of additional activities, or incentives, that will help steer future utility-scale solar energy development to the SEZs. These activities include facilitating faster and easier permitting in the SEZs, improving and facilitating mitigation, facilitating permitting of needed transmission to the SEZs, encouraging solar development on suitable adjacent nonfederal lands, and providing economic incentives for development in SEZs. As an additional mechanism to support the establishment of priority areas for solar energy development, the Secretary of the Interior is considering whether to withdraw the public lands encompassed by SEZs from potentially conflicting uses through the issuance of a Public Land Order.

The BLM believes that establishing a feasible process to identify new or expanded SEZs is an essential element of its overall approach to solar energy development. A part of the program alternatives, the BLM has developed a proposed SEZ identification protocol. New or expanded SEZs will be identified in the context of existing solar market conditions, existing and planned transmission systems, and new (or existing) state or federal policies affecting the level and location of utility-scale solar energy development. The BLM will endeavor to assess the need for new or expanded SEZs a *minimum* of every 5 years in each of the six states covered by the Solar PEIS. The process to identify new or expanded SEZs will be open and transparent, with opportunities for substantial involvement of multiple stakeholders. The BLM will identify new or expanded SEZs at the state- or field-office level as an individual land use planning effort or as part of an ongoing land use plan revision.

The BLM has initiated efforts to identify new SEZs in the states of California, Arizona, Nevada, and Colorado through ongoing state-based efforts (see Section 2.2.2.2.6 of this Final Solar PEIS for more information) and anticipates identifying new or expanded SEZs in the remaining states in the near future. This ongoing work makes effective use of existing collaborative efforts and is expected to result in new or expanded SEZs in these planning areas in the near term. The BLM welcomes industry, environmental organizations, state and local government partners, tribes, and the public to participate in these ongoing efforts to identify new or expanded SEZs and to submit petitions in other areas where they believe new or expanded SEZs are needed (see Section A.2.6 of Appendix A of this Final Solar PEIS).

ES.2.4.2.3 Proposed Variance Process

To accommodate the flexibility described in BLM's program objectives, the program alternative allows for responsible utility-scale solar development outside of SEZs. The BLM proposes to identify lands outside of proposed exclusion areas and SEZs as variance areas for utility-scale solar energy development. Variance areas would be open to application but would require developers to adhere to the proposed variance process (detailed in Section 2.2.2.3.1 of this Final Solar PEIS). Variances may be needed in the near term because the lands identified as SEZs might be insufficient to accommodate demand for utility-scale solar development or may not have access to adequate transmission capacity to facilitate such development. In addition, there might be market, technological, or site-specific factors that make a project appropriate in a non-SEZ area.

The BLM will consider ROW applications for utility-scale solar energy development in variance areas on a case-by-case basis based on environmental considerations; coordination with appropriate federal, state, and local agencies, and tribes; and public outreach. The responsibility for demonstrating to the BLM and other coordinating parties that a proposal in a variance area will avoid, minimize, and/or mitigate, as necessary, sensitive resources will rest with the applicant. Based on a thorough evaluation of the information provided by an applicant, and the input of federal, state, and local government agencies, tribes, and the public, the BLM will determine whether it is appropriate to continue to process, or to deny, a ROW application submitted through the variance process.

The proposed variance areas and associated variance process would only apply to utility-scale solar development. All non-utility-scale solar energy projects, including distributed generation, would follow existing management prescriptions in BLM land use plans and be subject to individual site-specific NEPA analyses.

ES.2.4.3 Solar Energy Zone Program Alternative

Under the SEZ program alternative (referred to as the "SEZ alternative"), the BLM would restrict utility-scale solar energy development applications to SEZs only, and identify all other lands as exclusion areas for utility-scale solar energy development (approximately 79 million acres [319,701 km^2). Under the SEZ alternative, the same programmatic authorization policies and design features applicable to the program alternative would apply to applications in SEZs. Over time, under the SEZ alternative, new or expanded SEZs would be identified following the SEZ identification protocol described above. As with the program alternative, the elements of the new Solar Energy Program under the SEZ alternative would be implemented through amendment of the land use plans within the six-state study area.

ES.2.4.4 No Action Alternative

Under the no action alternative, the BLM would continue the issuance of ROW authorizations for utility-scale solar energy development on BLM-administered lands by implementing the requirements of the BLM's existing solar energy policies on a project-by-project basis. The BLM would not implement any of the proposed elements of the Solar Energy Program. Specifically, the programmatic ROW authorization policies, design features, and land use plan amendments proposed in the two action alternatives would not be implemented.

ES.2.4.5 Reasonably Foreseeable Solar Energy Development

A full assessment of the potential impacts of solar energy development on the quality of the human and ecological environment over the next 20 years requires that an estimate be made of the amount of development that might occur in the six-state study area over that time frame. The amount of power projected to be generated through solar energy development in the six-state study area through 2030 is referred to as the reasonably foreseeable development scenario (RFDS) in this Solar PEIS. The RFDS was calculated on the basis of the requirements for electricity generation from renewable energy resources established in the Renewable Portfolio Standards (RPSs) in each of the six states. To establish an upper bound, it was assumed that 75% of development would occur on BLM-administered lands and that 50% of the RPS-based requirement for renewable energy production would be provided from solar energy. The RFDS that was developed for the Draft Solar PEIS is still considered to be valid to support analyses in this Final Solar PEIS.

On the basis of the RFDS, the estimated amount of solar energy generation on BLM-administered lands in the study area over the 20-year study period is about 24,000 MW, with a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands. Table ES.2-4 presents the RFDS for each state in terms of projected megawatts and estimated acres of land required to support that level of development.

ES.2.4.6 Summary of Impacts of BLM's Alternatives

As part of this Final Solar PEIS, the BLM has assessed the potential direct and indirect environmental, social, and economic impacts of solar energy development under the program alternatives. The generally qualitative level of detail of the impact assessment is commensurate with the programmatic decisions to be made, which are primarily planning-level decisions (i.e., allocation and exclusion decisions). The summary of impacts of the alternatives given in Table ES.2-5 is based on the detailed discussion of the affected environment and potential impacts of solar energy development provided in Chapters 4 and 5 of the Draft and Final Solar PEIS.[5] Appendix J also provides a comparison of potential species effects by alternative. The assessment of cumulative impacts at the program level (Section 6.5 of the Draft and Final Solar PEIS) also was considered. The in-depth analyses of potential impacts of development in the proposed SEZs as presented in Chapters 8 through 13 of the Draft and Final Solar PEIS provided an additional basis for the summary of impacts of the SEZ alternative that is provided in Table ES.2-5. The SEZ analyses included an assessment of cumulative impacts, considering ongoing and reasonably foreseeable actions specifically for the vicinity of each SEZ.

The potential impacts of solar development itself are largely similar across the program alternatives. However, because the alternatives represent planning-level decisions (i.e., allocation and exclusion decisions), differences between the alternatives are found in the location, pace, and

[5] The agencies have decided to prepare a condensed Final Solar PEIS (see Section 1.7). Several key chapters of the Draft Solar PEIS have been revised extensively and are presented in full in this Final Solar PEIS (e.g., Chapters 1, 2, 6, and 7). Other sections of this Final Solar PEIS (including Chapters 4 and 5) are presented as updates to the Draft Solar PEIS. The Final Solar PEIS is intended to be used in conjunction with the Draft Solar PEIS, which is being distributed electronically together with the Final PEIS.

TABLE ES.2-4 Reasonably Foreseeable Development Scenario: Projected Megawatts of Solar Power Development by 2030 and Corresponding Developed Acreage Estimates[a]

State	Landholding	Estimated MW under RFDS	Estimated Acres Developed under RFDS[b]
Arizona	BLM	2,424	21,816
	Non-BLM	808	7,272
California	BLM	15,421	138,789
	Non-BLM	5,140	46,260
Colorado	BLM	2,194	19,746
	Non-BLM	731	6,579
Nevada	BLM	1,701	15,309
	Non-BLM	567	5,103
New Mexico	BLM	833	7,497
	Non-BLM	278	2,502
Utah	BLM	1,219	10,971
	Non-BLM	406	3,654
	Total for BLM-administered lands	23,791	214,119
	Total for non-BLM lands	7,930	71,370

[a] See Appendix E of the Draft Solar PEIS for details on the methodologies used to calculate the RFDS.

[b] Acreage calculated assuming land use of 9 acres/MW. To convert acres to km^2, multiply by 0.004047.

concentration of solar energy development. The BLM evaluated each alternative to gauge the extent to which it would (1) meet the stated objectives for the PEIS identified in Section ES.2.1, (2) meet the projected demands for solar energy development as estimated by the RFDS for solar energy development in the six-state study area over the 20-year study period, and (3) support BLM's efforts to meet the mandates established in the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010) (Table ES.2-6).

ES.2.4.7 BLM's Preferred Alternative

The BLM has selected the program alternative as the preferred alternative for this Final Solar PEIS. On the basis of the comparisons presented in Table ES.2-6, it appears that the program alternative would best meet BLM's objectives for managing utility-scale solar energy development on BLM-administered lands. It would likely result in the high pace of development

TABLE ES.2-5 Summary-Level Assessment of Potential Environmental Impacts of Utility-Scale Solar Energy Development by Alternative

Resource	Program Alternative (approximately 285,000 acres[b] in priority areas, and approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Lands and Realty	Solar energy development would preclude other land uses within the project footprint and could alter the character of largely rural areas. Development of supporting infrastructure (e.g., new transmission lines and roads) would also locally affect land use. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could potentially be more dispersed. There would be no specific design features to reduce impacts.
Specially Designated Areas and Lands with Wilderness Characteristics	Specially designated areas and lands with wilderness characteristics could be significantly affected through direct and indirect impacts (e.g., visual impacts, reduced access, noise impacts, and fugitive dust) during both the construction and operations phases. Similar impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. All NLCS lands would be excluded. Also excluded would be ACECs; SRMAs (except in Nevada and portions of the Yuma East SRMA in Arizona); DWMAs; National Recreation Trails and National Backcountry Byways; National Historic and Scenic Trails; Wild, Scenic, and Recreational Rivers, and segments of rivers determined to be eligible or suitable for Wild and Scenic River status; and lands within the proposed Mojave Trails National Monument. All areas where there is an applicable land use plan decision to protect lands with wilderness characteristics would be excluded.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This concentration of development could increase the magnitude of potential impacts but affect a smaller number of areas.	Same impacts as program alternative, except that only most NLCS lands are excluded from solar energy development and other exclusions do not apply. There would be no specific design features to reduce impacts. Impacts could potentially be more dispersed and greater on specially designated lands and lands with wilderness characteristics due to few exclusions under the no action alternative.

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Rangeland Resources	Some livestock grazing allotments may be affected by solar energy development through reductions in acreage and/or loss of AUMs. Wild horses and burros also could be affected, with animals displaced from the development area; the number of wild horse and burro HMAs overlapping with or in the vicinity of lands available for ROW application would be less than under the no action alternative. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller geographic area within a known set of grazing allotments and HMAs (there is very little overlap of SEZs with wild horse and burro HMAs).	Same impacts as program alternative, except impacts could potentially be more dispersed, and there is less certainty about which grazing allotments and HMAs potentially could be affected. There would be no specific design features to reduce impacts.
Recreation	Recreational uses would be precluded within lands used for solar energy development. Recreational experiences could be adversely affected in areas proximate to solar energy projects and related transmission. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. All SRMAs are excluded from solar energy development (except in Nevada and portions of the Yuma East SRMA in Arizona). Also excluded are developed recreational facilities and special-use permit recreation sites.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect fewer recreational resources.	Same impacts as program alternative. There would be no explicit exclusions to avoid SRMAs, recreational facilities, and special-use permit recreation sites. There would be no specific design features to reduce impacts. Impacts could potentially be more dispersed and greater on those recreational areas that would be excluded under the action alternatives.

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Military and Civilian Aviation	Military and civilian aviation impacts would be identified and adequately avoided, minimized and/or mitigated prior to the BLM's issuance of a ROW authorization.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could potentially be more dispersed.
Soil Resources and Geologic Hazards	Development of large tracts of land up to several thousand acres for solar energy facilities and related infrastructure would result in impacts on soil resources in terms of soil compaction and erosion, although these impacts could be effectively avoided, minimized and/or mitigated. Impacts on biological soil crusts would be long term and possibly irreversible. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could potentially be more dispersed. There would be no specific design features to reduce impacts.
Mineral Resources	Mineral development within the project footprint for solar energy development would generally be an incompatible use; however, some resources underlying the project area might be developable (e.g., directional drilling for oil and gas or geothermal resources, underground mining). These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could be potentially more dispersed.
	Lands within SEZs may be withdrawn from location and entry under the mining laws.	Lands within SEZs may be withdrawn from location and entry under the mining laws.	No SEZs would be identified or withdrawn.

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Water Resources	Solar thermal projects with wet-cooling systems require large volumes of water, with potentially significant environmental impacts. Solar thermal projects with dry-cooling systems need less than one-tenth of the amount of water required for wet-cooling systems. Projects would necessarily be limited to locations with sufficient groundwater supplies where water rights and the approval of water authorities could be obtained. All solar energy facilities require smaller volumes of water for mirror or panel washing and potable water uses, which would result in relatively minor impacts on water supplies. Other potential impacts, including modification of surface and groundwater flow systems, water contamination resulting from chemical leaks or spills, and water quality degradation by runoff or excessive withdrawals, can be effectively avoided, minimized and/or mitigated. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect fewer water resources.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.
Vegetation	Solar development will typically require the total removal of vegetation at most facilities, which could result in significant direct impacts in terms of increased risk of invasive species introduction, changes in species composition and distribution, habitat loss (e.g., dune or riparian areas), and damage to biological soil crusts. Indirect impacts also likely in terms of dust deposition, altered drainage patterns, runoff, and sedimentation. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect a smaller number of areas.	Same impacts as program alternative. There would be no explicit exclusions to avoid known sensitive vegetation resources and no specific design features to reduce impacts.

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Vegetation *(Cont.)*	Design features could effectively avoid or minimize many impacts.		Impacts could potentially be more dispersed and greater on those vegetation resources excluded under the action alternatives.
	Less than 14% each of the Central Basin and Range and Chihuahuan Deserts Ecoregions, and less than 7% each of the Madrean Archipelago, Mojave Basin and Range, and Sonoran Basin and Range Ecoregions are located within the lands that would be available for application. Other ecoregions coincide with these lands at levels below 5%.	Of the five ecoregions that coincide with SEZs, less than 1% of each ecoregion would be available for ROW application.	Lands available for ROW application span 22 ecoregions. More than 50% of 2 ecoregions (Central Basin and Range, Northern Basin and Range) would be available for application.
	The land cover types for the following example species overlap with variance areas available for ROW application by the percentages shown: Joshua tree – less than 7% Saguaro – less than 7%	Less than 1% of the land cover type for Joshua tree and saguaro species is located within the SEZs.	The land cover types for the following example species overlap with the lands that would be available for ROW application by the percentages shown: Joshua tree – about 31% Saguaro – about 26%

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Wildlife and Aquatic Biota	Numerous wildlife species would be adversely affected by loss of habitat, disturbance, loss of food and prey species, loss of breeding areas, effects on movement and migration, introduction of new species, habitat fragmentation, and changes in water availability. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. Exclusion of ACECs, Research Natural Areas, big game migratory corridors and winter ranges, and lands with seasonal restrictions as identified in applicable land use plans would avoid impacts on wildlife in specific areas The following example species' habitats overlap with variance areas available for ROW application by the percentages shown:	Same impacts as program alternative, except the potential area of impact would be limited to a smaller, known geographic area.	Same impacts as program alternative. There would be no explicit exclusions to avoid known sensitive wildlife resources, and no specific design features to reduce impacts. Impacts could potentially be more dispersed and greater on those wildlife resources excluded under the action alternatives. The following example species' habitats overlap with the lands that would be available for ROW application by the percentages shown:
	Western rattlesnake – less than 6% Golden eagle – less than 6% Black-tailed jackrabbit – less than 6% Pronghorn – less than 5% Mule deer – less than 6% Mountain lion – less than 5%	Less than 1% of the habitats for western rattlesnake, golden eagle, black-tailed jackrabbit, pronghorn, mule deer, and mountain lion are located within the SEZs.	Western rattlesnake – about 27% Golden eagle – about 23% Black-tailed jackrabbit – about 24% Pronghorn – about 22% Mule deer – about 22% Mountain lion – about 21%

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Special Status Species	Special status species and critical habitats would be protected in accordance with ESA requirements either through avoidance, translocation (plants), or acquisition and protection of compensatory habitat. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. Critical habitat designated or proposed by the USFWS would be excluded. All ACECs designated for habitat would be excluded along with identified desert tortoise translocation sites and other areas where the BLM has made a commitment to protect sensitive species (including Mohave ground squirrel and flat-tailed horned lizard habitat in California, greater sage-grouse habitat in California, Nevada, and Utah, and Gunnison's sage-grouse habitat in Utah). Variance areas for ROW application include areas of potentially suitable habitat for special status species (see Appendix J of this Final Solar PEIS). For example, the following species' habitats overlap by the percentages shown:	Special status species and critical habitats would be protected as under program alternative. Lands available for ROW application within SEZs include areas of potentially suitable habitat for special status species (see Appendix J of this Final Solar PEIS).	Special status species and critical habitats would be protected as under program alternative. There would be no specific design features to reduce impacts. In some cases, habitat identified by state fish and game agencies would be excluded, as identified through applicable land use plan decisions. Critical habitat, ACECs designated for habitat value, and other areas where the BLM has made a commitment to protect sensitive species would not be excluded. Lands available for ROW application include areas of potentially suitable habitat for special status species (see Appendix J). For example, the following species' habitats overlap by the percentages shown:

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Special Status Species *(Cont.)*	Plants: Nevada dune beardtongue – less than 61% White-margined beardtongue – less than 8% Munz's cholla – less than 16% Animals: Desert tortoise – less than 12% Western burrowing owl – less than 8% Greater sage-grouse – less than 7% Gunnison prairie dog – less than 3% Gunnison sage-grouse – less than 1% Northern aplomado falcon – less than 11% Southwestern willow flycatcher – less than 1% Townsend's big-eared bat – less than 6% Utah prairie dog – less than 11%	For example, about 1% or less of the habitat for two plant species (Nevada dune beard tongue, white-margined beard tongue) and nine animal species (desert tortoise, western burrowing owl, greater sage-grouse, Gunnison prairie dog, Gunnison sage-grouse, northern aplomado falcon, and southwestern willow flycatcher, Townsend's big-eared bat, and Utah prairie dog) are located within the SEZs; less than 4% of Munz's cholla habitat is located within the SEZs.	Plants: Nevada dune beardtongue – 66% White-margined beardtongue – 34% Munz's cholla – 45% Animals: Desert tortoise – 29% Western burrowing owl – 27% Greater sage-grouse – 54% Gunnison prairie dog – 15% Gunnison sage-grouse – 24% Northern aplomado falcon – 26% Southwestern willow flycatcher – 7% Townsend's big-eared bat – 23% Utah prairie dog – 36%

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Air Quality and Climate	Air quality would be adversely affected locally and temporarily during construction by fugitive dust and vehicle emissions, although impacts would be relatively minor and could be mitigated (e.g., dust control measures, emissions control devices, and vehicle maintenance). Operations would result in few air quality impacts. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. Climate Change: Relatively minor CO_2 emissions would be generated by the use of heavy equipment, vehicles, and backup generators. Overall, CO_2 emissions could be reduced if solar energy production avoids fossil fuel energy production.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas. Climate Change: Same impacts as program alternative, assuming level of development is the same.	Same impacts as program alternative, except impacts could be potentially more dispersed and of smaller magnitude locally. There would be no specific design features to reduce impacts. Climate Change: Same impacts as program alternative, assuming level of development is the same.
Visual Resources	Solar energy projects and associated infrastructure introduce strong contrasts in forms, line, colors, and textures of the existing landscape, which may be perceived as negative visual impacts. Suitable development sites typically located in basin flats surrounded by elevated lands where sensitive viewing locations exist. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Various potentially sensitive visual resource areas, including National Historic and Scenic Trails, National Historic and Natural Landmarks, properties designated or eligible for the *National Register of Historic Places*, and areas with important cultural resources that possess historical vistas may be impacted.	Same impacts as program alternative, except the impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas. SEZs are visible from approximately	Same impacts as program alternative. Some NLCS lands are excluded from solar energy development under the no action alternative. There would be no specific design features to reduce impacts. Impacts could be potentially more dispersed and greater on those areas excluded under the action alternatives.

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Visual Resources *(Cont.)*	Design features could effectively avoid or minimize many impacts but some large impacts cannot be avoided. All NLCS lands and ACECs are excluded. All SRMAs are excluded (except in Nevada and portions of the Yuma East SRMA in Arizona). Developed recreational facilities, special-use permit recreation sites, National Recreation Trails, and National Backcountry Byways are excluded. Approximately 995 potentially sensitive visual resource areas (not including ACECs) are located in or within 25 mi[c] of the lands available for ROW viewsheds.	105 potentially sensitive visual resource areas (not including ACECs) within 25 mi.	About 1,473 potentially sensitive visual resource areas (not including ACECs) are located in or within 25 mi of the lands available for ROW application and could be affected by solar development within their viewsheds.
Acoustic Environment	Construction-related noise could adversely affect nearby residents and/or wildlife, and would be greatest for concentrating solar power projects requiring power block construction. Operations-related noise impacts would generally be less significant than construction-related noise impacts but could still be significant for some receptors located near power block or dish engine facilities. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.
Paleonto-logical Resources	Paleontological resources subject to loss during construction, but impacts also possible during operations. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.

TABLE ES.2-5 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Cultural Resources and Native American Concerns	Cultural resources subject to loss during construction, but impacts also possible during operations. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. ACECs designated for cultural or historic resource values, National Historic and Scenic Trails, National Historic and Natural Landmarks, properties designated or eligible for the *National Register of Historic Places,* and areas with important cultural and archaeological resources would be excluded.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. Same exclusions as program alternative.	Same impacts as program alternative. There would be no explicit exclusions to avoid known sensitive cultural resources. There would be no specific design features to reduce impacts. Impacts could be potentially more dispersed and greater on those cultural resources excluded under the action alternatives.
Transportation	Local road systems and traffic flow could be adversely affected during construction. Impacts during operations would be minor. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.

Abbreviations: ACEC = Area of Critical Environmental Concern; AUM = animal unit month; BLM = Bureau of Land Management; CO_2 = carbon dioxide; DWMA = Desert Wildlife Management Area; ESA = Endangered Species Act; HMA = herd management area; NLCS = National Landscape Conservation System; ROW = right-of-way; SRMA = Special Recreation Management Area; USFWS = U.S. Fish and Wildlife Service.

Footnotes on next page.

TABLE ES.2-5 (Cont.)

---

[a] The lands composing the no action alternative have not changed significantly since release of the Draft Solar PEIS; thus, the habitat overlap values (percentages) presented remain valid.

[b] To convert acres to km^2, multiply by 0.004047.

[c] The acreage estimates were calculated on the basis of the best available GIS data. GIS data were not available for the entire set of exclusions; therefore, the acreages cannot be quantified at this time.

[d] To convert mi to km, multiply by 1.609.

TABLE ES.2-6 Comparison of BLM's Alternatives with Respect to Objectives for the Agency's Action

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Facilitate near-term utility-scale development on public land	Increased pace of development Development in the prioritized SEZs likely to occur at an even faster pace due to detailed analyses of SEZs Reduced costs to the government, developers, and stakeholders Effective in assisting the BLM in meeting its mandates[a]	Increased pace of development likely due to detailed analyses of SEZs Reduced costs to the government, developers, and stakeholders Effective in assisting the BLM in meeting its mandates[a]	No discernible effect on pace of development Development could shift toward nonfederal lands due to delays, making it more difficult for the BLM to achieve its mandates[a]
Minimize potential environmental impacts	Comprehensive program to identify and avoid, mitigate, or minimize potential adverse impacts Protection of resources, resource uses, and special designations through combination of exclusions, variance areas and associated variance process, and mitigation Prioritization of development in SEZs that have been identified as lands well-suited for solar energy development where most potential resource conflicts and appropriate required mitigation have been identified	Comprehensive program to identify and avoid, mitigate, or minimize potential adverse impacts Development limited to the SEZs, protecting more resources, resource uses, and special designations Additional mitigation required in SEZs Limits possibilities for focusing development on previously disturbed lands outside of SEZs; however, this will be given consideration in the identification of new SEZs	Environmental impacts evaluated project-by-project with potential for inconsistencies in the type and degree of required mitigation If development shifts to nonfederal lands, such development would not be subject to the same level of federal environmental oversight and public involvement Potentially would allow a greater degree of development on previously disturbed lands due to 98 million acres of BLM-administered lands being open to application

TABLE ES.2-6 (Cont.)

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Minimize potential environmental impacts (*Cont.*)	Potentially would allow a greater degree of development on previously disturbed lands due to 19 million acres of variance areas being open to application		
Minimize potential social and economic impacts	Economic benefits in terms of (1) direct and indirect jobs and income created and (2) ROW rental payments to the federal government Potential adverse and beneficial social impacts Prioritization of development in the SEZs could concentrate benefits and adverse impacts in a smaller number of local economies	Economic benefits in terms of (1) direct and indirect jobs and income created and (2) ROW rental payments to the federal government Potential adverse and beneficial social impacts With development limited to the SEZs, benefits and adverse impacts would be concentrated in a smaller number of local economies	Potential economic benefits essentially the same as under the action alternatives, although realized at a slower rate if pace of development is slower Potential adverse and beneficial social impacts Less potential for benefits and adverse impacts to be concentrated in specific areas
Provide flexibility to solar industry	A great degree of flexibility in identifying appropriate locations for utility-scale development due to 19 million acres of variance areas being open to application	Limited flexibility in identifying appropriate locations for utility-scale development	Maximum degree of flexibility in identifying appropriate locations for utility-scale development Limited guidance to developers on which lands and projects would ultimately be approvable

TABLE ES.2-6 (Cont.)

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Optimize existing transmission infrastructure and corridors	Greater opportunities for developers to identify and propose projects that utilize existing transmission infrastructure and/or designated corridors due to 19 million acres of variance areas being open to application Opportunities to consolidate infrastructure required for new solar facilities in SEZs	Opportunities for developers to identify and propose projects that utilize existing transmission infrastructure and/or designated corridors limited to SEZs Proximity to existing transmission infrastructure and corridors will be given consideration in the identification of new SEZs Opportunities to consolidate infrastructure required for new solar facilities in SEZs	Maximum opportunities for developers to identify and propose projects that utilize existing transmission infrastructure and/or designated corridors
Standardize and streamline authorization process	Streamlining of project review and approval processes; more consistent management of ROW applications With prioritization of development in the SEZs, additional streamlining of opportunities over development on other available lands	Streamlining of project review and approval processes; more consistent management of ROW applications With development limited to the SEZs, streamlining maximized	No discernible effect in terms of standardizing and streamlining the authorization process

TABLE ES.2-6 (Cont.)

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Meet projected demand for solar energy development as estimated by the RFDS	About 19 million acres[b] open to ROW application, which is more than adequate to support the RFDS projected level of development	About 285,000 acres open to ROW application, which may not be enough land to support the RFDS projected level of development in some states BLM identification of additional SEZs in the future would make additional land available but would require additional environmental review and land use plan amendments	About 98 million acres open to ROW application, which is more than adequate to support the RFDS projected level of development

[a] These mandates are established by the Energy Policy Act of 2005 (P.L. 109-58) and Secretarial Order 3285A1 (Secretary of the Interior 2010) (see Section 1.1 of the Draft Solar PEIS).

[b] To convert acres to km^2, multiply by 0.004047.

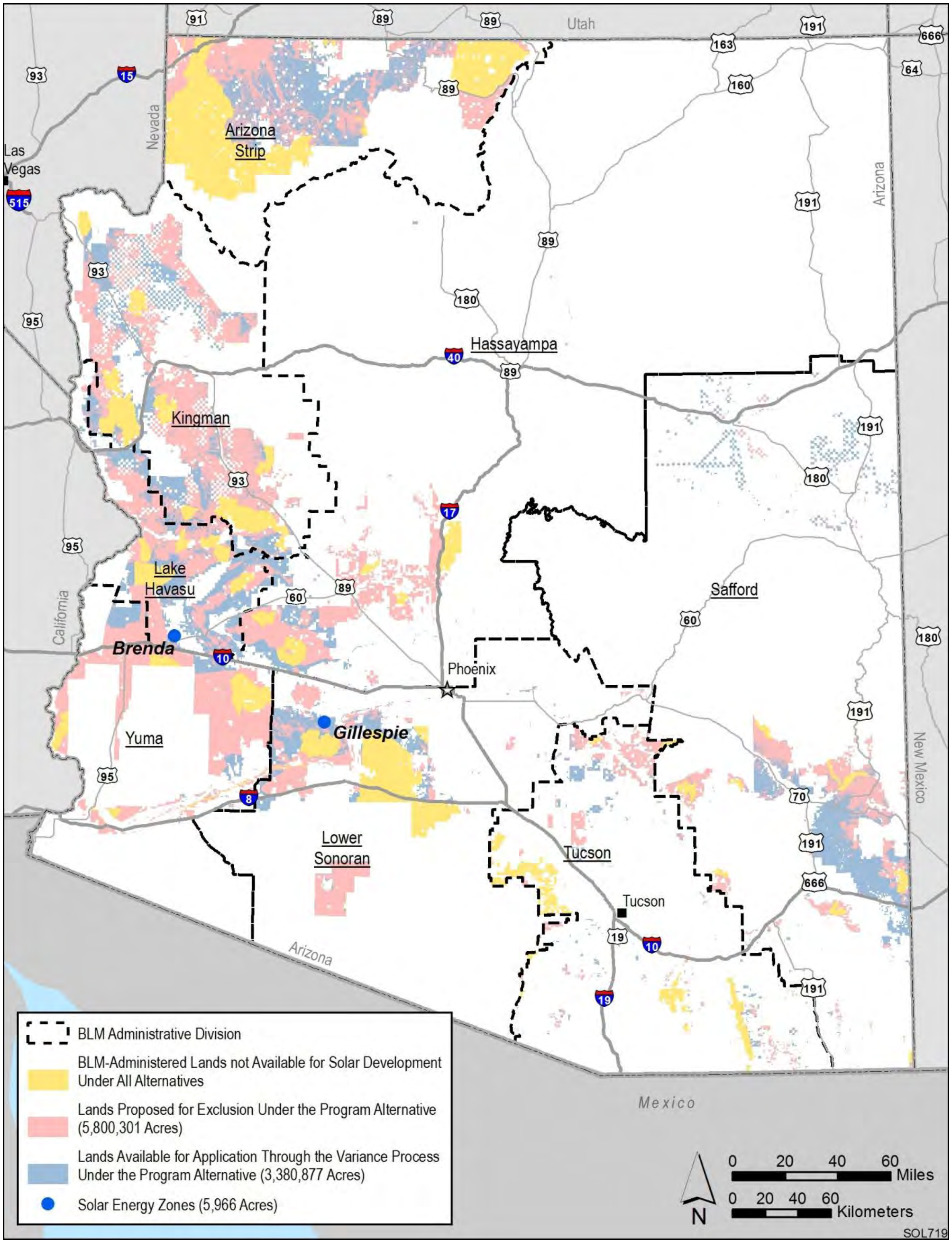


FIGURE ES.2-2 BLM-Administered Lands in Arizona Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

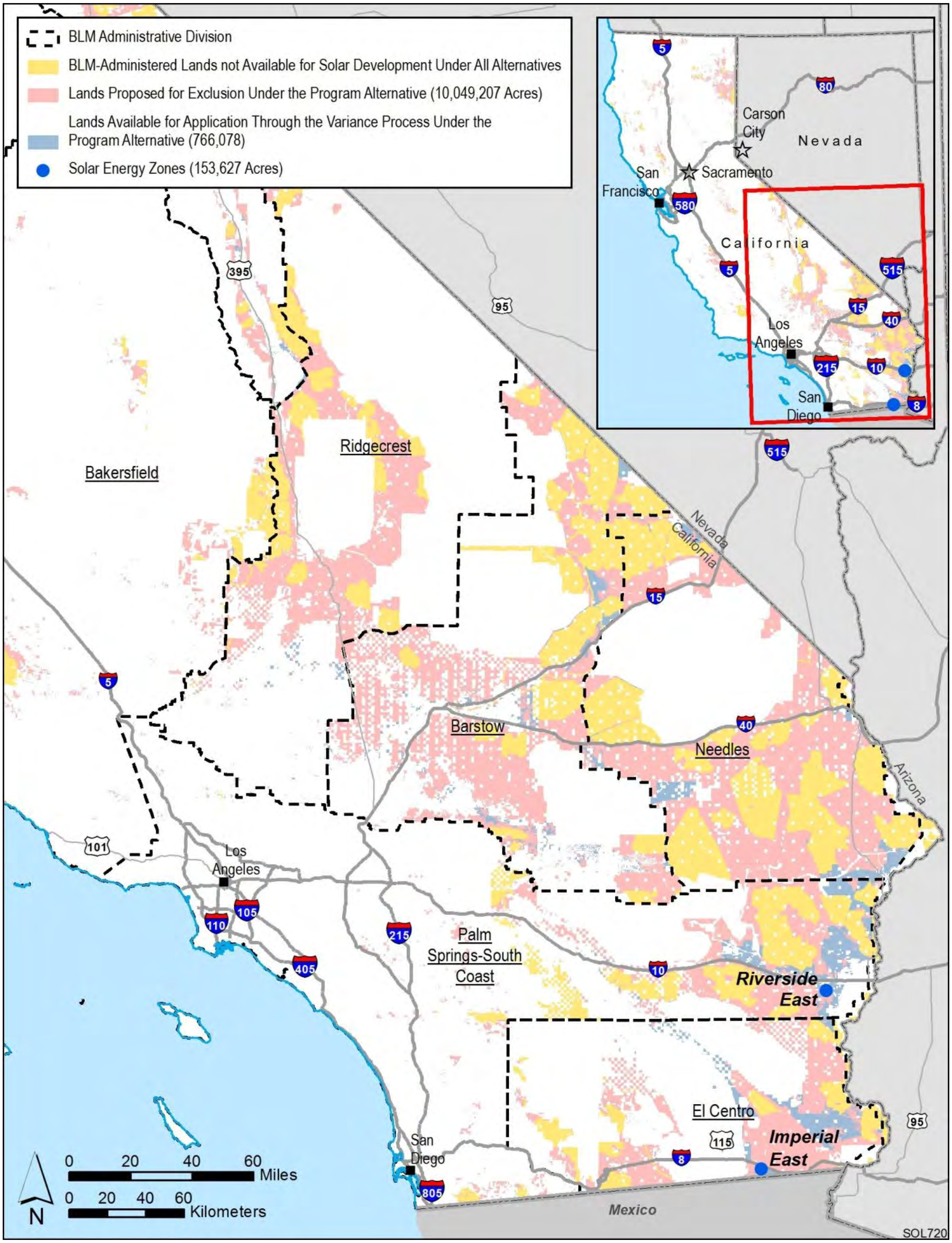


FIGURE ES.2-3 BLM-Administered Lands in California Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

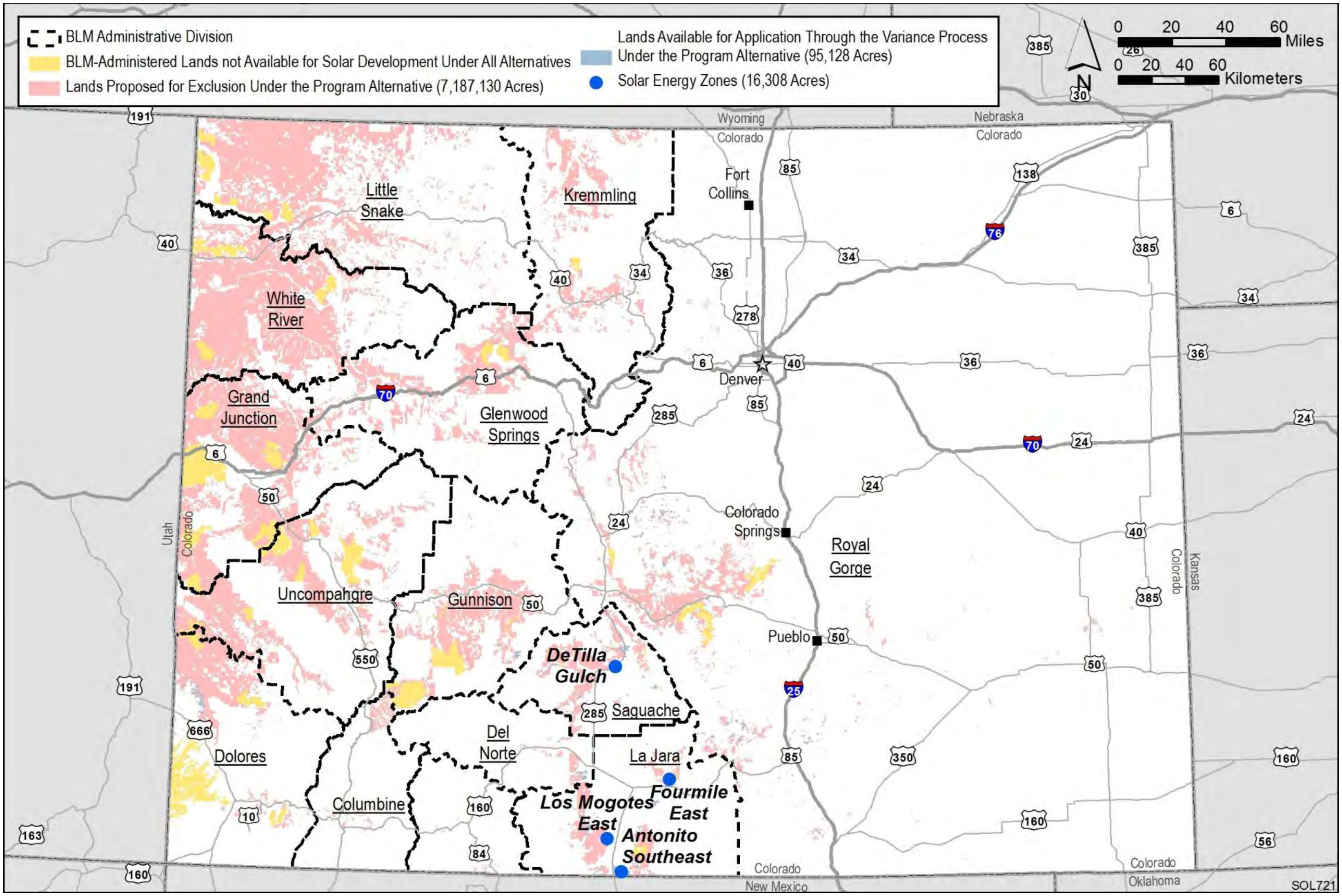


FIGURE ES.2-4 BLM-Administered Lands in Colorado Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

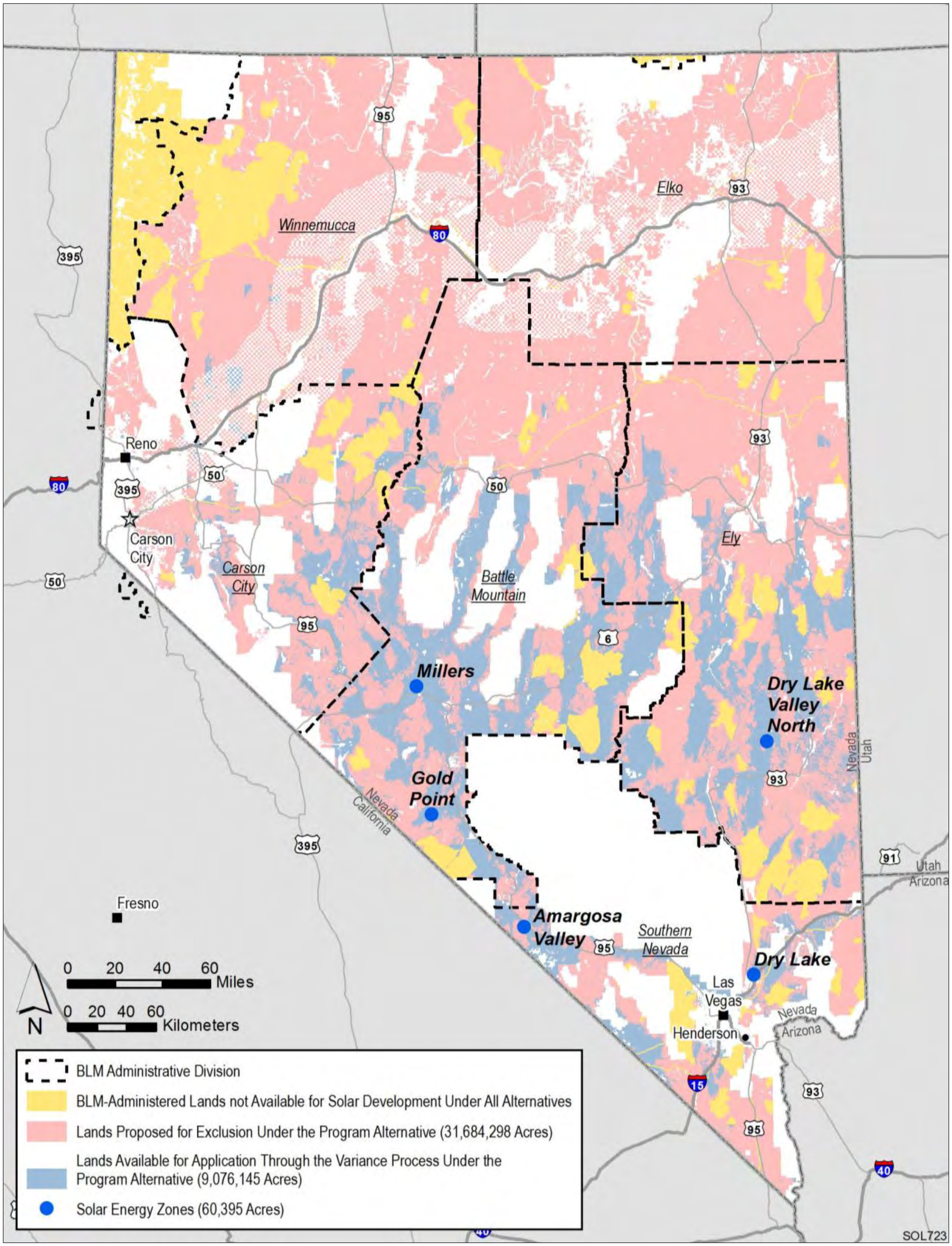


FIGURE ES.2-5 BLM-Administered Lands in Nevada Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

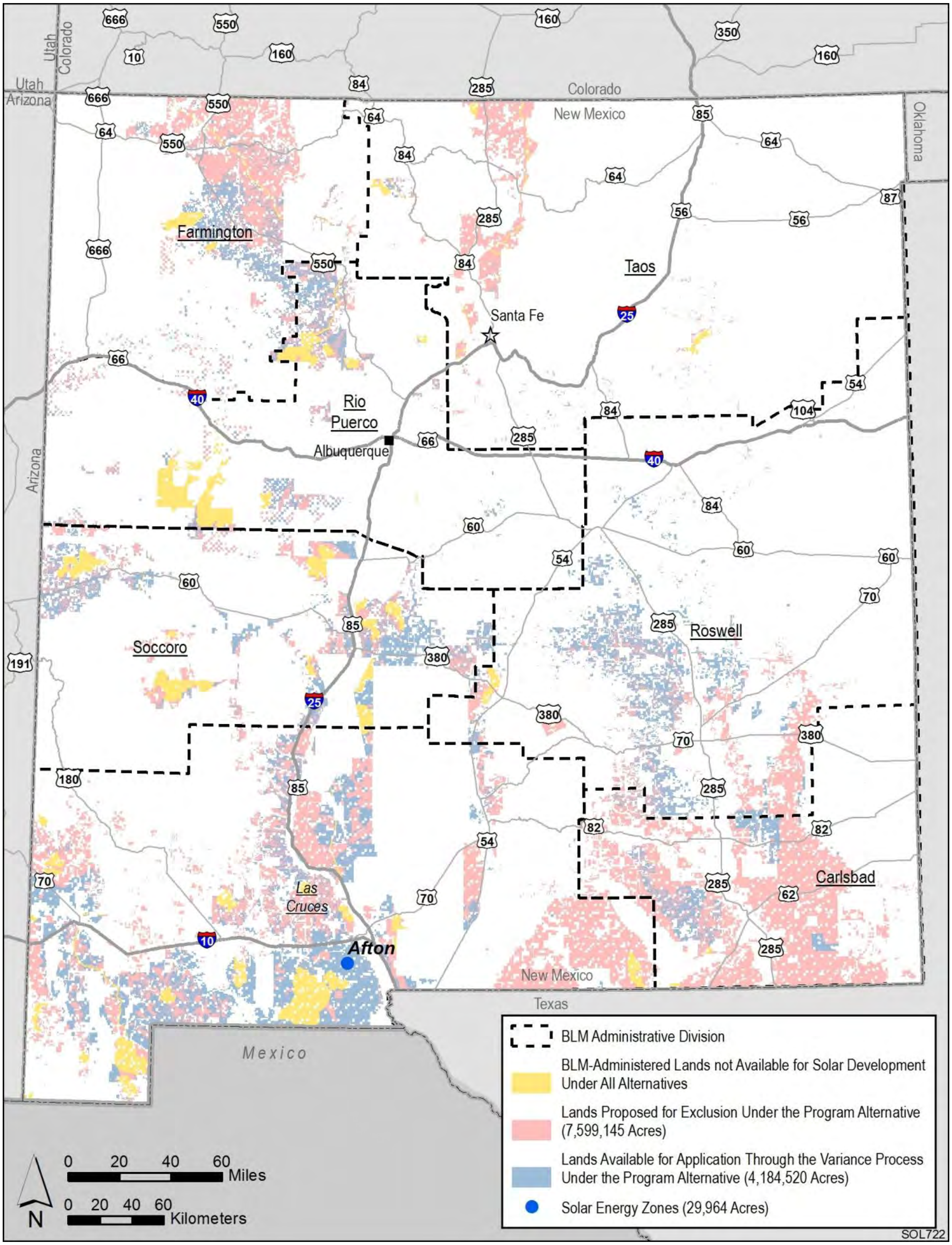


FIGURE ES.2-6 BLM-Administered Lands in New Mexico Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

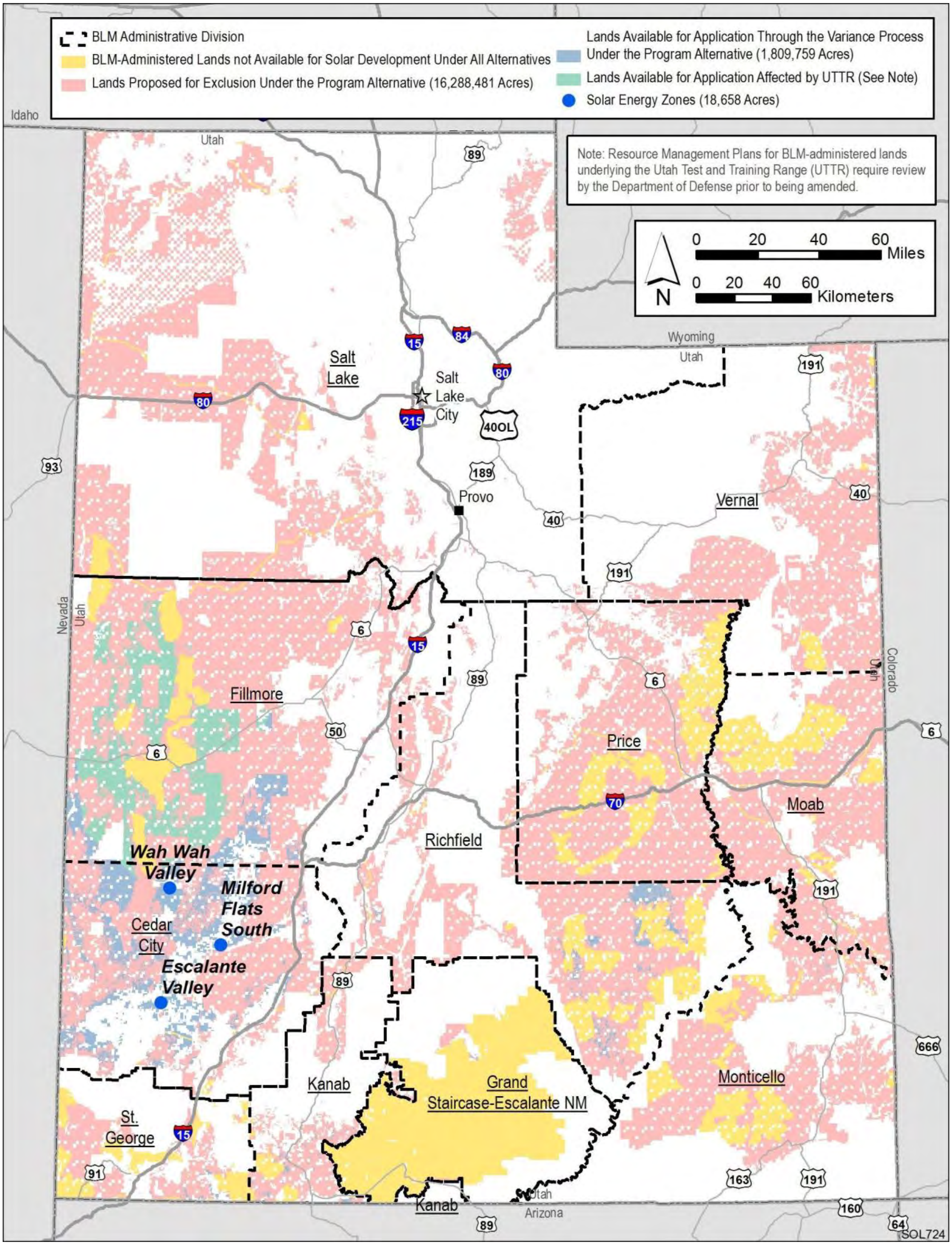


FIGURE ES.2-7 BLM-Administered Lands in Utah Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS at the low cost to the government, developers, and stakeholders. Simultaneously, it would provide a comprehensive approach for ensuring that potential adverse impacts would be minimized. The expected increased pace of development would accelerate the rate at which the economic benefits would be realized at the local, state, and regional levels. This alternative would make an adequate amount of suitable lands available to support the level of development projected in the RFDS and would provide flexibility in siting both solar energy facilities and associated transmission infrastructure. In addition, the program alternative would be effective at facilitating development on BLM-administered lands in accordance with the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

ES.3 DOE PROPOSED ACTION

As discussed in Chapter 1, different offices within DOE address different aspects and/or approaches to the mission of solar power development. For example, the DOE SunShot Initiative is a collaborative national initiative (including the Office of Energy Efficiency and Renewable Energy [EERE], Advanced Research Projects Agency – Energy [ARPA-E], and the Office of Science) to make solar energy cost competitive with other forms of energy by the end of the decade. One aspect of EERE’s mission in support of SunShot is to provide technical assistance and funding for solar technology research and development. EERE’s Solar Energy Technologies Program (Solar Program) is working to improve the efficiency and reduce the cost of solar technology through research, development, and demonstration (in partnership with industry, universities, and National Laboratories). The Solar Program also facilitates the deployment of solar technology through resource assessment; development of codes and standards; market and policy analysis; and by providing technical information to national, state, and local entities. DOE is also evaluating its sites around the country for suitability for various renewable energy technologies, including solar. The DOE’s National Nuclear Security Administration (NNSA) is evaluating a generic commercial solar power installation in the Nevada National Security Site Site-Wide Environmental Impact Statement (NNSS SWEIS; DOE/EIS-0426), which is scheduled for completion in 2012. In addition, DOE’s Loan Guarantee Program is available to provide financial support for the development of qualifying renewable energy projects, including solar energy projects implemented at utility scale.

DOE’s Western Area Power Administration (Western) markets and transmits wholesale electrical power through an integrated 17,000-circuit mile, high-voltage transmission system across 15 western states, including parts of the six-state study area for this PEIS. Western’s Open Access Transmission Service Tariff provides open access to its transmission system. With respect to new utility-scale solar energy facilities, any interconnection between such a facility and the Western transmission system would need to comply with Western’s interconnection policies and environmental requirements and would require NEPA review in accordance with DOE’s NEPA regulations.

While solar technologies generally are considered to be clean and sustainable, they can result in adverse direct and indirect impacts on the environment, especially utility-scale facilities. DOE is interested in exploring new ways to generate and store energy captured from the sun, while minimizing the impacts of solar development on the environment and reducing the cost of solar energy development. DOE is committed to supporting the development of solar and renewable energy projects in an environmentally responsible manner.

Through this PEIS, DOE is considering actions to develop new guidance that will further facilitate utility-scale solar energy development and minimize the associated potential environmental impacts. DOE would consider this guidance, including recommended environmental practices and mitigation measures, in its investment and deployment strategies and decision-making process. This guidance would provide DOE with a tool for making more informed, environmentally sound decisions on DOE-supported solar projects.

ES.3.1 DOE Purpose and Need

As discussed in Chapter 1, DOE is required to take actions to meet mandates under E.O. 13212, E.O. 13514, "Federal Leadership in Environmental, Energy, and Economic Performance" (*Federal Register*, Volume 74, page 52117, Oct. 5, 2009), and Section 603 of the Energy Independence and Security Act of 2007 (EISA) (P.L. 109-58). DOE's purpose and need is to satisfy both E.O.s and comply with congressional mandates to promote, expedite, and advance the production and transmission of environmentally sound energy resources, including renewable energy resources and, in particular, cost-competitive solar energy systems at the utility scale.

Western's purpose and need for participating in this PEIS is to identify potential transmission impacts and recommend mitigation measures for transmission lines associated with solar energy projects. Western anticipates using the transmission environmental impact and mitigation measures analysis in this PEIS to streamline its own NEPA documents once specific projects are identified and interconnection requests are filed with Western. With the PEIS providing the basis for this analysis, project-specific NEPA documentation for interconnections should be more concise and take less time to prepare, resulting in efficiencies for both Western and the project proponent.

ES.3.2 DOE Scope of Analysis

The geographic scope of applicability for DOE's proposed guidance includes both BLM-administered lands and other lands. DOE may support solar projects within SEZs identified by the BLM; on other BLM-administered lands; or on other federal, state, tribal, or private lands. Similarly, Western may be involved in associated transmission development on lands administered by any of these entities.

The scope of the impact analysis includes an assessment of the environmental, social, and economic impacts of utility-scale solar facilities and required transmission connections from these facilities to the existing electricity transmission grid. Viable solar technologies considered likely to be deployed over the next 20 years and assessed in this Solar PEIS include parabolic trough, power tower, dish engine systems, and PV.

ES.3.3 DOE Alternatives

Through this PEIS, DOE is evaluating two alternatives: an action alternative (proposed action) and a no action alternative.

ES.3.3.1 Action Alternative (DOE Preferred Alternative)

The proposed action (action alternative) is DOE's preferred alternative. Under the proposed action (action alternative), DOE would adopt programmatic environmental guidance for use in DOE-supported solar projects. In the Draft Solar PEIS, DOE presented its plans to develop such guidance; the Supplement to the Draft Solar PEIS presented the proposed guidance. The guidance is again described and analyzed in Sections 2.3 and Chapter 7 of this Final Solar PEIS.

DOE has many offices and sites that may fund or implement solar power programs or projects, including 20 National Laboratories and Technology Centers, 4 Power Marketing Administrations, and 10 Operations Offices. As a result, DOE has no single Solar Program analogous to that of the BLM Solar Program. Instead, individual DOE offices and sites would consider any future programmatic guidance in the context of their specific goals and responsibilities. DOE also would consider other factors such as specific congressional funding authorizations and legislated goals. In addition, under either alternative, every proposed DOE project or action would undergo the appropriate level of environmental review under NEPA, and DOE would undertake required consultations under Section 7 of the ESA and Section 106 of the NHPA, and comply with any other legal requirements.

ES.3.3.2 No Action Alternative

Under the no action alternative, DOE would continue its existing process for addressing environmental concerns for solar projects supported by DOE without the benefit of the proposed guidance. It would not adopt programmatic environmental guidance with recommended environmental best management practices and mitigation measures that could be applied to all DOE-supported solar projects.

ES.3.4 Summary of Impacts of DOE's Alternatives

The proposed guidance presented in Section 2.3 is intended to better enable DOE to comprehensively determine where to make technology and resource investments to minimize the environmental impacts of solar technologies for DOE-supported solar projects.

DOE could also consider the proposed guidance in establishing environmental mitigation recommendations to be considered by project proponents. The recommendations contained in the guidance, which are based upon the analysis of impacts of solar energy development and potentially applicable mitigation measures presented in Chapter 5 of the Draft and Final Solar

PEIS, would help DOE ensure that adverse environmental impacts of DOE-supported solar projects would be avoided, minimized, and/or mitigated.

Collectively, streamlined environmental reviews and quicker project approval processes would likely increase the pace of DOE-sponsored development and reduce the costs to industry, regulatory agencies, and stakeholders. These outcomes would support the mandates of E.O.s 13212 and 13514 and Section 603 of EISA.

Increasing the pace of solar energy development would, in turn, translate into other benefits. Utility-scale solar energy development would result in reduced emissions of greenhouse gases (GHGs) and combustion-related pollutants, if the development offsets electricity generation by fossil fuel power plants (see Section 5.11.4 of the Draft and Final Solar PEIS).[6] If the pace of solar energy development is faster as a result of DOE's proposed action, the potential beneficial impacts of reduced GHG emissions would be realized at a faster rate.

Utility-scale solar energy development would result in local and regional economic benefits in terms of both jobs and income created (see Section 5.17.2 of the Draft Solar PEIS). The associated transmission system development and related road construction would also produce new jobs and income. These benefits would occur as both direct impacts, resulting from wages and salaries, procurement of goods and services, and collection of state sales and income taxes, and indirect impacts, resulting from new jobs, income, expenditures, and tax revenues subsequently created as the direct impacts circulate through the economy. Increasing the pace of solar energy development would cause these economic benefits to be realized at a faster pace as well.

As discussed in Section 5.17.1.1 of the Draft Solar PEIS, there may be some adverse socioeconomic impacts resulting from changes in recreation, property values, and environmental amenities (e.g., environmental quality, rural community values, or cultural values), and disruption potentially associated with solar development. There could also be beneficial socioeconomic impacts in these areas resulting from economic growth and a positive reception to the presence of a renewable energy industry. Increasing the pace of solar energy development would also speed up the pace of these types of socioeconomic changes. At the programmatic level, it is difficult to quantify these impacts.

In summary, the proposed programmatic guidance that DOE has developed under its proposed action would likely minimize the potential adverse environmental impacts of solar energy development for DOE-supported projects. As a result of adopting this guidance in various DOE solar-related programs, the pace of solar energy development could increase.

---

[6] The agencies have decided to prepare a condensed Final Solar PEIS (see Section 1.7). Several key chapters of the Draft Solar PEIS have been revised extensively and are presented in full in this Final Solar PEIS (e.g., Chapters 1, 2, 6, and 7). Other sections of this Final Solar PEIS (including Chapter 5) are presented as updates to the Draft Solar PEIS. The Final Solar PEIS is intended to be used in conjunction with the Draft Solar PEIS, which is being distributed electronically together with the Final PEIS.

Under the no action alternative, DOE would continue its existing process for addressing environmental concerns for DOE-supported solar projects. It would not adopt programmatic environmental guidance to apply to DOE-supported solar projects. As a result, DOE would not undertake specific efforts to programmatically promote the reduction of environmental impacts of solar energy development or streamline environmental reviews for DOE-supported projects. Such achievements, and the potential benefits in terms of increased pace of solar energy development and decreased associated costs, might occur under the no action alternative, but they would not be programmatically promoted by DOE (by adoption of programmatic environmental guidance with recommended environmental practices and mitigation measures).

ES.4 PUBLIC INVOLVEMENT, CONSULTATION, AND COORDINATION

There has been extensive opportunity for public involvement during the preparation of this Solar PEIS. Initially, a Notice of Intent (NOI) to prepare this PEIS was published in Volume 73, page 30908 of the *Federal Register* on May 29, 2008. This notice initiated the first scoping period, which lasted from May 29 to July 15, 2008. During that period, the BLM and DOE invited the public to provide comments on the scope and objectives of the PEIS, including identification of issues and alternatives that should be considered in the PEIS analyses. Public meetings were held at 11 locations across the 6 states. Comments were also collected via the Solar PEIS project Web site (http://solareis.anl.gov) and by mail. A second scoping period was announced through a NOA of Maps and Additional Public Scoping published in the *Federal Register* (Volume 74, page 31307) on June 30, 2009. During this scoping period, the agencies solicited comments about environmental issues, existing resource data, and industry interest with respect to 24 proposed solar energy study areas (later the terminology was changed to solar energy zones, or SEZs). Public comments were collected via the project Web site and by mail. It is estimated that approximately 15,900 individuals, organizations, and government agencies provided comments during the first scoping process and approximately 300 entities provided comments during the second scoping process. The results of the first scoping process were documented in a report issued in December 2008 (DOE and BLM 2008). The comments received during the second scoping process are summarized in Chapter 14 of the Draft Solar PEIS.

After publication of the Draft Solar PEIS in December of 2010, 14 public meetings were held in the six-state study area between January and March 2011. More than 86,000 comments were received. The public, as well as many cooperating agencies and key stakeholders, offered suggestions on how the BLM and DOE could increase the utility of the document, strengthen elements of the proposed Solar Energy Program, and increase certainty regarding solar energy development on BLM-administered lands. These comments were considered in preparation of the Supplement to the Draft Solar PEIS, published in October of 2011. The Agencies held five public meetings in the study area between November 2011 and January 2012 to present the new information provided in the Supplement. During the public comment period on the Supplement to the Draft Solar PEIS, more than 134,000 comments were received.

Comments received on the Solar PEIS documents have largely fallen into several key categories: policy; expressions of support or opposition to the alternatives; environmental, socioeconomic, and siting concerns; technology; stakeholder involvement; cumulative impact analyses; impact mitigation; coordination with ongoing regional, state, and local planning efforts; and information on resources present in and around the SEZs.

In addition to public scoping, the BLM initiated government-to-government consultation with 316 tribes, chapters, and bands with a potential interest in solar energy development on BLM-administered lands in the six-state study area. The BLM also is coordinating with appropriate agencies in accordance with the requirements of Section 106 of the NHPA and Section 7 of the ESA.

Nineteen federal, state, and local government agencies, identified in Section 1.5, are working with the BLM and DOE as cooperating agencies. As cooperators, these agencies have been involved in the development of the Draft Solar PEIS, the Supplement to the Draft Solar PEIS, and the Final Solar PEIS.

All the documents published by the Agencies in connection with this Solar PEIS (e.g., the Draft and Final Solar PEIS and the Supplement to the Draft; existing applicable BLM policies; and *Federal Register* notices) are available on the Solar PEIS project Web site (http://solareis.anl.gov), along with supporting maps and geospatial data.

ES.5 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

BLM (Bureau of Land Management), 2005, *Land Use Planning Handbook*, H-1601-1, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., March.

BLM and DOE (BLM and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

DOE and BLM, 2008, *Summary of Public Scoping Comments Received during the Scoping Period for the Solar Energy Development Programmatic Environmental Impact Statement*, Washington, D.C., Oct.

Secretary of the Interior, 2010, "Renewable Energy Development by the Department of the Interior," Amendment No. 1 to Secretarial Order 3285, Feb. 22. Available at http://elips.doi.gov/app_so/act_getfiles.cfm?order_number=3285A1.

This page intentionally left blank.

1 INTRODUCTION

On December 17, 2010, the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and U.S. Department of Energy (DOE) working jointly as lead agencies published a *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* (Solar PEIS [BLM and DOE 2010]); the Notice of Availability (NOA) was published in the *Federal Register,* Volume 75, page 78980. During the comment period, the public, as well as many cooperating agencies and key stakeholders, offered suggestions on how the BLM and DOE could increase the utility of the analysis, strengthen elements of BLM's proposed Solar Energy Program, and increase certainty regarding solar energy development on BLM-administered lands. Subsequently, on October 28, 2011, the lead agencies published a Supplement to the Draft Solar PEIS (BLM and DOE 2011) (the NOA was published in the *Federal Register,* Volume 76, page 66958), in which adjustments were made to elements of the proposed Solar Energy Program and to guidance for facilitating utility-scale solar energy development to better meet the BLM and DOE's solar energy objectives.

A number of Executive Orders (E.O.s), Congressional mandates, and federal agency orders and policies promote expedited and concentrated federal action supporting the development of domestic renewable energy resources. The BLM and DOE are taking actions in support of U.S. renewable energy goals and objectives for solar energy development as described in this PEIS.

The BLM is evaluating further actions that will facilitate utility-scale solar energy development[1] on public lands. Multiple orders and mandates establish requirements for the DOI related to renewable energy development (see Section 1.1). Through the Solar PEIS, the BLM is considering replacing certain elements of its existing solar energy policies with a comprehensive Solar Energy Program that would allow the permitting of future solar energy development projects on public lands to proceed in a more efficient, standardized, and environmentally responsible manner.

DOE is considering actions to develop new guidance that will further facilitate utility-scale solar energy development and maximize the mitigation of associated environmental impacts. DOE would consider this guidance, including recommended environmental practices and mitigation measures, in its investment and deployment strategies and decision-making process. This guidance would provide DOE with a tool for making more informed, environmentally sound decisions on DOE-supported solar projects.

This PEIS evaluates the potential environmental, social, and economic effects of the agencies' proposed actions and alternatives in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality's (CEQ's) regulations for implementing NEPA (Title 40, Parts 1500–1508 of the *Code of Federal Regulations*

[1] Utility-scale facilities are defined as projects that generate electricity that is delivered into the electricity transmission grid, generally with capacities greater than 20 megawatts (MW).

[40 CFR Parts 1500–1508]), and applicable BLM and DOE authorities.[2] Programmatic NEPA analyses are broadly scoped analyses that assess the environmental impacts of federal actions across a span of conditions, such as facility types, geographic regions, or multiproject programs. The BLM and DOE have prepared this document in accordance with NEPA, as amended; the CEQ regulations for implementing NEPA cited above; the DOI and DOE regulations for implementing NEPA (43 CFR Part 46 and 10 CFR Part 1021, respectively); as well as the Federal Land Policy and Management Act of 1976 (FLPMA) (*United States Code*, Title 43, Section 1701 et seq. [43 USC 1701 et seq.]), as amended.

The following sections provide information about applicable federal orders and mandates; solar energy technologies and resources evaluated in the scope of this PEIS; the objectives, requirements, and scope of analyses for the BLM and DOE; the participation of cooperating agencies; the relationship of the proposed programs and strategies evaluated by this PEIS to other programs, policies, and plans; and the organization of the PEIS chapters and appendices.

1.1 APPLICABLE FEDERAL ORDERS AND MANDATES

The following orders and mandates, presented in chronological order, establish requirements for the BLM and/or DOE related to renewable energy development. They provide the drivers for specific actions being taken or being proposed by these agencies to facilitate solar energy development.

1.1.1 Executive Order 13212

On May 18, 2001, the President signed E.O. 13212, "Actions to Expedite Energy-Related Projects," which states that "the increased production and transmission of energy in a safe and environmentally sound manner is essential" (*Federal Register,* Volume 66, page 28357, May 22, 2001]). Executive departments and agencies are directed to "take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy." Executive Order 13212 further states that "For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections. The agencies shall take such actions to the extent permitted by law and regulation and where appropriate."

---

2 For the BLM, these authorities include the BLM's NEPA Handbook (BLM 2008), DOI's NEPA Implementing Procedures (43 CFR Part 46), and Chapter 11 of the DOI's Departmental Manual (DM) 516 (DOI 2008). For DOE, these authorities include DOE's NEPA Implementing Procedures (10 CFR Part 1021) and the Floodplain and Wetland Environmental Review Requirements (10 CFR Part 1022).

1.1.2 Energy Policy Act of 2005

On August 8, 2005, the Energy Policy Act of 2005 (Public Law [P.L.] 109-58) was signed into law. Section 211 of the Act states, "It is the sense of the Congress that the Secretary of the Interior should, before the end of the 10-year period beginning on the date of enactment of this Act, seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity." To date, the BLM has approved 43 geothermal projects with a total generation capacity of 1,350 megawatts (MW), 32 wind projects with a total capacity of 1,221 MW, and 11 solar projects with a total capacity of 4,512 MW. Other applications that are being processed could contribute to this goal.

1.1.3 Energy Independence and Security Act of 2007

On December 19, 2007, the Energy Independence and Security Act of 2007 (EISA) (P.L. 110-140) was signed into law. Section 603 of the EISA requires DOE to assess methods to integrate electric power generated at utility-scale solar facilities into regional electricity transmission systems and to identify transmission system expansions and upgrades needed to move solar-generated electricity to growing electricity demand centers throughout the United States. In addition, this section requires DOE to consider methods to reduce the amount of water consumed by concentrating solar power (CSP) systems.

1.1.4 DOI Secretarial Order 3285A1

On March 11, 2009, the Secretary of the Interior issued Secretarial Order 3285, which announced a policy goal of identifying and prioritizing specific locations best suited for large-scale production of solar energy on public lands (Secretary of the Interior 2009). The Secretarial Order requires DOI agencies and bureaus to work collaboratively with each other and with other federal agencies, individual states, tribes, local governments, and other interested stakeholders, including renewable energy generators and transmission and distribution utilities, to encourage the timely and responsible development of renewable energy and associated transmission, while protecting and enhancing the nation's water, wildlife, and other natural resources; to identify appropriate areas for generation and necessary transmission; to develop best management practices for renewable energy and transmission projects on public lands to ensure the most environmentally responsible development and delivery of renewable energy; and to establish clear policy direction for authorizing the development of solar energy on public lands. On February 22, 2010, Secretarial Order 3285 was amended to clarify Departmental roles and responsibilities in prioritizing development of renewable energy. The amended order is referred to as Secretarial Order 3285A1 (Secretary of the Interior 2010a).

The BLM, consistent with Secretarial Order 3285A1, is seeking to establish a comprehensive Solar Energy Program through the Solar PEIS that would allow the permitting of solar energy development projects on public lands to proceed in an efficient, standardized, and environmentally responsible manner, including the identification of areas best suited for utility-scale solar development. As a land management agency with a multiple-use mission, the BLM must make land use decisions that sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The BLM recognizes that the six southwestern states included in the Solar PEIS study area are rich in values and resources, which may limit the placement of solar facilities and their related infrastructure. The BLM also recognizes that for solar energy development to be successful, it must be consistent with the protection of other important areas, including units of the National Park System, National Wildlife Refuges (NWRs), and other specially designated areas. Such resource areas include almost 70 NWRs, more than 60 national park areas, and about 50 national forests, as well as hundreds of miles of national scenic and historic trail corridors. All of these areas were created under federal law as nationally significant resource areas.

1.1.5 Executive Order 13514

On October 5, 2009, the President signed E.O. 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," which requires that federal agencies take efforts to align their policies to advance local planning efforts for energy development, including renewable energy (*Federal Register,* Volume 74, page 52117, Oct. 5, 2009). Specifically, the order states that agencies shall "…advance regional and local integrated planning by…aligning Federal policies to increase the effectiveness of local planning for energy choices such as locally generated renewable energy."

1.1.6 DOI Secretarial Order 3297

On February 22, 2010, the Secretary of the Interior issued Secretarial Order 3297, which announced a new water sustainability strategy that centers on protecting water supplies by establishing federal leadership and assistance on the efficient use of water, integrating water and energy policies to support the sustainable use of all natural resources, and coordinating the water conservation activities of the various DOI bureaus and offices (Secretary of the Interior 2010b). The Secretarial Order acknowledges that water plays an important role in the development of both conventional and renewable energy and requires bureaus to develop criteria that identify and support projects and actions that promote sustainable water strategies.

The BLM, consistent with Secretarial Order 3297, recognizes that solar energy development may affect water supplies and will examine the water impacts associated with proposed development on a site-specific basis utilizing the guidance provided in this Solar PEIS.

1.2 OVERVIEW OF SOLAR ENERGY TECHNOLOGIES AND RESOURCES CONSIDERED IN THE PEIS

The scope of the PEIS includes analyses of the use of multiple solar energy technologies at utility scale over the next 20 years on lands within six southwestern states—Arizona, California, Colorado, Nevada, New Mexico, and Utah—where the solar energy resources are among the best in the United States.

Several technologies are currently in use and are being refined for the utility-scale capture of solar energy (i.e., ≥20 MW). The technologies evaluated in this PEIS are CSP, which includes parabolic trough, power tower, and dish engine systems, and photovoltaic (PV) (see Section 3.1 of the Draft Solar PEIS for details on these technologies). The main component that all the technologies have in common is a large solar field where solar collectors capture the sun's energy. In the parabolic trough and power tower systems, the energy is concentrated in a heat transfer fluid (HTF) and transferred to a power block, where steam-powered turbine systems generate electricity using similar technology to that used in fossil fuel–fired power plants. In contrast, the dish engine and PV systems are composed of many individual units or modules that generate electricity directly and whose output is combined; these systems do not use a central power block. Figure 1.2-1 shows a typical solar field for each of these technology types.

Commercially feasible utility-scale solar energy development requires adequate direct normal insolation (DNI) and large areas of land. Under clear sky conditions, about 85% of the sunlight is DNI, and 15% is scattered light that comes in at many different angles. DNI can be used by all solar energy systems, whereas the scattered light can only be used by PV systems. Because the solar resources in the six-state study area have high solar insolation levels, they are highly suitable for utility-scale solar power plants. Direct normal insolation levels in the six-state study area are depicted in Figure 1.2-2; DNI levels greater than or equal to 6.5 $kWh/m^2/day$ are generally considered to be optimal for solar development.

The scope of this PEIS is limited to utility-scale solar development, in part, because the Energy Policy Act of 2005 and DOI Secretarial Order 3285A1 require that the BLM take steps to facilitate development at that scale (see Section 1.1). The development of distributed generation, small-scale solar energy facilities, such as roof-top mounted PV systems, is not included in the scope of this PEIS. While such solar energy development will be an important component of future electricity supplies (and is the focus of separate DOE initiatives; see Section 2.5.1), current research indicates that the development of both distributed generation and utility-scale solar power will be needed, along with other energy resources and energy efficiency technologies (NREL 2010c). One analysis of available roof space concluded that up to 23% of required electricity supplies could be met with roof-top PV systems, although integrating PV into the electric grid at levels that high could be challenging (Denholm and Margolis 2008). Further, because these systems typically do not include electricity storage, they cannot provide power during the evenings or at night, and the power output can fluctuate significantly during cloudy weather. As a result, buildings equipped with roof-top PV systems remain dependent on the transmission grid, and electric utilities must maintain adequate generating capacity to provide electricity to these customers when needed. Ultimately, both utility-scale and distributed-generation solar power will need to be deployed at increased levels, and the highest penetration of solar power overall will require a combination of both types (NREL 2010c).

1.3 BLM REQUIREMENTS AND OBJECTIVES FOR THE PEIS

The BLM has identified utility-scale solar energy development on public lands as a potentially important component in meeting the nation's energy goals and objectives and

FIGURE 1.2-1 Typical Solar Fields for Various Technology Types: (a) Solar Parabolic Trough (Source: Hosoya et al. 2008), (b) Solar Power Tower (Credit: Sandia National Laboratories. Source: NREL 2010a), (c) Dish Engine (Credit: R. Montoya. Source: Sandia National Laboratories 2008), and (d) PV (Credit: Arizona Public Service. Source: NREL 2010b)

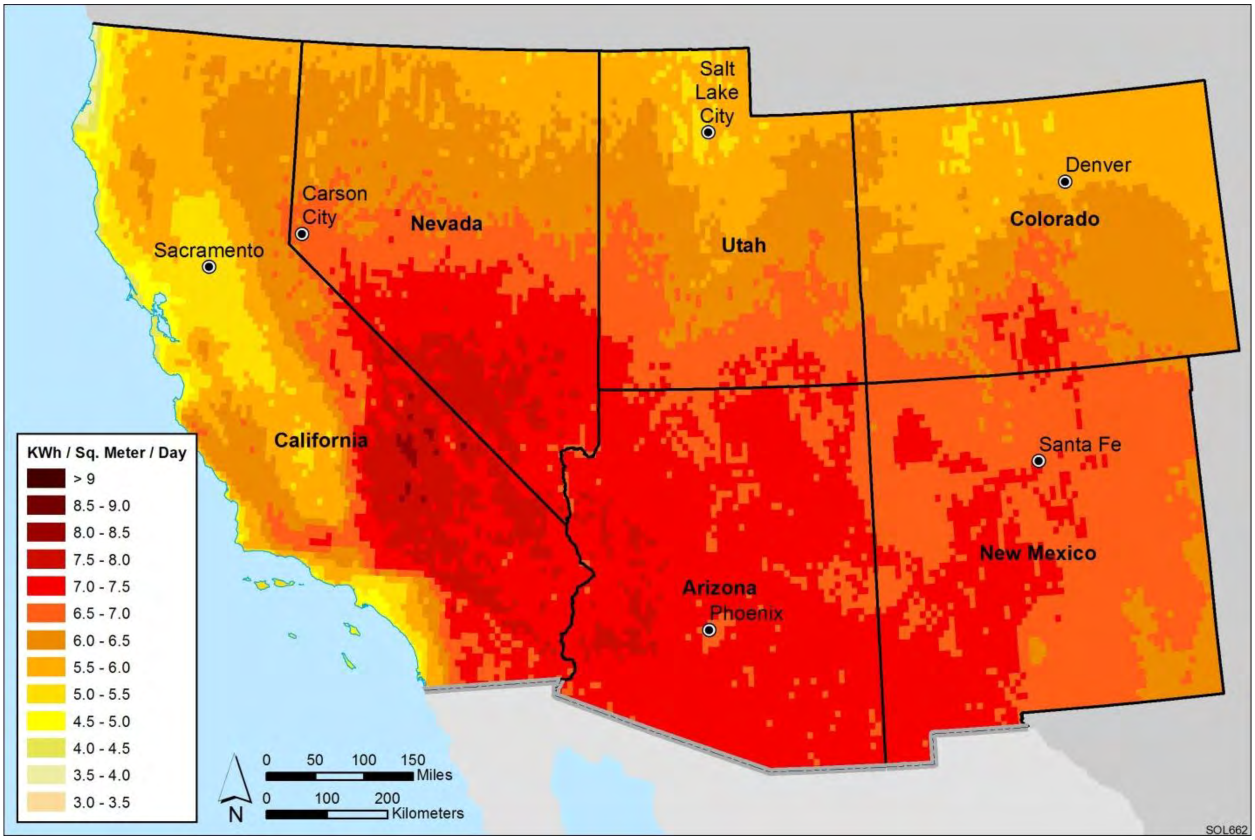


FIGURE 1.2-2 Solar Direct Normal Insolation Levels in the Southwestern United States

applicable orders and mandates (see Section 1.1). The BLM administers approximately 245 million acres (>1 million km^2) of public lands in 11 western states and Alaska. This administrative responsibility encompasses stewardship, conservation, and resource use, including the development of energy resources in an environmentally sound manner.

The BLM developed and issued a Solar Energy Development Policy in 2007 (BLM 2007) to address increased interest in solar energy development on BLM-administered lands and to implement goals to construct renewable energy facilities on public lands. This 2007 policy established procedures for processing right-of-way (ROW) applications for solar energy development projects on public lands administered by the BLM in accordance with the requirements of FLPMA and BLM's implementing regulations (43 CFR Part 2800), and for evaluating the feasibility of installing solar energy systems on BLM administrative facilities. This policy was updated in 2010 by two more detailed policies that established a maximum term for authorizations, diligent development requirements, bond coverage, potential best management practices for solar energy development projects, and interim guidance on how to calculate rent for utility-scale solar energy facilities (BLM 2010a,b). In 2011, the BLM issued additional policies relating to solar and wind energy development that addressed NEPA compliance, due diligence requirements, pre-application and screening processes, involvement of grazing permittees and lessees, segregating applications, and Native American consultation (BLM 2011a–f).[3]

The BLM's current practice is to evaluate solar energy ROW applications on a project-by-project basis. Many of BLM's land use plans do not specifically address solar energy development; therefore, projects that are not in conformance with the existing land use plan require individual land use plan amendments. Moreover, the BLM does not have a standard set of mitigation measures that would be applied consistently to all solar energy development projects.

The BLM is developing this PEIS to evaluate a comprehensive Solar Energy Program to further support utility-scale solar energy development on BLM-administered lands, as detailed below.

1.3.1 BLM's Purpose and Need

The BLM has identified a need to respond in a more efficient and effective manner to the high interest in siting utility-scale solar energy development on public lands and to ensure consistent application of measures to avoid, minimize, and mitigate the potential adverse impacts of such development. The BLM is therefore considering replacing certain elements of its existing solar energy policies with a comprehensive Solar Energy Program that would allow the permitting of future solar energy development projects to proceed in a more efficient, standardized, and environmentally responsible manner. While the proposed Solar Energy Program will further the BLM's ability to meet the mandates of E.O. 13212 and the Energy Policy Act of 2005, it also has been designed to meet the requirements of Secretarial Order 3285A1 (Secretary of the Interior 2010a) regarding the identification and prioritization of specific locations best suited for utility-scale solar energy development on public lands (see Section 1.1 for summaries of these orders and mandates).

In an effort to delineate areas best suited for utility-scale solar energy development, the BLM identified and analyzed proposed solar energy zones (SEZs) through the Draft Solar PEIS and the Supplement to the Draft to determine their suitability for solar energy development. On the basis of further data collection, consultation with land and resource managers, and comment analysis, the BLM has eliminated some proposed SEZs from further analysis and refined the boundaries of other SEZs. Most of these changes were reflected in the Supplement to the Draft Solar PEIS and are being carried forward into this Final Solar PEIS; some additional changes not presented in the Supplement were made for the Final Solar PEIS.

The objectives of BLM's proposed Solar Energy Program include the following:

- Facilitate near-term utility-scale solar energy development on public lands;

[3] All BLM Instruction Memoranda related to solar energy development are available for review on the Solar PEIS project Web site (http://solareis.anl.gov).

- Minimize potential negative environmental impacts;

- Minimize potential negative social and economic impacts;

- Provide flexibility to the solar industry to consider a variety of solar energy projects (location, facility size, technology, etc.);

- Optimize existing transmission infrastructure and corridors;

- Standardize and streamline the authorization process for utility-scale solar energy development on BLM-administered lands; and

- Meet projected demand for solar energy development.

The elements of BLM's proposed Solar Energy Program include the following:

1. Commitment to process pending applications for utility-scale solar energy development that meet due diligence and siting provisions under existing land use plans and other policies and procedures;

2. Identification of lands to be excluded from utility-scale solar energy development in the six-state study area;

3. Identification of priority areas (i.e., SEZs) that are well suited for utility-scale production of solar energy in accordance with the requirements of Secretarial Order 3285A1 and the associated authorization procedures for applications in these areas;

4. Establishment of a process to identify new or expanded SEZs;

5. Establishment of a process that allows for responsible utility-scale solar energy development outside of SEZs (i.e., variance process).

6. Establishment of design features for solar energy development on public lands to ensure the most environmentally responsible development and delivery of solar energy; and

7. Amendment of BLM land use plans in the six-state study area to adopt those elements of the new Solar Energy Program that pertain to planning.

1.3.2 BLM Decisions To Be Made

On the basis of the analyses presented in this Final Solar PEIS, the BLM anticipates making the following land use planning decisions that will establish the foundation for a comprehensive Solar Energy Program. Changes in these land use planning decisions in the future will require the BLM to complete land use plan amendments and associated NEPA analyses.

1. Land use plan amendments that identify exclusion areas for utility-scale solar energy development in the six-state study area;

2. Land use plan amendments that identify priority areas for solar energy development that are well suited for utility-scale production of solar energy (i.e., SEZs);

3. Land use plan amendments that identify areas potentially available for utility-scale solar energy development outside of SEZs in the six-state study area (i.e., variance areas[4]); and

4. Land use plan amendments that establish required design features for solar energy development on public lands to ensure the most environmentally responsible development and delivery of solar energy (some may be SEZ-specific, as necessary).

In addition to the planning-level decisions outlined above, the BLM's Solar Energy Program will include a number of policy components, such as the variance process to address ROW applications for utility-scale solar energy development outside of SEZs, and incentives for projects proposed in SEZs. These components will be reflected in the Record of Decision (ROD) for the Solar PEIS; the BLM will issue subsequent Instruction Memoranda (IM), as necessary, to formally establish such policies. Where applicable, the BLM retains the ability to change policies associated with its Solar Energy Program through existing policy-making tools rather than through a future land use planning process.

On the basis of the analysis in this Final Solar PEIS, the Secretary of the Interior is also considering whether to withdraw the public lands encompassed by SEZs from potentially conflicting uses through the issuance of a Public Land Order. The required withdrawal studies and analyses are being completed as part of the Solar PEIS (see Section 2.2.2.2.4 of this Final PEIS for the status of the Public Land Order). The Secretary of the Interior's ROD for the withdrawal decision will be made separate from the BLM's ROD for the land use planning decisions analyzed by the Solar PEIS.

While the Solar PEIS considers the impacts of constructing, operating, and decommissioning the related infrastructure needed to support utility-scale solar energy development, such as roads, transmission lines, and natural gas or water pipelines, the land use plan decisions to be made (e.g., exclusions, SEZs, etc.) will be applicable only to utility-scale solar energy generation facilities. Management decisions for supporting infrastructure would continue to be made in accordance with existing land use plan decisions and current applicable

---

4 A variance area is defined by the BLM as an area that may be available for a solar ROW with special stipulations or considerations; see avoidance area in the *Land Use Planning Handbook* (BLM 2005a), Appendix C, page 21, Part E.9.

policy and procedures. Siting of supporting infrastructure would be fully analyzed in project-specific environmental reviews in accordance with NEPA. Such reviews would be completed in combination with solar generation facility environmental reviews as appropriate.

1.3.3 Authorization Process for Solar Energy Development on BLM Lands

Currently, applications for utility-scale solar energy facilities on BLM-administered lands are processed on a project-by-project basis as ROW authorizations issued in accordance with Title V of FLPMA and BLM's ROW regulations (43 CFR Part 2800). When the BLM authorizes the construction of utility-scale solar energy generation facilities on BLM-administered lands, it must comply with NEPA, the Endangered Species Act (ESA), the National Historic Preservation Act of 1966 (NHPA), and other applicable statutes and regulations. The BLM's project-specific environmental analysis must address all applicable components of the solar energy generation facility, including, as appropriate, the installation and maintenance of solar collectors, the availability and consumption of water for steam generation and cooling, oil or gas backup generators, the creation and use of thermal or electrical storage, turbines or engines, access roads, electrical inverters and transmission facilities, and water or natural gas pipelines. In addition, solar energy development must be in conformance with the existing, approved land use plan (see Section 1.3.4). The BLM's existing solar energy policies and proposed Solar Energy Program, if adopted, will help the BLM prevent unnecessary damage to the environment, including unnecessary or undue degradation of the public lands, and otherwise meet the objectives of BLM's ROW regulations (43 CFR 2801.2), by establishing sound environmental policies, procedures, and siting and mitigation strategies for solar energy development on the public lands.

As of May 31, 2012, the BLM had authorized 11 ROW applications for solar facilities to be located on BLM-administered lands and was working to process additional pending ROW applications for solar facilities (see Sections 1.3.3.2 and 1.3.3.3 for additional information). To date, the BLM has received more than 300 such applications. Many of these applications have been closed (denied or withdrawn) for various reasons, such as the developer withdrawing the application or because due diligence requirements were not met. In addition, some applications are not currently being processed because they describe lands already applied for by another company (referred to as "second-in-line" applications).

The BLM is committed to continued processing of all pending solar energy applications that meet due diligence and siting requirements under existing land use plans and other policies and procedures that the BLM has adopted or might adopt. Pending applications will not be subject to any new program elements adopted by the Solar PEIS ROD. All new applications, however, will be subject to the program elements adopted by the Solar PEIS ROD. The approach that the BLM will use for processing new and pending applications is summarized in Table 1.3-1.

TABLE 1.3-1 Processing Approach for New and Pending Applications

Application Location	Filing Date	Type	Processing Approach
Inside proposed SEZs	Before June 30, 2009	Pending	Continued processing under existing land use plans and policies
	After June 30, 2009	New	Subject to program elements in the Solar PEIS ROD, including competitive process
Outside proposed SEZs	Before publication of Supplement	Pending	Continued processing under existing land use plans and policies
	After publication of Supplement	New	Subject to program elements in the Solar PEIS ROD, including variance process

1.3.3.1 New Applications

The BLM defines "new" applications as any applications filed within proposed SEZs[5] after June 30, 2009, and any applications filed within proposed variance and/or exclusion areas after the publication of the Supplement to the Draft Solar PEIS (October 28, 2011). All new applications will be subject to the program elements adopted by the Solar PEIS ROD, which may include a competitive process for projects in SEZs (see Section 2.2.2.2.1) and a variance process for projects proposed in variance areas (see Section 2.2.2.3).

1.3.3.2 Pending Applications

The BLM defines "pending" applications as any applications (regardless of place in line) filed within proposed variance and/or exclusion areas before the publication of the Supplement to the Draft Solar PEIS (October 28, 2011), and any applications filed within proposed SEZs before June 30, 2009.

The BLM has cataloged 91 first-in-line solar applications that meet the definition of pending: 31 in Arizona, 25 in California, 32 in Nevada, and 3 in New Mexico. A detailed list is included in Table B-2 of Appendix B of this Final Solar PEIS. As of June 1, 2012, 13 of these first in-line pending applications have been closed (denied or withdrawn. Second-in-line and subsequent applications will be processed as pending applications if they otherwise meet the criteria for pending and the first-in-line application is closed. While the BLM tracks

[5] In its June 30, 2009, *Federal Register* Notice, the BLM announced that applications for solar energy ROWs received *after* June 30, 2009, for lands inside a proposed Solar Energy Study Area (or proposed SEZ as described in the Draft PEIS) would not be processed until the signing of the Solar PEIS ROD and would be subject to the program elements adopted in the ROD. Such projects are considered to be new even if they are no longer in a proposed SEZ per this Final PEIS.

second-in-line and subsequent applications, they are not included in Table B-2 of Appendix B to avoid double counting of acres and megawatts.

In an effort to facilitate environmentally responsible solar energy development, the BLM will continue to process appropriately sited pending applications submitted by qualified, diligent applicants. Pending applications will not be subject to any new program elements adopted by the Solar PEIS ROD. The BLM will process pending solar applications consistent with existing land use plans and current policies and procedures (e.g., IM 2011-060 [BLM 2011a] and IM 2011-061 [BLM 2011b]), including current interagency coordination practices with DOI agencies, such as the U.S. Fish and Wildlife Service (USFWS) and National Park Service (NPS), or future policies and procedures that the BLM might adopt. These applications will be treated as project-specific undertakings under Section 106 of the NHPA and the BLM's National Programmatic Agreement (PA).

The BLM has determined that, in appropriate circumstances, it can rely on the broad discretion it has under FLPMA to deny ROW applications prior to completing the NEPA process if such applications do not meet due diligence requirements and/or environmental criteria. Such decisions must be made with regard for the public interest and be supported by reasoned analysis and an adequate administrative record. Decisions to deny applications must be assessed on a case-by-case basis. Although pending applications will not be subject to any new program elements adopted by the Solar PEIS ROD, the BLM still may decide to deny pending solar applications if there is a supportable, rational basis on other grounds. The BLM's denial of an application is subject to administrative appeal to the Interior Board of Land Appeals (IBLA).

Under the BLM's existing policies and procedures, the BLM will generally use the following guidelines when processing pending applications:

- Pending applications on the DOI's "priority" list shall continue to be given priority processing as long as the applicant continues to meet the due diligence provisions in IM 2011-060 (BLM 2011a).

- Pending applications that meet the criteria for "High Potential for Conflict" described in IM 2011-061 (BLM 2011b) are likely candidates for denial. High Potential for Conflict describes more complex projects that will require a greater level of consultation, analysis, and mitigation to resolve issues or that may not be feasible to authorize, including:
  - Lands near or adjacent to lands designated by Congress, the President, or the Secretary for the protection of sensitive viewsheds, resources, and values (e.g., all areas administered by the NPS, USFWS Refuge System, specially designated units of the National Forest System, and the BLM National Landscape Conservation System [NLCS][6]), which may be adversely affected by development;

[6] National Historic and Scenic Trails are part of the BLM NLCS but, because of their linear nature, were described in IM 2011-061 as areas of "Medium Potential for Conflict."

- Lands adjacent to Wild, Scenic, or Recreational Rivers and river segments determined eligible or suitable for Wild and Scenic River status, if project development may have significant adverse effects on sensitive viewsheds, resources, and values;
- Designated critical habitat for federally threatened and endangered species if project development is likely to result in the destruction or adverse modification of that critical habitat;
- Lands currently designated as Visual Resource Management (VRM) Class I or Class II in BLM land use plans;
- ROW exclusion areas identified in BLM land use plans; and
- Lands currently designated as no surface occupancy (NSO) in BLM land use plans.

- Pending applications shall be processed in accordance with the due diligence provisions in IM 2011-060:
  - Applications shall be denied if the applicant cannot demonstrate financial and technical capability, for example:
    - International or domestic experience with solar projects on federal or nonfederal lands;
    - Sufficient capitalization to carry out development;
    - Conditional commitments of DOE loan guarantees;
    - Confirmed Power Purchase Agreements (PPAs);
    - Engineering, procurement, and construction contracts; and
    - Supply contracts with credible third-party vendors for the manufacture and/or supply of key components for solar project facilities.
  - Applications shall be denied if the applicant cannot meet Plan of Development (POD) due diligence requirements:
    - The POD must be of sufficient detail to provide the information necessary to begin the environmental analysis and review process; and
    - Time lines established in IM 2011-060 will apply.

- Pending applications that meet due diligence requirements and have medium or low resource conflicts will be evaluated by the BLM in coordination with other DOI agencies. These evaluations will assist the BLM in identifying issues and developing appropriate strategies to resolve such issues (e.g., alternatives, mitigation, etc.) and will occur before the BLM initiates the NEPA process.

The BLM, in coordination with other DOI agencies, may continue to identify priority projects. The BLM will apply the due diligence and screening criteria requirements of IM 2011-060 and IM 2011-061, or other policies that the BLM might adopt in the future, to determine priority projects. Designation as a “priority” project means that the BLM and other DOI agencies have agreed to prioritize processing and review of the application. Priority projects are subject to all regulatory and statutory requirements, including full NEPA review. Designation of a project as priority does not confer any decrease in permitting time.

1.3.3.3 Approved Applications

The Solar PEIS ROD will recognize all previously approved solar projects. As of May 31, 2012, the BLM had approved 11 utility-scale solar projects on public lands and 5 linear ROWs that enabled development of projects on private lands. Each approval was based on a site-specific EIS and announced through a *Federal Register* Notice and press release accompanied by a project fact sheet and map. These documents are available at http://www.blm.gov/wo/st/en/prog/energy/renewable_energy/Renewable_Energy_Projects_Approved_to_Date.html. A summary of the approved public land projects is provided in Table B-1 of Appendix B of this Final Solar PEIS. Three of the approved public land projects in California will require additional case processing and environmental review to consider post-authorization requests to change technology.

Seven of the approved public land projects are located in the California Desert District planning boundary of the California Desert Conservation Area (CDCA) Plan. The CDCA Plan requires that all sites associated with power generation or transmission not already identified in that Plan be considered through the BLM's land use plan amendment process.[7] As a result, prior to approval of these seven projects, the BLM had to specifically amend the CDCA Plan to allow each solar project. The approved amendments revise the Plan to allow for utility-scale solar energy development on the specified tracts of land. The BLM intends to amend the CDCA Plan as part of the Solar PEIS ROD to designate proposed SEZs as additional areas appropriate for solar energy generation and related transmission. This amendment will help streamline future project approvals in SEZs in the CDCA planning area. Projects within the CDCA planning area that are subject to the variance process (see Section 2.2.2.3.1) would still require a plan amendment until further amended by a subsequent planning process (e.g., the California Desert Renewable Energy Conservation Plan [DRECP]; see Section 2.2.2.2.6). Variance projects in the DRECP planning area will require additional review by the California Renewable Energy Action Team (REAT) to ensure consistency with the DRECP's goals and objectives (see Section 1.6.2.3).

1.3.4 BLM Land Use Planning Process

The FLPMA requires the BLM to develop land use plans, also called Resource Management Plans (RMPs), to guide the management of the public lands it administers. An RMP typically covers public lands within a particular BLM field office. The BLM's Land Use Planning Handbook (H-1601-1; BLM 2005a) provides specific guidance for preparing, amending, and revising land use plans.

---

[7] The CDCA Plan, in addition to requiring that sites not previously associated with power generation or transmission be considered through a plan amendment process, also describes four multiple use classes (Class C, Class L, Class M, and Class I). Under the current CDCA Plan, solar energy projects can be sited on Class L, M, and I lands, provided that NEPA requirements are met. The BLM does not expect to change this regime in the Solar PEIS ROD, but may clarify that solar energy development is consistent with these Class L, M, and I designations in any SEZ or variance lands within the CDCA, provided that NEPA requirements are met.

As part of the land use planning process, the BLM identifies existing and potential development areas for renewable energy projects (e.g., wind and solar), communication sites, and other uses. The BLM also identifies ROW avoidance or exclusion areas (areas to be avoided but that may be available for location of ROWs with special stipulations, and areas that are not available for location of ROWs). In addition, the BLM identifies terms and conditions that may apply to ROW corridors or development areas, including best management practices to minimize environmental impacts and limitations on other uses that would be necessary to maintain the corridor and ROW values (H-1601-1, Appendix C (II E); BLM 2005a). Many of the existing land use plans in the six-state study area do not specifically address ROWs for solar energy development, although they contain many provisions, stipulations, and guidelines that are relevant to such development activities.

Solar energy development projects, as with other implementation actions, must be in conformance with the applicable land use plan. In cases where a proposed solar energy facility is not in conformance with the applicable land use plan, the BLM can reject the application for a ROW or amend the land use plan to allow for the ROW. The BLM must determine whether to initiate a plan amendment process when a proposal changes the scope of resource uses or the terms, conditions, and/or decisions of an approved plan (43 CFR 1610.5-5). Land use plan amendments are subject to environmental review under NEPA and must be completed in accordance with BLM planning regulations (43 CFR 1610 et seq.).

As part of BLM's proposed Solar Energy Program, land use plans in the six-state study area would be amended to address solar energy development (see Appendix C for a list of the proposed plan amendments associated with this PEIS). The amendments would become part of the land use plans and would include the exclusion areas, priority solar energy development areas, and required mitigation measures identified in this PEIS. Only approved land use plans can be amended. Land use plans that are undergoing revision or amendment concurrent with the development of the Solar PEIS will be reviewed to identify and resolve inconsistencies between the PEIS and individual planning efforts. In the event that the BLM determines that it is appropriate to amend additional land use plans outside the six-state study area, in order to adopt elements of the program, the BLM would initiate the planning process and conduct NEPA analysis, incorporating by reference the analysis in the Solar PEIS, as appropriate.

1.3.5 BLM Scope of the Analysis

The PEIS evaluates the potential environmental, social, and economic effects of establishing broad solar energy program elements and strategies across the six-state study area. The programmatic analysis will provide the basis for future utility-scale solar energy development decisions. The geographic scope of the PEIS for the BLM includes all BLM-administered lands in the six-state study area (i.e., in Arizona, California, Colorado, Nevada, New Mexico, and Utah). This scope was determined based on an internal initial resource assessment showing that these states include the majority of BLM-administered lands with the most prospective solar energy resources suitable for utility-scale development over the next 20 years.

The scope of this analysis is limited to utility-scale solar energy development. For the purposes of the Solar PEIS and associated decision making, utility-scale solar energy development is defined as any project capable of generating 20 MW or more. As a result, the BLM's new Solar Energy Program would apply only to projects of this scale; decisions on projects that are less than 20 MW would continue to be made in accordance with existing land use plan requirements,[8] current applicable policy, and individual site-specific NEPA analyses.

Several technologies for the utility-scale capture of solar energy are currently in use and are being refined. Viable utility-scale solar technologies considered likely to be deployed over the next 20 years and analyzed as part of the Solar PEIS include parabolic trough, power tower, dish engine systems, and PV systems.

The Solar PEIS also considers the impacts of construction and operation of transmission lines and substations (Chapter 5 of the Draft Solar PEIS). In addition, it includes a transmission constraint analysis to determine whether additional corridor designation on BLM-administered lands would be needed to facilitate solar development (analysis indicated that the majority of BLM-administered lands with developable solar resources are not constrained from development[9]—see Appendix G of the Draft PEIS), and an analysis of the environmental impacts of constructing transmission from the individual proposed SEZs to load centers (these analyses are included in the SEZ-specific sections of Chapters 8 through 13 of this Final Solar PEIS).

1.3.5.1 Program Analysis Versus SEZ-Specific Analysis

As discussed previously, the Solar PEIS will not eliminate the need for site-specific environmental reviews for future utility-scale solar energy development projects (see Section 1.3.5.1). The BLM will make separate decisions as to whether or not to authorize individual solar energy projects in conformance with the existing land use plan(s) as amended by the Solar PEIS ROD.

NEPA dictates that federal agencies take a "hard look" at the environmental consequences of a proposed action. The requisite environmental analysis performed by an agency must be commensurate with the action in question. In the case of the Solar PEIS, it is important to make a distinction between the Solar Energy Program elements to be decided upon based on the Solar PEIS, and the additional data collection and analysis being completed for SEZs to inform future project decisions in those priority areas.

As outlined in Sections 1.3.4 and 1.3.5, the BLM expects to make planning-level decisions through the Solar PEIS, such as land use designations and design features. The

---

[8] Co-generation projects involving a mix of solar energy technologies and other energy technologies (e.g., natural gas, wind, and hydropower) would be subject to the requirements of the new Solar Energy Program if the solar energy component is 20 MW or greater.

[9] "Constrained from development" was defined as being located more than 25 mi (40 km) from an existing transmission line or designated corridor (see details in Section 3.2.5).

program elements adopted via planning-level decisions will provide the basis for future project-specific utility-scale solar energy development decisions. The Solar PEIS appropriately evaluates the potential direct, indirect, and cumulative environmental, social, and economic effects of establishing broad Solar Energy Program elements and strategies across the six-state study area. Because the proposed program involves environmental effects over a broad geographic and time horizon, the depth and detail of the impact analysis are fairly general, focusing on major impacts in a qualitative manner.

In addition to the programmatic analysis described above, the Solar PEIS also provides in-depth data collection and environmental analysis for proposed SEZs. The primary purpose of this more rigorous analysis is to provide documentation from which the BLM can tier future project authorizations, thereby limiting the required scope and effort of project-specific NEPA analyses. The BLM will complete a site-specific environmental review of all solar energy ROW applications in accordance with NEPA prior to issuing a ROW authorization. All future projects proposed in SEZs will tier to the analysis in the Solar PEIS. The extent of this tiering, however, will vary from project to project, as will the necessary level of NEPA documentation (see Section 2.2.2.2.2 on the environmental review process for projects in SEZs).

1.3.6 BLM Planning Criteria

Planning criteria are the constraints, standards, and guidelines that determine what the BLM will or will not consider during its planning process. As such, they establish parameters and help focus the structure and preparation of the PEIS. The following are the planning criteria that were considered during preparation of this PEIS:

- The BLM will prepare RMP amendments in compliance with FLPMA, the ESA, the Clean Water Act (CWA), the Clean Air Act (CAA), NEPA, and all other applicable laws, E.O.s, and BLM management policies.

- The BLM will use the PEIS as the analytical basis for any decision it makes to amend these RMPs.

- The BLM will develop a reasonably foreseeable development scenario (RFDS) to predict future levels of development. It will identify lands available for utility-scale solar energy development, lands available for utility-scale solar energy development that have restrictive stipulations, and lands not available for utility-scale solar energy development in affected plans.

- The BLM will limit its amendment of these plans to utility-scale solar energy development and will not address the management of other resources, although the BLM will consider and analyze the impacts from increased use on other managed resource values.

- The BLM will continue to manage other resources in the affected planning areas under the pre-existing terms, conditions, and decisions in the applicable RMPs for those other resources.

- The BLM will recognize valid existing rights under the RMPs, as amended.

- The BLM will coordinate with federal, state, and local agencies, and tribal governments in the PEIS and plan amendment process to strive for consistency with existing plans and policies, to the extent practicable.

- The BLM will coordinate with tribal governments and provide strategies for the protection of recognized traditional uses in the PEIS and plan amendment process.

- The BLM will take into account appropriate protection and management of cultural and historic resources in the PEIS and plan amendment process and will engage in all required consultation.

- The BLM will recognize in the PEIS and plan amendments the special importance of public lands to people who live in communities surrounded by public lands and the importance of public lands to the nation as a whole.

- The BLM will make every effort to encourage public participation throughout the PEIS process.

- The BLM has the authority to develop protective management prescriptions for lands with wilderness characteristics within RMPs. As part of the public involvement process for land use planning, the BLM will consider public input regarding lands to be managed to maintain wilderness characteristics.

- Environmental protection and energy production are both desirable and necessary objectives of sound land management practices and are not to be considered mutually exclusive priorities.

- The BLM will consider and analyze relevant climate change impacts as part of the PEIS process, including the potential for climate change benefits from solar energy development.

1.4 DOE REQUIREMENTS AND OBJECTIVES FOR THE PEIS

Different offices within DOE address different aspects and/or approaches to the mission of solar power development. For example, the DOE SunShot Initiative is a collaborative national initiative (including the Office of Energy Efficiency and Renewable Energy [EERE], Advanced Research Projects Agency – Energy [ARPA-E], and the Office of Science) to make solar energy cost competitive with other forms of energy by the end of the decade. One aspect of EERE's mission in support of SunShot is to provide technical assistance and funding for solar technology research and development (R&D). EERE's Solar Energy Technologies Program (Solar Program) is working to improve the efficiency and reduce the cost of solar technology through research, development, and demonstration (RD&D) (in partnership with industry, universities, and national laboratories). The Solar Program also facilitates the deployment of solar technology through resource assessment; development of codes and standards; market and policy analysis; and by providing technical information to national, state, and local entities. DOE is also evaluating its sites around the country for suitability for various renewable energy technologies, including solar. DOE's National Nuclear Security Administration (NNSA) is evaluating a generic commercial solar power installation in the Nevada National Security Site Site-Wide Environmental Impact Statement (NNSS SWEIS; DOE/EIS-0426), which is scheduled for completion in 2012. In addition, DOE's Loan Guarantee Program is available to provide financial support for the development of qualifying renewable energy projects, including solar energy projects, implemented at the utility scale.

DOE's Western Area Power Administration (Western) markets and transmits wholesale electrical power through an integrated 17,000-circuit mile, high-voltage transmission system across 15 western states, including parts of the six-state study area for this PEIS. With respect to new utility-scale solar energy facilities, any interconnection between such a facility and the Western transmission system would need to comply with Western's interconnection policies and environmental requirements and would require NEPA review in accordance with DOE's NEPA regulations.

While solar technologies generally are considered to be clean and sustainable, they can result in adverse direct and indirect impacts on the environment, especially utility-scale facilities. DOE is interested in exploring new ways to generate and store energy captured from the sun, while minimizing the impacts of solar development and reducing the cost of solar energy development. DOE is committed to supporting the development of solar and renewable energy projects in an environmentally responsible manner.

1.4.1 DOE's Purpose and Need

As discussed in Section 1.1, DOE is required to take actions to meet mandates under E.O.s 13212 and 13514, as well as Section 603 of the EISA. DOE's purpose and need is to satisfy both E.O.s and comply with congressional mandates to promote, expedite, and advance the production and transmission of environmentally sound energy resources, including renewable energy resources and, in particular, cost-competitive solar energy systems at the utility scale.

Western's purpose and need for participating in this PEIS is to identify potential transmission impacts and recommend mitigation measures for transmission lines associated with solar energy projects. Western anticipates using the transmission environmental impact and mitigation measures analysis in this PEIS to streamline its own NEPA documents once specific projects are identified and interconnection requests are filed with Western. With the PEIS providing the basis for this analysis, project-specific NEPA documentation for interconnections should be more concise and take less time to prepare, resulting in efficiencies for both Western and the project proponent.

Chapter 2 provides a detailed discussion of DOE's proposed action and descriptions of alternatives.

1.4.2 DOE Decisions To Be Made

DOE proposes to further integrate environmental considerations into its analysis and selection of proposed solar projects. DOE has built on BLM's analysis of potential impacts of utility-scale solar development on the environment for all phases of development (i.e., during site characterization, construction, operation, and decommissioning), and on the identified potential mitigation measures, by developing proposed programmatic environmental guidance that could be applied to DOE-supported solar projects.

DOE's investment and deployment strategy would incorporate the decision-making framework of the programmatic guidance for early consideration of sound environmental practices and potential mitigation measures for solar energy development. The programmatic guidance, based on the analyses of the PEIS, would give DOE the tools with which to make more informed, environmentally sound decisions at the outset, would help to streamline future environmental analysis and documentation for DOE-supported solar projects, and would support DOE's efforts to (1) evaluate how to make technology and resource investments to minimize the environmental impacts of solar technologies, and (2) establish environmental mitigation recommendations for financial assistance recipients to consider in project plans when applying for DOE funding.

On the basis of the analysis in this PEIS, DOE could adopt the programmatic environmental guidance to be used in its analysis and selection of proposed solar projects. In addition, DOE's proposed programmatic guidance could be used for all projects receiving support from DOE, as appropriate, so that a consistent set of mitigation measures would be applied to these projects.

At this time, Western does not anticipate making any specific decisions at the programmatic level on the basis of the analysis in this PEIS. It anticipates using the analyses of transmission development to more expeditiously prepare project-specific NEPA documents and expedite decisions regarding future interconnection requests related to solar energy development and other energy development in the six-state study area.

1.4.3 DOE Scope of the Analysis

The geographic scope of applicability for DOE's proposed guidance includes both BLM-administered lands and other lands. DOE may support solar projects within SEZs identified by the BLM; on other BLM-administered lands; or on other federal, state, tribal, or private lands. Similarly, Western may be involved in associated transmission development on lands administered by any of these entities.

The scope of the impact analysis includes an assessment of the environmental, social, and economic impacts of utility-scale solar facilities and required transmission connections from these facilities to the existing electricity transmission grid. As discussed in Section 1.2, viable solar technologies to be deployed over the next 20 years include parabolic trough, power tower, dish engine systems, and PV. These technologies are discussed in greater detail in Section 3.1.

1.5 COOPERATING AGENCIES

The BLM and DOE are lead agencies jointly preparing this PEIS. Because the scope of the Solar PEIS is of interest to numerous federal, state, tribal, and local agencies, several agencies expressed an interest in participating as cooperating agencies. The entities listed below are cooperating in the preparation of this PEIS, and Memoranda of Understanding (MOUs) between these agencies and the DOE and/or the BLM have been established, as appropriate. The cooperating agencies were given the opportunity to review the Draft Solar PEIS and the Final Solar PEIS prior to their publication.

The following agencies are participating as cooperating agencies in the preparation of this PEIS:

- U.S. Department of Defense (DoD);
- U.S. Bureau of Reclamation (BOR);
- U.S. Fish and Wildlife Service (USFWS);
- U.S. National Park Service (NPS);
- U.S. Environmental Protection Agency (EPA), Region 9;
- U.S. Army Corps of Engineers (USACE), South Pacific Division;
- State of Arizona Game and Fish Department (AZGFD);
- State of California, California Energy Commission (CEC);
- State of California Public Utilities Commission (CPUC);
- State of Nevada Department of Wildlife (NDOW);
- N-4 Grazing Board, Nevada;
- State of Utah Public Lands Policy Coordination Office;

- Clark County (Nevada), including Clark County Department of Aviation;
- Doña Ana County (New Mexico);
- Esmeralda County (Nevada);
- Eureka County (Nevada);
- Lincoln County (Nevada);
- Nye County (Nevada); and
- Saguache County (Colorado).

In addition, the State of California has established an Interagency Working Group on the Solar PEIS as a means of facilitating and coordinating federal, state, and county agency participation in the PEIS process for the state. The CEC is coordinating this working group. Members of the California Interagency Working Group include some federal agencies that are participating as cooperators as well as several State of California agencies (including the Native American Heritage Commission, Office of Planning and Research, Department of Parks and Recreation, State Lands Commission, and Department of Fish and Game), and Inyo and San Bernardino Counties.

1.6 RELATIONSHIP OF THE BLM'S PROPOSED PROGRAM AND DOE'S PROPOSED STRATEGY TO OTHER PROGRAMS, POLICIES, AND PLANS

1.6.1 Renewable Portfolio Standards and Other Regional and State Initiatives

Some interstate and state initiatives have been created whose mission is to facilitate renewable energy development. This is partially in response to the passage of Renewable Portfolio Standards (RPSs) requiring that a certain percentage of a state's electricity capacity requirements be supplied from renewable sources (e.g., solar, wind, geothermal, or biomass) by a given year. The six states in the PEIS study area all have RPSs; Table 1.6-1 gives the specific requirements for each state along with information about other state initiatives.

The Western Governors' Association (WGA) and DOE launched the Western Renewable Energy Zones (WREZ) initiative in May 2008, with DOE providing substantial funding. The WREZ initiative, which encompasses the Western Interconnection region, seeks to identify those areas in the West with vast renewable resources to expedite the development and delivery

TABLE 1.6-1 RPS Requirements and Other State Initiatives in the Six-State Study Area[a]

State	RPS Requirements	Other State Renewable Energy Initiatives
Arizona	15% by 2025	Arizona Renewable Resource and Transmission Identification Subcommittee (ARRTIS 2009).
California	20% by 2013, 25% by 2016, and 33% by 2020	Renewable Energy Transmission Initiative (RETI) (CEC 2010). Desert Renewable Energy Conservation Plan (DRECP)—to prioritize and streamline renewable energy projects in the Mojave and Colorado Desert Regions on the basis of renewable energy potential and plant and animal habitat protection.
Colorado	30% by 2020	Colorado's Renewable Energy Development Infrastructure (Colorado Governor's Energy Office 2007, 2009, 2010).
Nevada	25% by 2025[b]	Renewable Energy Transmission Access Advisory Committee (RETAAC) (State of Nevada 2007, 2009) and Nevada Energy Assistance Corporation (NEAC 2012).
New Mexico	20% by 2020[c]	New Mexico's Renewable Energy Transmission Authority (RETA 2010).
Utah	20% by 2025[d]	Utah Renewable Energy Zone Task Force (Berry et al. 2009; State of Utah 2010).

[a] The RPS requirements are current as of June 2012 and were obtained from the Database of State Incentives for Renewables & Efficiency (North Carolina Solar Center and Interstate Renewable Energy Council [2012]).

[b] Includes a solar set-aside requiring that 5% of the investor-owned utilities' portfolios be from solar energy through 2015, and 6% per year beginning in 2016.

[c] Includes a solar set-aside requiring that 20% of the investor-owned utilities' portfolios be from solar energy by 2020.

[d] Utah's RPS is a voluntary standard.

of renewable energy to where it is needed.[10] The scope of the WREZ initiative includes solar, wind, biomass, geothermal, and hydropower resources. The initiative is intended to facilitate the construction of renewable energy facilities and the expansion of the electricity transmission system needed to deliver the energy to load centers across the Western Interconnection (WGA and DOE 2009).

[10] The Western Interconnection is the name of the electricity grid, overseen by the Western Electricity Coordinating Council (WECC), that serves the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; part of west Texas; the Canadian provinces of Alberta and British Columbia; and a small portion of northern Mexico in Baja California.

Appendix D of the Draft Solar PEIS presented information about WGA and state-level initiatives, including maps showing how designations from these initiatives related to the BLM's proposed designations for solar energy development, as presented in the Draft Solar PEIS. The information and maps presented in that appendix have not been revised to reflect BLM's new proposed designations; however, the variance process presented in Section 2.2.2.3.1 of this Final Solar PEIS does include ongoing coordination with state and regional transmission planning efforts, including the WGA initiative, as applicable.

1.6.2 Related Initiatives

Many ongoing and recently completed efforts address how best to enable environmentally responsible renewable energy development and its associated transmission needs in the Western United States. Examples of those initiatives are identified below. All demonstrate, to some degree, the challenges in identifying appropriate areas for renewable energy and transmission and underscore the importance of collaboration among agencies and stakeholders.

1.6.2.1 Energy Corridor Designation

In accordance with Section 368 of the Energy Policy Act of 2005, DOE and the BLM worked with the U.S. Forest Service (USFS) and DoD to prepare the *Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States*, which evaluates issues associated with the designation of energy corridors on federal lands in 11 western states, including the 6 states included in this PEIS plus Idaho, Montana, Oregon, Washington, and Wyoming (DOE and DOI 2008). Energy corridors are land corridors in which energy transport facilities (e.g., electric transmission lines, natural gas pipelines) could be sited. On the basis of the West-wide Energy Corridor PEIS, the BLM and USFS have amended their respective land use plans to designate a series of energy corridors across the western states. The lands identified in these amendments are within the planning areas that are included within the scope of this Solar PEIS.

The designation of energy corridors can help to facilitate energy development by identifying preferred locations for ROWs for development and construction of new electric transmission lines on federally managed lands. Information regarding the West-wide Energy Corridor PEIS (Corridor PEIS) is available at http://corridoreis.anl.gov. The development of transmission infrastructure will be a component of all solar energy projects. The Corridor PEIS provides standards and guidelines for transmission development that should make reviews and approvals of transmission projects located in established corridors more efficient.

1.6.2.2 Landscape Conservation Cooperatives and BLM's Proposed Landscape Approach

The DOI is establishing a national network of Landscape Conservation Cooperatives (LCCs). LCCs are management–science partnerships composed of private, state, and federal representatives who agree to establish a shared vision of landscape health and sustainability. The LCCs will facilitate collaboration, provide science-based information and tools needed for developing resource management strategies, and promote coordinated partnership actions at the landscape and local levels. The LCCs and the BLM's proposed landscape approach (discussed below) are complementary efforts that are anticipated to become more fully integrated as they progress.

The BLM's proposed landscape approach consists of five interconnected components that provide a framework for integrating science and management:

- Rapid Ecoregional Assessments (REAs);
- Ecoregional Direction;
- Field Implementation;
- Monitoring for Adaptive Management; and
- Science Integration.

REAs were initiated in 2010 for seven ecoregions in the western United States and Alaska that contain substantial amounts of public land, including the Mojave Basin and Range and Sonoran Desert ecoregions in the Solar PEIS six-state study area (for an explanation and maps of the ecoregions in the six-state study area, see Appendix I); these REAs are scheduled for completion in 2012. The REAs will synthesize existing information about resource conditions and trends within an ecoregion, highlight and map areas of high ecological value, and gauge their potential risk from climate change, wildfires, invasive species, energy development (including renewable energy), and urban growth. Ecoregional Direction will use the results of the REAs, with input from BLM staff, partner agencies, stakeholders, and tribes, to identify key management priorities for the public lands within an ecoregion. Field Implementation will include the establishment of mitigation measures for authorized land uses, amending land use plans (where necessary), and monitoring.

Management priorities established through Ecoregional Direction, Field Implementation, and Adaptive Management components of the landscape approach may influence where and how solar energy is sited in the future, by identifying additional areas of low resource conflict where solar energy should be prioritized or areas from which solar energy development should be excluded. The Solar Energy Program is designed to adapt and conform to new management direction and land use plan amendments that result from REAs.

1.6.2.3 California Desert Renewable Energy Conservation Plan

The DRECP is the largest landscape-level planning effort in California, covering approximately 22.5 million acres (91,054 km^2) of federal and nonfederal land in the Mojave and Colorado (Sonoran) Deserts of southern California. The planning area covers portions of seven counties, including Kern, Los Angeles, San Bernardino, Inyo, Riverside, Imperial, and San Diego. Approximately 10 million acres (40,469 km^2) of the DRECP are administered by the BLM California Office under the CDCA plan and under the Bishop, Caliente/Bakersfield, and Eastern San Diego County RMPs. The purpose of the DRECP is to advance state and federal species and ecosystem conservation goals in the deserts of southern California, while also facilitating the timely permitting of renewable energy projects on federal and nonfederal lands. Federal and state agencies (including the BLM) are cooperating in this planning effort and have formed REAT. See Section 2.2.2.2.6 for a discussion on how the Solar PEIS and DRECP planning efforts relate.

1.6.2.4 Arizona Restoration Design Energy Project

Arizona's Restoration Design Energy Project (RDEP) was chartered in 2009 by the Secretary of the Interior to support efforts for sustainable energy and to pilot the concept of using disturbed and low-conflict lands for renewable energy. The RDEP is a state-level planning effort that analyzes and considers the identification of lands for renewable energy development (solar and wind) at any scale. The RDEP allows a look across all ownership and jurisdictional management of lands. It addresses the nexus of public lands with renewable energy potential to the generation and transmission system and provides information to policy and decision makers in Arizona for siting and development. The RDEP will inform logical utility-scale siting (beyond just opportunities on public lands) and determine which public lands fit best. See Section 2.2.2.2.6 for a discussion on how the Solar PEIS and RDEP planning effort relate.

1.6.2.5 Wind Energy Development PEIS

On June 24, 2005, the BLM issued a Notice of Availability for its *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States, Including Proposed Amendments to Selected Land Use Plans* (Wind PEIS) (BLM 2005b). This PEIS evaluated a program of policies and mitigation measures applicable to wind energy development on BLM-administered lands and included amendments for appropriate BLM land use plans. The wind energy development program implemented by the ROD for the Wind PEIS is similar to BLM's proposed program for solar energy development being developed under this PEIS. The Notice of Availability for the Wind PEIS ROD was published in Volume 71, page 1768 of the Federal Register on January 11, 2006; information regarding the Wind Energy Programmatic EIS is available at http://windeis.anl.gov.

1.6.2.6 Geothermal PEIS

In October 2008, the BLM and USFS jointly issued the *Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States,* evaluating geothermal energy development in 12 western states, including Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming (BLM and USFS 2008). On December 17, 2008, the BLM signed a ROD to facilitate geothermal leasing of the federal mineral estate in these states. The decision (1) allocates BLM lands as open to be considered for geothermal leasing or closed for geothermal leasing and identifies those National Forest System lands that are legally open or closed to leasing; (2) develops an RFDS that indicates a potential for 12,210 MW of electrical generating capacity from 244 power plants by 2025, plus additional direct uses of geothermal resources; and (3) adopts stipulations, best management practices, and procedures for geothermal leasing and development. The BLM's ROD implemented these actions through amendments to 114 BLM land use plans. Information regarding the Geothermal Energy Programmatic EIS is available at http://www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide.html.

1.7 ORGANIZATION OF THE FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

The agencies have decided to prepare a condensed Final Solar PEIS in order to reduce the length of the document and facilitate an efficient review by cooperating agencies and the public. Several key chapters of the Draft Solar PEIS have been revised extensively and are presented in full in this Final Solar PEIS (this applies to Chapters 1, 2, 6, 7, 15, and 16, and Appendices A, B, C, and J). Other sections of this Final Solar PEIS are presented as updates to the Draft Solar PEIS (Chapters 3 through 5, 8 through 14, Appendices D through I, and Appendices K through N). For the updated sections, the information presented supplements, but does not replace, the information provided in the corresponding section of the Draft Solar PEIS. Each of these updated sections also includes an errata table for corrections to errors that were identified in the Draft Solar PEIS.

The Final Solar PEIS is intended to be used in conjunction with the Draft Solar PEIS, which is being distributed electronically together with the Final PEIS.[11] Except for the SEZ Action Plans provided in Sections C.1 through C.6 of the Supplement to the Draft Solar PEIS, this Final Solar PEIS replaces information provided in the Supplement. The SEZ Action Plans will be used to help guide ongoing SEZ characterization efforts; as new SEZ data become available, the data will be accessible through the Solar PEIS project Web site (http://solareis.anl.gov).

In the following summary, the sections that are presented in full are indicated with the words "PRESENTED IN FULL" in brackets following the description; sections prepared as updates rather than presented in full are indicated with the word "UPDATE" in brackets following the description. In addition, there are two new sections, Appendix O

[11] The Draft Solar PEIS is also available in its entirety on the Solar PEIS project Web site (http://solareis.anl.gov).

(Intermittent/Ephemeral Stream Evaluation and Groundwater Modeling Analyses), and the Comments and Responses Document (issued as a separate volume of the Final Solar PEIS).

Volume 1:

- Chapter 1 discusses the purpose and need for the agencies' actions; the scope of analysis; cooperating agencies, and the relationship of the proposed actions to other programs, policies, and plans. [PRESENTED IN FULL]

- Chapter 2 describes the alternatives assessed in this PEIS. These alternatives present different options for BLM's management of solar energy development on BLM-administered lands and for DOE's strategy for support of solar energy projects. The chapter includes discussions of the RFDS and describes alternatives considered but eliminated from further analysis in the PEIS. [PRESENTED IN FULL]

- Chapter 3 presents information describing solar energy technologies and projects, including descriptions of typical activities conducted during each phase of development, regulatory requirements, health and safety aspects, hazardous materials and waste management, transportation considerations, and relevant existing agency guidelines on impact mitigation. Information presented in this chapter is applicable to BLM's proposed Solar Energy Program, DOE's proposed strategy, and Western's future project-specific analyses. [UPDATE]

- Chapter 4 provides a general description of the existing conditions and trends of resources and resource uses in the six-state study area that may be affected by implementing BLM and DOE's proposed alternatives. The description of the affected environment provides the basis for identifying potential impacts in sufficient detail to support the programmatic nature of the Solar PEIS. Information presented in this chapter also is applicable to Western's future project-specific analyses. [UPDATE]

- Chapter 5 describes both potential impacts common to all types of utility-scale solar energy power production facilities as well as technology-specific impacts. Impacts from required transmission interconnections are also described. The chapter identifies programmatic-level impact mitigation measures that the BLM evaluated in order to determine appropriate mitigation requirements for its proposed Solar Energy Program. Information presented in this chapter is applicable to Western's future project-specific analyses. [UPDATE]

- Chapter 6 analyzes the potential impacts of BLM's alternatives described in Chapter 2. These analyses evaluate the effectiveness of the alternatives at meeting BLM's established program objectives and summarize the potential environmental consequences of the alternatives, including the expected cumulative impacts of solar energy development on BLM-administered lands and other NEPA considerations. [PRESENTED IN FULL, EXCEPT SECTION 6.5 UPDATE]

- Chapter 7 describes the potential impacts of DOE's alternatives described in Chapter 2, including cumulative impacts and other NEPA considerations. These analyses evaluate the effectiveness of the alternatives at facilitating and mitigating potential impacts from solar energy development supported by the DOE on BLM-administered lands and other federal, state, private, and tribal lands. [PRESENTED IN FULL]

- Chapter 14 describes the consultation and coordination activities conducted in the course of this PEIS, including public scoping, government-to-government consultation, coordination with BLM state and field offices, and interagency consultation and coordination. It also discusses the potential adoption of the program and strategy for solar energy development analyzed in the PEIS by other organizations, such as other federal agencies, tribes, or other entities responsible for the approval of utility-scale solar energy projects. [UPDATE]

- Chapters 15 and 16 provide the list of preparers and a glossary, respectively. [PRESENTED IN FULL]

Volumes 2 through 5:

- Chapters 8 through 13 present the affected environment and impact assessment (including cumulative impacts) for solar energy development in SEZs proposed in Arizona, California, Colorado, Nevada, New Mexico, and Utah, respectively. These chapters also identify SEZ-specific mitigation measures, where appropriate, that would be implemented in addition to the programmatic-level mitigation measures identified in Chapter 5. [UPDATES]

Volume 6:

- Appendix A presents BLM's proposed Solar Energy Program elements, including summaries of interim solar energy development policies (Section A.1); proposed programmatic design features (Section A.2); proposed SEZ-specific design features (Section A.3); BLM's framework for developing a monitoring and adaptive management plan (Section A.4); BLM's framework for developing regional mitigation plans (Section A.5); and the proposed SEZ identification protocol (Section A.6) [PRESENTED IN FULL]

- Appendix B provides information on BLM approved and pending solar energy ROW applications. [PRESENTED IN FULL]

- Appendix C contains a list of each of the BLM land use plans that are proposed for amendment through this PEIS, the proposed changes, and the amount of land that would be available for ROW application. [PRESENTED IN FULL]

- Appendix D gives a summary of the activities of other regional and state plans and programs related to solar energy development and/or transmission planning, including maps showing how designations from some of these initiatives relate to BLM's proposed designations for solar energy development. [UPDATE]

- Appendix E describes the methodologies that were used to construct the RFDS and to project the amount of solar power generation over the next 20 years. [UPDATE]

- Appendix F provides an overview of solar energy technologies. [UPDATE]

- Appendix G provides an analysis showing locations in the study area that have location-constrained transmission (i.e., locations that are greater than 25 mi [40 km] from existing transmission lines and/or designated energy transmission corridors). Section G.4 provides the description of the transmission analysis methodology for the SEZs [UPDATE; EXCEPT SECTION G.4 PRESENTED IN FULL]

- Appendix H contains information about federal and state regulations and statutes that may be applicable to solar energy development. [UPDATE]

- Appendix I contains detailed descriptions of ecoregions in the six-state study area, state maps showing where the potentially developable solar resources occur within the ecoregions, and the land cover types and descriptions for the proposed SEZs. [UPDATE]

- Appendix J provides information on federally listed species (i.e., species listed under the ESA) and BLM-designated sensitive species that occur on BLM-administered lands that are included under the three alternatives considered in the PEIS. Information in the appendix includes listing status, suitable habitat types, and occurrence of these species in alternative areas. [PRESENTED IN FULL]

- Appendix K documents consultation correspondence for the PEIS, including government-to-government consultation among the DOE, BLM, and Native American tribes, and cultural resource consultations. [UPDATE]

- Appendix L documents the data and methodology used for geographic information system (GIS) mapping in this PEIS. [UPDATE]

- Appendix M presents the methodologies used in the PEIS for analysis of impacts on resources. [UPDATE]

- Appendix N presents viewshed maps for four solar technology heights for each of the proposed SEZs. [UPDATE]

- Appendix O describes the methods used for additional analyses pertaining to ephemeral streams and groundwater. [NEW]

Volume 7:

- Volume 7 presents summaries of comments received on the Draft Solar PEIS and the Supplement to the Draft and responses to those comments prepared by the BLM and DOE. [NEW]

1.8 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

ARRTIS (Arizona Renewable Resource and Transmission Identification Subcommittee), 2009, *Final Report of the Arizona Renewable Resource and Transmission Identification Subcommittee*, submitted to the Renewable Transmission Task Force of the Southwest Area Transmission Planning Group, Sept. Available at http://www.westconnect.com/filestorage/ARRTIS%20Final%20Report.pdf.

Berry, J., et al., 2009, *Utah Renewable Energy Zones Task Force Phase I Report: Renewable Energy Zone Resource Identification*, Utah Geological Survey Miscellaneous Publication 09-1, prepared for Utah Renewable Energy Zone Task Force. Available at http://www.energy.utah.gov/renewable_energy/urez/urez_taskforce_I.htm.

BLM (Bureau of Land Management), 2005a, *Land Use Planning Handbook*, H-1601-1, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., March.

BLM, 2005b, *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States, Including Proposed Amendments to Selected Land Use Plans*, FES-95-11, Final, June. Available at http://windeis.anl.gov/documents/fpeis/index.cfm.

BLM, 2007, *Instruction Memorandum 2007-097, Solar Energy Development Policy*, U.S. Department of the Interior, Bureau of Land Management, Washington D.C., April 4.

BLM, 2008, *BLM National Environmental Policy Act Handbook*, H-1790-1, National Environmental Policy Act Program, Office of the Assistant Director, Renewable Resources and Planning (WO-200), Washington, D.C., Jan. Available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.24487.File.dat/h1790-1-2008-1.pdf.

BLM, 2010a, *Instruction Memorandum 2010-141, Solar Energy Interim Rental Policy*, U.S. Department of the Interior, Bureau of Land Management, Washington D.C., June 10.

BLM, 2010b, *Instruction Memorandum 2011-003, Solar Energy Development Policy*, U.S. Department of the Interior, Bureau of Land Management, Washington D.C., Oct. 7.

BLM, 2011a, *Instruction Memorandum 2011-060, Solar and Wind Energy Applications—Due Diligence*, U.S. Department of the Interior, Washington, D.C., Feb. 7.

BLM, 2011b, *Instruction Memorandum 2011-061, Solar and Wind Energy Applications—Pre-Application and Screening*, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., Feb. 7.

BLM, 2011c, *Instruction Memorandum 2011-061, Solar and Wind Energy Applications—Pre-Application and Screening*, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., Feb. 7.

BLM, 2011d, *Instruction Memorandum 2011-181, Involvement of Grazing Permittee/Lessee with Solar and Wind Energy Right-of-Way Application Process*, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., Sept. 21.

BLM, 2011e, *Instruction Memorandum 2011-183, Implementation Procedures—Interim Temporary Final Rule for Segregating Renewable Energy Right-of-Way Applications*, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., Sept. 21.

BLM, 2011f, *Instruction Memorandum 2012-032, Native American Consultation and Section 106 Compliance for the Solar Energy Program Described in the Solar PEIS*, U.S. Department of the Interior, Bureau of Land Management, Washington, D.C., Dec. 6.

BLM and DOE (BLM and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

BLM and USFS (BLM and U.S. Forest Service), 2008, *Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States*, FES 08-44, Final, Oct. Available at http://www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide.html.

CEC (California Energy Commission), 2010, *Renewable Energy Transmission Initiative (RETI)*. Available at http://www.energy.ca.gov/reti/. Accessed June 17, 2012.

Colorado Governor's Energy Office, 2007, *Connecting Colorado's Renewable Resources to the Markets*, Colorado Senate Bill 07-091, Renewable Resource Generation Development Areas Task Force, Dec. Available at http://rechargecolorado.com/images/uploads/pdfs/redi_full%5B1%5D.pdf.

Colorado Governor's Energy Office, 2009, *Renewable Energy Development Infrastructure: Connecting Colorado's Renewable Resources to the Markets in a Carbon-Constrained Electricity Sector*, Dec. Available at http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=Content-Type&blobheadervalue1=inline%3B+filename%3D%22REDI+Report+(Full+Version).pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251746588129&ssbinary=true.

Colorado Governor's Energy Office, 2010, *STAR Strategic Transmission and Renewables, A Vision of Colorado's Electric Power Sector to the Year 2050*, Dec. Available at http://rechargecolorado.org/images/uploads/pdfs/STAR_Report_12-10.pdf.

Denholm, P., and R. Margolis, 2008, *Supply Curves for Rooftop Solar PV-Generated Electricity for the United States*, NREL/TP-6A0-44073, National Renewable Energy Laboratory, Golden, Colo., Nov. Available at http://www.nrel.gov/docs/fy09osti/44073.pdf.

DOE and DOI (U.S. Department of Energy and U.S. Department of the Interior), 2008, *Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States,* DOE/EIS-0386, Final, Nov. Available at http://corridoreis.anl.gov/eis/guide/index.cfm.

DOI (U.S. Department of the Interior), 2008, "Managing the NEPA Process—Bureau of Land Management," Chapter 11 of *DOI Manual 516, National Environmental Policy Act of 1969*, May. Available at http://elips.doi.gov/app_dm/act_getfiles.cfm?relnum=3799.

Hosoya, N., et al., 2008, *Wind Tunnel Tests of Parabolic Trough Solar Collectors, March 2001–August 2003*, Subcontract Report NREL/SR-550-32282, May 2008. Available at http://www.nrel.gov/csp/troughnet/pdfs/32282.pdf. Accessed June 16, 2008.

NEAC (Nevada Energy Assistance Corporation), 2012, *Transmission Initiative Routing Study*, prepared by TriSage Consulting, Energy Source, and U.S. Geomatics, Feb. Available at http://energy.nv.gov/resources-forms/neac.html.

North Carolina Solar Center and Interstate Renewable Energy Council, 2012, *Database of State Incentives for Renewables & Efficiency*. Available at http://www.dsireusa.org.

NREL (National Renewable Energy Laboratory), 2010a, *Photographic Information eXchange,* NREL Photo # 01701. Available at http://www.nrel.gov/data/pix/searchpix.php?getrec=01701&display_type=verbose&search_reverse=1. Accessed July 26, 2010.

NREL 2010b, *Photographic Information eXchange,* NREL Photo # 13739. Available at http://www.nrel.gov/data/pix/searchpix.php?getrec=01701&display_type=verbose&search_reverse=1. Accessed July 26, 2010.

NREL, 2010c, *Solar Power and the Electric Grid, Energy Analysis (Fact Sheet)*, National Renewable Energy Laboratory, Golden, Colo., March. Available at http://www.nrel.gov/docs/fy10osti/45653.pdf.

RETA (Renewable Energy Transmission Authority), 2010, Home Page. Available at http://www.nmreta.org. Accessed July 29, 2010.

Sandia National Laboratories, 2008, *Stirling Dish Engines at the Stirling Energy Systems Test Facility in Albuquerque, New Mexico*. Available at http://www.sandia.gov/news/resources/releases/2008/solargrid.html. Accessed April 16, 2008.

Secretary of the Interior, 2009, "Renewable Energy Development by the Department of the Interior," Secretarial Order 3285, March 11. Available at http://www.doi.gov/archive/news/09_News_Releases/SOenergy.pdf.

Secretary of the Interior, 2010a, "Renewable Energy Development by the Department of the Interior," Amendment No. 1 to Secretarial Order 3285A1, Feb. 22. Available at http://elips.doi.gov/app_so/act_getfiles.cfm?order_number=3285A1.

Secretary of the Interior, 2010b, "Department of the Interior WaterSmart Program—Sustain and Manage America's Resources for Tomorrow," Secretarial Order 3297, Feb. 22. Available at http://elips.doi.gov/elips/Search.aspx.

State of Nevada, 2007, *Nevada Renewable Energy Transmission Access Advisory Committee Phase 1 Report*, Dec. Available at http://renewableenergy.state.nv.us/documents/renewable/RETAAC_PhaseI_Report05-08.pdf.

State of Nevada, 2009, *Nevada Renewable Energy Transmission Access Advisory Committee Phase II, Volume I, Executive Summary and Report*, July. Available at http://energy.nv.gov/documents/2009_RETAAC_Phase2reportvol1.pdf.

State of Utah, 2010, *Utah Renewable Energy Zone (UREZ) Task Force, Phase II, Zone Identification and Scenario Analysis, Final Report*, prepared by the Utah Renewable Energy Zone Task Force, May. Available at http://www.energy.utah.gov/renewable_energy/urez/urez_taskforce_II.htm.

WGA and DOE (Western Governors' Association and U.S. Department of Energy), 2009, *Western Renewable Energy Zones—Phase 1 Report*, June. Available at http://www.westgov.org/index.php?option=com_content&view=article&id=219&Itemid=81.

2 DESCRIPTION OF ALTERNATIVES AND REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

2.1 INTRODUCTION

This PEIS examines alternative management approaches for utility-scale solar energy development that could be implemented by the BLM and DOE.

For the BLM, the PEIS examines the no action alternative, which would continue the BLM's existing policies, and two action alternatives, each of which would have the BLM establish a comprehensive program to facilitate utility-scale solar energy development on BLM land. The three BLM alternatives that are examined include:

- A no action alternative that continues the issuance of ROW authorizations for utility-scale solar energy development on BLM-administered lands by implementing the requirements of the BLM's existing solar energy policies on a project-by-project basis. Lands available for solar energy development would include those areas currently allowable under existing applicable laws and statutes (approximately 98 million acres [396,600 km^2] in the six-state study area) and in conformance with the approved land use plans.

- A solar energy development program alternative that proposes categories of lands to be excluded from utility-scale solar energy development (about 79 million acres [319,702 km^2] proposed for exclusion) and identifies specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM would prioritize development (about 285,000 acres [1,553 km^2] in SEZs). The program alternative allows for utility-scale solar development in variance areas outside of SEZs in accordance with a proposed variance process (about 19 million acres [82,964 km^2] in variance areas). The program alternative also establishes ROW authorization policies and design features[1] for utility-scale solar energy development on BLM-administered lands.

- An SEZ program alternative that applies the same ROW authorization policies and design features as the solar energy development program alternative to utility-scale solar energy development but restricts ROW applications to SEZs only (up to approximately 285,000 acres [1,553 km^2] in the six-state study area).

[1] See text box on page 2-2 for more information about design features versus mitigation measures.

DOE examines two alternatives in this PEIS:

- A no action alternative under which DOE continues its existing case-by-case process for addressing environmental concerns for solar projects supported by the agency on any lands (i.e., not restricted to BLM-administered lands); and

- A programmatic environmental guidance alternative that develops guidance with recommended environmental best management practices and mitigation measures that could be applied to all DOE solar energy projects.

This chapter describes each of the agencies' alternatives in detail, including the specific policies and guidelines that would be implemented under the various alternatives. The BLM program would be applicable to all utility-scale solar energy technologies implemented under BLM jurisdiction in the six-state study area (i.e., projects implemented under a BLM-issued ROW authorization). The DOE guidance would be applicable to all utility-scale solar energy technologies implemented under DOE's jurisdiction (i.e., DOE-funded solar projects), as appropriate. Technologies described in Chapter 3 of the Draft Solar PEIS are representative of the technologies most likely to be deployed over the next 20 years; however, the agencies' programs could apply to other technologies, with additional mitigation requirements developed on a project-by-project basis, as applicable.

This chapter also presents the results of a reasonably foreseeable development scenario (RFDS) analysis for solar energy over the next 20 years (Section 2.4) and discusses other alternatives and issues considered in this PEIS (Section 2.5).

Mitigation Measures and Design Features

Mitigation measures are measures that could reduce or avoid adverse impacts. Mitigation measures can include (40 CFR 1508.20):

- Avoiding the impact altogether by not taking a certain action or parts of an action;

- Minimizing the impact by limiting the degree of magnitude of the action and its implementation;

- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

- Compensating for the impact by replacing or providing substitute resources or environments.

Design features are mitigation measures that have been incorporated into the proposed action or alternatives to avoid or reduce adverse impacts. The proposed programmatic design features of the Solar Energy Program would apply to all utility-scale solar energy ROWs on BLM-administered lands under both action alternatives. Additional design features have been proposed for individual SEZs.

2.2 BLM ALTERNATIVES

The BLM alternatives being analyzed through the Solar PEIS include the no action alternative, which would continue the BLM's existing policies, and two action alternatives, each of which would have the BLM establish a comprehensive Solar Energy Program to facilitate utility-scale solar energy development on BLM lands. On the basis of further data collection, consultation with cooperating agencies and resource managers, and consideration of comments submitted on the Draft Solar PEIS (BLM and DOE 2010) and the Supplement to the Draft Solar PEIS (BLM and DOE 2011), modifications have been made to the BLM's action alternatives. Those changes are described below and analyzed in Chapter 6.

The BLM may choose to adopt one of the alternatives or a combination of alternatives from this Final Solar PEIS; selected alternatives may also vary by geographic region.[2] The BLM's final decisions regarding its Solar Energy Program will be informed by public comment and ongoing consultations.

The total estimated acreages of BLM-administered lands potentially available for utility-scale solar energy ROW applications under each of the three alternatives are summarized by state in Table 2.2-1. Maps showing the approximate locations of these lands are provided in Figures 2.2-1 through 2.2-6 at the end of this chapter.

2.2.1 Program Elements Common to Both BLM Action Alternatives

Under the BLM's proposed action alternatives, the Solar Energy Program would include comprehensive ROW authorization policies; requirements for monitoring, adaptive management and mitigation; and programmatic design features that would avoid, minimize, and/or mitigate the potential adverse effects of solar energy development. These elements of the proposed program are described in detail in the following subsections.

2.2.1.1 Right-of-Way Authorization Policies

This section includes a comprehensive list of authorization policies applicable to all solar energy ROWs on BLM-administered lands. Changes in BLM's proposed ROW authorization policies have been made to reflect comments received on the Draft Solar PEIS and the Supplement to the Draft Solar PEIS, as well as to ensure consistency with BLM Instruction Memoranda (IM) in existence or released after the publication of the Draft Solar PEIS and the Supplement. Note that the BLM has decided to undertake rulemaking to establish a competitive

---

2 As described in Section 1.3.3 of this Final Solar PEIS, the BLM is committed to continued processing of all "pending" solar energy applications that meet due diligence and siting requirements under existing land use plans and other policies and procedures that the BLM has adopted or might adopt. Pending applications will not be subject to any new land use plan decisions or program elements adopted by the Solar PEIS ROD (such as exclusions or variance requirements). All "new" applications, however, will be subject to the land use plan decisions and program elements adopted by the Solar PEIS ROD.

TABLE 2.2-1 Summary of Potentially Developable BLM-Administered Land under the No Action Alternative, the Solar Energy Development Program Alternative, and the SEZ Program Alternative[a]

State	Total State Acreage[b]	BLM-Administered Lands Constituting No Action Alternative (acres)	BLM-Administered Lands Constituting Solar Energy Development Program Alternative (acres)[c,d]	BLM-Administered Lands Constituting SEZ Program Alternative (acres)
Arizona	72,700,000	9,181,178	3,380,877	5,966
California	100,200,000	10,815,285	766,078	153,627
Colorado	66,500,000	7,282,258	95,128	16,308
Nevada	70,300,000	40,760,443	9,076,145	60,395
New Mexico	77,800,000	11,783,665	4,184,520	29,964
Utah	52,700,000	18,098,240	1,809,759	18,658
Total	440,200,000	97,921,069	19,312,506	284,918

[a] To convert acres to km^2, multiply by 0.004047.

[b] From Table 4.2-1.

[c] The acreage estimates were calculated on the basis of the best available geographic information system (GIS) data. GIS data were not available for the entire set of exclusions listed in Table 2.2-2; thus the exact acreage could not be calculated. Exclusions that could not be mapped would be identified during the ROW application process.

[d] Values shown include areas of less than 247 acres (1 km^2).

process for offering public lands for solar as well as wind energy development within designated leasing areas (i.e., SEZs). When established, the rule may supersede some of the current authorization policies identified below (see Section 2.2.2.2.1 for more information). The revised comprehensive list of authorization policies follows:

- ***ROW Authorizations.*** Applications for utility-scale solar energy facilities will be authorized as ROWs under Title V of FLPMA and 43 CFR Part 2800. Applications submitted to the BLM for utility-scale solar energy development will use Form SF-299, Application for Transportation and Utility Systems and Facilities on Federal Land (available at https://www.blm.gov/FormsCentral/show-form.do?nodeId=1011) consistent with the requirements of 43 CFR Part 2804.

  The Secretary of the Interior, with respect to public lands, is authorized to grant, issue, or renew ROWs over, upon, under, or through such lands for systems for generation, transmission, and distribution of electric energy (43 USC 1761(a)(4)). The term "ROW" as defined by FLPMA includes an easement, lease, permit, or license to occupy, use, or traverse public lands (43 USC 1702(f)). The BLM has prepared a template ROW lease/grant that would be used to authorize utility-scale solar energy development projects (see http://www.blm.gov/wo/st/en/prog/energy/solar_energy.html). Authorizations will include the solar collectors, tower, turbine generator, fossil-fired generator for hybrid systems, thermal storage, access roads, electrical and transmission facilities, and other testing and support facilities.

- ***Competing Applications.*** If the BLM determines that competition exists, the BLM has the regulatory authority to use competitive bid procedures (43 CFR 2804.23). Multiple applications for the same lands can provide an indication of the need to consider a competitive process. The purpose of a competitive process under existing regulations is to determine which application would be processed.

- ***Term of ROW***. In accordance with Title V of FLPMA and the BLM's ROW regulations, the term or length of a solar energy ROW authorization is limited to a reasonable term (43 USC 1764(b); 43 CFR 2805.11(b)). The BLM will issue all solar energy ROW authorizations for a term not to exceed 30 years; shorter terms may be justified in some cases. Thirty years provides a reasonable period consistent with the expected needs of a solar energy facility; it also provides for operation periods that are consistent with typical PPAs. The BLM will also include in each solar energy ROW authorization a specific provision allowing for renewal, consistent with the regulations at 43 CFR 2807.22.

- ***Renewal of ROW.*** An application for renewal must be submitted at least 120 days prior to the expiration of the existing authorization. The BLM authorized officer will review the application for renewal to ensure the holder is complying with the terms, conditions, and stipulations of the existing authorization instrument and applicable laws and regulations. If renewed, the ROW authorization shall be subject to the regulations existing at the time of renewal and any other terms and conditions that the authorized officer deems necessary to protect the public interest.

- ***Cost-Recovery Payments.*** Applicants must submit a complete and acceptable application and provide a cost-recovery payment before the BLM will initiate processing of a ROW application for utility-scale solar energy development. It is anticipated that most ROW applications for solar energy development will be Category 6, full cost-recovery applications.

- ***Valid Existing Rights.*** All solar energy ROW authorizations will be issued subject to valid existing rights.

- ***Rental Fees.*** In accordance with the requirements of Section 504(g) of FLPMA and the provisions of 43 CFR Part 2806, the BLM will require payment of annual rent for use of the public lands for utility-scale solar energy development on the basis of a rental schedule. FLPMA does not provide existing or current authorities for the collection of royalties. The BLM will calculate rents on all solar energy ROW authorizations consistent with the provisions of 43 CFR Part 2806. Some holders or facilities may be exempt from rent pursuant to the Rural Electrification Act of 1936 (REA), as amended (43 CFR 2806.14(d)). Electric facilities that are financed or are eligible for REA financing, qualify for a rent exemption under the provisions of the Act.

The holder of a solar energy ROW authorization must pay an annual rent in conformance with the regulations (43 CFR 2806.10(a)). Consistent with the current regulations at 43 CFR 2806.50, the BLM has developed a schedule to calculate rental fees for solar energy ROW authorizations. This rental schedule includes a base rent for the acreage of public land included within the solar energy ROW authorization and an additional MW capacity fee based on the total authorized MW capacity for the approved solar energy project on the public land administrated by the BLM. The details of BLM's current rental policy can be found in IM 2010-141, issued June 10, 2010 (BLM 2010) (see Section A.1 of Appendix A of the Draft Solar PEIS).

The BLM may adjust the rental whenever necessary, to reflect changes in fair market value as determined by the application of sound business management principles, and so far as practicable and feasible, in accordance with comparable commercial practices. The rental provisions of the authorization may also be modified consistent with the provisions of any regulatory changes or pursuant to the provisions of new or revised statutory authorities.

- ***Due Diligence—Applicant Qualifications.*** The ROW regulations (43 CFR 2804.12(a)(5)) require all solar energy applications to include information on the financial and technical capability of the applicant to construct, operate, maintain and decommission the project. In addition, the BLM will include provisions requiring diligent development in each solar energy ROW authorization. The regulations (43 CFR 2804.26(a)(5)) provide authority to the BLM to deny any application where the applicant cannot demonstrate the technical or financial capability to construct the project or operate the facilities within the ROW.

  The ROW regulations set forth the qualifications that an individual, business, or government entity must possess in order to hold a ROW authorization, including the requirement that the potential grantee be technically and financially able to construct, operate, maintain, and terminate the use of the public lands covered by the authorization (43 CFR 2803.10(b) and 2804.12(a)(5)). In carrying out its obligation to limit ROW authorizations to qualified individuals or entities and to prevent such individuals or entities from holding ROW authorizations merely for purposes of speculating, controlling, or hindering development on the public lands, the BLM will focus on ensuring that the applicant meets the qualification requirements in the regulations.

In ensuring that an applicant meets the regulatory requirement to demonstrate its technical and financial capability to construct, operate, maintain, and terminate the proposed solar energy facility (43 CFR 2803.10(b) and 43 CFR 2804.12(a)(5)), the BLM will consider a variety of factors, including the following. (1) Applicant qualifications can be demonstrated by international or domestic experience with solar or wind energy projects on either federal or nonfederal lands. (2) The applicant should provide information on the availability of sufficient capitalization to carry out development, including the preliminary study phase of the project and the environmental review and clearance process. (3) Applicants in bankruptcy or with other financial difficulties would generally present financial risk and should be required to provide additional information regarding financial capability. Failure to provide such additional information can be the basis for the BLM authorized officer to deny the application pursuant to the regulations (43 CFR 2804.26(a)(5)). Further evidence of financial and technical capability can include conditional commitments of DOE loan guarantees; confirmed PPAs; engineering, procurement and construction (EPC) contracts; and supply contracts with credible third-party vendors for the manufacture and/or supply of key components for the solar energy project facilities.

During the assessment of technical and financial capability, the BLM authorized officer should also inform applicants that such requirements are continuous during the application process, and the BLM may periodically seek confirmation of these requirements. The BLM authorized officer should additionally inform applicants that such technical and financial capability will become a condition of any ROW authorization, and failure to sustain technical and financial capability for the development of an approved project could be grounds for termination of the authorization.

- ***Due Diligence—Plan of Development (POD).*** The BLM requires that a plan of development (POD) be submitted for all solar energy development ROW applications, consistent with the provisions of 43 CFR 2804.25(b). The BLM will not accept a POD that is simply a conceptual plan. The POD must be of sufficient detail to provide the basic information necessary to begin the environmental analysis and review process for a proposed solar or wind energy project on the public lands (e.g., technology to be used, proposed location of generation facilities, buildings, infrastructure, etc.). It is critically important that due diligence be demonstrated by the applicant in the timely submittal of an acceptable POD to ensure that the BLM processes those applications that are most likely to result in appropriate renewable energy development on the public lands.

  The BLM authorized officer initiates the due diligence process by requesting, in writing, submittal of a sufficiently detailed POD to the BLM for review. The applicant will be requested to provide the POD within 90 days. If the applicant does not respond within 90 days, or if the applicant has responded and the information is not sufficient, the BLM authorized officer will send a second written request with a 60-day response. A final 30-day show cause letter will be provided to the applicant prior to issuing any decision to deny the application for failure to respond pursuant to the regulations (43 CFR 2804.26(a)(6)).

The BLM may also deny an application if the applicant does not provide in a timely manner the processing fees required by 43 CFR 2804.14.

- ***Notification to Livestock Grazing Operators.*** The BLM will coordinate with any potentially affected grazing permittee/lessee to discuss how a proposed solar project may affect grazing operations and to address possible alternatives as well as mitigation and compensation strategies. Upon acceptance of a POD that is likely to adversely affect a current livestock grazing operation, the BLM authorized officer will send a certified letter to the permittee/lessee to serve as the 2-year notification of the BLM's potential decision to cancel the permit/lease, in whole or in part, and devote the public lands to a public purpose that may preclude livestock grazing, as required by 43 CFR 4110.4-2(b). The intent of the 2-year notification is to provide the grazing permittee/lessee time to make any necessary financial, business, or management adjustments should the permit/lease be cancelled (in whole or in part). The letter will also inform the permittee/lessee of its ability to unconditionally waive the 2-year prior notification.

  Upon completion of an environmental assessment (EA) or Draft EIS for a solar project that may preclude livestock grazing, the BLM authorized officer will issue a separate proposed grazing decision to the grazing permittee/lessee. The proposed grazing decision will (1) state that the effective date of the permit/lease cancellation and issuance of any new permit/lease for any remaining permitted use will be 2 years from the permittee's/lessee's receipt of the certified letter sent by the BLM authorized officer to the permittee/lessee as described in the preceding paragraph; (2) address compensation for range improvements (43 CFR 4110.4-2); and (3) address grazing management changes for the new permit/lease, as well as interim grazing adjustments as appropriate. The BLM will send the proposed grazing decision to the affected ROW applicant, grazing permittees/lessees, and any agent and lienholder of record who are affected by the proposed action, terms and conditions, or modifications relating to applications, permits, and agreements by certified mail or personal delivery. Copies of proposed decisions shall also be sent to the interested public (see 43 CFR 4160.1). The proposed grazing decision will become final unless protested.

- ***Performance and Reclamation Bond***. Title V of FLPMA and the ROW regulations authorize the BLM to require a ROW holder to provide a bond to secure the obligations imposed by the ROW authorization (43 USC 1764(i) and 43 CFR 2805.12(g)). The BLM will require a Performance and

Reclamation bond for all solar energy projects to ensure compliance with the terms and conditions of the ROW authorization.

Acceptable bond instruments include cash, cashier's or certified check, certificate or book entry deposits, negotiable U.S. Treasury securities equal in value to the bond amount, surety bonds from the approved list of sureties (U.S. Treasury Circular 570) (Department of the Treasury 2011) payable to the BLM, irrevocable letters of credit payable to the BLM issued by financial institutions that have the authority to issue letters of credit and whose operations are regulated and examined by a federal agency, or a policy of insurance that provides the BLM with acceptable rights as a beneficiary and is issued by an insurance carrier that has the authority to issue insurance policies in the applicable jurisdiction and whose insurance operations are regulated and examined by a federal or state agency. The BLM will not accept a corporate guarantee as an acceptable form of bond. If a state regulatory authority requires a bond to cover some portion of environmental liabilities, such as hazardous material damages or releases, reclamation, or other requirements for the project, the BLM must be listed as an additional name insured on the bond instrument. This inclusion would suffice to cover the BLM's exposure should a holder default in any environmental liability listed in the respective state bond. Each bond instrument will be reviewed by the appropriate Regional or Field Solicitor's Office for the DOI prior to its acceptance by the BLM.

The BLM authorized officer will review all bonds on an annual basis to ensure adequacy of the bond amount. The bond will also be reviewed at the time of any ROW assignment, amendment, or renewal. The BLM authorized officer may increase or decrease the bond amount at any time during the term of the ROW authorization, consistent with the regulations (43 CFR 2805.12(g)).

The BLM authorized officer will identify the total amount of the Performance and Reclamation bond in the decision that supports the issuance of the ROW authorization. The BLM will require the holder to post the portion of the bond associated with the activities to be approved by the Notice to Proceed (Form 2800-15; available at https://www.blm.gov/FormsCentral/show-form.do?nodeId=1666) prior to the issuance of that Notice. For example, if the Notice to Proceed is limited to an initial phase of development, the bond amount required to be posted before issuance of the Notice to Proceed will be limited to that phase. The bond amount required to be posted would increase with the issuance of a Notice to Proceed for future phases of the project.

The Performance and Reclamation bond will consist of three components for purposes of determining its amount. The first component will address environmental liabilities, including hazardous materials liabilities, such as risks associated with hazardous waste and hazardous substances. This component may also account for herbicide use, petroleum-based fluids, and dust control or soil stabilization materials. If a holder uses herbicides extensively, this component of the bond amount may be significant. The second component will address the decommissioning, removal, and proper disposal, as appropriate, of improvements and facilities. All solar projects involve the construction of substantial surface facilities, and the bond amount for this component could be substantial. The third component will address reclamation, revegetation, restoration, and soil stabilization. This component will be determined based on the amount of vegetation retained on-site and the potential for flood events and downstream sedimentation from the site that may result in off-site impacts, including CWA violations or other violations of law. The holder of the ROW authorization can potentially reduce the bond amount for this component by limiting the amount of vegetation removal as part of the project design and limiting the amount of grading required for project construction.

The BLM may also require bond coverage for all expenses tied to cultural resources identification, protection, and mitigation. This may include, but is not limited to, costs associated with ethnographic studies, inventory, testing, geomorphological studies, data recovery, compensatory mitigation programs, curation, monitoring, treatment of damaged sites, and the preparation and submission of reports. Bonding for cultural resource identification, protection, and mitigation is necessary in the event that a ROW holder disturbs a site where such resources are present but discontinues development before taking the necessary steps to complete all analysis, documentation, and proper curation of site contents, and to stabilize or reclaim the cultural and historic properties so that they are returned to a secure condition.

Ultimately, the Performance and Reclamation bond will be a single instrument to cover all potential liabilities. The entire bond amount could be used to address a single risk event, such as hazardous materials release or groundwater contamination, regardless of the fact that in calculating the total bond amount other risks were also considered. If the bond is used to address a particular risk, the holder would then be required to increase the bond amount to compensate for this use. This approach to establishing a bond is preferable to one allowing holders to maintain separate bonds for each contingency. If separate bonds are held, an underestimation of one type of liability may leave the BLM responsible for making up the difference, as the funds associated with one bond may not be applicable for the purposes of another. Requiring a single, larger bond will ensure that the holders are bonded with a surety that has the capacity to underwrite the entire amount associated with the authorization.

The regulations authorize the BLM to require that applicants submit a Decommissioning and Site Reclamation Plan (DSRP) that defines the reclamation, revegetation, restoration, and soil stabilization requirements for the project area as a component of their POD (43 CFR 2804.25(b)). The DSRP shall require expeditious reclamation of construction areas and the revegetation of disturbed areas to reduce invasive weed infestation and erosion and must be approved by the BLM authorized officer prior to the authorization of the ROW. The approved DSRP will be used as the basis for determining the standard for reclamation, revegetation, restoration, and soil stabilization of the project area and, ultimately, in determining the full bond amount.

The BLM has issued policy guidance for determining bonding requirements for 43 Part CFR 3809 mining operations on the public lands (IM 2009-153 [BLM 2009a]) that provides detailed information about the process for determining the appropriate financial guarantees for intensive land uses on the public lands. This guidance can also be used to assist in calculating the bond amount for utility-scale solar energy development projects on public lands. The guidance requires that mining operators submit a Reclamation Cost Estimate (RCE) to the BLM authorized officer for review to assist in determining the bond amount. Although the ROW regulations do not specifically require that a holder of a ROW submit a RCE to the BLM, the BLM can require a ROW applicant to submit a POD in accordance with 43 CFR 2804.25(b). Because an RCE is key to determining the bond amount, a figure that is set forth in any decision authorizing a solar energy project on the public lands, BLM policy requires all solar energy ROW applicants to submit an RCE as part of the DSRP and the overall POD for a solar energy project. Attachment 1 to IM 2009-153 provides Guidelines for Reviewing RCEs and can be used as a guideline to assist in reviewing RCEs submitted for solar energy projects.

- ***Notice to Proceed.*** All solar energy ROW authorizations will include a provision that specifies that ground-disturbing activities cannot begin until the BLM authorized officer issues a Notice to Proceed. Each Notice to Proceed will authorize construction or use and occupancy only as therein expressly stated and only for the particular location or use and occupancy therein described (i.e., a construction phase or site location). The holder will not initiate any construction or other surface-disturbing activities on the ROW without such prior written authorization of the BLM authorized officer. The issuance of a BLM Notice to Proceed by the authorized officer could be delayed pending completion of a requirement(s) imposed by another federal, state, and/or local entity (e.g., permit issuance, mitigation compliance, or biological, opinion issuance).

- ***Administrative Appeal.*** All final decisions issued by the authorized officer in connection to the authorization of solar energy projects can be appealed under 43 CFR Part 4 and 43 CFR 2801.10. ROW authorizations are issued as full force and effect decisions (43 CFR 2801.10(b)) and will remain effective during any appeal period. Final decisions issued by the Secretary, Deputy

Secretary, or Assistant Secretary will not be subject to administrative appeals to the IBLA.

- ***Air Navigation Hazards.*** Upon issuance of a ROW authorization that includes meteorological or power towers or other tall structures that could pose a hazard to air navigation (including DoD training and operations), the BLM, after coordination with the Federal Aviation Administration [FAA] and DoD, will ensure that the locations of such facilities are noted on aerial navigation hazard maps for low-level flight operations that may be undertaken by the BLM and other federal or state agencies for fire operations, wild horse and burro censuses and gathers, wildlife inventories, facility maintenance, or other activities.

- ***Cadastral Survey Policies.*** Prior to approval of any solar energy ROW application that (1) is within 0.25 mi (0.4 km) of a boundary as described in BLM IM 2011-122 issued May 24, 2011 (BLM 2011a), (2) does not conform to the Public Land Survey System (PLSS), (3) can be located only by protraction diagram, or (4) may potentially affect a body of water, the responsible field office will coordinate with the respective State Office Chief Cadastral Surveyor to ensure adequate Cadastral Survey review of Boundary Evidence. The applicant shall be liable to the BLM for the reasonable cost of such review under the ROW application cost-recovery agreement with the BLM.

  All authorizations for solar energy development on BLM-administered lands will contain the following stipulation:

  > Evidence of the PLSS and related federal property boundaries will be identified and protected prior to commencement of any ground-disturbing activity. This will be accomplished by contacting BLM Cadastral Survey to coordinate data research, evidence examination and evaluation, and locating, referencing or protecting monuments of the PLSS and related land boundary markers from destruction. In the event of obliteration or disturbance of the federal boundary evidence, the responsible party shall immediately report the incident, in writing, to the authorizing official. BLM Cadastral Survey will determine how the marker is to be restored. In rehabilitating or replacing the evidence, the responsible party will be instructed to use the services of a Certified Federal Surveyor (CFedS), procurement shall be per qualification-based selection, or reimburse the BLM for costs. All surveying activities will conform to the *Manual of Surveying Instructions* (Manual) (BLM 2009b) and appropriate state laws and regulations. Local surveys will be reviewed by Cadastral Survey before being finalized or filed in the appropriate state or county office. The responsible party shall pay for all survey, investigation, penalties, and administrative costs.

- ***Diligent Development.*** The ROW regulations specify that a ROW authorization conveys to the holder only the rights that the authorization expressly contains (43 CFR 2805.14) and that the holder must comply with all terms and conditions included in the authorization (43 CFR 2805.12). In order to facilitate efficient development of solar energy on the public lands, the BLM will include a requirement in each ROW authorization that the holder begin construction of the initial phase of development within 12 months after issuance of the Notice to Proceed, but no later than 24 months after the effective date of the ROW authorization. Each authorization will also specify that construction must be completed within the time frames in the approved POD, but no later than 24 months after start of construction unless the project has been approved for phased development as described below. A Notice to Proceed will be issued for each phase of development.

  The BLM will not authorize more than three development phases for any solar energy ROW authorization. If an approved POD provides for phased development, the ROW authorization will include provisions specifying that construction of each phase (following the first) must begin within 3 years of the start of construction of the previous phase.

  The BLM authorized officer may suspend or terminate the authorization when the holder fails to comply with the diligent development terms and conditions of the authorization (43 CFR 2807.17). The regulations provide that before suspending or terminating the authorization, the BLM will send the holder a written notice that gives the holder a reasonable opportunity to correct any noncompliance or to start or resume use of the ROW (43 CFR 2807.18). This notice may be satisfied by the BLM sending a Notice of Failure to Ensure Diligent Development.

  To address a failure to comply with an authorization's diligent development provisions, the holder must show good cause for any delays in construction, provide the anticipated date of completion of construction and evidence of progress toward the start or resumption of construction, and submit a written request for extension of the time lines in the approved POD. Good cause may be shown, for example, by delays in equipment delivery, legal challenges, and acts of God. This procedure will apply whether a project has multiple development phases or a single phase.

  If, following receipt of a Notice of Failure to Ensure Diligent Development, the holder has satisfactorily complied with each of the requirements of the procedure described above, the authorized officer may grant the holder's request for an extension of the time lines in the approved POD. If, following receipt of such Notice, the holder does not satisfactorily comply with each of the requirements of this procedure, the authorized officer may elect to suspend or terminate the ROW authorization pursuant to 43 CFR 2807.17 where such action is justified.

Each ROW authorization for solar energy development will include terms and conditions requiring the holder to maintain all on-site electrical generation equipment and facilities in accordance with the design standards in the approved POD. In addition, the authorization will specify that any idle, improperly functioning, or abandoned equipment or facilities that have been inoperative for any continuous period of 3 months must be repaired, placed into service, or removed from the site within 30 days from receipt of a written Notice of Failure to Ensure Diligent Development, unless the holder is provided an extension of time by the BLM authorized officer. Upon receipt of such Notice from the BLM authorized officer, the holder must repair, place into service, or remove the equipment or facilities described in the Notice in a timely manner. Alternatively, the holder must show good cause for any delays in repairs, use, or removal; estimate when corrective action will be completed; provide evidence of diligent operation of the equipment and/or facilities; and submit a written request for an extension of the 30-day deadline. If the holder satisfies neither approach, the BLM authorized officer may elect to suspend or terminate the authorization in accordance with 43 CFR 2807.17–2807.19 where such action is justified. In addition, the BLM may use the posted Performance and Reclamation bond to cover the costs for removal of any idle or abandoned equipment and/or facilities.

All solar energy ROW authorizations must include the diligent development provisions as described above in the terms and conditions of the authorization, consistent with the requirements of 43 USC 1765(b) and the ROW regulations at 43 CFR 2801.2.

- ***Operating Standards.*** The authorization holder shall perform all operations in a good and workmanlike manner, consistent with the approved POD, so as to ensure protection of the environment and the health and safety of the public. To ensure compliance with the terms and conditions of the ROW authorization and to ensure that operations are conducted consistent with those terms and conditions, the BLM authorized officer will conduct inspections of such operations and can issue notices of violations. The authorized officer may also order an immediate temporary suspension of operations, orally or in writing, in accordance with 43 CFR 2807.16 to protect public health or safety or the environment.

- ***Access to Records.*** The BLM may require the holder of a solar energy development ROW authorization to provide any pertinent environmental, technical, and financial records, reports, and other information, including PPAs and Interconnection Agreements, related to project construction, operation, maintenance, and decommissioning, including the production and sale of electricity generated from the approved facilities on public land (43 CFR 2805.12(p); 43 USC 1765(b); 43 USC 1764(g); 43 USC 1761(b)). The BLM may use this information for the purpose of monitoring the authorization and for periodic evaluation and adjustment of rental fees or other financial obligations under the authorization.

Upon the request of the BLM authorized officer, the appropriate records, reports, or information shall be made available for inspection and duplication by such officer. Any information marked confidential or proprietary will be kept confidential to the extent allowed by law. Failure to cooperate with such request, provide data, or grant access to information or records, may, at the discretion of the BLM authorized officer, result in suspension or termination of the ROW authorization. All solar energy ROW authorizations must include such disclosure provisions in the terms and conditions of the authorization in accordance with the regulations (43 CFR 2807.17).

- ***Changes to Terms and Conditions.*** The BLM authorized officer may change the terms and conditions of the authorization as a result of changes in legislation, regulations, or as otherwise necessary to protect public health or safety or the environment in accordance with 43 CFR 2801.15(e).

- ***Upgrades or Changes to Facility Design or Operation***. Operators of solar power facilities on BLM-administered lands shall coordinate with the BLM and other appropriate federal, state, and local agencies regarding any planned upgrades or changes to the solar facility design or operation. Proposed changes of this nature may require additional environmental analysis and/or revision of the POD.

- ***10-Year Review.*** The solar ROW authorization, shall, at a minimum, be reviewed by the BLM authorized officer at the end of the 10th year and at regular intervals thereafter not to exceed 10 years.

- ***Transfers or Assignments Require BLM Approval.*** The ROW authorization may be assigned (i.e., transfer of interest) consistent with the provisions of the regulations (43 CFR 2807.21(b)). However, all assignments shall be approved by the BLM authorized officer, and the qualifications of all assignees must comply with 43 CFR 2803.10 and the due diligence requirements of the regulations (43 CFR2807.21(c)(1) and 43 CFR 2807.21(d)). The assignment shall not interfere with the BLM's enforcement of the terms and conditions of the authorization or management of the associated public lands. Transfers other than assignments must be approved by the BLM and may result in requirements for submittal of a new application or a Notice of Termination.

2.2.1.2 Monitoring, Adaptive Management, and Mitigation

2.2.1.2.1 Monitoring and Adaptive Management

The BLM is committed to developing and incorporating into its Solar Energy Program a monitoring and adaptive management strategy to ensure that data and lessons learned about the impacts of solar energy projects will be collected, reviewed, and, as appropriate, incorporated into the BLM's Solar Energy Program and individual projects in the future. Changes to the BLM's Solar Energy Program resulting from monitoring and adaptive management (e.g., modifications to exclusion areas) will be subject to appropriate land use planning, environmental review, and/or policy development.

Comments on both the Draft Solar PEIS and Supplement to the Draft Solar PEIS indicate substantial public interest in a robust, long-term, scientifically sound monitoring and adaptive management plan for BLM's Solar Energy Program. Commentors with an interest in monitoring strategies expressed a preference for public engagement, transparency and data availability.

In 2011, the BLM released the Assessment, Inventory and Monitoring (AIM) Strategy for condition and trend monitoring of BLM-managed resources and lands. The BLM supports the use of the AIM Strategy as the basis for a long-term solar monitoring and adaptive management plan (Solar LTMP). The AIM Strategy provides a replicable, consistent framework for collecting monitoring data across solar program areas and for adaptively managing the siting and permitting of solar energy projects and SEZs. Further, an AIM-based Solar LTMP will take advantage of and augment other AIM efforts underway, including Rapid Ecoregional Assessments, the national landscape monitoring framework, greater sage-grouse analysis, and an array of local, management-driven monitoring efforts. The information derived from these coordinated, multiprogram efforts will provide an unprecedented understanding of the condition and trend of BLM-managed lands and support informed decision-making across jurisdictional boundaries.

An introduction to the AIM Strategy and proposed steps to deploy an AIM-based Solar LTMP are presented in Section A.2.4 of Appendix A of this Final Solar PEIS. The BLM is proposing to pilot the Solar LTMP in a limited fashion initially by implementing the steps outlined in one or more of the proposed SEZs. Results of the pilot will aid the BLM in refining the Solar LTMP framework and will allow for replication of a sound process across the remainder of the SEZs and other program lands.

2.2.1.2.2 Mitigation

The BLM's proposed Solar Energy Program under both action alternatives employs a mitigation hierarchy to address potential impacts—avoidance, minimization, and offset of unavoidable impacts. The BLM first employs avoidance and minimization strategies to eliminate or reduce potential adverse impacts. For those impacts that are not fully avoided or minimized, the BLM determines, in consultation with affected stakeholders, if any measures to offset or mitigate adverse impacts would be appropriate.

Avoidance and Minimization

The BLM's approach to mitigation first calls for avoidance of areas where there is a high potential for natural, visual, or cultural resource conflict; for example, the most ecologically important and/or sensitive habitats. For the Solar Energy Program, the BLM proposes to accomplish this goal through the identification of extensive exclusions and the incentivizing of development in SEZs (i.e., priority areas with low or relatively low resource conflict). Further, the BLM proposes to use landscape-scale ecological assessments and other natural, visual, and cultural resource screening factors in the proposed variance process to identify and avoid core, sensitive, and/or intact landscapes outside of priority areas.

The BLM's approach to mitigation secondarily calls for the BLM to consider how best to minimize unavoidable impacts. For the Solar Energy Program, the BLM proposes to accomplish this goal by developing and employing programmatic and SEZ-specific design features that limit harm to sensitive natural, visual, and cultural resources. In addition, projects on BLM-administered lands will be required to follow all applicable federal, state, and local laws and regulations such as the ESA, which will result in additional measures that avoid and/or minimize resource impacts.

As described in the previous section, the BLM proposes to establish a robust monitoring and adaptive management plan as part of its Solar Energy Program (see Section A.2.4 of Appendix A). The BLM will use information derived from its monitoring efforts to make necessary adjustments to its solar energy–related avoidance and minimization strategies over time.

Offset of Unavoidable Impacts

For those impacts that cannot be avoided or minimized, the BLM will consider the implementation of effective measures to offset (or mitigate) impacts with a goal of ensuring viability of resources over time. To help accomplish this goal, the BLM proposes to establish regional mitigation plans that will facilitate development in SEZs (see Section 2.2.2.2.3). As envisioned, regional mitigation plans will simplify and improve the mitigation process for future projects in SEZs. A framework for developing regional mitigation plans is presented in Section A.2.5 of Appendix A of this Final Solar PEIS. The BLM is proposing to undertake pilot regional mitigation plans in one or more of the proposed SEZs. Results of these pilot plans will aid the BLM in refining the framework for regional mitigation plans and will allow for replication of a sound process across the remainder of the SEZs. Projects proposed outside of SEZs would be required to follow the mitigation hierarchy outlined above, but may not be able to take advantage of specific regional mitigation plans.

2.2.1.3 Design Features

The BLM has established a set of proposed programmatic design features that would be required for all utility-scale solar energy development on BLM-administered lands under both action alternatives. Design features are mitigation requirements that have been incorporated into the proposed action or alternatives to avoid or reduce adverse impacts. The programmatic design features are presented in Section A.2.2 of Appendix A of this Final Solar PEIS. The proposed design features are presented by resource type and by project phase (i.e., general; site characterization, siting, and design construction; operations and maintenance; and reclamation and decommissioning). These design features address resource conflicts associated with utility-scale solar energy development described in Chapter 5 of the Draft Solar PEIS.

The proposed design features were derived from comprehensive reviews of solar energy development activities, published data regarding solar energy development impacts, existing relevant mitigation guidance, and standard industry practices. The BLM has revised the list of proposed programmatic design features based on input received through the Draft Solar PEIS and additional outreach conducted between the publication of the Supplement to the Draft Solar PEIS and this Final Solar PEIS.

2.2.1.4 Segregation of Lands with Potential for Solar Development

On April 26, 2011, the BLM published concurrently an Interim Temporary Final Rulemaking (ITFR) and a Proposed Rule pertaining to the segregation of public lands. The ITFR is found in 43 CFR 2091.3-1(e) and 2804.25(e), which comprise regulations for segregations in general and ROW protection through segregations, respectively. The ITFR is intended to promote the orderly administration of public lands and allows an authorized officer to close (segregate) public lands from operation of the public land laws for a period of up to 2 years. This includes the mining law and the public land disposal laws, but not the mineral leasing or materials sale acts. This segregation may not be extended under the ITFR. Through the segregation, a solar or wind energy ROW applicant has assurances that the application will not be subject to adverse activities caused by either the filing of mining claims or impacts from other proposed land uses or disposals. The BLM is currently analyzing comments received as part of the proposed rulemaking process and also drafting a final rule.

2.2.2 Solar Energy Development Program Alternative (BLM Preferred Alternative)

Under the solar energy development program alternative (referred to as the “program alternative”), the BLM proposes categories of lands to be excluded from utility-scale solar energy development and identifies specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM proposes to prioritize development (and to apply any identified SEZ-specific design features). The program alternative emphasizes and incentivizes development within SEZs and proposes a collaborative process to identify additional SEZs. To accommodate the flexibility described in the BLM’s program objectives, the program alternative allows for utility-scale solar development in variance areas outside of SEZs in accordance with the proposed variance process. The program alternative also establishes ROW authorization policies and programmatic design features for utility-scale solar energy development on BLM-administered lands.

The BLM has made further modifications to the program alternative that was presented in the Supplement to the Draft Solar PEIS based on comments and concerns raised by the public, stakeholders, and cooperating agencies.

2.2.2.1 Proposed Right-of-Way Exclusion Areas

Under the program alternative, the BLM proposes to exclude specific categories of land from utility-scale solar energy development. Right-of way exclusion areas are defined as areas that are not available for location of ROWs under any conditions (BLM Land Use Planning Handbook, H-1601-1 [BLM 2005]). On the basis of input received from the public, stakeholders, cooperating agencies, and tribes on the Supplement to the Draft Solar PEIS, the list of proposed exclusions has been modified and now totals approximately 79 million acres (319,072 km^2), including some state specific exclusions (see Table 2.2-2).

The identification of exclusion areas allows the BLM to support the highest and best use of public lands by avoiding potential resource conflicts and reserving for other uses public lands that are not well suited for utility-scale solar energy development. Due to the size and scale of utility-scale solar energy development (typically involving a single use of public lands), the BLM is proposing to exclude a broader set of categories than would be identified in a land use plan for other types of ROWs. Consistent with existing planning regulations, applicants may request that the BLM amend a land use plan to allow for an otherwise nonconforming proposal (BLM Land Use Planning Handbook H-1601-1, Section VII(B) [BLM 2005]).[3] For example, an applicant may request a land use plan amendment for utility-scale solar development in areas with higher slope or lower insolation than previously identified in the Solar PEIS in order to avoid a potential resource conflict or maximize the use of existing transmission.

The exclusions proposed through the Solar PEIS include (1) *explicit* exclusions that will be delineated in the Solar PEIS ROD by a land base that would not change except by future land use plan amendment; and (2) *implicit* exclusions that will be defined in the Solar PEIS ROD by the presence or absence of a specific resource or condition where the land base may change over time (e.g., critical habitat). Implicit exclusions will be based on information in applicable land use plans as amended, Species' Recovery Plans, or similar planning or guidance documents, and verified by site-specific information as necessary. For the purposes of the Solar PEIS and its associated NEPA analysis, the BLM has mapped and estimated the acreage for all proposed exclusions in the aggregate based on best available existing information. The identification of any additional exclusions for utility-scale solar energy development would involve planning-level decisions and require the BLM to amend applicable land use plans.

---

[3] The decision to amend a land use plan is within the BLM's discretion. Denial of a request to amend a plan is a plan-level decision made by a BLM State Director and may be protested to the BLM Director under 43 CFR 1610.5-2(a).

TABLE 2.2-2 Exclusions under BLM's Solar Energy Development Program Alternative

1. Lands with slopes greater than 5% determined through geographical information system (GIS) analysis using digital elevation models.[a]

2. Lands with solar insolation levels less than 6.5 kWh/m^2/day determined through National Renewable Energy Laboratory solar radiation GIS data (http://www.nrel.gov/rredc/solar_data.html).

3. All Areas of Critical Environmental Concern (ACECs) identified in applicable land use plans (including Desert Wildlife Management Areas [DWMAs] in the California Desert District planning area).

4. All designated and proposed critical habitat areas for species protected under the Endangered Species Act (ESA) of 1973 (as amended) as identified in respective recovery plans (http://ecos.fws.gov/tess_public/TESSWebpageRecovery?sort=1).

5. All areas for which an applicable land use plan establishes protection for lands with wilderness characteristics.

6. Developed recreational facilities, special-use permit recreation sites (e.g., ski resorts and camps), and all Special Recreation Management Areas (SRMAs) identified in applicable land use plans, except for those in the State of Nevada and a portion of the Yuma East SRMA in Arizona.[b]

7. All areas where the BLM has made a commitment to state agency partners and other entities to manage sensitive species habitat, including but not limited to sage-grouse core areas, nesting habitat, and winter habitat; Mohave ground squirrel habitat; flat-tailed horned lizard habitat; and fringe-toed lizard habitat.

8. Greater sage-grouse habitat (currently occupied, brooding, and winter habitat) as identified by the BLM in California, Nevada, and Utah, and Gunnison's sage-grouse habitat (currently occupied, brooding, and winter habitat) as identified by the BLM in Utah.[c]

9. All areas designated as no surface occupancy (NSO) in applicable land use plans

10. All right-of-way (ROW) exclusion areas identified in applicable land use plans.

11. All ROW avoidance areas identified in applicable land use plans.

12. In California, lands classified as Class C in the California Desert Conservation Area (CDCA) planning area.

13. In California and Nevada, lands in the Ivanpah Valley.

14. In Nevada, lands in Coal Valley and Garden Valley.

15. All Desert Tortoise translocation sites identified in applicable land use plans, project-level mitigation plans or Biological Opinions.

16. All Big Game Migratory Corridors identified in applicable land use plans.

17. All Big Game Winter Ranges identified in applicable land use plans.

18. Research Natural Areas identified in applicable land use plans.

TABLE 2.2-2 (Cont.)

19. Lands classified as Visual Resource Management (VRM) Class I or II (and, in Utah, Class III[d]) in applicable land use plans.

20. Secretarially designated National Recreation, Water, or Side and Connecting Trails and National Back Country Byways (BLM State Director approved) identified in applicable BLM and local land use plans (available at http://www.americantrails.org/NRTDatabase), including any associated corridor or lands identified for protection through an applicable land use plan.

21. All units of the BLM National Landscape Conservation System, congressionally designated National Scenic and Historic Trails (National Trails System Act [NTSA], P.L. 90-543, as amended), and trails recommended as suitable for designation through a congressionally authorized National Trail Feasibility Study, or such qualifying trails identified as additional routes in law (e.g., West Fork of the Old Spanish National Historic Trail), including any trail management corridors identified for protection through an applicable land use plan. Trails undergoing a congressionally authorized National Trail Feasibility Study will also be excluded pending the outcome of the study.[e]

22. National Historic and Natural Landmarks identified in applicable land use plans, including any associated lands identified for protection through an applicable land use plan.

23. Lands within the boundaries of properties listed in the *National Register of Historic Places* (NRHP) and any additional lands outside the designated boundaries identified for protection through an applicable land use plan.

24. Traditional cultural properties and Native American sacred sites as identified through consultation with tribes and recognized by the BLM.

25. Wild, Scenic, and Recreational Rivers designated by Congress, including any associated corridor or lands identified for protection through an applicable river corridor plan.

26. Segments of rivers determined to be eligible or suitable for Wild or Scenic River status identified in applicable land use plans, including any associated corridor or lands identified for protection through an applicable land use plan.

27. Old Growth Forest identified in applicable land use plans.

28. Lands within a solar energy development application area found to be inappropriate for solar energy development through an environmental review process that occurred prior to finalization of the Draft Solar PEIS.[f]

29. Lands previously proposed for inclusion in SEZs that were determined to be inappropriate for development through the NEPA process for the Solar PEIS (limited to parts of the Brenda SEZ in Arizona; the previously proposed Iron Mountain SEZ area and parts of the Pisgah and Riverside East SEZs in California; parts of the De Tilla Gulch, Fourmile East, and Los Mogotes East SEZs in Colorado; and parts of the Amargosa Valley SEZ in Nevada).

30. In California, all lands within the proposed Mojave Trails National Monument[g] and all conservation lands acquired outside of the proposed Monument through donations or use of Land and Water Conservation Funds.

31. In California, BLM-administered lands proposed for transfer to the National Park Service with the concurrence of the BLM.[h]

TABLE 2.2-2 (Cont.)

32.	Specific areas identified since the publication of the Supplement to the Draft Solar PEIS by the BLM based on continued consultation with cooperating agencies and tribes to protect sensitive natural, visual, and cultural resources (total of 1,066,497 acres [4,316 km^2]; see Figure 2.2-7. Note there are some overlapping exclusions). Data and finer scale maps will be made available through the Solar PEIS project Web site (http://solareis.anl.gov). Note that in some cases, the description of these areas will be withheld from the public to ensure protection of the resource.

[a] Applications may include some lands with up to 10% slope where higher slopes inclusions meet all of the following: (1) are proximate to variance lands in the application, (2) are not otherwise excluded from development, (3) allow for the avoidance or minimization of resource conflicts, and (4) do not create any significant new or additional conflicts. In such cases, a land use plan amendment would have to be adopted as part of the project-specific analysis to permit the slope exception.

[b] In Nevada, many designated SRMAs are located on semi-degraded lands that might be appropriate for solar development. Decisions on solar ROW applications within Nevada SRMAs will be made on a case-by-case basis. A portion of the Yuma East SRMA was identified as a variance area rather than as an exclusion area based on its designation as VRM Class III and as a rural developed recreation setting, both of which allow for modifications to the natural environment.

[c] In April 2010, the USFWS published its listing for the greater sage-grouse as “Warranted but Precluded.” Inadequacy of regulatory mechanisms was identified as a major threat in the USFWS finding on the petition to list the greater sage-grouse. The USFWS has identified the principal regulatory mechanism for the BLM as conservation measures in RMPs. On the basis of the identified threats to the greater sage-grouse and the USFWS’s time line for making a listing decision on this species, the BLM has initiated action to incorporate explicit objectives and adequate conservation measures into RMPs (including PEISs and project EISs) within the next 3 years in order to conserve greater sage-grouse and avoid a potential listing under the ESA. To meet the objectives of BLM’s sage-grouse conservation policy, the Solar PEIS has excluded specifically identified sage-grouse habitat (currently occupied, brooding, and winter habitat) located on BLM public lands in Nevada and Utah. These exclusions will be subject to change based on the outcome of the BLM’s sage-grouse planning efforts and resulting plan amendments.

[d] In Utah, VRM Class III lands have also been removed due to the high sensitivity and location proximity to Zion, Bryce, Capital Reef, Arches, and Canyonlands National Parks, and to significant Cultural Resource Special Management Areas (in southeast Utah).

[e] National Scenic Trails are comprised of extended pathways located for recreational opportunities and the conservation and enjoyment of the scenic, historic, natural, and cultural qualities of the areas through which they pass (NTSA Sec. 3(a)(2)).

National Historic Trails are comprised of Federal Protection Components and/or high-potential historic sites and high-potential route segments, including original trails or routes of travel, developed trail or access points, artifacts, remnants, traces, and the associated settings and primary uses identified and protected for public use and enjoyment (NTSA Sec. 3(a)(3)) and may include associated auto tour routes (NTSA Sec. 5(b)(A) and 7(c)). National Historic Trails or other types of historic trails may also contain properties listed or eligible for listing on the NRHP or National Historic Landmarks. National Historic Trails are protected and identified as required by law (NTSA Sec.3(a)(3)), through BLM inventory and planning processes.

[f] For example, lands considered non-developable in the environmental analyses completed for the Genesis Ford Dry Lake Solar Project, Blythe Solar Project, and Desert Sunlight Solar Project, and some lands previously within the Pisgah and Brenda proposed SEZs.

Footnotes continued on next page.

TABLE 2.2-2 (Cont.)

---

[g] As described in Senate Bill 138, California Desert Protection Act of 2011, introduced in the 112th Congress.

[h] Three specific geographic areas described as (1) the narrow strip of BLM-administered lands between Fort Irwin and Death Valley National Park, (2) an area of public lands on the northeastern side of the Mojave National Preserve adjacent to the California and Nevada border, and (3) an area along the northern boundary of Joshua Tree National Park.

The exclusions proposed through the Solar PEIS would apply only to the siting of utility-scale solar energy generation facilities and not to any required supporting linear infrastructure, such as roads, transmission lines, and natural gas or water pipelines. Management decisions for supporting linear infrastructure, including available lands, are defined in existing applicable land use plans. Siting of supporting infrastructure would be analyzed fully in project-specific environmental reviews.

2.2.2.2 Proposed Solar Energy Zones

An SEZ is defined by the BLM as an area within which the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development. SEZs should be relatively large areas that provide highly suitable locations for utility-scale solar development: locations where solar development is economically and technically feasible, where there is good potential for connecting new electricity-generating plants to the transmission distribution system, and where there is generally low resource conflict.

ROWs for utility-scale solar energy development in SEZs would be given priority over all other ROW applications. The BLM may decide to authorize other ROWs or uses in SEZs, however, if they are found to be compatible with utility-scale solar energy development such as shared access roads, transmission lines, or other generation sources such as geothermal. The identification of an area as an SEZ will not affect previously authorized ROWs, whether or not construction has been initiated on those ROWs. The BLM will consider the processing of pending ROW applications in identified SEZs on a case-by-case basis.

The BLM has carried 17 SEZs forward for analysis in the Final Solar PEIS. These SEZs total approximately 285,000 acres (1,153 km^2) of land potentially available for development (see Table 2.2-3). Chapters 8 through 13 of the Draft and Final Solar PEIS include assessments of the affected environment and potential environmental impacts of solar energy development in each of the SEZs. This SEZ-specific analysis provides documentation from which the BLM will tier future project authorizations, thereby limiting the required scope and effort of project-specific NEPA analyses. The BLM is committed to collecting additional SEZ-specific resource data and conducting additional analysis in order to more effectively facilitate future development in SEZs.

The BLM developed action plans for each of the 17 SEZs as part of the Supplement to the Draft Solar PEIS (see Appendix C of the Supplement). These action plans described

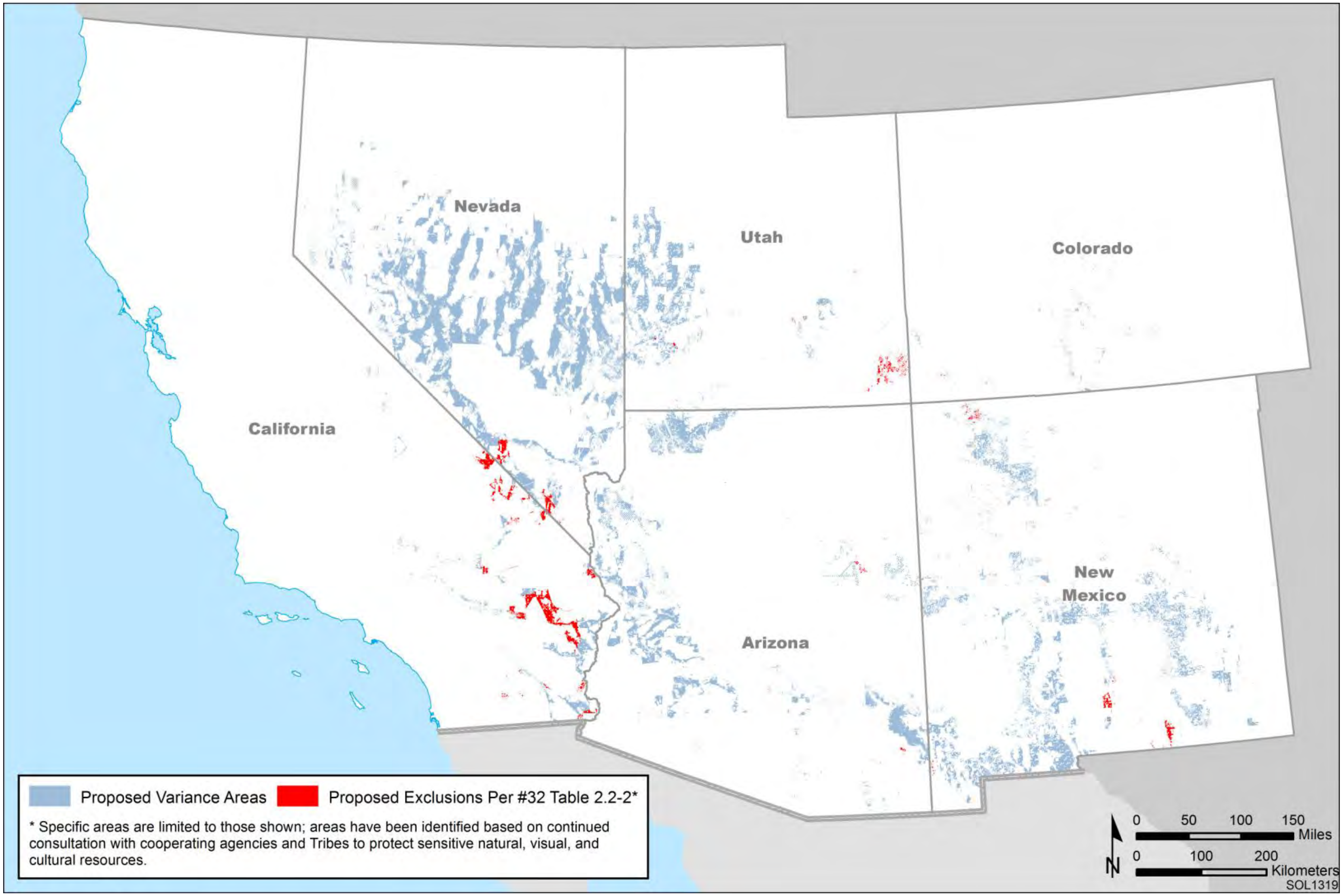


FIGURE 2.2-7 Areas Proposed for Exclusion Since Publication of the Supplement to the Draft Solar PEIS Based on Continued Consultation with Cooperating Agencies and Tribes

TABLE 2.2-3 Proposed SEZs and Approximate Acreage by State[a]

Proposed SEZ (BLM Office/County)	Approximate Acreage
Arizona	
Brenda (Lake Havasu/La Paz)	3,348
Gillespie (Lower Sonoran/Maricopa)	2,618
Total	5,966
California	
Imperial East (El Centro/Imperial)	5,717
Riverside East (Palm Springs–South Coast/Riverside)	147,910
Total	153,627
Colorado	
Antonito Southeast (La Jara/Conejos)	9,712
De Tilla Gulch (Saguache/Saguache)	1,064
Fourmile East (La Jara/Alamosa)	2,882
Los Mogotes East (La Jara/Conejos)	2,650
Total	16,308
Nevada	
Amargosa Valley (Southern Nevada/Nye)	8,479
Dry Lake (Southern Nevada/Clark)	5,717
Dry Lake Valley North (Ely/Lincoln)	25,069
Gold Point (Battle Mountain/Esmeralda)	4,596
Millers (Battle Mountain/Esmeralda)	16,534
Total	60,395
New Mexico	
Afton (Las Cruces/Dona Ana)	29,964
Total	29,964
Utah	
Escalante Valley (Cedar City/Iron)	6,533
Milford Flats South (Cedar City/Beaver)	6,252
Wah Wah Valley (Cedar City/Beaver)	5,873
Total	18,658
Total	284,918

[a] To convert acres to km^2, multiply by 0.004047.

additional data that could be collected for individual SEZs and proposed data sources and methods for the collection of those data. Work is under way to collect additional data as specified under these action plans (e.g., additional data collection to support evaluation of cultural, visual, and water resources has begun). Additional data collected for SEZs will be made available as appropriate through the Solar PEIS project Web site (http://solareis.anl.gov).

2.2.2.2.1 Authorization Process for Projects in SEZs

The BLM proposes to offer lands in SEZs through a competitive process. The BLM has initiated a rulemaking to establish a competitive process for offering public lands for solar and wind development within designated leasing areas (i.e., SEZs in the Solar PEIS). The Advance Notice of Proposed Rulemaking was published on December 29, 2011. The BLM intends to have a Proposed Rule available for public comment closely following the release of the Solar PEIS ROD.

Section 501 of FLPMA authorizes the Secretary of the Interior, with respect to public lands, to grant, issue, or renew ROWs over, upon, under, or through such lands for systems for the generation, transmission, and distribution of electric energy (43 USC 1761(4)). This authority includes the issuance of ROW lease authorizations for solar energy generation systems. The existing ROW regulations (43 CFR 2804.23(c)) currently provide authority for identifying public lands under competitive bidding procedures, but limit the competitive process to responding to ROW applications. The purpose of a competitive process under existing regulations is to determine which application would be processed. Through rulemaking, the BLM intends to provide broader authority and a new competitive process for making lands available for solar energy development within SEZs (i.e., designated leasing areas).

The proposed rule may include the following provisions for a competitive process for lands within SEZs:

- **Call for nominations.** A call for nominations would be published in the *Federal Register* to solicit expressions of interest for parcels of land within individual SEZs. A nomination of a specific parcel would require payment of a nomination fee to be determined by the regulations. (Section 504 of FLPMA provides authority to the BLM to establish reasonable filing fees.)

- **Review of nominations.** The BLM would review the nominations to determine parcels of land to offer in individual SEZs. The BLM would complete the work necessary to prepare the selected parcels for the competitive offer.

  In preparing selected parcels for competitive offer, the BLM would review existing analysis for an SEZ and consider any new or changed circumstances that may affect the development of the SEZ. The BLM would also work with appropriate federal, state, and local agencies, and tribes, as necessary, to ensure that the consideration of potential environmental, cultural, or other resource conflicts is brought forward into the review, including information provided through the Solar PEIS. This would include areas identified as having a high potential for conflict with sensitive natural, visual, or cultural resources. This work would ultimately inform how a parcel would be offered competitively (e.g., parcel size and configuration, technology limitations, mitigation requirements, and parcel-specific competitive process). Prior to issuing a notice of competitive offer, the BLM would complete appropriate

NEPA analysis to support the offer. This analysis would tier to the analysis for SEZs in the Solar PEIS to the extent practicable.

- **Notice of competitive offer.** A Notice would be published at least 30 days prior to the competitive offer. The Notice would include a legal description of the lands involved, the process for conducting the competitive offer, any development requirements or restrictions, a minimum bid requirement, and the due diligence requirements for the successful bidder to submit a POD for the lands involved in the competitive offer.

- **Bonus bid competitive process or other competitive procedures.** A variety of competitive bid procedures could be defined by the new regulations. These other competitive procedures could include sealed bids, oral auctions or continuous bidding, two-stage bidding, or multiple factor bidding methods. Bonus bids would be handled as Treasury receipts. The accepted bonus bid would be nonrefundable.

- **Issuance of competitive ROW lease authorization.** A ROW lease authorization (lease) would be issued to the successful bidder. The lease would be a 30-year, fixed-term lease with a fixed rental fee. The holder of the lease would be required to submit a POD and cost-recovery fees within the time frames specified in the lease.

- **Administration of competitive ROW leases.** The leaseholder would submit a POD for authorization prior to the start of any construction. A NEPA review would be required prior to approval of the POD; this NEPA would be tiered to all previous NEPA analyses for the SEZ and parcel offered competitively. The BLM would include a requirement in each competitive solar ROW lease that the holder begin construction within the time frames approved in the POD and comply with terms and conditions requiring the holder to maintain all facilities in accordance with the design standards in the approved POD. The BLM would require that a minimum performance bond be provided for all competitive solar ROW leases to ensure compliance with the provisions of the regulations and the terms and conditions of the lease.

All solar energy ROW applications for lands inside SEZs received *before* June 30, 2009 (defined as "pending" applications; see Section 1.3.3.2), will be processed consistent with existing land use plans and current policies and procedures; these applications will not be subject to any new program elements adopted by the Solar PEIS ROD. All solar energy ROW applications for lands inside SEZs received *after* June 30, 2009 (defined as "new" applications; see Section 1.3.3.1), will be subject to the program elements adopted by the Solar PEIS ROD, which may include a competitive process as outlined above. New applications in SEZs may be given some consideration by the BLM as part of the nomination procedures under the competitive process. The ongoing rulemaking effort to establish a competitive process is expected to address this issue.

2.2.2.2.2 Environmental Review for Projects in SEZs

Utility-scale solar energy development projects[4] in SEZs will be required to comply with NEPA and other applicable laws, including, but not limited to the ESA and the NHPA, and applicable regulations and policies. The BLM has taken a number of important steps through the Solar PEIS to facilitate future development in SEZs in a streamlined and standardized manner. For projects in SEZs, the BLM expects to comply with applicable laws, regulations, and policies in the manner described below. Projects located in SEZs that were identified and analyzed through other state or local land use planning efforts (see Section 2.2.2.2.6) would receive the same treatment as projects located in SEZs identified through the Solar PEIS.

The BLM expects that the Secretary, Deputy Secretary, or Assistant Secretary will authorize all utility-scale solar energy projects in SEZs, and the BLM authorized officer will issue authorizations consistent with the Secretary's, Deputy Secretary's, or Assistant Secretary's decision. Authorization of projects in SEZs are therefore not generally expected to be subject to administrative appeals to the IBLA.

Land Use Plan Conformance

Through the Solar PEIS ROD, the BLM will amend land use plans in the six-state study area to adopt those elements of the new Solar Energy Program that pertain to planning. No additional land use plan amendments are expected to be required to approve projects in identified SEZs.

NEPA

The BLM will complete a site-specific environmental review of all solar energy projects in SEZs in accordance with NEPA prior to issuing a project authorization. As part of the Solar PEIS, the BLM is conducting a thorough environmental review of the proposed SEZs so that future reviews of projects within SEZs can tier to the existing NEPA analysis, thereby limiting the required scope and effort of additional project-specific NEPA analyses. Tiering is defined as using the coverage of general matters in broader NEPA documents in subsequent, narrower NEPA documents (40 CFR 1508.28, 40 CFR 1502.20, 43 CFR 46.140). This allows the tiered NEPA document to concentrate solely on the issues not already addressed.

All future projects in SEZs will tier to the analysis in the Solar PEIS and, as appropriate, the NEPA analysis completed to support the competitive offer (see Section 2.2.2.2.1). The extent of this tiering, however, will vary from project to project, as will the necessary level of NEPA documentation. While the SEZ analysis in the Solar PEIS analyzes the likely environmental effects of utility-scale solar development and identifies required SEZ-specific design features to address many resource conflicts, further evaluation will typically be required for individual projects.

[4] In this section, "project" is used interchangeably with POD submitted by a leaseholder.

The BLM authorized officer must determine whether potential environmental impacts associated with a project are within the scope of analysis considered in the Solar PEIS for a given SEZ and/or the NEPA analysis completed to support the competitive offer. If not, the authorized officer must determine the potential significance of any impacts outside the scope of existing analysis and complete appropriate NEPA analysis. For example, if the water impacts associated with a project were not covered previously and those water impacts are expected to be significant, a tiered EIS would be appropriate (if the impacts did not rise to the level of significance, a tiered EA may be appropriate). No matter the level of NEPA documentation, tiered analyses for projects in SEZs are expected to be narrowly focused on those issues not already adequately analyzed in the Solar PEIS and/or the NEPA analysis completed to support the competitive offer. Field offices are instructed to incorporate by reference the relevant portions of the NEPA documents to which project-specific NEPA documents will be tiered.

The level of NEPA documentation to be required for an individual solar project in an SEZ will be determined by the BLM authorized officer. All projects in SEZs that the authorized officer determines will require an EIS level of analysis must be submitted through the State Director to the BLM Washington Office for the Director's concurrence prior to the issuance of an NOI. This will help ensure consistent and effective implementation of the BLM's Solar Energy Program.

An EA prepared in support of an individual action can tier to a programmatic EIS. An EA can be prepared for an action with significant effects, whether direct, indirect, or cumulative, if the EA tiers to a broader EIS that fully analyzed those significant effects. Tiering to the programmatic EIS would allow the preparation of an EA and Finding of No Significant Impact (FONSI) for the individual action, so long as any additional effects of the individual action not analyzed in the programmatic EIS are not significant. The finding of no significant impact in these circumstances may also be called a "Finding of No New Significant Impact" (43 CFR 46.140(c)). However, if an individual action is anticipated to have significant effects not considered in the programmatic EIS, tiering to the EIS cannot provide the necessary analysis to support a FONSI for the individual action. In these cases, an EIS would need to be prepared that tiers, to the extent practicable, to the programmatic EIS (BLM NEPA Handbook H-1790-1, Section 5.2.2 [BLM 2008]; 43 CFR 46.140(c)).

Public Involvement

Through the Solar PEIS, extensive public involvement specific to solar energy development in SEZs has occurred. On June 30, 2009, the agencies announced the availability of maps that identified 24 tracts of BLM-administered land for in-depth study for solar development. The BLM issued a *Federal Register* Notice of Availability to inform the public of the availability of the maps (Volume 74, page 31307). Through public scoping (June 30–September 14, 2009), the BLM solicited public comments for consideration in identifying environmental issues, existing resource data, and industry interest with respect to the proposed SEZs. Subsequently, public comments were solicited on the SEZ analysis presented in the Draft Solar PEIS from December 17, 2010, to May 2, 2011, and as part of 14 public meetings held in February and March 2011. Public comments were again solicited on the SEZ action plans presented in the Supplement to the Draft Solar PEIS from October 28, 2011, to January 27, 2012, and as part of five public meetings held between November 2011 and January 2012. The BLM will use this input to inform future development in SEZs. Additional public involvement for projects in SEZs will not be required to exceed the requirements of NEPA.

Endangered Species Act

The BLM is currently engaged in ESA consultation on the Solar PEIS with the USFWS under Sections 7(a)(1) and 7(a)(2) of the ESA. The BLM, in consultation with the USFWS, is undertaking a conservation review pursuant to Section 7(a)(1) of the ESA on the overall Solar Energy Program, including the amendment of 91 land use plans and associated conservation measures. This consultation on the overarching program will provide guidance for subsequent solar projects by ensuring that the appropriate conservation measures for listed species are incorporated into project-level actions.

The BLM is also engaged in programmatic consultation with the USFWS on the identification of SEZs under Section 7(a)(2) of the ESA initiated through the submission of a programmatic Biological Assessment (BA). This BA describes potential effects on listed (endangered and/or threatened) species and designated critical habitat from expected solar development in SEZs and any appropriate mitigation, minimization, and avoidance measures. Further Section 7(a)(2) consultation will occur, as necessary, at the level of individual solar energy projects and will benefit from the preceding programmatic consultation and resulting programmatic Biological Opinion (BO) for SEZs.

As individual projects are proposed in SEZs under the programmatic consultation approach, project-specific information will be provided that (1) describes each proposed action and the specific areas to be affected; (2) identifies the species and critical habitat that may be affected; (3) describes the anticipated effects from the proposed project; (4) specifies whether the anticipated effects from the proposed project are consistent with those analyzed in the programmatic BO; (5) describes proposed measures to minimize potential effects of the action; and (6) describes additional effects, if any, not considered in the programmatic consultation. The USFWS will review this information and, if applicable, will complete a BO that includes a project-specific incidental take statement. This document will generally require less effort to complete as compared to standard Section 7(a)(2) consultation because of the ability to utilize the analysis in the programmatic BO.

National Historic Preservation Act

The BLM has taken numerous actions to comply with requirements of the NHPA in relation to the Solar PEIS, including SEZs. The BLM consulted with Indian tribes, the State Historic Preservation Offices (SHPOs) from the six states, the Advisory Council on Historic Preservation (ACHP), and the National Trust for Historic Preservation (NTHP). A Solar PA among the BLM, the six SHPOs, and the ACHP, will be executed prior to signing of the Solar

PEIS ROD. The PA will define steps the BLM will follow to take into account the effects of the BLM's Solar Energy Program on historic properties under Section 106 of the NHPA.

The first draft of the Solar PA was sent to tribes in February 2011, seeking their input and inviting them to consult on the PA. The BLM modified the draft and, in October 2011, sent a revised draft Solar PA to tribes requesting their comments and continued participation, and inviting them to participate as Concurring Parties. Consultations are ongoing between the BLM and Signatory and Concurring Parties to the PA. All drafts will continue to be provided to tribes for comment and input as they are developed. Tribes will play an active role in the execution of the PA, whether or not they choose to sign it as Concurring Parties.

The BLM is implementing a tiered approach to the identification and consideration of effects on historic properties. Staff preparing the Solar PEIS utilized existing site record and surveyed geographic information system (GIS) databases to identify potential areas of conflict and define initial SEZ boundaries. Comments on the Draft Solar PEIS submitted by tribes and organizations such as the NTHP led to the elimination of a number of proposed SEZs and the reconfiguration of some of the remaining SEZs to minimize conflicts with cultural resources.

On March 2, 2012, the BLM awarded a contract to SWCA Environmental Consultants to conduct a statistically based, Class II sample survey of all proposed SEZs in Arizona, California, and Nevada where current development pressure for solar energy is the greatest. Acquisition of sample inventory data will enable the BLM to anticipate the adverse effects on historic properties likely to arise from development in SEZs. The final survey report will estimate the density and distribution of archeological sites. Sensitivity maps will be generated that focus on management priorities and *National Register of Historic Places* (NRHP) eligibility. Final results will be submitted to the BLM by the end of October 2012 and will be made available as appropriate through the Solar PEIS project Web site (http://solareis.anl.gov).

For future projects in SEZs, the BLM will coordinate with SHPOs and tribes to define what levels of additional survey would be required as part of submitting a POD consistent with the approved PA. The BLM would also discuss with SHPOs and tribes the need for additional ethnographic and archeological data required as part of submitting a POD. The terms and conditions of the project authorization will require documentation of a completed BLM-approved cultural resources mitigation plan before ground disturbance and construction begin.

Tribal Consultation

As part of the Solar PEIS process, the BLM has consulted and engaged with tribes through various means in order to meet the agency's affirmative responsibilities under the NHPA, NEPA, E.O. 13007 ("Indian Sacred Sites," *Federal Register,* Volume 61, page 26771, May 24, 1996), the American Indian Religious Freedom Information Act, and other statutes. Beginning in 2008 and continuing through the Final Solar PEIS, the BLM has written to tribes, provided complete documentation, maps, and current information, and requested government-to-government consultation. Tribes were invited to and participated in public meetings regarding the Draft Solar PEIS and Supplement. Tribal comments regarding the Draft Solar PEIS affected decisions to eliminate certain SEZs and to reduce and reconfigure the boundaries of those carried forward.

The BLM contracted with SWCA Environmental Consultants to produce an ethnographic overview of six tribes with cultural and historic ties to SEZs in Nevada and Utah. Detailed interviews with tribal members and an ethnographic overview have identified traditional cultural properties, significant ethnobotanical resources, visual resource concerns, and tribal perspectives on direct and indirect effects of solar development on tribal interests. These ethnographic overviews are available through the Solar PEIS project Web site (http://solareis.anl.gov). Summaries of the findings were included in SEZ-specific action plans in the Supplement to the Draft Solar PEIS.

The BLM has received input from a number of tribes on the Draft Solar PEIS and the Supplement to the Draft Solar PEIS. The Final Solar PEIS addresses each of the issues and concerns raised by tribes. In addition, a written explanation for how the BLM utilized tribal input in developing the Final Solar PEIS will be mailed to all tribes with the issuance of the Final PEIS.

The BLM issued IM 2012-032 in December 2011 (BLM 2011b). It directed BLM State Directors in the six-state study area to request face-to-face meetings with those tribes who provided detailed comments on the Solar PEIS. State Directors also offered to meet face-to-face with any tribe with historical or cultural ties to the proposed SEZs. As a result, the BLM has written to many tribes and provided them with maps, information, and other documentation. E-mail follow-ups and telephone contacts have been made. As of April 2012, the BLM had contacted 41 tribes and met face-to-face with 6 tribes. The BLM considers tribal consultation to be an open-ended process, and consultation efforts are ongoing.

For future projects in SEZs, BLM field office cultural staff, in consultation with their Deputy Preservation Officer, will recommend to responsible BLM line officers whether to collect additional archeological or ethnographic data. These recommendations will be based on dialogue resulting from government-to-government consultation and the active involvement of tribes in the evaluation of individual projects in SEZs. Should new ethnographic research, studies, or interviews be recommended, the BLM cultural staff, in consultation with tribal officials, will provide guidance to BLM line officers about the appropriate scope of work, provisions for safeguarding data confidentiality, and programs of mitigation.

2.2.2.2.3 Incentives for Projects in SEZs

In addition to the work already underway in SEZs (as described above), the BLM is proposing to undertake a variety of additional activities that will help steer future utility-scale solar energy development to the SEZs. Some of the incentives that follow are being given consideration through the rulemaking to establish a competitive process for offering public lands for solar and wind development within designated leasing areas.

Facilitate Faster and Easier Permitting in SEZs

- Consistent with applicable law, the BLM will endeavor to adhere internally to strict schedules for the completion of environmental reviews for projects in SEZs.

- The DOI will undertake interagency coordination to expedite service and provide priority processing to projects in SEZs, provide a single point of contact for all DOI agencies responsible for coordinating environmental reviews and consultations, ensure timely performance of agencies, and facilitate stakeholder reviews.

- The BLM will maintain its Renewable Energy Coordination Offices in Washington, D.C., California, Nevada, and Arizona, and will maintain Renewable Energy Coordination Teams in Colorado, New Mexico, and Utah as long as needed to assist with efficient authorization of projects in SEZs.

- The BLM may, through its rulemaking effort, establish a competitive process that results in the immediate issuance of a ROW lease authorization to the successful bidder.

Improve and Facilitate Mitigation

- The BLM proposes to develop regional mitigation plans for SEZs (see Section 2.2.1.2.2). Regional mitigation plans will be composed of goals and objectives applicable to individual SEZs. As envisioned, regional mitigation plans will simplify and improve the mitigation process for future projects in SEZs. Regional mitigation plans will address mitigation for a variety of resources such as biological resources, ecological resources, cultural resources, visual resources, and socioeconomic factors, as appropriate. Regional mitigation plans can increase permit efficiencies and financial predictability for developers. Regional mitigation plans are also expected to enhance the ability of state and federal agencies to invest in larger scale conservation efforts that benefit sensitive resources through higher quality habitat, improved connectivity between habitat areas, and long-term conservation of landscapes.

- Developers will be allowed to mitigate biological impacts for projects in SEZs through funding conservation priorities that are identified in a regional mitigation plan.

Facilitate the Permitting of Needed Transmission to SEZs

- The Final Solar PEIS includes a more detailed evaluation of the potential transmission needs and impacts for anticipated solar development within the proposed SEZs. This evaluation is intended to provide a better estimate of the potential environmental impacts of bringing transmission to the SEZs.

- The BLM will continue to evaluate transmission needs for the currently proposed SEZs, including consideration of available capacity on existing lines and the need for new or modified corridors; efforts will also be made to proactively plan for any new or expanded corridors that may be needed to serve currently proposed SEZs.

- As part of the identification process for new or expanded SEZs, the BLM will simultaneously evaluate their transmission needs, including the need to designate new corridors or modify existing corridors (e.g., modify widths, modify locations). Corridor designations or modifications may be achieved through a joint land use planning and NEPA process to the extent practicable (see Section A.2.6 of Appendix A).

- The BLM will offer incentives to projects that propose to bring transmission to SEZs (e.g., facilitated permitting of needed gen-ties, transmission lines and upgrades by Renewable Energy Coordination Office staff, and identification of priority transmission projects that will get facilitated permitting).

- The BLM will commit staff from BLM's Renewable Energy Coordination Offices and Teams to engage in ongoing and comprehensive regional transmission planning efforts, as well as subregional transmission planning affecting SEZs, to ensure the recognition of SEZs as a priority in transmission development. For example, the BLM will identify a BLM liaison to the Western Electricity Coordinating Council (WECC) and the appropriate subregional planning groups, as well as the California Independent System Operator (CAISO).

- The BLM will seek to establish cooperative agreements, Memoranda of Understanding (MOU) and/or Memoranda of Agreement (MOA) with federal, state, local, and regional agencies, and tribes, as appropriate, to expedite permitting of needed transmission to support SEZ development.

- As part of the ongoing evaluation of the currently proposed SEZs, as well as the identification process for new or expanded SEZs, the BLM will consult with state and regional transmission planning and coordination authorities, state public utility commissions, state energy offices, and transmission system operators to evaluate available capacity on existing and proposed lines and to discuss other potential transmission-related barriers. In addition, the BLM will use its participation in WECC and subregional planning efforts to help inform the evaluation of currently proposed SEZs and the identification of new or expanded SEZs.

- As part of the Solar PEIS, the BLM has requested that the currently proposed SEZs be reviewed as a case study by the Transmission Expansion Planning Policy Committee (TEPPC) of the WECC as part of the 2012 Study Program. The Draft 2012 Study Program shows that request has been prioritized as high, meaning that it will be studied in the first round of TEPPC cases.[5]

- For all new or expanded SEZs, the BLM will submit study requests for timely TEPCC analysis as appropriate.

- In preparing parcels in SEZs for competitive offer, the BLM will seek to make the most efficient use of existing corridors, consider opportunities for co-location, and avoid geographically stranding future projects from key transmission interconnection points.

Encourage Solar Development on Suitable Nonfederal Lands

- For projects located jointly on SEZ lands and suitable adjacent private, state, tribal, or DoD withdrawn lands (e.g., lands with low resource conflict or degraded, disturbed, or previously disturbed areas), DOI's permitting incentives as described for SEZs would apply to the entire project. Note, however, that additional effort may be required to collect necessary data and conduct appropriate environmental analysis for adjoining lands as compared to SEZ lands.

Provide Economic Incentives for Development in SEZs

- The BLM anticipates lower cost recovery for projects in SEZs because of the BLM's extensive upfront data collection and environmental review through the Solar PEIS.

- The BLM may adopt a longer phase-in period for rental payments for projects in SEZs (e.g., 10 years), which could effectively reduce the overall cost to operators.

- The BLM may establish a fixed MW capacity fee rental payment for the life of the authorization for projects in SEZs, which could effectively reduce the overall cost to operators.

[5] The TEPPC analysis process is an existing, formal, biennial process used by WECC to assess system impacts across the interconnection when adding resources and/or transmission. It analyzes system congestion and system performance under reliable system operating criteria.

- The BLM may require a limited base acreage rental payment for projects in SEZs, which could effectively reduce the overall cost to operators.

- The BLM may restructure bonding requirements for projects in SEZs (e.g., a fixed or standard bond per acre), which could result in reduced costs to operators.

- The BLM may issue a 30-year fixed term lease with a fixed rental fee for projects in SEZs, which could reduce uncertainty for operators.

2.2.2.2.4 Proposed Withdrawal for SEZs

As a possible mechanism to support the establishment of priority areas, the Secretary of the Interior may decide to withdraw the public lands encompassed by SEZs from potentially conflicting uses through the issuance of a Public Land Order. If approved, the public lands in proposed SEZs would be withdrawn, subject to valid existing rights, from settlement, sale, location, or entry under the general land laws, including the mining laws, as follows:

- New mining claims could not be filed on the withdrawn lands; however, valid mining claims filed prior to the date the lands were segregated (i.e., withdrawal application notice was published in the *Federal Register*) would take precedence over future solar energy development ROW application filings.

- Lands could not be sold, exchanged, or otherwise disposed of during the term of the withdrawal.

- Withdrawn lands would remain open to mineral leasing, geothermal leasing, and mineral material laws; the BLM could elect to lease the oil, gas, coal, or geothermal steam resources, or to sell common-variety mineral materials, such as sand and gravel, if the authorized officer determined there would be no unacceptable impacts on future solar energy development.

- Withdrawn lands would remain open to ROW authorizations and land leases or permits authorized under Section 302 of FLPMA.

On June 30, 2009, the BLM sought and received permission from the Secretary of the Interior to issue a notice of proposed withdrawal for the original 24 identified Solar Energy Study Areas. This *Federal Register* notice (Volume 74, page 31308) segregated the public lands encompassed in the 24 Solar Energy Study Areas (approximately 676,000 acres [2,735.7 km^2]) for up to 2 years from surface entry and mining, while various studies and analyses were conducted to support a final decision on withdrawing the land from conflicting uses. On April 21, 2011, the BLM amended the proposed withdrawal through a notice in the *Federal Register* (Volume 76, page 22414) to reflect acreage adjustments for slope considerations and compatibility (approximately 677,384 acres [2,741 km^2]). The BLM's temporary segregation expired on June 29, 2011.

On June 30, 2011, the BLM applied its new ITFR to the 24 proposed SEZs to avoid a lapse in the existing segregation (see Section 2.2.1.4 for additional information). On the basis of the application of the ITFR, the terms of the segregation for the 24 proposed SEZs remain unchanged; however, it is now set to expire June 30, 2013.

The BLM held two public meetings in connection with the proposed withdrawal. The first meeting was held on July 6, 2011, in Las Vegas, Nevada; the second meeting was held on July 7, 2011, in Victorville, California. The public was given an opportunity to provide oral and written comments at these meetings, as well as in writing via notification in the *Federal Register*. Public comments received on the proposed withdrawal were used by the BLM in its decisions to modify SEZs that would be carried forward in the Solar PEIS.

The BLM now intends to cancel a portion of the withdrawal proposal to reflect the changes to the proposed SEZs that were described in the Supplement to the Draft Solar PEIS and further adjusted in this Final Solar PEIS (to be noticed via the *Federal Register*). The amended withdrawal proposal will include only those lands within SEZs that are proposed to be carried forward through the Final Solar PEIS. The BLM will seek approval to change the proposed withdrawal period from 5 to 20 years. Also by notice in the *Federal Register,* the temporary segregation of lands in SEZs (applied through the ITFR described above) will be removed for all proposed SEZs and portions of proposed SEZs that have been eliminated from further consideration by the BLM.

The required withdrawal studies and analyses have been completed as part of the Final Solar PEIS, including full mineral potential assessment reports that meet the standards set forth in 43 CFR Part 2300 and BLM Manual 3060 (BLM 1994). The Secretary of the Interior's final decision regarding the withdrawal of these lands will be made based on the Solar PEIS. However, the Secretary's ROD pertaining to the withdrawal will likely be made separate from and subsequent to the BLM's ROD for the Solar PEIS.

2.2.2.2.5 Proposed Identification Protocol for New SEZs

The SEZs being carried forward in the Final Solar PEIS identify approximately 285,000 acres (1,153 km^2) across the six-state study area. In addition, the BLM has made a commitment to continued processing of pending applications. Although this is a strong start in facilitating utility-scale solar energy development on public lands, the BLM intends to identify new and/or expanded SEZs as part of the Solar Program to enhance the opportunities for development of solar energy. The BLM believes that establishing a feasible process to identify new or expanded SEZs is an essential element of its overall approach to solar energy development. New or expanded SEZs must be anticipated and planned for ahead of the need so as not to delay solar energy development. Successful identification of new or expanded SEZs will require meaningful participation by the BLM in planning processes for both generation and transmission.

New or expanded SEZs will be identified in the context of existing solar market conditions, existing and planned transmission systems, and new (or existing) state or federal policies affecting the level and location of utility-scale solar energy development. The BLM will endeavor to assess the need for new or expanded SEZs a *minimum* of every 5 years in each of the six states covered by the Solar PEIS. The process to identify new or expanded SEZs will be open and transparent, with opportunities for substantial involvement of multiple stakeholders. The BLM will identify new or expanded SEZs at the state- or field office-level as an individual land use planning effort or as part of an ongoing land use planning efforts. In all cases, the planning of new or expanded SEZs will tier from the Solar PEIS and utilize information carried forward from the PEIS to assist the analyses. It is BLM's goal to complete the work to identify new SEZs and amend applicable land use plans within 12 to 18 months of initiating such efforts.

The BLM has initiated efforts to identify new SEZs in the states of California, Arizona, Nevada, and Colorado through ongoing state-based efforts (see Section 2.2.2.2.6 for more information) and anticipates identifying new or expanded SEZs in the remaining states in the near future. This ongoing work makes effective use of existing collaborative efforts and is expected to result in new or expanded SEZs in these planning areas in the near term. The BLM welcomes industry, environmental organizations, state and local government partners, tribes, and the public to participate in these efforts to identify new SEZs through petitions or participation in ongoing land use planning efforts (see Section A.2.6 of Appendix A for more information on the petition process).

Figure 2.2-8 outlines a step-by-step process for identifying new or expanded SEZs. This process is described in detail in Section A.2.6 of Appendix A of this Final Solar PEIS.

2.2.2.2.6 Ongoing Efforts To Analyze New SEZs

The BLM considers the future identification of additional SEZs an essential element of its overall approach to solar energy development on public lands. The BLM has identified a need for additional SEZs in some states, particularly in Arizona and California. The BLM has initiated efforts to identify new SEZs in these states. Such efforts are taking place outside of the Solar PEIS process but consistent with the principles outlined in the SEZ identification protocol presented in the Final Solar PEIS (see Section A.2.6 of Appendix A). The BLM believes that the future identification of new SEZs will most appropriately be managed at the BLM state and/or field office levels where there is a better understanding of need and potential resource conflicts.

Ongoing efforts that may result in the identification of new SEZs include Arizona's RDEP, California's DRECP, and California's West Chocolate Mountains Renewable Energy Evaluation Area (REEA) planning effort. In addition, the BLM will encourage local land use planning efforts to consider the need for, and identify as appropriate, new SEZs as part of regular land use plan activities. Currently, plan revisions in Nevada and Colorado follow this approach. Ongoing efforts to identify new SEZs and associated time lines are described below. These ongoing planning efforts may also result in other decisions that support renewable energy development on public lands beyond the identification of new SEZs such as further screening of variance areas for suitability and/or additional exclusions.

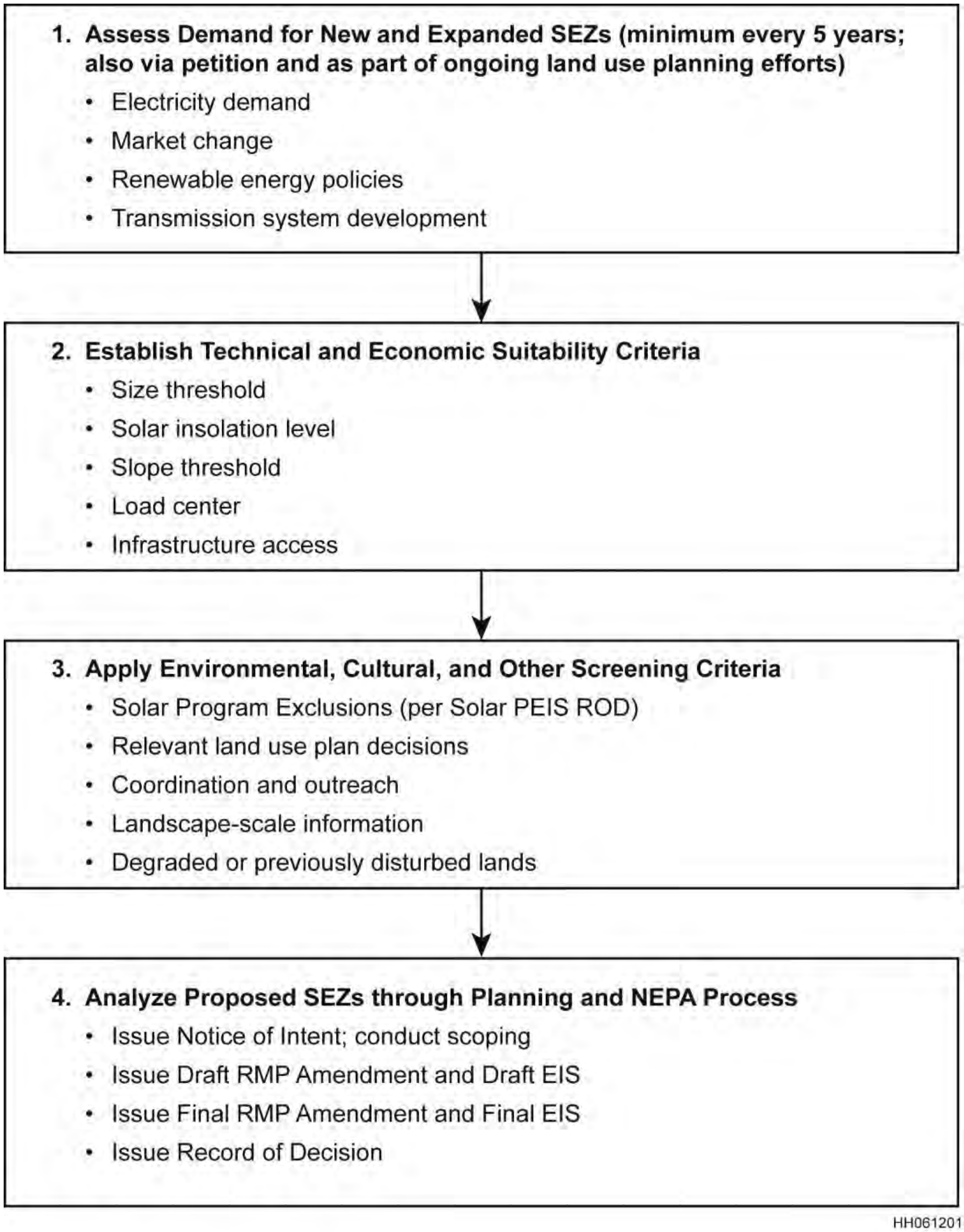


FIGURE 2.2-8 Proposed SEZ Identification Protocol (approximately 12 to 18 months to complete)

All SEZs identified through concurrent planning efforts would be analyzed through a planning and NEPA process at a level similar to the analysis in the Solar PEIS to ensure that key issues, such as wildlife, cultural resources, transmission, and cumulative impacts, are fully considered. The authorization of future projects in these SEZs would involve tiered-NEPA analyses as in the case of SEZs to be identified through the Solar PEIS. Projects proposed in SEZs that have been identified and analyzed through state or local land use planning efforts are expected to receive the same incentives as SEZs identified through the Solar PEIS.

Arizona's Restoration Design Energy Project

Arizona's Restoration Design Energy Project (RDEP) was chartered in 2009 by the Secretary of the Interior to support the efforts for sustainable energy and to pilot the concept of using disturbed and low-conflict lands for renewable energy. The RDEP is both a state-level step-down to the Solar PEIS decisions and an amendment process for all land use plans in Arizona to integrate and update them with renewable energy land use allocations. The RDEP will analyze and consider the identification of additional lands for renewable energy development (solar and wind) at any scale and in multiple jurisdictions.

The RDEP allows a look across all ownership and jurisdictional management of lands. It addresses the nexus of public lands with renewable energy potential to the generation and transmission system and provides information to policy- and decision-makers in Arizona for siting and development. The RDEP will inform logical utility-scale siting (beyond just opportunities on public lands) and determine which public lands fit best.

The RDEP will provide for the integration of all renewable energy planning designations at the local and state level, based on environmental considerations (low resource conflicts), and will be tailored to fit with the statewide transmission system and existing generation facilities. In addition to utility-scale opportunities, the RDEP will also offer information to assist in siting of community-level distributed energy generation with diminished transmission requirements.

For utility scale-solar development specifically, the RDEP will serve as a step-down analysis to the Solar PEIS. The RDEP will consider the identification of an additional SEZ, consider increasing the Arizona acreage identified for renewable energy, and may help to streamline the variance process for some of the variance areas potentially identified through the Solar PEIS ROD. The RDEP will consider amending land use plans in Arizona to potentially identify the following:

- One additional SEZ, the Agua Caliente SEZ (up to 22,000 acres [89 km^2]), which will be provided the same level of inventory and analysis as the SEZs in the Solar PEIS;

- Renewable Energy Development Areas (REDAs), areas within the larger utility-scale solar energy variance areas that have been intensively prescreened and analyzed for suitability for development. It is anticipated that applications proposed in REDAs may comply with some elements of the proposed variance process and therefore could qualify for priority processing. This will serve as an additional incentive for developers.

The RDEP Draft EIS was published in February 2012, the Final EIS is expected to be published in late fall 2012, with a target of signing the ROD by the end of 2012.

California's Desert Renewable Energy Conservation Plan

In 2008, 2009, and 2012, BLM California (BLM-CA) and the DOI signed an MOU with the California Governor's Office establishing the REAT, initiating the Renewable Energy Policy Group (REPG), describing BLM-CA's role in the DRECP, and setting time lines for the completion of the DRECP. BLM-CA, the CEC, the California Department of Fish and Game (CDFG), and the USFWS form the core of the REAT and REPG, with additional participation from other state and federal agencies. The core REAT agencies are leading the development of the DRECP.

The DRECP is the largest landscape-level planning effort in California, covering approximately 22.5 million acres (91,054 km^2) of federal and nonfederal land in the Mojave and Colorado (Sonoran) Deserts of southern California. The planning area covers all or portions of seven counties, including Kern, Los Angeles, San Bernardino, Inyo, Riverside, Imperial, and San Diego. Approximately 10 million acres (40,469 km^2) of the DRECP are administered by the BLM-CA under the CDCA Plan and under the Bishop, Caliente/Bakersfield, and Eastern San Diego County RMPs.

The purpose of the DRECP is to advance state and federal species and ecosystem conservation goals in the deserts of southern California, while also facilitating the timely permitting of renewable energy projects on federal and nonfederal lands.

BLM-CA intends to use the DRECP as the foundation for possible amendments to the CDCA Plan and three additional RMPs. The DRECP is also being designed as a Habitat Conservation Plan in accordance with the ESA and a Natural Communities Conservation Plan in accordance with the California Natural Communities Conservation Planning Act. Through potential land use plan amendments, the DRECP may be used to identify priority areas for renewable energy development (potentially through the identification of Development Focus Areas, similar to SEZs but open to renewable development beyond solar) and associated reserve areas within the DRECP planning area.

The DRECP Draft EIS is expected to be published in fall 2012, the Final EIS in early 2013, and the ROD in spring 2013. Between the publication of the Solar PEIS ROD in 2012 and the publication of the DRECP ROD in 2013, the BLM expects some new applications to be filed in SEZs and variance lands within the DRECP planning area. The REAT agencies will be engaged in evaluating solar applications submitted in the DRECP planning area to maintain consistency between the PEIS and the DRECP's goals and objectives (see Section 2.2.2.3.1 below on the variance process).

The DRECP planning effort has established a statewide RFDS for renewable energy by using a calculator to gauge total energy needs within the lifetime of the DRECP based on varying energy demand, growing population, available technology, and stakeholder input. The DRECP calculator indicates a *total* renewable energy need for California of approximately 21,000 MW, to include all types of renewable energy generation and land ownership. Because of its refined and regional focus, the DRECP planning effort will likely result in further adjustment to the decisions for utility-scale solar development made in the Solar PEIS such as modified Development Focus Areas or SEZs, new Development Focus Areas or SEZs, and/or additional exclusions that support the reserve design. The DRECP would tier to the NEPA analysis in the Solar PEIS, to the extent practicable, to take advantage of the work already completed in the CDCA planning area.

California's West Chocolate Mountains Renewable Energy Evaluation Area

The BLM is currently engaged in a planning effort within the West Chocolate Mountains near the Salton Sea in Imperial County, California (referred to as the West Chocolate Mountains REEA). Through this effort, the BLM is evaluating the potential environmental impacts associated with renewable energy testing and development on public lands within the West Chocolate Mountains REEA, including solar, wind, and geothermal. The proposed planning area covers approximately 17,900 acres (72 km^2) of BLM-administered public lands.

The West Chocolate Mountains planning effort is expected to result in amendments to the CDCA Plan of 1980 (BLM 1999) to identify sites within the West Chocolate Mountains REEA as suitable and not suitable for solar and wind energy development, and geothermal leasing and development. It is anticipated that utility-scale solar energy applications proposed in suitable areas for solar energy development may comply with some elements of the proposed variance process and therefore could qualify for priority processing. The West Chocolate Mountains REEA is also considering the identification and evaluation of an SEZ as part of the planning process.

The Draft EIS for the West Chocolate Mountains REEA was published in June 2011. The Final EIS will be published in the summer or fall of 2012, with a ROD expected in early 2013.

Other Planning Efforts

The BLM is engaged in several RMP revisions that are looking at opportunities to identify renewable energy priority areas such as new SEZs. Examples include the Grand Junction RMP revision in Colorado, which has a draft scheduled for release in September 2012, and the Las Vegas–Pahrump RMP revision in Nevada, which has a draft scheduled for release in late spring or early summer of 2013.

2.2.2.3 Proposed Variance Areas for Utility-Scale Solar Energy Development

To accommodate the flexibility described in the BLM's program objectives, the program alternative allows for responsible utility-scale solar development outside of SEZs. The BLM proposes to identify lands outside of proposed exclusion areas and SEZs as variance areas for utility-scale solar energy development. Variance areas would be open to application but would require developers to adhere to the proposed variance process (detailed in Section 2.2.2.3.1).

The proposed variance areas and associated variance process would only apply to utility-scale solar development, which is defined for the purposes of the Solar PEIS as projects capable of generating 20 MW or greater of electricity. All non-utility-scale solar energy projects, including distributed generation, would follow existing management prescriptions in BLM land use plans and be subject to individual site-specific NEPA analyses.

2.2.2.3.1 Variance Process

The variance process provides an opportunity for developers to propose applications outside of identified SEZs and complements the directed development approach in the program alternative. Variances may be needed in the near term because the lands identified as SEZs might be insufficient to accommodate demand for utility-scale solar development or may not have access to adequate transmission capacity to facilitate such development. In addition, there might be market, technological, or site-specific factors that make a project appropriate in a non-SEZ area. The variance process, however, is intended to be the exception rather than the rule.

The BLM will consider ROW applications for utility-scale solar energy development in variance areas on a case-by-case basis based on environmental considerations; coordination with appropriate federal, state, and local agencies and tribes; and public outreach. The responsibility for demonstrating to the BLM and other coordinating parties that a proposal in a variance area will avoid, minimize, and/or mitigate, as necessary, sensitive resources will rest with the applicant. The applicant is also expected to demonstrate that the proposed project is compatible with state and local plans and is capable of acquiring all required permits and authorities to implement the project. The USFWS and NPS have identified sensitive resources areas within variance areas that require special consideration as further described below. The BLM will use current information and best available science in its evaluation of ROW applications in variance areas.

In coordination with other agencies, the BLM will conduct preliminary screening of potential ROW applications in variance areas to assess likely conflicts with sensitive resources and will inform applicants of any anticipated issues with the siting of their project in a proposed location. ROW applications in variance areas will be deemed a lower priority for processing than applications in SEZs. The BLM will typically process ROW applications in variance areas on a first-come, first-served basis. However, the BLM has the discretion to apply competitive procedures to variance areas. In making this determination, the BLM may consider variables such as public interest, market demand for solar development in the region (including markets in other states), expressions of interest from other parties, authorized use and/or ownership of adjoining lands, and the purpose of the project.

All ROW applications in variance areas that the BLM determines to be appropriate for continued processing (see Section 2.2.2.3.2) will, at the applicant's expense, be processed in compliance with NEPA and all other applicable laws, regulations, and policies. Applicants applying for a ROW in variance areas assume all risk associated with their application and should understand that their financial commitments in connection with their applications will not be a factor in the BLM's evaluation process.

Required Preliminary Meetings

The BLM will require prospective applicants in variance areas to schedule and participate in two preliminary meetings with the BLM before filing a ROW application (43 CFR 2804.10(a)). The purpose of the first preliminary meeting is to discuss the status of BLM land use planning in the area; potential land use and siting constraints; potential environmental issues in the area; NPS and USFWS sensitive resource maps and information; potential alternative site locations for the project; and the variance process itself, including cost-recovery requirements, application requirements, consultation requirements, public involvement requirements, and associated time lines. The purpose of the second preliminary meeting is to initiate and ensure early coordination with federal (e.g., NPS, USFWS, and DoD), state, and local government agencies and tribes as contemplated by the regulations (43 CFR 2804.10(b)). Cost-recovery fees will generally not be required for preliminary meetings.

Through these preliminary discussions, the BLM and coordinating agencies will identify the likely challenges in proceeding with an application in a proposed location and identify natural, visual, and/or cultural resource information that applicants would likely be required to gather to support the variance process. On the basis of internal review and collaboration with other agencies, the BLM may advise a potential applicant not to submit an application for a particular site and/or technology or to modify its proposed project. In providing such advice, the BLM will consider factors including, but not limited to the following:

- Lands within an SEZ are sufficient to meet the potential applicant's needs, including adequate access to available transmission.

- The proposed project will be in conflict with landscape conservation strategies and/or landscape protection, conservation, or restoration objectives established in documents such as the DRECP or an applicable RMP.

- The proposed project poses a high potential for conflict with sensitive natural, visual, and/or cultural resources identified by the BLM, NPS, and/or USFWS.

ROW Applications in Variance Areas – Process

Following completion of the preliminary meetings described above, an applicant seeking to develop a project in a variance area will be required to submit a ROW application to the BLM (Form SF-299, Application for Transportation and Utility Systems and Facilities on Federal Land). The POD submitted with an application must be of sufficient detail (as determined by the BLM) to evaluate the suitability of the site for utility-scale solar energy development. Solar ROW applications in variance areas will typically be required to include a description of the proposed solar technology and the proposed location of solar panels or reflectors, buildings, and other infrastructure such as transmission lines and roads. Additional specific information required for an application in a variance area is outlined below. The BLM will determine if and when the information is of sufficient detail to initiate coordination activities as described below.

Upon submission and BLM review of a ROW application, a cost-recovery agreement will be established with the applicant (43 CFR 2804.14). An applicant for a ROW in a variance area must establish a cost-recovery account sufficient to cover all costs of the United States associated with accepting, reviewing, and processing the application, including, but not limited to conducting environmental review and related consultations; conducting inventories for resources such as cultural resources, visual resources, and special status species; and inspecting and monitoring the construction, operation, and decommissioning of the proposed ROW facility.

ROW Applications in Variance Areas – Factors To Be Considered

Applicants for utility-scale solar energy development ROWs in variance areas will be required to adhere to the data collection and survey protocols prescribed by resource agencies, including, but not limited to, those outlined below. The BLM will consider a variety of factors when evaluating ROW applications and associated data in variance areas. The focus of the proposed variance process is on collecting the right data and evaluating it with the right parties to assess the appropriateness of a given proposal, rather than on a prescriptive set of measures that would be established at the programmatic level. The BLM believes that this approach allows flexibility to adapt as data and science improves, recognizes the variability and trade-offs associated with individual applications, and allows for satisfactory protection of resources of concern.

The BLM will consider the following factors, as appropriate, when evaluating ROW applications in variance areas:

- The availability of lands in an SEZ that could meet the applicant's needs, including adequate access to available transmission.

- Documentation that the proposed project will be in conformance with decisions in current land use plan(s) (e.g., visual resource management class designations and seasonal restrictions) or, if necessary, represents an acceptable proposal for a land use plan amendment.

- Documentation that the proposed project will be consistent with priority conservation, restoration, and/or adaptation objectives in best available landscape-scale information (e.g., landscape conservation cooperatives, rapid ecological assessments, and state and regional-level crucial habitat assessment tools [CHATs]).

- Documentation that the proposed project can meet applicable programmatic design features adopted in the Solar PEIS ROD (see Section A.2.2 of Appendix A).

- Documentation that the applicant has coordinated with state and local (county and/or municipal) governments, including consideration of consistency with officially adopted plans and policies (e.g., comprehensive land use plans, open space plans, and conservation plans) and permit requirements (e.g., special use permits).

- Documentation of the financial and technical capability of the applicant, including, but not limited to:
  - International or domestic experience with solar projects on either federal or nonfederal lands,
  - Sufficient capitalization to carry out development, monitoring, and decommissioning, including the preliminary study phase of the project and the environmental review and clearance process.

- Documentation that the proposed project is in an area with low or comparatively low resource conflicts and where conflicts can be resolved (as demonstrated through many of the factors that follow).

- Documentation that the proposed project will minimize the need to build new roads.

- Documentation that the proposed project will meet one or more of the following transmission sub-criteria: (1) transmission with existing capacity and substations is already available; (2) lands are adjacent to designated transmission corridors; (3) only incremental transmission is needed (e.g., re-conductoring or network upgrades and development of substations); or (4) new transmission upgrades or additions to serve the area have been permitted or are reasonably expected to be permitted in time to serve the generation project.

- Documentation that the proposed project will make efficient use of the land considering the solar resource, the technology to be used, and the proposed project layout.

- If applicable, documentation that the proposed project will be located in an area identified as suitable for solar energy development in an applicable BLM land use plan and/or by another related process such as the California DRECP (e.g., Development Focus Areas) or Arizona RDEP (e.g., REDAs).

- If applicable, special circumstances associated with an application such as an expansion or repowering of an existing project or unique interagency partnership.

- If applicable, opportunities to combine federal and nonfederal lands for optimum siting (e.g., combining BLM-administered land with adjacent previously disturbed private lands).

- If applicable, documentation that the proposed project will be located in, or adjacent to, previously contaminated or disturbed lands such as brownfields identified by the EPA's RE-Powering America's Land Initiative (http://www.epa.gov/renewableenergyland); mechanically altered lands such as mine-scarred lands and fallowed agricultural lands; idle or underutilized industrial areas; lands adjacent to urbanized areas and/or load centers; or areas repeatedly burned and invaded by fire-promoting non-native grasses where the probability of restoration is determined to be limited.

- Documentation that the proposed project will minimize adverse impacts on access and recreational opportunities on public lands (including hunting, fishing, and other fish- and wildlife-related activities).

- Documentation that the proposed project will minimize adverse impacts on important fish and wildlife habitats and migration/movement corridors (e.g., utilizing the Western Wildlife CHAT, administered by the Western Governor's Wildlife Council [http://www.westgov.org/wildlife/380-chat] and coordinating with state fish and wildlife agencies).

- Documentation that the proposed project will be designed, constructed, and operated to use the best available technology for limiting water use that is applicable to the specific generation technology.

- Documentation that any groundwater withdrawal associated with a proposed project will not cause or contribute to withdrawals over the perennial yield of the basin, or cause an adverse effect on ESA-listed or other special status species or their habitats over the long term. However, where groundwater extraction may affect groundwater-dependent ecosystems, and especially within groundwater basins that have been overappropriated by state water resource agencies, an application may be acceptable if commitments are made to provide mitigation measures that will provide a net benefit to that specific groundwater resource over the duration of the project. Determination of impacts on groundwater will likely require applicants to undertake hydrological studies using available data and accepted models.

- Documentation that the proposed project will not adversely affect lands donated or acquired for conservation purposes, or mitigation lands identified in previously approved projects such as translocation areas for desert tortoise.

- Documentation that significant cumulative impacts on resources of concern should not occur as a result of the proposed project (i.e., exceedance of an established threshold such as air quality standards).

- *Desert Tortoise*

  Designated desert tortoise conservation areas will be excluded from BLM's proposed Solar Energy Program (see Section 2.2.2.1). These areas include, but are not limited to, critical habitat for desert tortoise and specially designated areas such as BLM-designated ACECs that specifically identified desert tortoise as one of the Relevant and Important Values, National Parks, National Recreation Areas, and NWRs.

  The USFWS has identified certain other areas that may be important for desert tortoise connectivity (i.e., priority desert connectivity habitat). Recovering desert tortoises throughout their range requires that conservation areas be connected by habitat linkages in which tortoises reside and reproduce. Such areas will need to be free of large-scale impediments from anthropogenic activities. Since publication of the Supplement to the Draft Solar PEIS, the BLM is proposing to exclude from the proposed Solar Energy Program an additional 515,000 acres (2,084 km^2) of land that coincides with priority desert tortoise connectivity habitat (see Table 2.2-2, Exclusion 32).

  Maps and supporting information regarding priority desert tortoise connectivity habitat will be made available through the Solar PEIS project Web site (http://solareis.anl.gov).[6] Developers that propose utility-scale solar energy projects in variance areas that overlap priority desert tortoise connectivity habitat identified on USFWS maps will be required to meet with the BLM and USFWS early in the process as part of the previously mentioned preliminary meetings to receive instructions on the appropriate desert tortoise survey protocols and the criteria the BLM and USFWS will use to evaluate results of those surveys (see outline below). Applicants will be required to work with the BLM and USFWS to survey an appropriately sized area (which may be 3 to 4 times larger than the proposed project area) in an attempt to find a suitable project location or configuration that minimizes impacts on desert

[6] The USFWS expects to update its map of priority connectivity habitat to reflect new information about desert tortoise connectivity habitat. The USFWS will make these map updates available through the Solar PEIS project Web site (http://solareis.anl.gov). These updates to USFWS maps will provide the public with current information regarding USFWS and BLM considerations under the variance process. Any amendment of applicable land use plans, including a decision by the BLM to exclude additional lands from future solar energy development, would follow compliance with all applicable BLM land use planning procedures.

tortoises. The BLM and USFWS will discourage applications in the highest priority areas given anticipated high conflict, higher survey costs, and high mitigation requirements.

- Tortoise density and distribution surveys. Desert tortoise density and distribution surveys will be conducted consistent with approved survey protocols (http://www.fws.gov/ventura/species_information/protocols_guidelines/index.html) and will be conducted by USFWS-approved desert tortoise authorized biologists unless the USFWS determines authorized biologists are unnecessary(http://www.fws.gov/ventura/ species information/protocols_guidelines/index.html). The spacing and intensity of surveys will be determined in consultation with the BLM and USFWS. Two consecutive survey passes of the potential project development area will be surveyed with the transects in the second pass oriented 90 degrees from those walked in the first pass. Once a refined project site has been selected within the larger survey area, additional surveys could be recommended to ensure effective avoidance of desert tortoises.
- Habitat quality analyses. Evaluate the presence and condition of native vegetation communities (including herbaceous plants), soils, and so forth in the survey area.
- Tortoise connectivity studies. The methodologies for connectivity studies must be approved by the BLM and USFWS and peer-reviewed by an accredited scientist prior to data collection. A first study should demonstrate that the linkage area and adjacent Tortoise Conservation Areas (TCAs) contain suitable tortoise habitat of sufficient size to support desert tortoise populations. If sufficient habitat is present, a second study should demonstrate that demographic and genetic connections can be maintained once the proposed project is developed. This should include evaluating existing barriers to connectivity and opportunities for tortoise-to-tortoise interactions at a local and regional scale and the availability of "live-in habitat."
- Corridor width evaluation. Using the site-specific data collected, including desert tortoise density and distribution (from protocol surveys), habitat quality analysis, and the desert tortoise connectivity evaluation, an applicant should identify corridors that will adequately maintain the connectivity around the proposed project. Such corridors must be approved by the BLM and USFWS.
- Survey for areas suitable for tortoise translocation if applicable.

In evaluating information provided by an applicant, the BLM and USFWS will consider cumulative effects and landscape-level information consistent with desert tortoise recovery goals and objectives and best available science to determine if a project will result in acceptable impacts on desert tortoise. The applicant must provide documentation to the satisfaction of the BLM and USFWS of the following, unless a project is otherwise determined by the BLM and USFWS to have acceptable impacts on desert tortoise:

– The project can be sited and constructed to allow for adequate connectivity corridors as determined by the BLM and USFWS that ensure that the project does not isolate or fragment tortoise habitat and populations;
– The proposed site contains low tortoise densities consistent with best available information for the subject geographic area, including data on local desert tortoise densities, when available, and data from the long-term USFWS rangewide monitoring of the Mojave Population of the desert tortoise (http://www.fws.gov/nevada/desert_tortoise/dt_reports.html);
– The project will result in minimal translocation of adult and sub-adult tortoise to acceptable locations (>160 mm Midline Carapace Length) as determined by the BLM and USFWS[7];
– Any necessary mitigation will improve conditions within the connectivity area, and if these options do not exist, necessary mitigation will be applied toward the nearest tortoise conservation area (e.g., ACEC for which tortoise had been identified in the Relevant and Important Criteria or critical habitat); and
– A plan is in place to effectively monitor desert tortoise impacts, including verification that desert tortoise connectivity corridors are functional. The required ESA consultation will further define this monitoring plan.

• *Greater Sage-Grouse*

Greater sage-grouse habitat (i.e., currently occupied, brooding, and winter habitat) as identified by the BLM in California, Nevada, and Utah will be excluded from BLM's proposed Solar Energy Program (see Section 2.2.2.1).

Developers that propose utility-scale solar energy projects in variance areas that overlap the range of the greater sage-grouse, will be required to provide documentation of the following, unless a project is otherwise determined by the BLM and USFWS and appropriate state wildlife agencies to have acceptable impacts on greater sage-grouse[8]:
– Project is at least 4 mi (6 km) from the nearest lek;
– Project will not adversely affect Preliminary Priority Habitat; and
– Project will be mitigated through land acquisition or habitat enhancement at a ratio of at least 1:1 for any impact on Preliminary General Habitat as determined by accepted standards of habitat analysis (e.g., habitat

[7] For additional information on the criteria the USFWS will use to assess impacts on desert tortoise and desert tortoise connectivity habitat, see http://www.fws.gov/cno/energy.html.

[8] Preliminary Priority Habitat (PPH) comprises areas that have been preliminarily identified as having the highest conservation value to maintaining sustainable greater sage-grouse populations. These areas would include breeding, late brood-rearing, and winter concentration areas. Preliminary General Habitat (PGH) comprises areas of occupied seasonal or year-round habitat outside of priority habitat. PPH and PGH have been preliminarily identified by the BLM in coordination with respective state wildlife agencies (BLM 2011c).

equivalency analysis [HEA]) and in coordination with the USFWS and the appropriate state wildlife agencies.

- *Protecting Resources and Values of Units of the National Park System and Other Special Status Areas under National Park Service Administration*

  The construction and operation of utility-scale solar energy projects and related transmission infrastructure near units of the National Park System and other special areas administered by the NPS, including National Historic Trails, may significantly affect park programs, resources, and values. For example, ecological resources (such as habitat and migration of species) and physical resources (such as wind, water, air, and scenic views) cross park boundaries, and park boundaries often do not represent all of the natural resources, cultural sites, and scenic vistas that make up resources and the quality of the park visitor's experience in these special places.

  The NPS has identified areas within the proposed variance areas where utility-scale solar development poses a high potential for conflict with the natural, cultural, and/or visual resources administered by the NPS. Since publication of the Supplement to the Draft Solar PEIS, the BLM is proposing to exclude from the proposed Solar Energy Program an additional 821,000 acres (3,322 km^2) of land that coincides with NPS-identified areas of high-potential conflict (see Table 2.2-2, Exclusion 32).

  Maps and data documenting areas of high-potential conflict with National Parks, historic trails, and other areas under NPS administration will be made available through the Solar PEIS project Web site (http://solareis.anl.gov).[9] This information will promote public awareness and notify industry where additional documentation may be required to proceed with an application in variance areas. The maps and data are regarded as a first-order approximation of landscape-scale conditions and potential resource conflict and will be updated as new information and analytical tools are developed.

  The BLM will utilize these maps and data in the screening of proposed solar energy projects in variance areas (these data may also be useful in evaluating projects in SEZs as well, see Section 2.2.2.2.2). In cases where a utility-scale solar energy development ROW application is submitted in a variance area identified as having a high potential for conflict with the resources of a unit of

[9] Maps and data document areas of high potential for conflict with sensitive natural and cultural resources near 33 National Parks and one National Historic Trail. The NPS intends to update its maps and data to reflect new information regarding potential conflicts associated with units of the National Park System and other special areas administered by the NPS. The NPS will make updated maps and data available through the Solar PEIS project Web site (http://solareis.anl.gov). These updates to NPS maps and data will provide the public with current information regarding NPS and BLM considerations under the variance process. Any amendment of applicable land use plans, including a decision by the BLM to exclude additional lands from future solar energy development, would follow compliance with all applicable BLM land use planning procedures.

the National Park System or special areas administered by the NPS, additional documentation will be required. This documentation may include information to verify any or all of the following potential resource conditions resulting from the proposed project:

- Increased loading of fine particulates (criteria pollutants: $PM_{2.5}$ and PM_{10} [particulate matter with a diameter of 2.5 µm or less and 10 µm or less, respectively]) and reduced visibility in Class I and sensitive Class II areas;
- Vulnerability of sensitive cultural sites and landscapes, loss of historical interpretative value due to destruction or vandalism;
- Altered frequency and magnitude of floods, and water quantity and quality;
- Reduced habitat quality and integrity and wildlife movement and/or migration corridors; increased isolation and mortality of key species;
- Fragmentation of natural landscapes;
- Diminished wilderness, scenic viewsheds, and night sky values on landscapes within and beyond boundaries of areas administered by the NPS; and
- Diminished cultural landscape qualities within and beyond boundaries administered by the NPS.

The documentation provided by an applicant must be sufficiently detailed as determined by the BLM and NPS. The documentation should represent the findings of science and the analyses of scientifically trained specialists in the appropriate natural, visual, and/or cultural resource disciplines. The NPS will prepare a response to the BLM as to (1) whether the proposed project meets NPS protection, conservation, and/or restoration objectives; and (2) whether the resource conflict documentation is adequate to support a finding by the NPS and BLM that the proposed project is likely to avoid a high potential for conflict with resources and values associated with a National Park or other special status area under the administration of the NPS.

The NPS will continue to refine data for determining resource conflict and provide this information to the BLM for use in the variance process. The NPS will assist the BLM in identifying alternate project locations, if there is insufficient information to verify potential resource conflict with sensitive resources and values of National Park and other NPS special status areas. In all cases, evaluations will be performed to ensure that natural, visual, and cultural resources of units of the National Park System and other special areas administered by the NPS are protected.

Public Outreach

To sufficiently gather information on potential issues and barriers and/or opportunities related to a ROW application in a variance area, the BLM will require that a minimum of one public meeting be held as part of the variance process to allow for participation by all interested parties. The public meeting shall be located in close proximity to the community most affected by the proposal and be adequately noticed. This variance process requirement for a public meeting will occur before the NEPA process is initiated; comments received, however, may be used to inform the NEPA process for projects that the BLM decides to continue to process (see Section 2.2.2.3.2). The BLM will also make information regarding ROW applications in variance areas available to the public online via the BLM Web site (www.blm.gov) and the Solar PEIS project Web site (http://solareis.anl.gov).

BLM Coordination Activities

As part of the variance process, the BLM will coordinate with appropriate federal, state, and local government agencies and tribes. The review of ROW applications in coordination with these other entities will help the BLM determine the potential for impacts on important resources; explore ways to avoid, minimize, and/or mitigate such impacts; and ensure consistency with relevant plans, policies, and initiatives. Coordination activities will include:

- Consultation with tribes. Government-to-government consultation with tribal staff will provide opportunities for tribes to identify traditional cultural properties and sacred sites with applications in variance areas. Tribes will be invited to attend pre-application meetings with the applicant and the BLM. On the basis of information and discussions arising from the pre-application meetings, the BLM will determine whether there is a need for new ethnographic research to provide sufficient information to adequately consider the effects of solar development on issues and resources of concern to tribes. BLM field office cultural staff, including specialists assigned to Renewable Energy Coordination Offices where present, in consultation with their Deputy Preservation Officer, shall recommend to responsible BLM line officers whether to collect additional ethnographic data for a given solar application. Should new ethnographic research, studies, or interviews be recommended, the BLM cultural staff, in consultation with tribal officials, will provide guidance to BLM line officers about the appropriate scope of that work, provisions for safeguarding data confidentiality, and programs of mitigation.

- Coordination with the SHPO. The BLM will consult with the SHPO to determine the steps required to identify historic properties in the area of effect for the ROW application. Additional inventories may include Class II or Class III surveys in areas of direct and indirect effect depending on the potential for impacts. On the basis of the results of the inventory, determinations of eligibility of sites to the NRHP, determinations of effect, and programs of mitigation would be approved by the BLM and carried out by the applicant prior to ground disturbance.

- Coordination with state fish and wildlife agencies.

- For applications in the DRECP planning area, the BLM will coordinate with California REAT agencies (BLM, USFWS, CDFG, and CEC) to ensure consistency with any DRECP reserve and development area designs. The REAT agencies will evaluate applications in areas proposed for development, focus areas, and areas proposed for reserves on a case-by-case basis. The REAT agencies will consider the best available information, including data generated as part of the DRECP planning effort. The BLM may choose to defer or modify projects on a case-by-case basis if it determines that approval of the proposed project would harm resource values so as to limit the choice of reasonable alternative actions in the DRECP (H-1601-1 – Land Use Planning Handbook [BLM 2005]).

- Coordination with the NPS to assess the potential for impacts on the resources and values of units of the National Park System and other special status areas under NPS administration (e.g., National Scenic or Historic Trails).

- Coordination with the NPS, USFS, and/or the BLM National Trails System Office charged with trail-wide administration or management for National Scenic or Historic Trails to review inventory adequacy or needs, and to assess potential adverse impacts on trails (see Section A.2.2.23 of Appendix A for inventory requirements). Coordination is also required with the study agency for trails recommended as suitable in congressionally authorized Trail Feasibility Studies or trails undergoing such study. Coordination is also required with nonprofit national trail organizations for trails subject to exclusion provisions. Other related program coordination requirements must also be met, such as for cultural resources, recreation and visitor services, visual resources, or NLCS.

- Coordination with the USFWS on any application that could result in impacts on ESA-listed species and their habitat (including, but not limited to, desert tortoise and sage-grouse), bald and golden eagles, and migratory birds.

- Coordination with state and local (county and/or municipal) governments to determine compatibility with officially adopted plans and policies (e.g., comprehensive land use plans, open space plans, conservation plans) and permit requirements (e.g., special use permits).

- Consultation with the DoD. The BLM will consult the DoD to minimize and/or eliminate impacts on military operations and encourage compatible development. This consultation will include both general discussions for early planning and detailed assessments of specific proposals at the local level. The BLM will accept formal DoD submissions once they have been vetted through both the Military Departments and the DoD Siting Clearinghouse.

- Coordination with the USACE.

- Coordination with the EPA.

- Coordination with state and regional transmission planning efforts (e.g., WGA, Nevada Renewable Energy Transmission Access Advisory Committee, New Mexico Renewable Energy Transmission Authority), transmission coordination authorities (e.g., WECC), state energy offices, and transmission system operators to identify any transmission issues associated with the proposed project (e.g., capacity and land use considerations).

- Coordination with railroad industry to determine potential for impacts on railroad ROWs and railroad operations.

- Coordination with any potentially affected grazing permittee/lessee to discuss how the proposed project may affect grazing operations and address possible alternatives, as well as mitigation and compensation strategies.

- Coordination with existing ROW holders to determine potential impacts on existing BLM authorizations.

- Coordination with the owner of any federal mining claims and/or mineral leases located within the boundaries of the proposed project to determine the potential for impacts on mining claims and/or mineral leases and discuss ways to avoid, minimize, or mitigate such impacts.

2.2.2.3.2 Variance Process Determination

The BLM has determined that, in appropriate circumstances, it can rely on the broad discretion it has under FLPMA to deny ROW applications without completing the NEPA process. Such decisions must be made with regard for the public interest and be supported by reasoned analysis and an adequate administrative record. Decisions to deny pending applications must be assessed on a case-by-case basis. Denial of an application constitutes a “final agency action” and is therefore subject to administrative appeals to the IBLA.

On the basis of a thorough evaluation of the information provided by an applicant and the input of federal, state, and local government agencies, tribes, and the public, the BLM will determine whether it is appropriate to continue to process, or to deny, a ROW application submitted through the variance process. Variance evaluations will be conducted and documented at the BLM state and field office levels. To ensure a consistent application of the variance process, all ROW applications in variance areas that are determined to be appropriate for continued processing will be submitted by the BLM State Director to the BLM Washington Office for the Director’s concurrence.

ROW applications in variance areas that the BLM determines to be appropriate for continued processing will generally be processed, at the applicant’s expense, in compliance with NEPA and all other applicable laws, regulations, and policies, including but not limited to the

ESA, the NHPA, and the NPS Organic Act of 1916. Many of the actions taken under the variance process, however, could be incorporated into subsequent requirements such as NEPA. Proposed projects in variance areas will require consideration of alternatives and will likely result in EIS-level NEPA documentation. Compliance with applicable laws, regulations, and policies could result in substantial changes to a project proposal or application denial.

2.2.2.4 Land Use Plans To Be Amended

Land use plans in the six-state study area would be amended under the program alternative to incorporate the planning elements of the proposed Solar Energy Program. Table C-1 of Appendix C lists all of the land use plans to be amended. The amendments would identify (1) lands that would be excluded from utility-scale solar energy development, (2) lands to be included in SEZs, and (3) lands that would be identified as variance areas for utility-scale solar energy development. The land use plans would also be amended to adopt the programmatic design features and SEZ-specific design features.

2.2.3 SEZ Program Alternative

Under the SEZ program alternative (referred to as "SEZ alternative"), the BLM would restrict utility-scale solar energy development applications to SEZs only and identify all other lands as exclusion areas for utility-scale solar energy development. Under the SEZ alternative, all proposed ROW authorization policies described above in Sections 2.2.1.1 and under the program alternative (Section 2.2.2.2.1) would apply to new applications in SEZs. Over time, under the SEZ program alternative, new or expanded SEZs would be identified following the SEZ identification protocol outlined in Appendix A (see Section A.2.6 of Appendix A).

2.2.3.1 Proposed Right-of-Way Exclusion Areas

Under the SEZ alternative, all areas outside of proposed SEZs would be identified as exclusion areas for utility-scale solar energy development. No lands would be identified as variance areas for utility-scale solar energy development.

2.2.3.2 Proposed Solar Energy Zones

The proposed SEZs to be carried forward into the Final Solar PEIS under the SEZ alternative are the same as those described under the program alternative (see Section 2.2.2.2). The BLM has carried forward 17 proposed SEZs totaling approximately 285,000 acres (1,153 km^2) of land potentially available for development (see Table 2.2-3). New or expanded SEZs would be identified following the SEZ identification protocol outlined in Appendix A (see Section A.2.6 of Appendix A). As described previously, the BLM has initiated efforts to identify new SEZs that are outside of the Solar PEIS but consistent with the principles outlined in the Solar PEIS (see Section 2.2.2.2.6).

2.2.3.3 Solar Energy Zone Policies

The policies common to both action alternatives (Section 2.2.1) and those presented under the program alternative specific to SEZs (Section 2.2.2.2), including the authorization process for projects in SEZs, incentives for projects in SEZs, the protocol to identify new SEZs, and the proposed withdrawal of SEZs, are applicable to the SEZ program alternative. In addition the programmatic design features for utility-scale solar energy development presented in Section A.2.2 of Appendix A would apply to development in SEZs.

2.2.3.4 Land Use Plans To Be Amended

Land use plans in the six-state study area would be amended under the SEZ alternative to incorporate the planning components of the proposed Solar Energy Program. Table C-1 of Appendix C lists all of the land use plans to be amended. The amendments would identify (1) lands that would be excluded from utility-scale solar energy development and (2) lands to be included in SEZs. Under the SEZ alternative, no lands would be identified as variance areas for utility-scale solar energy development (i.e., all lands outside of identified SEZs would be excluded from utility-scale solar development). The land use plans would also be amended to adopt the programmatic design features and SEZ-specific design features.

2.3 DOE ALTERNATIVES

The DOE alternatives being analyzed through this PEIS include the no action alternative and an action alternative (DOE's proposed action) under which DOE would adopt programmatic environmental guidance for use in DOE-supported solar projects. In the Draft Solar PEIS, DOE presented its plans to develop such guidance; the Supplement presented the proposed guidance (described and analyzed in Sections 2.3 and Chapter 7). DOE has many offices and sites that may fund or implement solar power programs or projects, including 20 National Laboratories and Technology Centers, 4 Power Marketing Administrations, and 10 Operations Offices. As a result, DOE has no single Solar Program analogous to that of the BLM Solar Program. Instead, individual DOE offices and sites would consider any future programmatic guidance in the context of their specific goals and responsibilities. DOE also would consider other factors such as specific Congressional funding authorizations and legislated goals. In addition, under either alternative, every proposed DOE project or action would undergo the appropriate level of environmental review under NEPA, and DOE would undertake required consultations under Section 7 of the ESA and Section 106 of the NHPA, and comply with any other legal requirements. Examples of DOE-supported solar projects are briefly described in Section 1.4 of the Final Solar PEIS.

2.3.1 No Action Alternative

Under the no action alternative, DOE would continue its existing process for addressing environmental concerns for solar projects supported by DOE without the benefit of the proposed guidance. It would not adopt programmatic environmental guidance with recommended environmental best management practices and mitigation measures that could be applied to all DOE-supported solar projects.

2.3.2 Action Alternative—DOE's Proposed Programmatic Environmental Guidance (DOE Preferred Alternative)

As described in the Draft Solar PEIS and the Supplement to the Draft, under the proposed action (action alternative), DOE would adopt programmatic environmental guidance, which it would use to further integrate environmental considerations into its analysis and selection of proposed solar projects. In the Final Programmatic EIS, DOE has identified the proposed action (action alternative) as its preferred alternative. Early consideration of this guidance, especially both in project planning and development, could substantially streamline the project-specific NEPA review, permitting processes, and community interactions. DOE application of this guidance is limited to those actions where DOE has authority for a federal decision-making role. DOE's proposed programmatic environmental guidance is presented in Sections 2.3.2.1 through 2.3.2.11.

2.3.2.1 General Mitigation Measures

- Consider siting facilities in predetermined solar development zones (e.g., an SEZ designated by the BLM) in order to assist in the sharing of technologies, resources, and data to ensure a more detailed understanding of environmental resources, to facilitate consistency with land use planning and zoning designations, and to make use of existing infrastructure (e.g., access to transmission equipment and lines).

- Include in early correspondence between the applicant and appropriate permitting or interested government agencies, preliminary project designs, planned use of new technologies, PODs, and related information in sufficient detail to allow adequate evaluation of potential impacts.

- Develop a thorough understanding of all applicable federal, state, and local environmental regulatory requirements, processes, consultations, and interactions.

- Make early contact with local officials, regulators, and inspectors to explore all applicable regulations and address concerns unique to solar power generation projects.

- Conduct early project development discussions with potential energy users to identify how energy production can be transmitted to load centers and increase the ability to finance projects.

- Be aware of possible pre- and post-construction environmental monitoring through agency and public interactions.

2.3.2.2 Institutional and Public Outreach

- Emphasize early identification of, and communication and coordination with, stakeholders, including, but not limited to, federal, state, and local agencies; special interest groups; Native American tribes and organizations; elected officials; and concerned citizens.

- Consider holding periodic public update meetings and/or hosting a Web site with project and contact information.

- Consider providing renewable energy public relations and scientific program speaker support and input to community educational programs, other interest groups, and the media.

2.3.2.3 Land Use

- Maximize the use of previously disturbed lands.

- Avoid land requiring deforestation/de-shrubbing and/or significant slope leveling or grading.

- Avoid siting projects on prime or unique farmland and rangelands.

- Avoid impacts on special use lands such as NPS lands, Wilderness Areas, National Wildlife Refuge System lands, ACECs, Wildlife Management Areas, National Historic and Scenic Trails, traditional cultural properties and other culturally sensitive sites, critical habitat for special status species, and military operations areas and other regulated military lands.

- Consult with local agencies regarding potential impacts of developing within, adjacent, or close to state or local special use areas such as parks.

- Use technologies and facility layouts and designs that will minimize land disturbance at a site.

- Avoid or minimize the use of lands that would adversely affect high-use recreational areas such as hiking, camping, and off-highway vehicle (OHV) use locales.

- Consider potential direct and indirect impacts on private lands from project siting.

- Ensure lands considered are appropriately zoned for project development (e.g., industrial or energy development uses). Avoid lands identified as incompatible for renewable energy development by local governments.

- Solar development in close proximity to airports will likely trigger the need for consultation with the FAA; development in proximity to military lands will likely trigger the need for consultation with the appropriate DoD organization(s).

2.3.2.4 Water Resources and Erosion Control

- Prioritize technologies that minimize water use.

- Promote the sustainable use of water resources through appropriate technology selection and implementation of conservation practices that protect and preserve the function, acreage, and quality of the existing natural water bodies (including streams, wetlands, ephemeral washes, microphyll woodlands, and floodplains, as well as groundwater aquifers).

- Consider the use of rain, gray, and/or other recycled water for facility operations, including plant cooling, steam generation, irrigation, maintenance, and dust suppression.

- Avoid locations that would involve impacts on surface water bodies, ephemeral washes, playas, microphyll woodlands, and natural drainage areas (including groundwater recharge areas).

- To the extent practicable, minimize the use of and impacts on surface and groundwater resources (including sole source aquifers) during construction and operations.

- Avoid groundwater resource project requirements that would result in overappropriation or overdrafting of any groundwater basin.

- Identify source capacity, prior water rights, and adequacy of capacity to serve project requirements and dependent biological resources in the area.

- Avoid or minimize the use of land within an identified 100-year floodplain or identify engineering controls to mitigate potential impacts.

- Avoid locating facilities on steep slopes, in alluvial fans, and in other areas prone to landslides or flash floods, or within gullies or washes.

- Compare preliminary site grading, drainage, erosion, and sediment control plans with applicable local jurisdiction requirements.

- Consult federal, state, and local "water-wise" guidelines, as applicable, for project development in the arid southwest.

- Coordinate with the USACE to discuss the reach and extent of waters of the United States on the proposed project site. As appropriate, present a reasonable range of on-site and off-site alternatives and an analysis that evaluates alternatives to avoid impacts on waters in compliance with Section 404 of the CWA.

2.3.2.5 Biological Resources

- Review federal and state databases and technical reports for regulatory requirements for protection of special status animal and plant species and habitats.

- Begin early consultation processes with the USFWS and state environmental and wildlife agencies for identification of potential issues, and ensure ongoing communication in the course of project development.

- Locate project facilities and ancillary components so that environmentally sensitive areas (e.g., riparian habitats, streams, wetlands, critical wildlife habitats, and migration corridors, and other protected areas) are avoided.

- Consider glint, glare, reflection, and linear characteristics of project components on bird and terrestrial animal movements in the project area.

- Develop biological survey protocols and plans in consultation with regulatory agencies to ensure that specific regional and other requirements are met.

- Consider potential impacts on indigenous and special status plant species (including State Natural Heritage ranks G1 and G2), while addressing controls for non-native/invasive species and noxious weeds.

- Consider reclamation and conservation initiatives for disturbed lands after construction.

- Consider developing habitat restoration and management plans and compensatory mitigation and monitoring plans.

2.3.2.6 Air Quality

- Identify applicable federal, state, and local air quality management agencies and follow requirements and application procedures.

- Identify all emission sources associated with the proposed technology and/or use information from existing facilities with similar characteristics.

- Consider dust abatement procedures that will minimize particulate matter emissions while reducing the use of extensive amounts of water.

2.3.2.7 Cultural Resources and Native American Interactions

- Consult cultural resource experts who meet the Secretary of the Interior's Professional Qualification Standards (as defined in 36 CFR Part 61).

- Identify all tribes and tribal organizations with cultural and religious ties to the land and resources in the proposed project vicinity and begin a dialogue of information sharing (formal government-to-government consultations may be requested between federal agencies and federally recognized tribal governments if the federal government or federal funds are involved in a project that affects a tribe).

- Avoid locations that are in close proximity to sensitive cultural and historic resources.

- Begin early interactions with the SHPO and/or Tribal Historic Preservation Officer to identify cultural resources and potential issues associated with a proposed site.

- In addition to qualified cultural resource experts, consider employment of a qualified Native American monitor to help identify issues and to work in the field during construction activities should unanticipated cultural resources be encountered.

2.3.2.8 Visual Resources and Aesthetics

- Consider potential impacts on visual resources in the project planning and siting phase, for example, when siting structures, consider landscape characteristics when siting structures, lighting and glare from facility components, minimizing structure profiles, views from key observation points and nearby recreation lands, and integration of project components with natural land contours and colors.

- Consider potential visual impacts on the nature and character of nearby culturally sensitive and historic structures.

- Consider visual effects of project location and components on nearby units of the National Park System and other areas under NPS management.

- Consider visual effects of project components on local infrastructure facilities such as schools, hospitals, and housing developments in urban and rural communities.

2.3.2.9 Socioeconomics

- Site facilities to maximize local, regional, and statewide economic benefits and utilize coordination with local and state entities such as state and county commissions, planning departments, and so forth.

- Site projects to minimize adverse effects on area housing markets and local infrastructure (e.g., schools and other public services) and to ensure adequate housing vacancy rates and local infrastructure support for workers and their families.

- Site facilities to maximize effective integration with existing electrical transmission corridors, including Western and other power marketing organization transmission resources and population centers that will use the power.

- Give maximum priority to buying American-made solar technologies and components to the extent practicable.

- Employ "local to global" practices in hiring and procurement of goods and services, giving priority to using local labor forces and businesses during construction and operation prior to considering regional, national, and international resources.

2.3.2.10 Environmental Justice

- Avoid locating facilities where disproportionately high and adverse impacts would be incurred by a minority population or a population whose income is below the poverty level, unless requested by the minority or low-income population.

- Where applicable, work with potentially affected low-income and minority communities to develop appropriate mitigation measures to reduce environmental, human health, social, and economic impacts from the project on identified populations.

2.3.2.11 Safety and Health

- Consider state and local fire protection ordinances and fire hazard severity zones when siting a project.

- Where appropriate, consider facility setback distances and buffers to separate nearby populations and structures from a proposed facility to minimize impacts from sun reflection (glare), low-frequency sound, electromagnetic fields, noise, air pollution, and other facility-related hazards, wastes, emissions, and discharges.

- Coordinate with the FAA and local aviation or military facility managers to address safety concerns and potential impacts on airports or flight paths in close proximity to solar facilities.

- Consider potential impacts from electromagnetic interference (e.g., impacts on radar, microwave, television, and radio transmissions) in facility design and comply with Federal Communications Commission regulations.

2.4 DESCRIPTION OF REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

A full assessment of the potential impact of solar energy development on the quality of the human and ecological environment over the next 20 years requires that an estimate be made of the amount of development that might occur in the six-state study area over that time frame. The amount of power projected to be generated through solar energy development in the six-state study area through 2030 is referred to as the RFDS in this Solar PEIS. For the Draft Solar PEIS, two methods were used to estimate an RFDS; one used the Regional Energy Deployment System (ReEDS) model, developed by the National Renewable Energy Laboratory (NREL), the other used each state's RPSs (see Table 1.6-1) to estimate corresponding renewable energy and solar development required to meet those standards. Results obtained by both methods and detailed discussions of the two methods were provided in Appendix E of the Draft Solar PEIS.

To establish an upper bound on potential environmental impacts under the various alternatives assessed in the Solar PEIS, the maximum estimated development as projected by the RPS-based method was used as the RFDS for the cumulative impact assessments presented in Chapters 6 and 7. The RFDS that was developed for the Draft Solar PEIS is still considered to be valid to support analyses in this Final Solar PEIS. The RFDS was calculated on the basis of the requirements for electricity generation from renewable energy resources established in the RPSs in each of the six states. To establish an upper bound, it was assumed that 50% of the RPS-based requirement for renewable energy production would be provided from solar energy and that 75% of the solar development would occur on BLM-administered lands within the specific state.

Table 2.4-1 presents the RFDS for each state in terms of projected megawatts and estimated acres of land required to support that level of development. The calculated number of BLM- and non-BLM-administered acres likely to be developed over the next 20 years is

TABLE 2.4-1 Projected Megawatts of Solar Power Development by 2030 and Corresponding Developed Acreage Estimates for the RFDS[a]

State	Landholding	Estimated MW under RFDS	Estimated Acres under RFDS[b]
Arizona	BLM	2,424	21,816
	Non-BLM	808	7,272
California	BLM	15,421	138,789
	Non-BLM	5,140	46,260
Colorado	BLM	2,194	19,746
	Non-BLM	731	6,579
Nevada	BLM	1,701	15,309
	Non-BLM	567	5,103
New Mexico	BLM	833	7,497
	Non-BLM	278	2,502
Utah	BLM	1,219	10,971
	Non-BLM	406	3,654
Total	BLM	23,791	214,119
	Non-BLM	7,930	71,370

[a] See Appendix E of the Draft Solar PEIS for details on the methodologies used to calculate the RFDS.

[b] Acreage calculated assuming land use of 9 acres/MW (0.04 km^2/MW). To convert acres to km^2, multiply by 0.004047.

based on the assumed RFDS and on a high-end estimated land requirement of 9 acres/MW (0.04 km^2/MW) for development. As shown, the estimated amount of solar energy generation on BLM-administered lands in the study area over the 20-year study period is about 24,000 MW, with a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands. The estimated total amount of solar energy generation on all lands in the study area over the 20-year study period is 32,000 MW, with a corresponding dedicated use of about 285,500 acres (1,155km^2) of land.

A number of comments on the Draft Solar PEIS pointed out that the RFDS calculations do not account for the import and export of solar-generated electricity between states and, as a result, the calculations could underestimate potential development in a given state. Specifically, it was pointed out that renewable energy generated in Arizona, Nevada, and even Utah might be exported to California as utilities try to meet the RPS established in that state. In such cases, the total level of development in these states would be greater than that projected by the RFDS. While these are valid considerations, the conditions assumed in the RFDS (i.e., that 50% of the renewable energy development would be from solar and that 75% of it would occur on BLM-administered lands) provide an upper bound on the potential solar development both within a state and on BLM-administered lands that might accommodate additional development for exported electricity.

2.4.1 Comparison of RFDS with Lands Available under the Action Alternatives

The estimates of acres developed under the state-specific RFDS levels are presented in Table 2.4-2. For the evaluation of BLM alternatives, the estimated percentage of BLM-administered lands available for development under the development program alternative (i.e., about 19 million acres [82,964 km^2]) or under the SEZ program alternative (i.e., about 285,000 acres [2,741 km^2]) that would be developed based on the RFDS projections varies by

TABLE 2.4-2 Percentage of Available Lands Developed by the BLM Action Alternative Based on Estimated Acres Developed under the RFDS

State	Estimated Acres[a] Needed for Development under the RFDS[b]	Program Alternative: Total Proposed Acres Available[c]	Program Alternative: Percentage Developed under the RFDS	SEZ Alternative: Total Proposed Acres Available[d]	SEZ Alternative: Percentage Developed under the RFDS
Arizona	21,816	3,380,877	0.7	5,966	100[e]
California	138,789	766,078	18.1	153,627	90.3
Colorado	19,746	95,128	20.8	16,308	100
Nevada	15,309	9,076,145	0.2	60,395	25.4
New Mexico	7,497	4,184,520	0.2	29,964	25.0
Utah	10,971	1,809,759	0.6	18,658	58.8
Total	214,119	19,312,506	1.1	284,918	75.2

[a] To convert acres to km^2, multiply by 0.004047.

[b] See Table 2.4-1 for basis for these estimates.

[c] See Section 2.2-1.

[d] See Section 2.2.3. For the purpose of the RFDS estimates of development, the entire estimated developable acreage of the SEZs is assumed to be developed in the calculation of percentage developed; however, some portion will not be developable due to various restrictions.

[e] The estimated number of acres needed for development based on the RFDS projection exceeds the acreage proposed to be available in Arizona and Colorado under the SEZ alternative; thus it is assumed that 100% of the SEZs in those states would be developed over the 20-year time frame assessed in this PEIS.

state. Under the program alternative, the overall percentage of available lands that would be developed based on the RFDS projections is about 1.1%. Under the SEZ alternative, the overall percentage of available lands that would be developed based on the RFDS projections is about 75%.

Table 2.4-2 compares the amount of land needed to support the RFDS-based projections of solar development to the amount of land that would be made available for solar development in each state under the BLM's action alternatives. Because the SEZs proposed under both alternatives do not make enough land available to meet the RFDS requirements in some states (e.g., Arizona and Colorado, and likely also California), the BLM has initiated efforts to identify new SEZs through ongoing state-based efforts (see Section 2.2.2.2.6). The BLM also anticipates that it will identify additional SEZs in other states in the near future using the protocol for identifying new SEZs presented in Section A.2.6 of Appendix A. There is also the opportunity to develop projects outside of SEZs in variance areas, in accordance with the variance process described in this Final PEIS (see Section 2.2.2.3.1).

Solar development on both BLM- and non-BLM-administered lands (estimated as 32,000 MW) is relevant for the evaluation of DOE's alternatives, because DOE may support solar projects on federal, state, tribal, or private lands, as well as on BLM-administered lands. A small portion of the solar development in the six-state study area would be supported by DOE. However, through emphasizing support of projects researching ways to decrease environmental impacts (e.g., to decrease water consumption or land use), DOE could influence the course of future solar development such that lower impact technologies would be employed.

2.5 OTHER ALTERNATIVES AND ISSUES CONSIDERED

The BLM and DOE considered a number of additional alternatives and issues beyond those described in Sections 2.2 and 2.3 during the preparation of this PEIS. This process included a review of the public comments received during the initial scoping period held in 2008 (which are summarized in the scoping summary report [DOE and BLM 2008); the second scoping period held in 2009; the comment period on the Draft Solar PEIS held December 17, 2010, through May 2, 2011; and the comment period on the Supplement to the Draft Solar PEIS held October 2011 through January 2012. (See Chapter 14 for a discussion of the public scoping activities.)

Many of the suggestions provided through external scoping were incorporated into the Solar PEIS, including, but not limited to, the analysis of mitigation requirements; the exclusion of sensitive areas and, conversely, the development of some sensitive areas with appropriate mitigation; and focusing development in areas with existing transmission lines and roads to minimize the need for new infrastructure. Recommendations that the agencies analyze various development levels and scenarios were considered in constructing the RFDS analyzed in this PEIS. As discussed in Section 2.4, the agencies elected to evaluate a relatively high development scenario corresponding to most renewable energy required to meet RPS demands coming from solar sources in order to establish an upper bound on potential environmental impacts. Similarly, recommendations that the PEIS evaluate new and evolving solar energy technologies were considered in defining the scope of the PEIS analyses; however, the agencies determined it was appropriate to evaluate only those technologies considered to be technically and economically viable within the 20-year time frame being assessed.

The following sections discuss other suggestions that were considered.

2.5.1 Distributed Generation

A number of comments were received during the public scoping period suggesting that the agencies evaluate distributed generation of solar energy resources as opposed to, or in addition to, the development of centralized, utility-scale solar energy facilities. Distributed generation refers to the installation of small-scale solar energy facilities at individual locations at or near the point of consumption (e.g., use of solar PV panels on a business or home to generate electricity for on-site consumption). Distributed generation systems typically generate less than 10 MW. Other terms for distributed generation include on-site generation, dispersed generation, distributed energy, and others.

As discussed in Section 1.2, current research indicates that development of both distributed generation and utility-scale solar power will be needed to meet future energy needs in the United States, along with other energy resources and energy efficiency technologies (NREL 2010). For a variety of reasons (e.g., upper limits on interconnecting and integrating distributed generation into the electric grid, cost, technical challenges related to voltage control and system protection with high-penetration PV, and continued dependency of buildings on grid-supplied power), distributed solar energy generation alone cannot meet the goals for renewable energy development. Ultimately, both utility-scale and distributed generation solar power will need to be deployed at increased levels, and the highest penetration of solar power overall will require a combination of both types (NREL 2010).

Alternatives incorporating distributed generation with utility-scale generation, or looking exclusively at distributed generation, do not respond to the agencies' purpose and need for agency action in this PEIS. The applicable federal orders and mandates providing the drivers for specific actions being evaluated in this PEIS compel the agencies to evaluate utility-scale solar energy development. As discussed in Section 1.1, the Energy Policy Act of 2005 (P.L. 109-58) requires the Secretary of the Interior to seek to approve non-hydropower renewable energy projects on public lands with a generation capacity of at least 10,000 MW of electricity by 2015; this level of renewable energy generation cannot be achieved through distributed generation systems. In addition, Order 3285A1 issued by the Secretary of the Interior requires the BLM and other Interior agencies to undertake multiple actions to facilitate large-scale solar energy production (Secretary of the Interior 2010). Accordingly, the BLM's purpose and need for agency action in this PEIS is focused on the siting and management of utility-scale solar energy development on public lands (see Section 1.3.1). Furthermore, the agency has no authority or influence over the installation of distributed generation systems, other than on its own facilities, which the agency is evaluating at individual sites through other initiatives.

The evaluation of distributed generation systems does fall within the scope of DOE's mission; however, it is being handled in other initiatives separate from this PEIS. DOE recognizes that the present electric grid, built decades ago, was based on a centralized generation approach and was not designed to handle high levels of distributed renewable energy systems. In 2007, DOE launched the Renewable Systems Interconnection (RSI) study to identify the technical and analytical challenges that must be addressed to enable high penetration levels for distributed energy systems, with a particular emphasis on solar PV systems (see http://www1.eere.energy.gov/solar/rsi.html). As a result of the RSI study, in 2008, DOE initiated the Solar Energy Grid Integration Systems (SEGIS) program to further develop electronics and build smarter, more interactive systems and components so that solar energy can be integrated into the electric power distribution and transmission grid at higher levels.

In addition, in 2011, the DOE launched the Rooftop Solar Challenge to accelerate significant improvements in market conditions for solar PV projects. This nationwide effort engages diverse teams of local and state governments, along with utilities, installers, non-governmental organizations (NGOs), and others to make solar energy more accessible and affordable. These collaborative teams are working to reduce administrative barriers to residential and small commercial PV solar installations by streamlining, standardizing, and digitizing administrative processes. Complex permitting and grid connection processes increase the cost of solar energy systems and limit the growth of the solar industry. The objective of the Challenge is to make the process of going solar simpler, faster, and more cost-effective for residents and businesses.

Through these efforts, DOE is actively pursuing the expansion of distributed generation systems and their contribution to the country's electricity supply. While distributed generation of solar energy clearly is an important component of DOE's SunShot Initiative and Solar Energy Technologies Program, inclusion in this analysis of an alternative incorporating distributed generation does not address the DOE's purpose and need to satisfy both E.O.s and respond to this congressional mandate and promote, expedite, and advance the production and transmission of environmentally sound energy resources, including renewable energy resources and, in particular, cost-competitive solar energy systems at the utility scale (see Section 1.4.1).

2.5.2 Conservation and Demand-Side Management

Like the requests for distributed generation alternatives, recommendations that the BLM and DOE evaluate alternatives incorporating conservation of energy and demand-side management do not respond to the purpose and need for agency action in this PEIS. In general, conservation initiatives would be designed to reduce energy consumption levels in order to reduce the need for increased electricity generation capacity. Demand-side management would involve specific actions taken by utilities, their regulators, and other entities to induce, influence, or compel consumers to reduce their energy consumption, particularly during periods of peak demand.

While these types of initiatives are important components of the country's efforts to address future energy needs, they do not respond to the purpose and need for agency action in this PEIS as defined by the agencies (see Sections 1.3 and 1.4). These efforts do not address the agencies' purpose and need to satisfy both E.O.s and respond to this congressional mandate and promote, expedite, and advance the production and transmission of environmentally sound energy resources, including renewable energy resources and in particular, cost-competitive solar energy systems at the utility scale.

2.5.3 Analysis of Life-Cycle Impacts of Solar Energy Development

Several comments were submitted suggesting that this PEIS should address impacts associated with the life cycle of solar energy development, including the manufacturing of solar facility components. The action agencies recognize that consideration of life-cycle impacts will provide valuable information supporting energy policy development in this country. However, the impacts associated with other solar energy life-cycle activities were not determined to be connected actions for the purposes of this PEIS (40 CFR 1508.25(a)(1)). As appropriate, these types of activities would be addressed as part of the cumulative effects analysis in project-specific environmental reviews.

For DOE, life-cycle analysis of energy development is an important research topic. Such analyses are being conducted by DOE across its programs, including life-cycle analyses for solar energy technologies.

2.5.4 Analysis of Development on Other Federal, State, or Private Lands

Comments were received suggesting that the scope of the PEIS include evaluation of development on other federal lands (e.g., lands managed by the DoD), state lands, and private lands. A related suggestion was to sell BLM-administered public land to the private sector and limit all utility-scale solar power facilities to only private land. Alternatives based on these suggestions do not respond to the purpose and need for agency action in this PEIS and would not meet the objectives established for the BLM by the Energy Policy Act of 2005 and Secretarial Order 3285A1, both of which require the BLM to facilitate renewable energy development on public lands. However, the BLM may decide to dispose of some parcels of land through land sales or exchanges to support the development of solar energy on a case-by-case basis. The BLM's existing ROW regulations (43 CFR Part 2800), existing land sale regulations (43 CFR Parts 2710 and 2711), and existing exchange regulations (43 CFR Part 2200) provide for these possible procedural approaches. The NEPA analysis contained in the Solar PEIS will be used to the extent practicable to support such future decisions; however, additional NEPA analysis may be necessary.

It is also important to point out that the analysis of solar energy development on other federal or private lands is encompassed in the scope of the PEIS analysis. The geographic scope of DOE's analysis includes all lands in the six-state study area. As discussed in Section 1.4.1, DOE may support solar projects on all types of lands, including BLM-administered lands and other federal, state, tribal, and private lands. The description of the affected environment in Chapter 4 and the results of the analysis of potential impacts and mitigation measures in

Chapter 5 may be applicable, as appropriate, across all lands within the study area. Because the scope of Chapters 4 and 5 encompasses all lands within the six-state study area, parties other than the BLM and DOE may be able to use the information in this PEIS to support their own analyses of utility-scale solar energy development in this area.

2.5.5 Restricting Development to Previously Disturbed Lands

A number of comments suggested that the agencies limit utility-scale solar energy development to lands that have been "previously disturbed." This issue has not been incorporated into the PEIS as an independent alternative; however, consideration was given to previously disturbed lands in identifying areas best suited to solar energy development. While there is no clear and well-established definition of what constitutes "previously disturbed public lands," nor are there any clearly defined thresholds for determining when lands cannot be restored to their former, undeveloped state, the BLM identified some lands within SEZs as particularly well suited for solar development because previous human or natural disturbance had occurred on those lands. In addition, the proposed SEZ Identification Protocol (Section A.2.6 of Appendix A) highlights the consideration of degraded, disturbed, and/or previously disturbed lands as part of all future processes to identify new or expanded SEZs. The proposed variance process also provides for favorable consideration of ROW applications on disturbed lands.

As discussed in Section 1.6.2.4, separate from the Solar PEIS, the BLM Arizona State Office, through its RDEP (launched in April 2010), is taking steps to identify disturbed or previously disturbed sites in Arizona that can be made available for renewable energy projects (http://www.blm.gov/az/st/en/prog/energy/arra_solar.html). That initiative is not limited to public lands, but also includes private lands. Identified sites will be evaluated in terms of their restoration potential, potential for other land use, and technical suitability for renewable energy development. In the future, the BLM may implement similar programs in other states. In addition, the EPA has launched the RE-Powering America's Land initiative to promote the siting of renewable energy production facilities on contaminated land (see http://www.epa.gov/renewableenergyland/index.htm); however, the types of contaminated properties it has identified are not likely to coincide substantially with BLM-administered public lands.

From DOE's perspective, it may elect to establish programmatic guidance that promotes utility-scale solar development on previously disturbed lands.

2.5.6 Restricting Development to Populated Areas

Suggestions also were made to restrict solar energy development to areas near population centers. While this issue has not been incorporated into the PEIS as an independent alternative, consideration was given to proximity of available lands to existing infrastructure such as transmission lines. Some of the proposed SEZs are located close to population centers. The Solar PEIS also analyzes the social, economic, and environmental impacts of constructing and operating solar energy facilities that may be located away from population centers.

From DOE's perspective, it has elected to include the following provision in its proposed programmatic guidance that promotes utility-scale solar development near populated areas: "Site facilities to maximize effective integration with existing electrical transmission corridors, including Western and other power marketing organization transmission resources and population centers that will use the power" (see Section 2.3.2.9).

2.5.7 Restricting Development to the Fast-Track Project Applications

Comments were received during scoping for the Draft Solar PEIS requesting that the BLM evaluate an alternative under which development on BLM-administered lands would be limited to the 14 fast-track solar projects proposed at that time. These projects were to be located in three states and would have a total electricity generating capacity of about 6,022 MW (see Section 1.3.3).[10] This alternative was not considered for several reasons. While the fast-track projects would contribute to the goal of 10,000 MW of electricity generated from renewable energy projects located on public lands as set forth in the Energy Policy Act of 2005, an alternative limiting solar development to these projects would not meet the requirements of Secretarial Order 3285A1 to identify and prioritize locations best suited for large-scale production of solar energy on public lands. Limiting development to BLM-administered lands included in fast-track applications would completely exclude development on BLM-administered lands in three of the states included in this assessment (Colorado, New Mexico, and Utah). This restriction would arbitrarily limit solar development on BLM-administered lands over the next 20 years. Finally, since the fast-track projects were still in the environmental review phase, it was possible that some would not be approved or would be approved at a reduced capacity. In fact, since the publication of the Draft Solar PEIS, several of the fast-track projects have submitted requests to change technology, and will require additional case processing and environmental review prior to authorization.

2.5.8 Analysis of Development on the Maximum Amount of Public Lands Allowable

Under both of the action alternatives being evaluated by the BLM in this PEIS, the BLM is considering restricting utility-scale solar energy development from lands where it has determined such development is incompatible with existing resources, resource uses, and special designations. These discretionary exclusions are listed in Section 2.2.2.2. The BLM has decided not to evaluate a maximum lands alternative that would make some or all of these potentially sensitive lands available for application for solar energy development, because it believes that ROW authorizations for solar energy development would not be approvable in these areas given existing resource protections. Utility-scale solar energy development requires that large parcels of land be converted to a single-use, with a year-round dominance over other potential uses of the land and long-term commitment of resources. These conditions are inherently in conflict with

[10] Six fast-track projects have been approved in California and two have been approved in Nevada: BrightSource Energy's Ivanpah Solar Electric Generating System, Tessera Solar's Imperial Valley and Calico Solar Projects, Chevron Energy Solution's Lucerne Valley Solar Project, NextEra's Genesis Ford Dry Lake Solar Project, Solar Millennium's Blythe and Amargosa Farm Road Solar Projects, and First Solar's Silver State North Solar Project.

the important resources, resource uses, and special designations on some BLM-administered lands.

In determining which lands should be excluded from solar energy development, the BLM also has decided to not make lands available for application for solar energy development where the slope is equal to or greater than 5% or where the solar insolation level is less than 6.5 $kWh/m^2/day$. As discussed in Section 2.2.2.2, the solar technologies evaluated in the PEIS are limited in terms of the slope of the land on which they can be constructed, with 5% slope being a reasonable upper limit. The rationale for restricting the available lands based on the solar insolation level is to maximize the efficient use of BLM-administered lands and meet the multiple use intent of FLPMA by reserving for other uses lands that are not ideal for solar energy development.

On a related note, one commentor suggested that the PEIS should evaluate solar energy development in Wilderness Areas (WAs). This suggestion was not incorporated into any of the BLM's alternatives because such development is prohibited by law and, therefore, is not appropriate to analyze.

2.5.9 Changes to BLM's Proposed Solar Energy Zones

Several commentors requested evaluation of different and/or additional locations to the BLM's proposed SEZs. As discussed in Section 2.2.2.2, suggestions to modify the boundaries of the proposed SEZs were considered, along with input from BLM state and field office staff, in defining the areas proposed and evaluated in the PEIS. Modifications were made to SEZs in each of the six states both prior to and subsequent to the publication of the Draft Solar PEIS; a detailed description of these modifications is included in the SEZ-specific sections in Chapters 8 through 13.

Suggestions to include additional SEZs were considered. However, because the site-specific evaluation of SEZs requires a large amount of data and lengthy evaluation time, the BLM decided not to include additional proposed SEZs in the Solar PEIS. As discussed in Section 2.2.2.25, the BLM intends to identify new and/or expanded SEZs as part of the Solar Energy Program in the future, using an SEZ Identification Protocol outlined in Section A.2.6 of Appendix A. The BLM will identify new or expanded SEZs at the state or field office level as an individual land use planning effort or as part of an ongoing land use plan revision. Further, the BLM has initiated efforts to identify new SEZs in the states of California, Arizona, Nevada, and Colorado through ongoing state-based efforts (see Section 2.2.2.2.6 for more information) and anticipates identifying new or expanded SEZs in the remaining states in the near future.

2.5.10 Other Suggested Alternatives

A few suggestions regarding alternatives to be analyzed in the Solar PEIS were determined to be beyond the scope of DOE and BLM's purpose and need for agency action in this PEIS, as defined by the agencies. While certainly worthy of analysis, suggestions to also evaluate other electricity generation technologies (e.g., coal, nuclear, natural gas, geothermal, and wind) and compare the relative impacts and benefits of these alternatives were determined to be beyond the scope of this PEIS. In addition, suggestions to evaluate hauling ice from outside the study area to supply water for solar power facilities and to site solar power facilities in space were considered to be out of scope.

2.5.11 DOE Environmental Requirements

DOE received several comments suggesting that the proposed guidance should be implemented as requirements and offering additional suggestions for requirements. DOE is a large, multifaceted agency with a three-pronged mission: (1) to transform the nation's energy system and secure U.S. leadership in clean energy technologies; (2) to be a leader in science and innovation as a cornerstone of economic prosperity; and (3) to enhance nuclear security through defense, nonproliferation and environmental efforts.

To meet this mission, the DOE has 10 program offices, including, among others, Advanced Research Projects Agency–Energy (ARPA-E), the Loan Programs Office, and Energy Efficiency and Renewable Energy (EERE). DOE also includes National Laboratories and Technology Centers that are leaders in R&D in all aspects of clean energy. In addition, DOE has 4 Power Marketing Administrations and 10 Operations Offices, some of which administer sites that are as large and complex as major communities. All of these organizations have different purposes and specific goals, many of which may include implementation of solar energy production at some level, whether to supply local energy at an operating site, to productively use a brownfield managed by Legacy Management, to fund basic R&D to make a technology more efficient and/or competitive, to provide grants to help local communities meet clean energy goals, or to support commercial development of solar technology. All of these programs may have differing funding mechanisms or authorizations from Congress, which ultimately defines the purpose(s) of expended funds.

The application of existing requirements supplemented by programmatic guidance that is adaptable to the circumstances of a particular proposal will provide DOE flexibility to best ensure environmental protection across the variety of DOE solar activities.

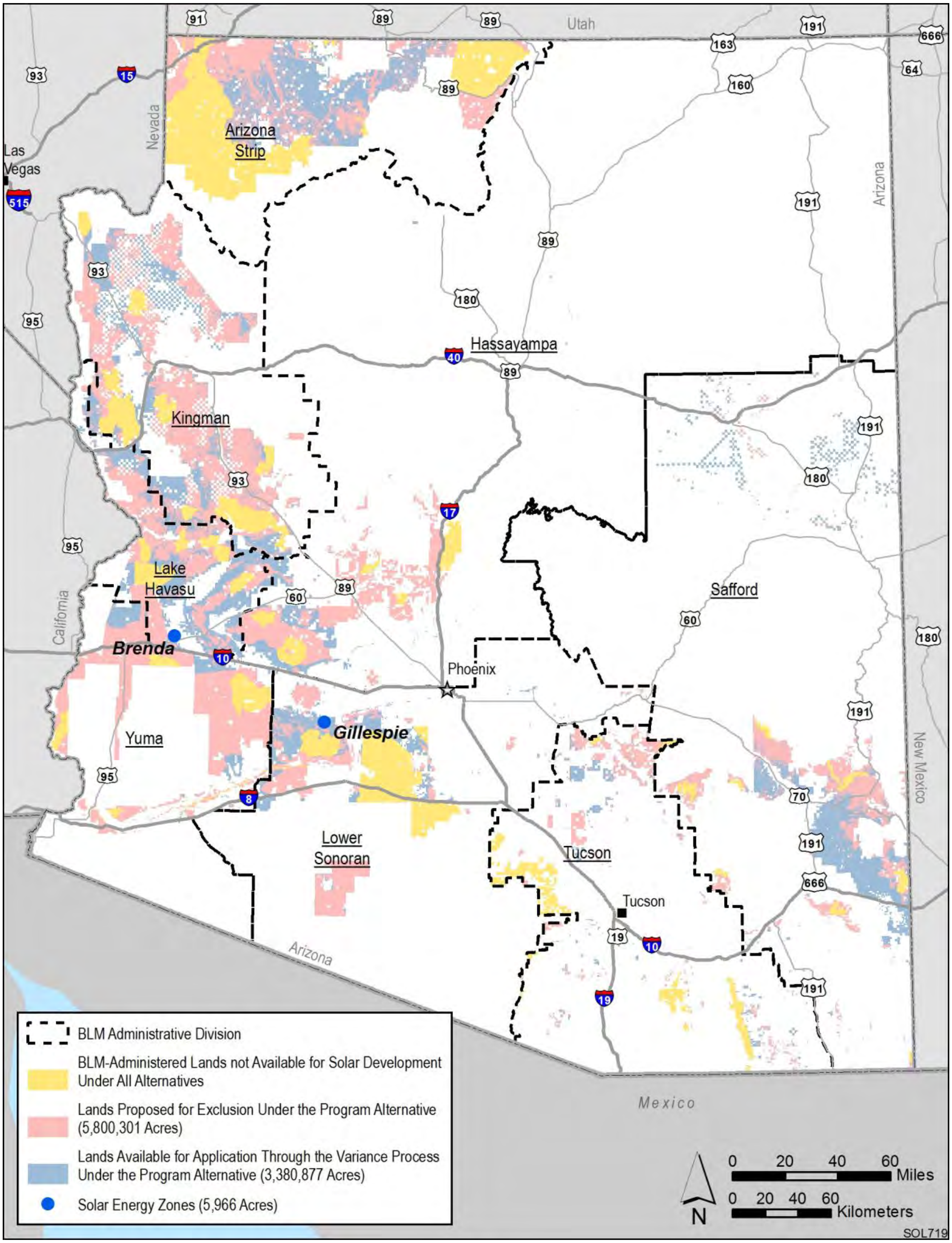


FIGURE 2.2-1 BLM-Administered Lands in Arizona Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

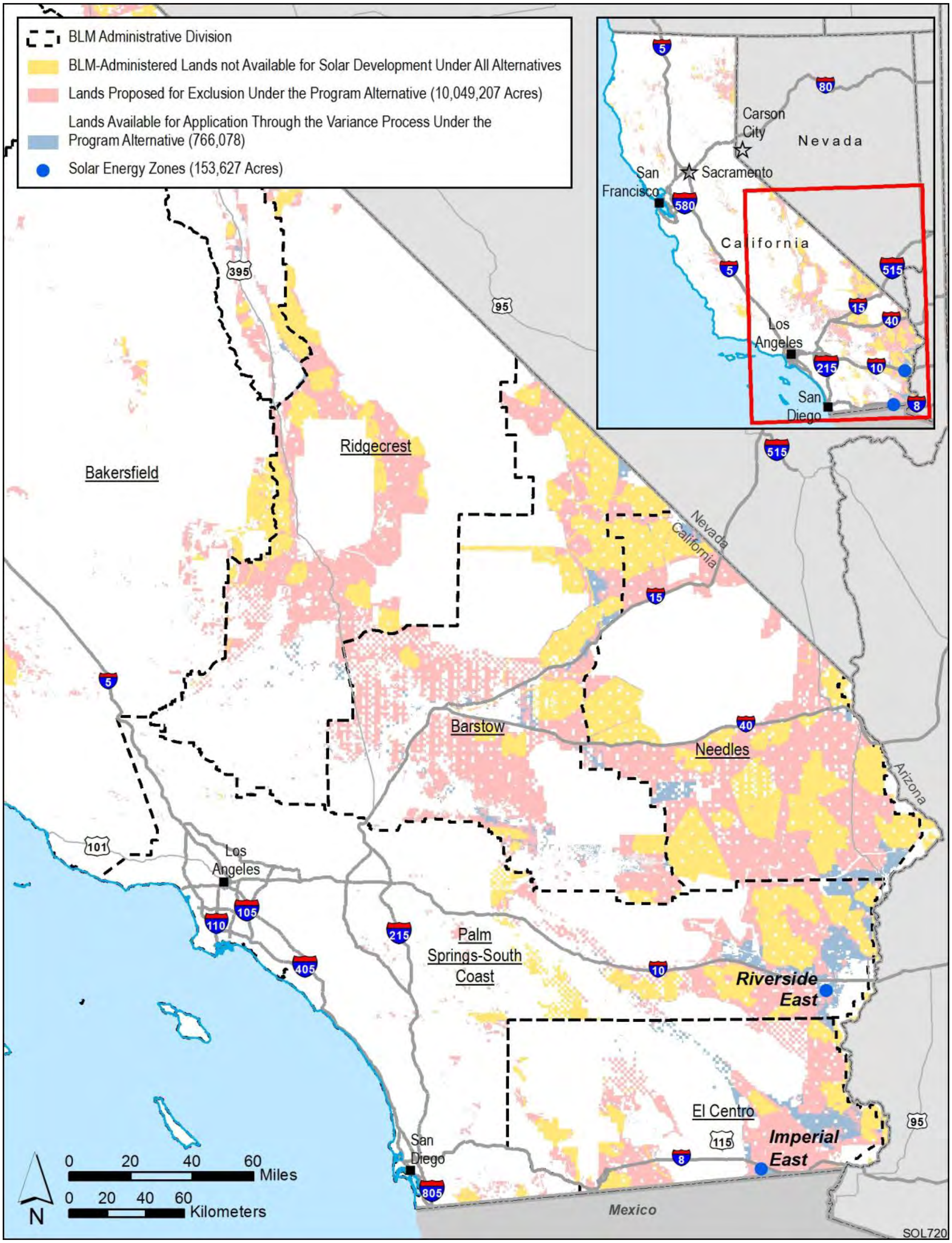


FIGURE 2.2-2 BLM-Administered Lands in California Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

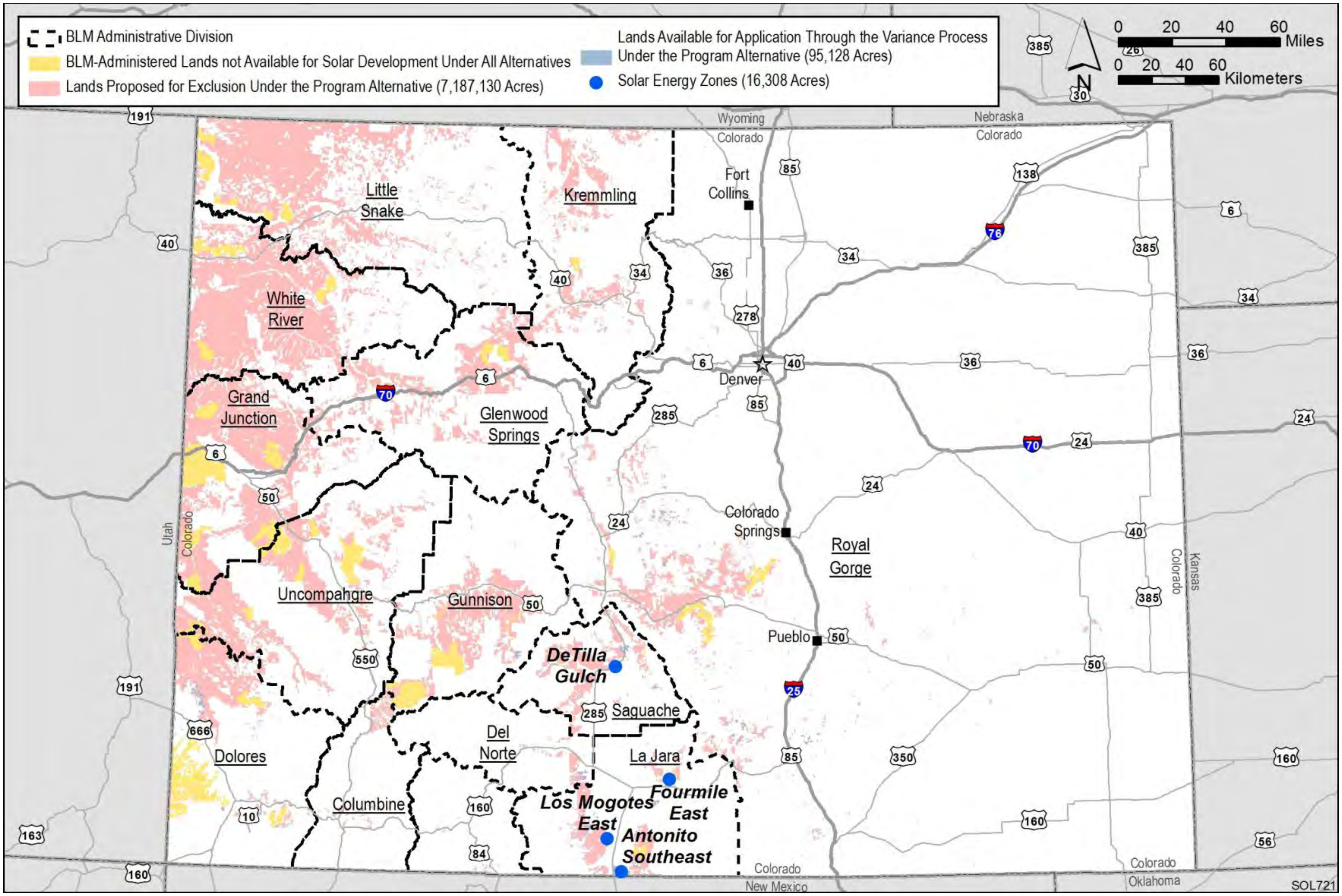


FIGURE 2.2-3 BLM-Administered Lands in Colorado Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

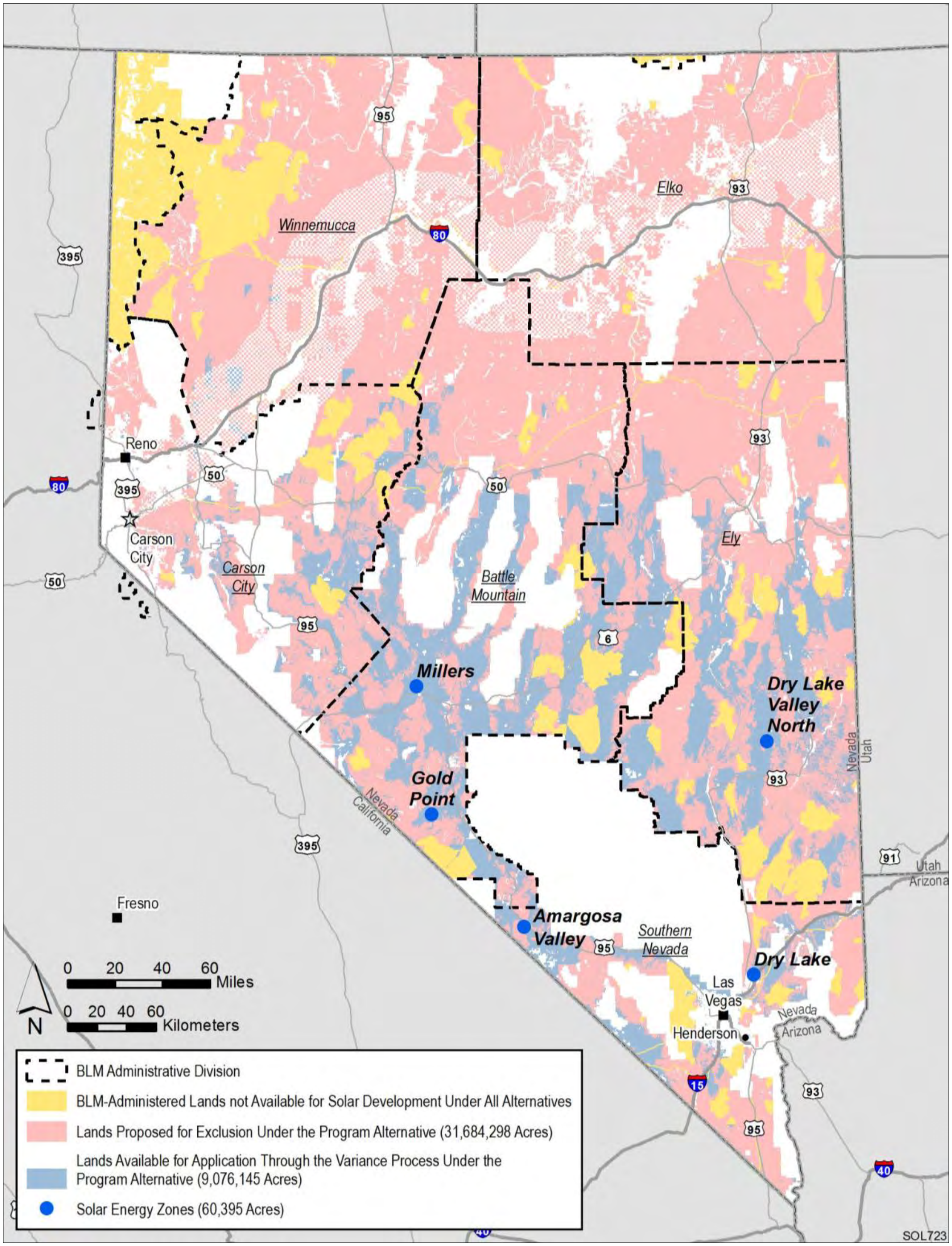


FIGURE 2.2-4 BLM-Administered Lands in Nevada Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

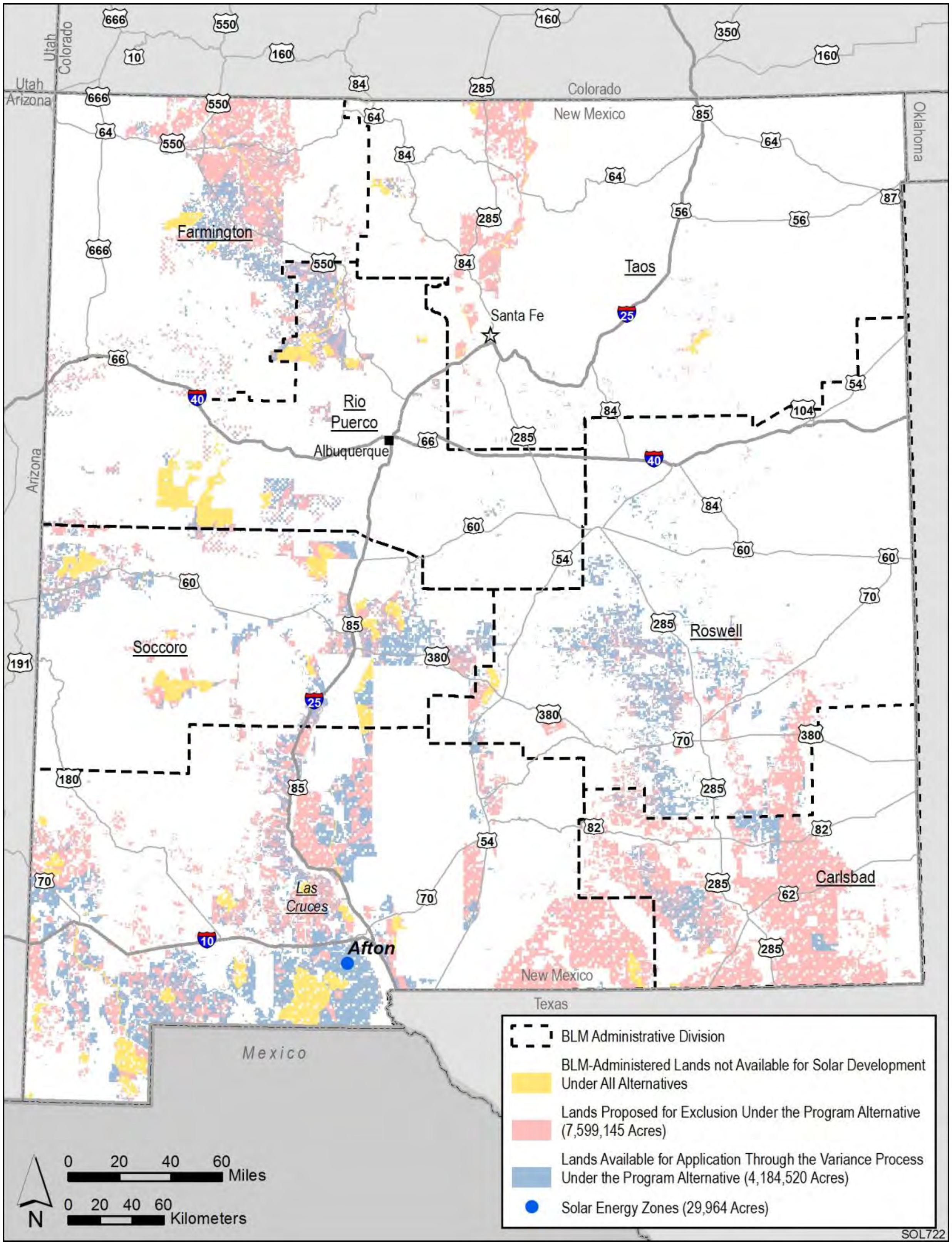


FIGURE 2.2-5 BLM-Administered Lands in New Mexico Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

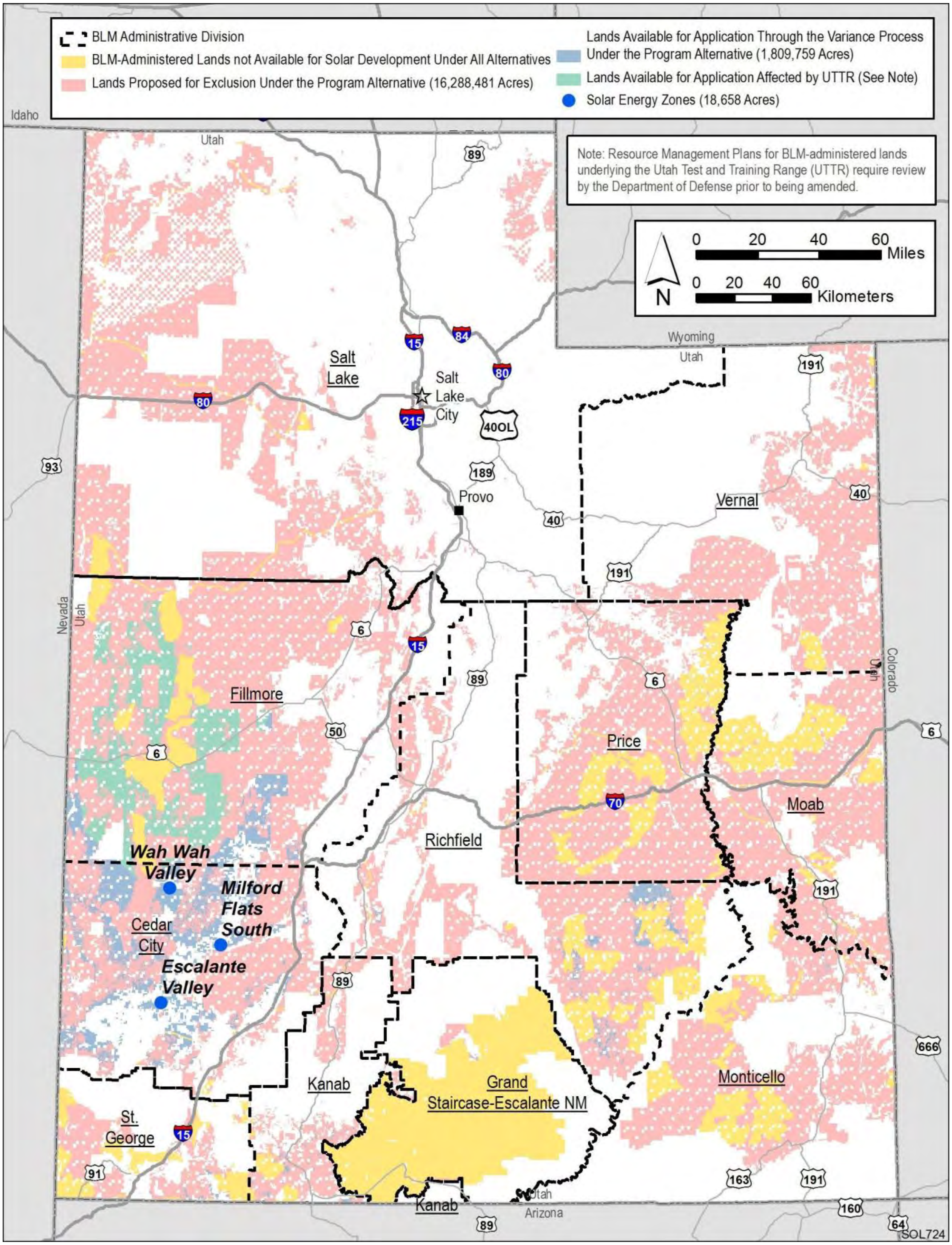


FIGURE 2.2-6 BLM-Administered Lands in Utah Available for Application for Solar Energy ROW Authorizations under the BLM Alternatives Considered in This PEIS

2.6 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

BLM (Bureau of Land Management), 1994, *BLM Manual 3060*, *Mineral Reports—Preparation and Review*, Rel. 3-284, U.S. Department of the Interior, Washington, D.C., April 7.

BLM, 1999, *The California Desert Conservation Area Plan 1980, as Amended*, California Desert District Office, Riverside, Calif., Aug. 17.

BLM, 2005, *Land Use Planning Handbook*, H-1601-1, U.S. Department of the Interior, Washington, D.C., March.

BLM, 2008, *BLM National Environmental Policy Act Handbook*, H-1790-1, National Environmental Policy Act Program, Office of the Assistant Director, Renewable Resources and Planning (WO-200), Washington, D.C., Jan. Available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.24487.File.dat/h1790-1-2008-1.pdf.

BLM, 2009a, *Instruction Memorandum 2009-153, Financial Guarantees for Notices and Plans of Operations*, U.S. Department of the Interior, Washington D.C., June 19.

BLM, 2009b, *Manual of Surveying*, U.S. Department of the Interior, Washington, D.C.

BLM, 2010, *Instruction Memorandum 2010-141, Solar Energy Interim Rental Policy*, U.S. Department of the Interior, Washington, D.C., June 10.

BLM, 2011a, *Instruction Memorandum 2011-122, Plan to Ensure Adequate Cadastral Survey Review of Boundary Evidence Prior to the Approval of Significant Land and Resource Transactions and Commercial Projects,* U.S. Department of the Interior, Washington, D.C., May 24.

BLM, 2011b, *Instruction Memorandum 2012-032, Native American Consultation and Section 106 Compliance for the Solar Energy Program Described in Solar Programmatic Impact Statement*, U.S. Department of the Interior, Washington, D.C., Dec. 1.

BLM, 2011c, *Instruction Memorandum 2012-043, Greater Sage-Grouse Interim Management Policies and Procedures*, U.S. Department of the Interior, Washington, D.C., Dec. 22.

BLM and DOE (BLM and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

Department of the Treasury, 2011, *Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies,* 4810-35, Dept. Circular 570, 2011 Revision, July 1.

DOE and BLM (U.S. Department of Energy and BLM), 2008, *Summary of Public Scoping Comments Received during the Scoping Period for the Solar Energy Development Programmatic Environmental Impact Statement*, prepared by Argonne National Laboratory, Argonne, Ill., for DOE and BLM, Washington, D.C., Oct.

NREL (National Renewable Energy Laboratory), 2010, *Solar Power and the Electric Grid, Energy Analysis (Fact Sheet)*, Golden, Colo., March. Available at http://www.nrel.gov/docs/fy10osti/45653.pdf.

Secretary of the Interior, 2010, "Renewable Energy Development by the Department of the Interior," Amendment No. 1 to Secretarial Order 3285, Feb. 22. Available at http://elips.doi.gov/app_so/act_getfiles.cfm?order_number=3285A1.

3 UPDATE TO OVERVIEW OF SOLAR ENERGY POWER PRODUCTION TECHNOLOGIES, DEVELOPMENT, AND REGULATION

Chapter 3 of the Draft Solar PEIS (BLM and DOE 2010) provided general information about the types of solar facilities likely to be developed in the United States over the next 20 years, along with their sizes and resource needs (Section 3.1); a general description of the phases of solar facility development (from site characterization through decommissioning) and of associated transmission line development (Section 3.2); a brief discussion of regulatory requirements pertaining to solar facilities (Section 3.3); and solar facility considerations with respect to transportation, hazardous materials and waste, and health and safety (Sections 3.4 through 3.6). A description of BLM and DOE processes that are in place and are relevant for solar energy development was given in Section 3.7.

The information presented in this update to Chapter 3 for the Final Solar PEIS summarizes and supplements, but does not replace, the information provided in the corresponding Chapter 3 in the Draft Solar PEIS. Information on the topics listed above that has become available subsequent to publication of the Draft Solar PEIS is presented in this section.

3.1 TECHNOLOGIES

The solar technologies considered in the Draft and Final Solar PEIS are those deemed most likely to be deployed at utility scale over the next 20 years. The technologies evaluated fall into two general categories—CSP and PV. CSP technologies are those that concentrate the sun's energy to produce heat; the heat then drives either a steam turbine or an external heat engine to produce electricity. Parabolic trough, power tower, and dish engine technologies fall into the CSP category. In PV technologies, the photons in sunlight are converted directly to electricity. The information on these technologies presented in Section 3.1 of the Draft Solar PEIS remains generally valid, although some changes in technology designs may have occurred. Of key relevance for the impact assessments in the Solar PEIS are the assumed resource requirements (e.g., land area and water requirements) that were presented in Section 3.1 of the Draft Solar PEIS. These are again presented in Table 3.1-1. The resource requirement assumptions were a basis for the programmatic assessment of impacts from solar energy development presented in Chapter 5 of the Draft and Final Solar PEIS, and for the assessment of impacts for the SEZs. An expanded discussion of potential water sources (e.g., use of degraded water) has been included in Section 5.9 of this Final Solar PEIS. The resource requirement values in Table 3.1-1 are subject to change as technologies evolve and may also vary with specific plant operating conditions. If applicable, significant differences from the assumed resource requirements would be evaluated for individual projects.

TABLE 3.1-1 Technology-Specific Assumptions for Environmental Impact Analyses

Parameter	Parabolic Trough	Power Tower	Dish Engine	PV
Facility power capacities (MW)	100–400	100–400	10–750	10–750
Land area requirements (acres/MW)[a]	5	9	9	9
Operational water use (ac-ft/yr/MW)				
Wet (recirculating) cooling[b]	4.5–14.5	4.5–14.5	NA[e]	NA
Dry cooling[b]	0.2–1.0	0.2–1.0	NA	NA
Hybrid system[c]	0.9–2.9	0.9–2.9	NA	NA
Mirror/panel washing/other[d]	0.5	0.5	0.5	0.05
Chemicals/hazardous materials present on-site	HTF, water treatment chemicals; herbicides	HTF, water treatment chemicals; herbicides	Hydrogen tanks; herbicides	Encased semiconductor materials; herbicides

[a] Land area estimates were based on areas required for existing facilities and estimated areas for proposed facilities. In some cases disturbed area estimates were not available; thus values were based on total plant area (should approximate disturbed area). The estimated land use values for parabolic trough and tower facilities are minimums; the land area requirement could be higher if thermal energy storage (TES) were incorporated into facilities.

[b] Wet-cooling and dry-cooling requirements are based on estimates given as gal/h/MW in DOE (2009). An assumed range of operational hours of 30 to 60% of annual hours (1 gal = $\sim 3.1 \times 10^{-6}$ ac-ft) was used to generate ac-ft/yr/MW values.

[c] Hybrid systems are assumed to use 20% of the water requirements of wet-cooling systems.

[d] The mirror washing estimates originate from the assumed 2% of total water needs of wet-cooled parabolic trough facilities from DOE (2009). This estimate equals 20 gal/h/MW, which corresponds to 0.5 ac-ft/yr/MW, with no assumption on operational time (conservative estimate). The panel washing estimate for PV facilities was assumed to be a factor of 10 less than that for CSP technologies (see Appendix M of the Draft Solar PEIS).

[e] NA = not applicable.

3.2 DEVELOPMENT PROCESS OVERVIEW FOR ALL TECHNOLOGIES

3.2.1 Site Characterization

During site characterization, generally very little modification of the site occurs. The activities could include construction of meteorological towers, surface hydrology assessment and floodplain mapping, slope evaluation, soil stability studies, due diligence assessment for lands with previous industrial uses, evaluation of seismic stability and potential storm event runoff, and soil coring (especially where substantial foundations would be required). The site characterization phase would include conducting surveys for ecological, cultural, and paleontological resources (including surveys for special status species if needed). Many of these activities would involve minimal or no site disturbance. The more detailed description of these activities provided in the Draft Solar PEIS remains valid.

3.2.2 Site Preparation and Construction

Construction of any solar energy development project is likely to involve the following major actions: establishing site access; performing site grading; constructing laydown areas and an on-site road system; removing vegetation from the solar field and construction and laydown areas (primarily for fire safety); and constructing the solar field, power block area (for parabolic trough and power tower facilities), central control building, electrical substations, and meteorological towers (if not done during site characterization). Additional activities may also be necessary at some facilities, including pile driving, constructing a concrete batching plant, constructing sanitary facilities and temporary offices, and landscaping. Construction would generally be divided into two phases, which would include a site preparation phase of relatively short duration (e.g., a few months) followed by a much longer assembly, testing, and start-up phase. The description and information about site preparation and construction activities provided in the Draft Solar PEIS remains valid.

3.2.3 Operations

Operation of solar facilities would require varying numbers of on-site personnel, depending on the technology and the capacity of the facility; PV facilities might require very few (less than 5) personnel on-site daily, whereas larger solar trough or power tower facilities would require an operations workforce on the order of 100 individuals. All facilities would require facility control staff to monitor solar array and substation operations, and the power block if present. All solar facilities would require provisions for reflector/mirror washing at frequencies appropriate to the technology being utilized. Facilities utilizing steam cycles and circulating both steam water and heat transfer fluids (HTFs) would have additional maintenance activities. The description of operations in the Draft Solar PEIS remains valid.

3.2.4 Decommissioning and Reclamation

Decommissioning would include removal of equipment, removal of permanent structures and on-site roads, proper closure of all on-site wells, removal of all hazardous materials and wastes and closure of related storage areas, remediation of all spills or leaks of chemicals, and return of the site to its native state to the greatest extent possible, including re-establishment of the native vegetative communities. The removal of electrical substations would require inspection for contamination of the soil and decontamination as necessary. The description of decommissioning and reclamation in the Draft Solar PEIS remains valid.

3.2.5 Transmission Facilities

As described in Section 3.2.5 of the Draft Solar PEIS, construction and operation of transmission lines to tie solar energy facilities into the main power grid would be required for most new solar energy facilities. The length of transmission line required would depend on the distance from the site to existing lines having sufficient uncommitted capacity to accept power from the facility (if such lines exist). If no capacity is available on existing lines, it is possible that entirely new lines would be needed to transmit electrical power from solar facilities to load centers (i.e., populated areas with a demand for the generated electricity).

An analysis of the distance from all eligible solar facility locations on BLM-administered lands in the six-state study area to the existing transmission grid or to federally or locally designated transmission corridors was provided in the Draft Solar PEIS; the analysis showed that few locations are greater than 25 mi (40 km) from these existing lines or corridors[1] (see Appendix G of the Draft Solar PEIS).

The general information on transmission facilities provided in Section 3.2.5 of the Draft Solar PEIS remains valid. The following paragraphs describe the changes in the analysis of the impacts of construction and operation of transmission facilities to support solar energy development that are being presented in this Final Solar PEIS.

In Chapter 5 of the Draft Solar PEIS, a general analysis of the impacts of transmission line construction and/or line upgrades was provided for each resource area addressed. The description of these impacts remains valid.

The analysis of transmission impacts for the proposed SEZs presented in the Draft Solar PEIS assumed land disturbance from construction of a new line from each SEZ to the nearest existing transmission line; it was acknowledged that if additional construction or line upgrades were necessary for specific solar projects within SEZs, developers would need to analyze those environmental impacts. The transmission analysis for the SEZs did not evaluate the available capacity on existing lines; the assumption was made that existing lines could be upgraded if additional capacity were needed. Comments were received stating that this assumption was generally not valid because of almost full allocation of the transmission grid capacity in the study area. These comments correctly pointed out that it was possible that new transmission line construction might be required to transport power from the SEZs along at least part of the route to the purchasing load center. For this Final Solar PEIS, an analysis for each SEZ has been added estimating the potential costs and land disturbance associated with constructing new transmission

---

[1] Subtitle F of the Energy Policy Act of 2005 required various federal agencies, led by the DOE and the BLM, to designate corridors for energy transmission in the 11 western states, including the six-state study area of this PEIS. Local BLM offices have also designated corridors under separate authorities. Both federally and locally designated corridors are addressed in the *Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States (Corridor PEIS)* (DOE and DOI 2008). The Corridor PEIS, as well as various state and regional initiatives, such as California's Renewable Energy Transmission Initiative (RETI) (see http://www.energy.ca.gov/reti/index.html and Appendix D of this PEIS), should help to facilitate solar development by creating corridors through which power from remotely located solar facilities can be efficiently delivered to customers with minimum adverse impacts.

lines along the entire route to likely load centers. These analyses also include estimates of costs and land disturbance associated with required new transmission substations, as requested in comments. The new analyses provide upper bound estimates of the costs and environmental impacts (in terms of land disturbance) of providing transmission to each of the SEZs. SEZ-specific dedicated line transmission (DLT) analyses are provided for each of the proposed SEZs carried forward in the Supplement to the Draft Solar PEIS (BLM and DOE 2011) in Chapters 8 through 13 of this Final Solar PEIS.

3.3 LAWS AND EXECUTIVE ORDERS POTENTIALLY APPLICABLE TO SOLAR ENERGY AND TRANSMISSION LINE PROJECTS

Section 3.3 of the Draft Solar PEIS discussed in general terms the existing major laws, E.O.s and policies that might impose environmental protection and compliance requirements on the siting, construction, operation, and decommissioning phases of utility-scale solar energy and transmission line projects. Related lists of specific E.O.s, federal and state laws, and county ordinances that might be applicable, were provided in Appendix H of the Draft Solar PEIS. The information presented in Section 3.3 of the Draft Solar PEIS remains valid, with the following update.

The text of Section 3.3 of the Draft Solar PEIS stated the following regarding noise: "The EPA issued guidelines for outdoor noise levels that are consistent with the protection of human health and welfare against hearing loss, annoyance, and activity interference. The guidelines state that annoyance and undue interference with activity will not occur if outdoor levels of noise are maintained below an energy equivalent of 55 dB. However, these levels are not legally enforceable standards." Note that noise and soundscape protection policies have been developed by the NPS. These policies are discussed in Section 5.13 of this Final Solar PEIS.

3.4 TRANSPORTATION CONSIDERATIONS

Section 3.4 of the Draft Solar PEIS addressed transportation requirements to support solar energy development during construction, operations, decommissioning, and reclamation. This information is summarized below; there are no updates for this section.

In general, heavy equipment and materials needed for site access, site preparation, and solar array foundation construction are typical of road construction projects and do not pose unique transportation considerations. Solar collectors would be assembled on-site, and materials would be delivered to the project location by regular truck shipments without the need for oversize or overweight permits. The total number of shipments over the course of the construction period would depend on the type of solar technology and the size of the facility. The number of workers required during different phases of development would vary, but increased commuter traffic in the vicinity of the project may require road improvements or other measures to alleviate congestion or traffic hazards. Deliveries of materials during operations could also include hazardous materials such as fuels or ammonia. Shipments from facilities would include wastes for disposal.

3.5 HAZARDOUS MATERIALS AND WASTES ASSOCIATED WITH SOLAR ENERGY FACILITIES

Section 3.5 of the Draft Solar PEIS discussed the types and estimated the quantities of hazardous materials and wastes associated with the construction, operation, and decommissioning of a solar energy facility. The information presented in Section 3.5 of the Draft Solar PEIS remains valid; there are no updates for this section.

3.6 HEALTH AND SAFETY ASPECTS OF SOLAR ENERGY PROJECTS

In Section 3.6 of the Draft Solar PEIS, the potential human health and safety issues potentially related to solar energy development projects were summarized. The occupational hazards of key concern included potential eye damage from glare from solar fields, risk of injury or fatality from physical hazards (e.g., working at heights for power tower facilities), and risk of heat stress from working outdoors in a hot climate. Detailed project-specific health and safety plans and adequate worker training would minimize these risks. Public safety issues discussed included electric shock hazards from unauthorized access to transformers or other equipment, potential eye damage from glare from solar fields, and fire hazards, The potential for health impacts from exposure to electric and magnetic fields was also discussed. The information presented in Section 3.6 of the Draft Solar PEIS remains valid; there are no updates for this section.

3.7 EXISTING AGENCY PROCESSES AND GUIDANCE

Section 3.7 of the Draft Solar PEIS presented information on the BLM processes for issuing solar development ROWs based on Instructional Memoranda available at the time; options for ROW processing (such as case-by-case, through competitive bidding, land withdrawals, or land disposal); and guidance for mitigation of solar energy development impacts available at the time of the Draft Solar PEIS publication. In general, the information presented in Section 3.7 of the Draft Solar PEIS remains valid. With respect to the information on process for issuing solar development ROWs presented in Section 3.7.1 of the Draft Solar PEIS, several pertinent interim Instructional Memoranda have been issued by the BLM subsequent to release of the Draft Solar PEIS. These Instructional Memoranda are summarized and referenced in Section A.1 of Appendix A of this Final Solar PEIS. In addition, the final version of Best Management Practices and Guidance for Desert Renewable Energy Projects (REAT 2010) was released concurrent with the Draft Solar PEIS. This guidance was considered in the preparation of programmatic design features presented in Section A.2.2 of Appendix A of this Final Solar PEIS.

3.8 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

BLM and DOE (Bureau of Land Management and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

DOE, 2009, *Report to Congress, Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar Power Electricity Generation,* Jan. 13.

REAT (Renewable Energy Action Team; California Energy Commission, California Department of Fish and Game, U.S. Department of Interior Bureau of Land Management, and Fish and Wildlife Service), 2010, *Best Management Practices and Guidance Manual: Desert Renewable Energy Projects,* REAT-1000-2010-009-F, California Energy Commission, Siting, Transmission and Environmental Protection Division, Nov.

This page intentionally left blank.

4 UPDATE TO AFFECTED ENVIRONMENT

4.1 INTRODUCTION

Chapter 4 of the Draft Solar PEIS presented a general description of the existing conditions and trends for resources and resource uses in the six-state study area that may be affected by implementing the BLM and DOE proposed alternatives. The information presented in this update to Chapter 4 for the Final Solar PEIS summarizes and supplements, but does not replace, the information provided in the corresponding Chapter 4 in the Draft Solar PEIS. In this Final Solar PEIS, information on the affected environment that has become available subsequent to publication of the Draft Solar PEIS is presented. In addition, corrections to incorrect information on the affected environment in the Draft Solar PEIS are provided via the errata table in Section 4.20.

As stated in the Draft Solar PEIS, the description of the affected environment in general covers the six-state area. With respect to certain resources, however, the discussion of the affected environment on BLM-administered lands receives additional focus. The description of the affected environment provides the basis for identifying potential impacts and is of sufficient detail to support the programmatic nature of the Solar PEIS.

4.2 LANDS AND REALTY

Within the six-state PEIS study area, the BLM manages almost 120 million acres (486,000 km^2) of public lands. The BLM grants or renews ROWs on public lands for a wide variety of uses, including reservoirs; pipelines; electrical generation, transmission, and distribution systems; and roads. Once granted, a ROW conveys a right to occupy public lands and, depending on the specific ROW grant, provides a priority for use of the public land for the specified term of the ROW. Applications for utility-scale solar and transmission facilities would be processed as ROW authorizations.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.3 SPECIALLY DESIGNATED AREAS AND LANDS WITH WILDERNESS CHARACTERISTICS

Specially designated areas include a variety of types of areas that have received recognition or designation because they possess unique or important resource values. While these areas would not be available for development of solar energy resources, they could be located near solar development areas and could be affected by solar development. The majority of specially designated areas discussed in this PEIS are located on BLM-administered public lands; however, there are many specially designated areas managed by the USFS, USFWS, and

NPS, as well as areas designated and managed by states and localities, that are also included in the analysis when they could be affected by solar development on public lands.

Data presented in the Draft Solar PEIS remain valid, but clarification is needed regarding specially designated areas managed by other federal and state agencies.

Units managed by other federal agencies identified as "specially designated" refer to standard management units of these agencies. For example, for the NPS, these are units of the National Park System and can include a wide array of designated areas. More common examples include National Parks and Monuments and National Recreation Areas, but NPS-managed units are quite varied in their nomenclature. Within these NPS units, there can be additional "special designations," including designated wilderness or areas administratively managed to protect wilderness values. For the USFS, units are generally national forests but they also manage national grassland units as well as some other designated areas. As with the NPS, some USFS units may also have wilderness or recreation area designations. The USFWS manages the national wildlife refuge system, and these units are sometimes interspersed with BLM-administered public lands. Lands managed by all of these federal agencies can have important recreation, scenic, and historic values.

State and local governments are important providers of recreation, historic, and cultural resource services within the study area of this PEIS. State and local parks are common examples of areas that are interspersed among BLM-administered public lands that can be affected by solar developments on public lands and are considered to be specially designated units.

4.4 RANGELAND RESOURCES

4.4.1 Livestock Grazing

Livestock grazing is a major and widespread use of public lands. About 105 million acres (424,920 km^2) are included within grazing allotments located on public lands being considered in this PEIS. Grazing that occurs on public lands is authorized either through a grazing permit or lease. In fiscal year (FY) 2007, the BLM issued 6,439 grazing permits and leases in the six-state study area.

Data presented in the Draft Solar PEIS remain valid, but additional information is needed regarding the monetary values associated with public land grazing operations.

Livestock grazing on BLM-administered public lands is tied to base property that is privately owned. The value of an individual's ranching operation is linked to the value of the animal unit months (AUMs) of forage authorized under the federal grazing permit, the value of a permittee's interest in range improvements, in some cases the value of water rights attached to grazing use, and the value of the private lands associated with the grazing permit. Reductions in the forage allocated in the grazing permit affect the overall value of the ranch, including the private lands.

4.4.2 Wild Horses and Burros

In the Draft Solar PEIS, this section described the Wild Free-Roaming Horses and Burros Act and BLM's management objectives for wild horses and burros. The section also described the management of wild horses and burros within herd management areas (HMAs). Section 4.4.2 of the Draft Solar PEIS provided a table of wild horse and burro statistics for the six-state study area for FY 2009 that included the number and acreage of HMAs and the populations of wild horses and burros in the six-state study area. Information provided in Section 4.4.2 of the Draft PEIS remains valid. Wild horse and burro statistics for FY 2011 can be found at BLM (2011).

4.4.3 Wildland Fire

The six states in the PEIS study area have a wide range of climates and fuel types, and wildland fire is a factor to be considered as part of the site-specific planning for solar energy facilities. The causes of fires can be either natural (lightning) or man-made, with lightning fires being more common in the states of Colorado, Nevada, and Utah and human-caused fires being ubiquitous. Fire management and protection may be provided by the BLM or cooperator organizations that could include private, state, or other federal agency fire organizations.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.5 RECREATION

The vast majority of the American public's interaction with BLM-administered lands is through outdoor recreation activities. In FY 2007, more than 57 million visitors participated in activities such as rafting, hiking, biking, back-country driving, hunting, fishing, and camping in the six- state study area. Other activities include visits to heritage sites, national monuments, wild and scenic rivers, wilderness areas, national trails, and national conservation areas.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.6 MILITARY AND CIVILIAN AVIATION

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.7 GEOLOGIC SETTING AND SOIL RESOURCES

4.7.1 Geologic Setting

The six-state study area encompasses several physiographic provinces. From east to west, the physiographic provinces are (1) the Pacific Border and the Lower California provinces; (2) the Cascade-Sierra Mountains province; (3) the Basin and Range province; (4) the Columbia-Snake River Plateau (mostly in Oregon and Idaho, but with a small portion overlapping northern Nevada); (5) the Colorado Plateau; (6) the Middle and Southern Rocky Mountains provinces; (7) the Wyoming Basin; and (8) the Great Plains province, covering eastern Colorado and New Mexico.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.7.2 Geologic Hazards

Geologic hazards occurring in the six-state study area include seismicity, liquefaction and landslide susceptibility, volcanic activity, mass wasting (landslides and debris flows), and land subsidence.

Data provided in the Draft Solar PEIS remain valid, with the following update:

- In Section 4.7.2.3.2 (Debris Flows), note that some investigators, such as House (2005), have had success in using geologic information to improve flood-hazard management on alluvial fans in desert areas. Methods such as those employed by House could be of great value in delineating significant flood areas.

4.7.3 Soil Resources

Soils in the six-state study area belong to eight soil orders (Aridisols, Mollisols, Entisols, Alfisols, Inceptisols, Andisols, Vertisols, and Ultisols). Most of the SEZs are located in alluvial basins on soils that are predominantly Aridisols. Biological soil crusts are commonly found in semiarid and arid environments, such as those throughout the study area, and occur on all types of soils. Biological soil crusts are highly susceptible to disturbance, especially in sandy soils. Desert pavement is a type of surface armor that forms on the ground in hot desert environments, such as those covering the southern portion of the six-state study area. Desert pavements consist of a thin layer of closely packed, angular to sub-rounded coarse rock fragments and are associated with alluvial fans and other unsorted alluvial deposits.

The soils of desert environments within the six-state study area are highly vulnerable to erosion by wind. Airborne dust is generated when wind forces exceed the ability of stabilizing factors to hold the fine-grained components of soil in place. Factors that function to stabilize soils include vegetation cover, biological soil crust cover, rock cover, high salt or calcium carbonate content, high clay and silt content, physical crusts (e.g., playa efflorescent crusts), and desert pavement. When these factors are compromised by the compressional and shear forces created by vehicles and the trampling effects of livestock and humans, soil fines are lost to erosion, thus reducing the soil's productivity. The replacement of lost soil is very slow; therefore the best mitigation to reduce soil loss by wind erosion is to follow practices that avoid soil disturbance and control dust emissions to the maximum extent possible.

Deposition of soil fines may also be problematic because it reduces the fertility of plants and biological crusts (by burial of photosynthetic components) and contributes to sedimentation in nearby surface water bodies.

Data provided in the Draft Solar PEIS remain valid, with the following updates:

- In Section 4.7.3.2 (Biological Soil Crusts), note that biological soil crusts are an important source of fixed carbon (and other nutrients like nitrogen) in desert environments and these processes are vital to soil fertility.

- Section 4.7.3.2 (Biological Soil Crusts) should have included a citation of DOI's technical reference on biological soil crust management (Belnap et al. 2001).

- In Section 4.7.3.4 (Wind Erosion of Soils), text should have been included to indicate that wind erosion and deposition are important processes in alluvial valleys where many of the SEZs are located, especially for the formation of eolian landforms such as yardangs and sand dunes.

4.8 MINERALS

Energy and mineral resource uses have the highest economic values of all commercial uses of the surface lands and subsurface estates administered by the BLM in the six-state study area. These economic values derive from the production of a wide range of locatable, leasable, and salable mineral resources.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.9 WATER RESOURCES

4.9.1 Surface Water Resources

The six-state study area encompasses nine major hydrologic regions, as defined by the USGS (2008). Surface water resources of the affected environment include lakes and rivers, as well as numerous floodplains, ephemeral streams (i.e., streams that carry water only briefly in direct response to precipitation), and wetlands. Stream discharge in the six-state study area is affected by precipitation (which varies with season) and the regional topography. Seasonally, spring snowmelts cause high streamflows during the spring months. High streamflows also occur during summer thunderstorms. Many streams rely on groundwater discharge for their flow. A decrease in natural streamflow may occur as a result of the consumptive use of surface water and/or groundwater in a basin, such as for irrigation and the public drinking water supply. Many rivers in the six-state study area are regulated by dams and other flow control structures, so stream discharge is also controlled by release schedules from reservoirs. Surface water quality varies by stream segment and is related to the volume of streamflow, the local geology and soils, and human activities (e.g., mining, wastewater discharges, agriculture).

Data provided in the Draft Solar PEIS remain valid, with the following updates:

- Table 4.9-2 has been updated (see below).

- Section 4.9.1.4.1 is being updated with the following information about the Colorado River.

In accordance with the Law of the River, the USGS developed a method for identifying groundwater wells outside the Colorado River's floodplain, where groundwater is replenished by Colorado River water. This method is known as the Accounting Surface, and it establishes a surface of static groundwater elevations below which water is accounted for as Colorado River water and above which water is accounted for as local tributary replenished water (Wilson and Owen-Joyce 1994; Wiele et al. 2008). Groundwater below the Accounting Surface is subject to water management by the Law of the River, which is administered by the U.S. Bureau of Reclamation (Wilson and Owen-Joyce 1994), and water above the Accounting Surface is subject to water management by state and local entities.

4.9.2 Groundwater Resources

Fourteen major aquifer systems occur in the six-state study area (USGS 2003). Groundwater occurs primarily in basin-filled sediments, volcanic rocks, and carbonate bedrock. The most widely distributed systems are the basin-fill aquifers of the Basin and Range Region in Nevada, southeastern California, and western Utah, and the aquifers within the Colorado Plateau that occupy western Colorado, eastern Utah, northeastern Arizona, and northwestern New Mexico. Other major aquifer systems include the Central Valley aquifer system in

TABLE 4.9-2 Designation Classification and Administrative Authority for Wild and Scenic Rivers in the Six-State Study Area

State	Wild and Scenic River	Administrative Authority[a]	Designation Classification and Length (mi)[b] Wild	Scenic	Recreational	Total Designated Miles[b]	Designated Location and Length[b]
Arizona	Verde	USFS	22.2	18.3	–[c]	40.5	The northern boundary of the Scenic River Area from the section line between Sections 26 and 27, the Gila-Salt River meridian, to the southern boundary, the Mazatzal Wilderness. The northern boundary of the Wild River Area from the boundary of the Mazatzal Wilderness to the southern boundary at the confluence of Red Creek with the Verde River.
California	Amargosa	BLM					From the northern boundary of Section 7, Township 21 North, Range 7 East to 100 ft upstream of the Tecopa Hot Springs Road crossing. From 100 ft downstream of the Tecopa Hot Springs Road crossing to 100 ft upstream of the Old Spanish Trail Highway crossing near Tecopa. From the northern boundary of Section 16, Township 20 North, Range 7 East to 100 ft upstream of the Dumont Dunes Access Road crossing in Section 32, Township 19 North, Range 7 East. From 100 ft downstream of the Dumont Dunes Access Road for the next 1.4 mi.
	American (Lower)	State of California	–	–	23.0	23.0	From the confluence with the Sacramento River to the Nimbus Dam.
	American (North Fork)	USFS BLM	26.3 12.0	– –	– –	26.3 12.0	From a point 0.3 mi above Health Springs downstream to a point 1,000 ft upstream of Colfax-Iona Hill Bridge.
	Bautista Creek	USFS	–	–	9.8	9.8	From the San Bernardino National Forest boundary in Section 36, Township 6 South, Range 2 East to the San Bernardino National Forest boundary in Section 2, Township 6 South, Range 1 East.
	Big Sur	USFS	19.5	–	–	19.5	From the confluence of the South and North Forks downstream to the boundary of the Ventana Wilderness. The South Fork and the North Fork from their headwaters to their confluence.

TABLE 4.9-2 (Cont.)

State	Wild and Scenic River	Administrative Authority[a]	Designation Classification and Length (mi)[b] Wild	Scenic	Recreational	Total Designated Miles[b]	Designated Location and Length[b]
California *(Cont.)*	Black Butte	USFS	17.5	3.5	–	21.0	The segment from the Mendocino County line to its confluence with the Middle Eel River. Cold Creek from the Mendocino County line to its confluence with the Black Butte River.
	Cottonwood Creek	USFS	17.4	–	4.1	21.5	From its headwaters at the spring in Section 27, Township 4 South, Range 34 East to the northern boundary of Section 5, Township 4 South, Range 34 East.
	Eel	State of California USFS BLM Round Valley Reservation	36.0 35.0 21.0 5.0	22.5 – 4.5 1.0	250.5 – 6.5 16.0	309.0 35.0 32.0 22.0	From the mouth of the river to 100 yd below Van Ardsdale Dam. The Middle Fork from its confluence with the main stem to the southern boundary of the Yolla Bolly Wilderness Area. The South Fork from its confluence with the main stem to the Section Four Creek confluence. The North Fork from its confluence with the main stem to Old Gilman Ranch. The Van Duzen River from its confluence with the Eel River to Dinsmure Bridge.
	Feather	USFS	32.9	9.7	35.0	77.6	The entire Middle Fork downstream from the confluence of its tributary streams 0.6 mi south of Beckwourth, California.
	Fuller Mill Creek	USFS	–	2.6	0.9	3.5	From the source of Fuller Mill Creek in the San Jacinto Wilderness to its confluence with the North Fork San Jacinto River.
	Kern	USFS NPS	96.1 27.0	20.9 –	7.0 –	124.0 27.0	The North Fork from the Tulare-Kern County line to its headwaters in Sequoia National Park. The South Fork from its headwaters in the Inyo National Forest to the southern boundary of the Domelands Wilderness in the Sequoia National Forest.
	Kings	USFS NPS	16.5 49.0	– –	9.0 6.5	25.5 55.5	From the confluence of the Middle Fork and the South Fork to the point at elevation 1,595 ft above mean sea level. The Middle Fork from its headwaters at Lake Helen to its confluence with the main stem. The South Fork from its headwaters at Lake 11599 to its confluence with the main stem.

TABLE 4.9-2 (Cont.)

State	Wild and Scenic River	Administrative Authority[a]	Designation Classification and Length (mi)[b] Wild	Scenic	Recreational	Total Designated Miles[b]	Designated Location and Length[b]
California *(Cont.)*	Klamath	State of California	–	3.0	41.0	44.0	From the mouth to 3,600 ft below Iron Gate Dam. The Salmon River from its confluence with the Klamath to the confluence of the North and South Forks of the Salmon River. The North Fork of the Salmon River from the Salmon River confluence to the southern boundary of the Marble Mountain Wilderness Area. The South Fork of the Salmon River from the Salmon River confluence to the Cecilville Bridge. The Scott River from its confluence with the Klamath to its confluence with Schackleford Creek. All of Wooley Creek.
		USFS	12.0	21.0	177.5	210.5	
		BLM	–	–	1.5	1.5	
		Hoopa Valley Reservation	–	–	29.0	29.0	
		NPS	–	–	1.0	1.0	
	Merced	USFS	15.0	2.0	12.5	29.5	From its source (including Red Peak Fork, Merced Peak Fork, Triple Peak Fork, and Lyle Fork) in Yosemite National Park to a point 300 ft upstream of the confluence with Bear Creek. The South Fork from its source in Yosemite National Park to the confluence with the main stem.
		NPS	53.0	14.0	14.0	81.0	
		BLM	3.0	–	9.0	12.0	
	Owens	USFS	6.3	6.6	6.2	19.1	Deadman Creek from the two-forked source east of San Joaquin Peak to 100 ft upstream of Big Springs. The upper Owens River from 100 ft upstream of Big Springs to the private property boundary in Section 19, Township 2 South, Range 28 East. Glass Creek from its two-forked source to its confluence with Deadman Creek.
	Palm Canyon Creek	USFS	8.1	–	–	8.1	From the southern boundary of Section 6, Township 7 South, Range 5 East to the San Bernardino National Forest boundary in Section 1, Township 6 South, Range 4 East.
	Piru Creek	USFS	4.3	–	3.0	7.3	From 0.5 mi downstream of Pyramid Dam at the first bridge crossing to the boundary between Los Angeles and Ventura Counties.
	San Jacinto (North Fork)	USFS	7.2	2.3	0.7	10.2	From the source of the North Fork San Jacinto River at Deer Springs in Mt. San Jacinto State Park to the northern boundary of Section 17, Township 5 South, Range 2 East.

TABLE 4.9-2 (Cont.)

State	Wild and Scenic River	Administrative Authority[a]	Designation Classification and Length (mi)[b] Wild	Scenic	Recreational	Total Designated Miles[b]	Designated Location and Length[b]
California *(Cont.)*	Sespe Creek	USFS	27.5	4.0	–	31.5	The main stem from its confluence with Rock Creek and Howard Creek downstream to where it leaves Section 26, Township 5 North, Range 20 West.
	Sisquoc	USFS	33.0	–	–	33.0	From its origin downstream to the Los Padres National Forest boundary.
	Smith	State of California USFS	– 78.0	0.5 30.5	28.5 187.9	29.0 296.4	The segment from the confluence of the Middle Fork Smith River and the North Fork Smith River to its mouth at the Pacific Ocean. The Middle Fork from its headwaters to its confluence with the North Fork Smith River, including Myrtle Creek, Shelly Creek, Kelly Creek, Packsaddle Creek, the East Fork of Patrick Creek, the West Fork of Patrick Creek, Little Jones Creek, Griffin Creek, Knopki Creek, Monkey Creek, Patrick Creek, and Hardscrabble Creek. The Siskiyou from its headwaters to its confluence with the Middle Fork, including the South Siskyou Fork of the Smith River. The South Fork from its headwaters to its confluence with the main stem, including Williams Creek, Eightmile Creek, Harrington Creek, Prescott Fork, Quartz Creek, Jones Creek, Hurdy Gurdy Creek, Gordon Creek, Coon Creek, Craigs Creek, Goose Creek, the East Fork of Goose Creek, Buch Creek, Muzzleloader Creek, Canthook Creek, Rock Creek, and Blackhawk Creek. The North Fork from the California–Oregon border to its confluence with the Middle Fork of the Smith River, including Diamond Creek, Bear Creek, Still Creek, the North Fork of Diamond Creek, High Plateau Creek, Stony Creek, and Peridotite Creek.
	Trinity	State of California USFS BLM Hoopa Valley Reservation	2.0 42.0 – –	11.0 22.0 – 6.0	24.0 71.0 17.0 8.0	37.0 135.0 17.0 14.0	From the confluence with the Klamath River to 100 yd below Lewiston Dam. The North Fork from the Trinity River confluence to the southern boundary of the Salmon–Trinity Primitive Area. The South Fork from the Trinity River confluence to the California State Highway 36 bridge crossing. The New River from the Trinity River confluence to the Salmon–Trinity Primitive Area.

TABLE 4.9-2 (Cont.)

State	Wild and Scenic River	Administrative Authority[a]	Designation Classification and Length (mi)[b] Wild	Scenic	Recreational	Total Designated Miles[b]	Designated Location and Length[b]
California *(Cont.)*	Tuolomne	USFS NPS BLM	7.0 37.0 3.0	6.0 17.0 –	13.0 – –	26.0 54.0 3.0	The main stem from its source to the Don Pedro Reservoir.
Colorado	Cache La Poudre	USFS NPS	18.0 12.0	– –	46.0 –	64.0 12.0	From Poudre Lake downstream to where the river intersects the easterly north-south line of the west half of the southwest quarter of Section 1, Township 8 North, Range 71 West of the sixth principal meridian. The South Fork from its source to Section 1, Township 7 North, Range 73 West of the sixth principal meridian, from its intersection with the easterly section line of Section 30 of the sixth principal meridian to the confluence with the main stem.
Nevada	No WSR						
New Mexico	Jemez (East Fork)	USFS	4.0	5.0	2.0	11.0	From the Santa Fe National Forest boundary to its confluence with the Rio San Antonio.
	Pecos	USFS	13.5	–	7.0	20.5	From its headwaters to the town of Terrerro.
	Rio Chama	USFS and BLM	19.8	4.9	–	24.7	From El Vado Ranch launch site (immediately south of El Vado Dam) downstream for 24.7 mi.
	Rio Grande	USFS and BLM	53.2	–	2.5	55.7	The segment extending from the Colorado state line downstream approximately 68 mi to the west section line of Section 15, Township 23 North, Range 10 East. The lower 4 mi of the Red River.
Utah	Virgin River and Tributaries	NPS	TBD	TBD	TBD	165.5	List of 36 tributaries provided at http://www.rivers.gov/rivers/rivers/virgin.php..

Footnotes on next page.

TABLE 4.9-1 (Cont.)

[a] BLM = Bureau of Land Management; USFS = U.S. Forest Service; NPS = National Park Service.

[b] To convert mi to km, multiply by 1.609; to convert ft to m, multiply by 0.3048; to convert yd to m, multiply by 0.9144.

[c] A dash indicates zero mileage.

Sources: Interagency Wild & Scenic Rivers Council (2012); NPS (2006).

California, the Rio Grande aquifer system in New Mexico, and the High Plains aquifer system east of the Rocky Mountains (Planert and Williams 1995; Robson and Banta 1995).

Shallow groundwater is typically found near the surface in the vicinity of large surface water bodies (i.e., lakes and streams) and near the areas with the lowest elevation in a basin. Deeper groundwater may occur at great depths in bedrock aquifers. Recharge of these aquifer systems occurs mainly through precipitation, especially in mountainous areas where snow precipitation is significant and evaporation is relatively low. Groundwater discharges to local streams and rivers and to springs in valleys of low-lying areas and in alluvial fans. Recharge of aquifers can be of critical importance to the appropriate management of groundwater resources. Overdraft conditions occur when more water is discharged from an aquifer than is recharged to the aquifer. Overdraft conditions can lead to permanent damage to the storage capacity of an aquifer. Subsidence and surface fissures may occur due to severe overdraft. Determining the water budget of a specific local basin is an important tool for proper management of groundwater use.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.9.3 Water Rights, Supply, and Use

The arid climate and scarcity of water resources of the Southwest make water rights and management of extreme importance in achieving beneficial uses of water resources while maintaining healthy aquatic ecosystems. Water rights and management activity vary by state, and, in addition, surface water and groundwater can be managed either together or separately. Beneficial uses of water resources vary by state but typically include irrigation, domestic, recreational, and industrial uses. Balancing beneficial uses with scarce water resources, in combination with complex water rights and management practices, can make obtaining water supplies for solar energy development difficult. A significant component to any solar energy development plan will be an analysis to determine the ability to meet the necessary water requirements. Regulation of water resources can be imposed by state and local agencies, legislation, Native American water rights, court decisions, and international compacts. The myriad of applicable laws and agencies regulating water resources in any one location is complex and often needs to be assessed on a case-by-case basis. There are varying water management doctrines and approaches among the states, and sometimes surface water resources are managed differently than groundwater resources. The variation in management among the states stems from the quantities and types of available resources, the climate and terrain of a state, and historical development. Water management strategies must accommodate many water needs and uses (human and ecological) while maintaining the sustainability of those resources.

- Section 4.9.3.1 is being updated with the following information about the San Pedro River and the Upper San Pedro Groundwater basin.

The San Pedro River has been the focus of federal and state legislation to protect this perennial and intermittent stream and the riparian ecosystem that it supports. In 1998, 57,000 acres (231 km^2) of BLM lands were designated as the San Pedro Riparian National Conservation Area along 40 mi (64 km) of the San Pedro River (BLM 2012). This area provides habitat for more than 230 birds, mammals, reptiles, amphibians, and fish species, in addition to containing many archeological sites. The San Pedro River is supported by base flow from the Upper San Pedro Groundwater Basin, and in 2005, groundwater overdraft in the basin led to significant changes in flow, prompting concerns from stakeholders in the region (Upper San Pedro Water District 2010). In 2007, the Arizona legislature passed a law to create the Upper San Pedro Water District; the entity was created *"to maintain the aquifer and base flow conditions needed to sustain the Upper San Pedro River and to assist in meeting the water supply needs and water conservation requirements for Fort Huachuca and the communities within the District"* (Upper San Pedro Water District 2010).

- Section 4.9.3.2 is being updated with the following information about the California Desert Protection Act.

The California Desert Protection Act of 1994 (P.L. 103-433) designated 69 parcels of BLM land (and additional NPS lands) in southern California as "wilderness areas" to be managed in accordance with the Wilderness Act. Federal water rights for each parcel in an unspecified quantity to support the uses designated in the Act, which include maintenance and restoration of fish and wildlife populations, were a part of the designations.

- In Section 4.9.3.6, information presented about groundwater resources in Utah is updated with the following paragraphs, based on comments received and updated information.

The Utah Division of Water Rights (Utah DWR) has divided the state into 55 groundwater policy areas (Utah DWR 2012). Of these, 21 groundwater policy areas in Utah (or portions thereof), are closed to new appropriations of water rights; 4 groundwater policy areas (or portions thereof) are "restricted," implying that the assessment of proposed water rights by the Utah Division of Water Rights is conditional on a number of factors (Utah DWR 2012; Utah DWR 2001); and 30 groundwater policy areas (or portions thereof) are open to new water right appropriation applications, which are assessed on a regional basis (Utah DWR 2012; Utah DWR 2001).

There are 37 areas recognized to have significant groundwater development in Utah, and reports describing current conditions are published annually by a cooperative group including the USGS, Utah Division of Water Rights, and Utah Division of Water Quality (Burden et al. 2011). A third of these basins have experienced water level drops of up to 110 ft (33.5 m) since 1950. Twelve of the basins have implemented groundwater management plans, and two basins are working to complete basinwide groundwater management plans that outline conservation guidelines and goals for the future. Some of the plans include strict guidelines involving water right transfers (Utah DWR 2005).

4.10 ECOLOGICAL RESOURCES

4.10.1 Vegetation

Because of the great variety and complexity of the plant communities occurring within the six states, the area is best represented by description at the ecoregion level. The 22 Level III ecoregions covering the six-state area include a wide variety of upland plant community types, such as coniferous forest, coniferous and deciduous woodland, shrub communities, shrub steppe, and grassland. Numerous basins occur in the study area and often support shrublands, such as Great Basin sagebrush, saltbush-greasewood, creosotebush, or palo verde-cactus shrublands. Basins in the region are typically arid and include the Chihuahuan, Mojave, and Sonoran Deserts. Habitats on plateaus may include woodland, shrubland, or grassland. Shrublands and pinyon-juniper woodlands are common in the Colorado Plateaus ecoregion. The basins and plateaus of the study area include the predominance of those areas where solar energy development is most likely to occur.

Wetlands occurring within these ecoregions are extremely varied. While surface flows provide the water source for some wetlands, other wetlands are supported by groundwater discharge. Wetlands are often associated with perennial water sources, such as springs, perennial segments of streams, or lakes and ponds. However, some wetlands have seasonal or intermittent sources of water. Riparian vegetation communities occur along rivers, perennial and intermittent streams, lakes, and reservoirs, and at springs. These communities generally form a vegetation zone along the margin that is distinct from the adjacent upland area. Riparian communities are dependent on streamflows or reservoir levels and are strongly influenced by the hydrologic regime.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.10.2 Wildlife

Section 4.10.2 of the Draft Solar PEIS discussed the wildlife management objectives of the BLM and other agencies in the six-state study area. The section also described the wildlife species (amphibians, reptiles, birds, and mammals) that may occur on BLM lands where solar energy development could occur (special status wildlife species were discussed in Section 4.10.4 of the Draft Solar PEIS). The section included information on the number of wildlife species reported for each of the states and on the species hunted or trapped within the six-state study area. The regulatory framework to protect migratory birds, bald and golden eagles, and greater sage-grouse was also described. General life history information and state conservation status ranks were provided for the big game species. The information provided in Section 4.10.2 of the Draft Solar PEIS remains valid.

4.10.3 Aquatic Biota

Section 4.10.3 of the Draft Solar PEIS provided a general description of freshwater aquatic organisms and habitats grouped according to the major USGS water resource regions that coincide with the six-state study area. The information provided in the Draft Solar PEIS is still correct, but the following updates are provided based on comments received. Within the six-state study area, the BLM administers lands containing a variety of freshwater aquatic habitats; these, in turn, support a wide diversity of aquatic biota. The area considered contains a variety of freshwater aquatic habitats that in turn support a wide diversity of aquatic biota. Aquatic habitats on these lands range from isolated desert springs in the southwestern portion, which support unique and endemic fish species such as pupfish (family Cyprinodontidae); cold- and coolwater portions of the Colorado, Green, and Snake Rivers that support trout fisheries; and coastal rivers of northern California that support anadromous salmon. In addition to fish, aquatic habitats also support a large variety of aquatic invertebrates, including mollusks, crustaceans, and insects. The information provided in the Draft Solar PEIS is still correct, but the following updates are provided based on comments received.

4.10.3.1 Pacific Northwest Hydrologic Region

The description of aquatic communities provided in the Draft Solar PEIS remains valid, and no updates were needed. Fish and invertebrates of the Pacific Northwest hydrologic region were described in the Draft Solar PEIS. Only a small portion (in northern Nevada and northern Utah) of the Pacific Northwest hydrologic region falls within the six-state study area.

4.10.3.2 Lower Colorado, Rio Grande, and Great Basin Hydrologic Regions

Fish and invertebrates of the Lower Colorado, Rio Grande, and Great Basin Hydrologic Regions were described in the Draft Solar PEIS. The description of aquatic communities provided in the Draft Solar PEIS remains valid, but an expanded description of invertebrate communities in desert surface waters is provided below based on comments received on the Draft Solar PEIS.

Surface water features in arid ecosystems can contain a seasonally variable community of aquatic invertebrates (Levick et al. 2008). In intermittent streams, invertebrate communities are profoundly structured by habitat variables, such as short and long-term trends in seasonal flooding, drought duration, proximity to perennial water, and instream drought refugia (Stanley et al. 1994; Sponseller et al. 2010; Lake 2003). Invertebrates have several adaptations to dry conditions. Some invertebrates employ physiological mechanisms such as desiccation tolerance (e.g., Chironomidae and Oligochaetes) and aestivation during dry periods. Other invertebrates survive seasonal drying by using a variety of behavioral mechanisms. For example, invertebrates in intermittent streams can burrow into the hyporheic zone or drift to perennial reaches as the stream dries (Levick et al. 2008; Lytle et al. 2008). Invertebrate communities in ephemeral surface waters are studied far less, and there is little information on these communities available for the six-state area. Invertebrates that live in fishless ephemeral streams or pools are typically either aquatic opportunists (i.e., species that occupy both temporary and permanent waters) or specialists adapted to living in temporary aquatic environments (Graham 2001). Ostracods (seed shrimp) and small planktonic crustaceans (e.g., copepods or cladocerans), and branchiopod crustaceans such as fairy shrimp could occur, as could aquatic insects like beetles, water boatman (Heteroptera), larval flies (Diptera), and dragonflies (Odonata) (Graham 2001; URS Corporation 2006). Although most ephemeral aquatic habitats are populated with widespread species, some contain species endemic to particular geographic regions or even specific habitats (Graham 2001).

4.10.3.3 California Hydrologic Region

Fish and invertebrates of the California hydrologic region were described in the Draft Solar PEIS. The description of aquatic communities provided in the Draft Solar PEIS remains valid, and no updates were needed.

4.10.3.4 Upper Colorado River Hydrologic Region

Fish and invertebrates of the Upper Colorado River Hydrologic Region were described in the Draft Solar PEIS. The description of aquatic communities provided in the Draft Solar PEIS remains valid, and no updates were needed.

4.10.3.5 Missouri River Basin Hydrologic Region

Fish and invertebrates of the Missouri River Basin Hydrologic Region were described in the Draft Solar PEIS. The description of aquatic communities provided in the Draft Solar PEIS remains valid, and no updates were needed.

4.10.4 Special Status Species

In the Draft Solar PEIS, Section 4.10.4 defined the category listings for species listed under the ESA. It identified species that could occur in the six-state study area that are listed, proposed for listing, or candidates for listing under the ESA. The section also discussed the implementation of BLM Manual 6840, *Special Status Species Management* (BLM 2008) with regard to the protection of special status species under the proposed solar energy program. Comments received on this section pertained to updating or revising the status information for listed species. New or updated information regarding the number, status, and distribution of special status species is provided in Appendix J of this Final Solar PEIS.

4.11 AIR QUALITY AND CLIMATE

The information presented in Section 4.11 of the Draft Solar PEIS remains valid, with the following updates.

4.11.1 Update to Section 4.11.2.2 of the Draft Solar PEIS: National Ambient Air Quality Standards

- Table 4.11-4 has been updated to reflect changes in the NAAQS and SAAQS.

- Figure 4.11-4 has been updated to reflect changes in nonattainment areas. The map showing CO nonattainment areas has been replaced with a map of Pb nonattainment areas, because the single CO nonattainment area was declared a maintenance area. Currently, there are no NO_2 or CO nonattainment areas in the United States. Eight-hour O_3 accounts for more nonattainment areas than any other criteria pollutant. Many counties in California have nonattainment areas for PM_{10} and $PM_{2.5}$. Nonattainment areas for SO_2 are limited to three counties and nonattainment areas for Pb are limited to one in the six-state study area.

4.11.2 Update to Section 4.11.2.3 of the Draft Solar PEIS: Prevention of Significant Deterioration

- Table 4.11-5 of the Draft Solar PEIS and the associated text have been updated to reflect the recently promulgated $PM_{2.5}$ PSD increment.

While the NAAQS (and SAAQS) place upper limits on the levels of air pollution, PSD regulations applying to attainment areas place limits on the total increase in ambient pollution levels above established baseline levels for SO_2, NO_2, PM_{10}, and $PM_{2,}$ thus preventing "polluting up to the standard" (see Table 4.11-5). These allowable increases are smallest in Class I areas, such as national parks and wilderness areas. The rest of the country is subject to larger Class II increments. States can choose a less stringent set of Class III increments, but they have not done so. Major (large) new and modified stationary sources must meet the requirements for the area in which they are locating and any areas they impact. Thus, a source locating in a Class II area near a Class I area would need to meet the more stringent Class I increment in the Class I area and the Class II increment elsewhere, as well as any other applicable requirements.

- A correction is being made to the discussion of AQRVs, as follows: In cases where the PSD increments are met, if the Federal Land Manager determines that there is an adverse impact on an AQRV and if the permitting authority agrees, the permit may not be issued. Figure 4.11-5 of the Draft Solar PEIS shows the locations of Class I PSD areas over the six-state study area. All BLM-administered lands are currently designated as Class II areas, with few exceptions.

TABLE 4.11-4 National Ambient Air Quality Standards (NAAQS) and State Ambient Air Quality Standards (SAAQS) for Criteria Pollutants in the Six-State Study Area as Updated[a]

		NAAQS							
Pollutant[b]	Averaging Time	Value	Type[c]	Arizona[d]	California[e]	Colorado	Nevada[f]	New Mexico[g]	Utah[d]
SO_2	1-hour	75 ppb	P	*	0.25 ppm (655 μg/m^3)	–[h]	–	–	*
	3-hour	0.5 ppm	S	*	–	700 μg/m^3 (0.267 ppm)	0.5 ppm (1,300 μg/m^3)	–	*
	24-hour	–	–	*	0.04 ppm (105 μg/m^3)	–	0.14 ppm (365 μg/m^3)	0.10 ppm	*
	Annual	–	–	*	–	–	0.030 ppm (80 μg/m^3)	0.02 ppm	*
NO_2	1-hour	100 ppb	P	*	0.18 ppm (339 μg/m^3)	–	–	–	*
	24-hour	–	–	*	–	–	–	0.10 ppm	*
	Annual	0.053 ppm	P, S	*	0.030 ppm (57 μg/m^3)	–	0.053 ppm (100 μg/m^3)	0.05 ppm	*
CO	1-hour	35 ppm	P	*	20 ppm (23 mg/m^3)	–	35 ppm (40,500 μg/m^3)	13.1 ppm	*
	8-hour	9 ppm	P	*	9.0 ppm (10 mg/m^3) 6 ppm (7 mg/m^3)[i]	–	9 ppm (10,500 μg/m^3)[j] 6 ppm (7,000 μg/m^3)[k]	8.7 ppm	*
O_3	1-hour	–	–	*	0.09 ppm (180 μg/m^3)	–	0.12 ppm (235 μg/m^3) 0.10 ppm (195 μg/m^3)[l]	–	*
	8-hour	0.075 ppm	P, S	*	0.070 ppm (137 μg/m^3)	–	–	–	*
PM_{10}	24-hour	150 μg/m^3	P, S	*	50 μg/m^3	–	150 μg/m^3	–	*
	Annual	–	–	*	20 μg/m^3	–	50 μg/m^3	–	*
$PM_{2.5}$	24-hour	35 μg/m^3	P, S	*	–	–	–	–	*
	Annual	15 μg/m^3	P, S	*	12 μg/m^3	–	–	–	*

TABLE 4.11-4 (Cont.)

Pollutant[b]	Averaging Time	NAAQS Value	NAAQS Type[c]	Arizona[d]	California[e]	Colorado	Nevada[f]	New Mexico[g]	Utah[d]
Pb	30-day	–	–	*	1.5 μg/m^3	–	–	–	*
	calendar quarter	–	–	*	–	–	1.5 μg/m^3	–	*
	rolling 3-month	0.15 μg/m^3	P, S	*	–	–	–	–	*

[a] Detailed information on attainment determination criteria for NAAQS and on the reference method for monitoring is available in Title 40, Part 50 of the *Code of Federal Regulations.* Attainment determination criteria for each state are similar to those for the NAAQS.

[b] CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter with a diameter of ≤2.5 μm; PM_{10} = particulate matter with a diameter of ≤10 μm; SO_2 = sulfur dioxide.

[c] P = Primary standard whose limits were set to protect public health; S = Secondary standard whose limits were set to protect public welfare.

[d] An asterisk indicates same as the NAAQS.

[e] The State of California has standards for additional pollutants, such as visibility-reducing particles, sulfates, hydrogen sulfide, and vinyl chloride, which are not presented in this table; also refer to CARB (2012) for additional pollutants for California.

[f] The State of Nevada has standards for hydrogen sulfide, which are not presented in this table; also refer to NDEP (2010) for hydrogen sulfide for Nevada.

[g] The State of New Mexico has standards for additional pollutants, such as hydrogen sulfide, total reduced sulfur, and total suspended particulates, which are not presented in this table; also refer to NMED (2009) for additional pollutants for New Mexico.

[h] A dash indicates that no standard exists.

[i] Lake Tahoe.

[j] Below 5,000 ft (1,500 m) above mean sea level.

[k] Above 5,000 ft (1,500 m) above mean sea level.

[l] Lake Tahoe Basin.

Sources: ADEQ (2012); CARB (2012); CDPHE (2010); EPA (2011); NDEP (2010); NMED (2009); UDEQ (2012).

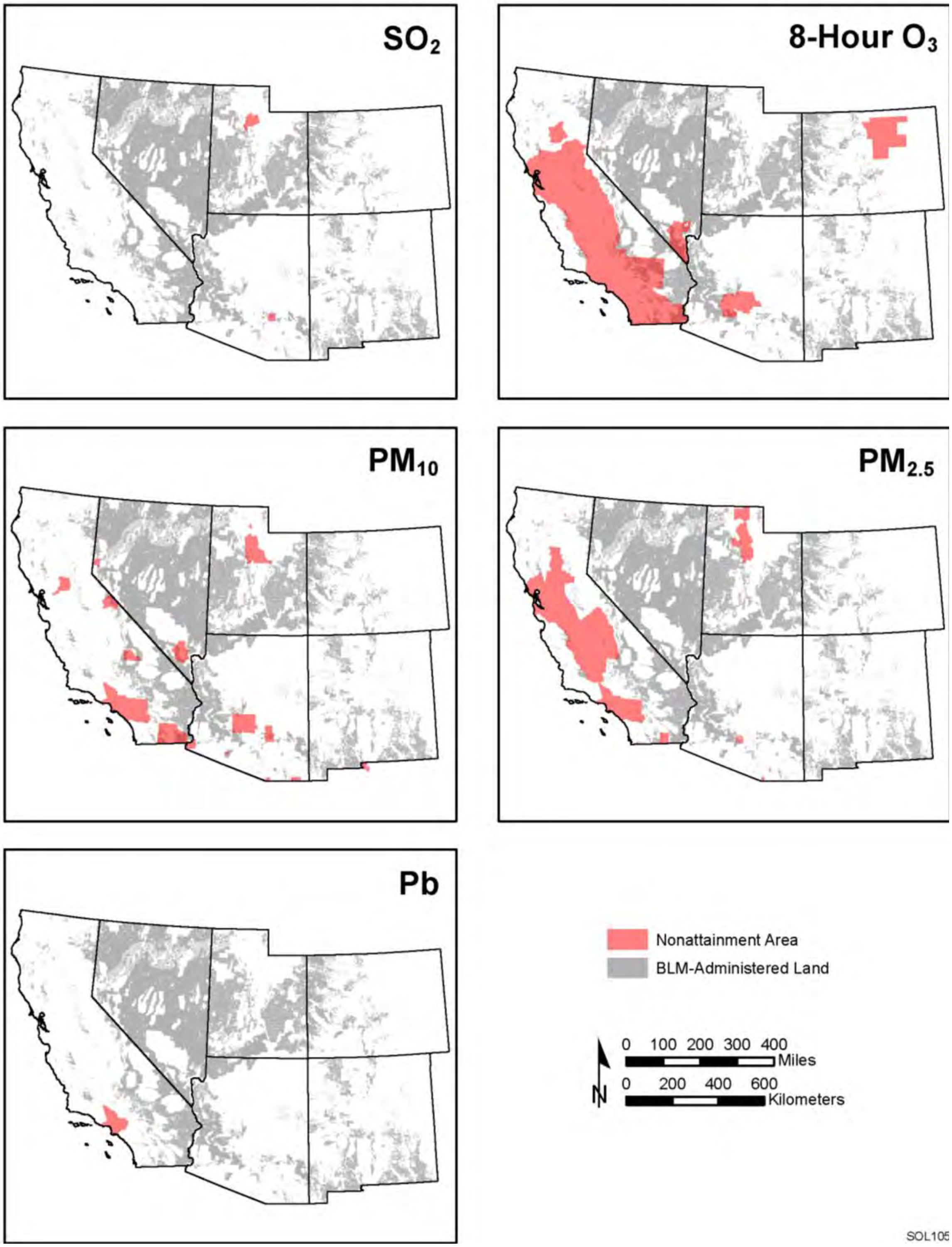


FIGURE 4.11-4 Nonattainment Areas for SO_2, 8-Hour O_3, PM_{10}, $PM_{2.5}$, and Pb in the Six-State Study Area (Note that currently there are no nonattainment areas for NO_2 and CO in the United States.) (Source: EPA 2012)

TABLE 4.11-5 Maximum Allowable PSD Increments as Updated for PSD Class I and Class II Areas

Pollutant	Averaging Time	PSD Increment ($\mu g/m^3$) Class I	Class II
SO_2	3-hour	25	512
	24-hour	5	91
	Annual	2	20
NO_2	Annual	2.5	25
PM_{10}	24-hour	8	30
	Annual	4	17
$PM_{2.5}$	24-hour	2	9
	Annual	1	4

Sources: *Code of Federal Regulations*, Title 40, Subpart 52.21; *Federal Register*, Volume 75, page 64864.

4.11.3 Update to Section 4.11.2.4 of the Draft Solar PEIS: Visibility Protection

- A discussion of existing visibility conditions resulting from fine soil and coarse mass has been added, as follows.

Visibility degradation is caused by cumulative emissions of air pollutants from a myriad of sources scattered over a wide geographical area. In general, the primary cause of visibility degradation is the scattering and absorption of light by fine particles, with a secondary contribution provided by gases. In general, visibility conditions in the western United States are substantially better than those in the eastern United States because of the higher pollutant loads and humidity levels in the East. The typical visual range (defined as the farthest distance at which a large black object can be seen and recognized against the background sky) in most of the West is about 60 to 90 mi (97 to 145 km), while that in most of the eastern United States is about 15 to 30 mi (24 to 48 km) (EPA 2006). Visibility degradation is associated with combustion-related sources and fugitive sources. $PM_{2.5}$ includes ammonium sulfate, ammonium nitrate, particulate organic matter, light-absorbing carbon (or soot), mineral fine soil, and sea salt. Interagency Monitoring of Protected Visual Environments (IMPROVE) also uses a coarse mass (CM) defined as PM_{10}–$PM_{2.5}$.

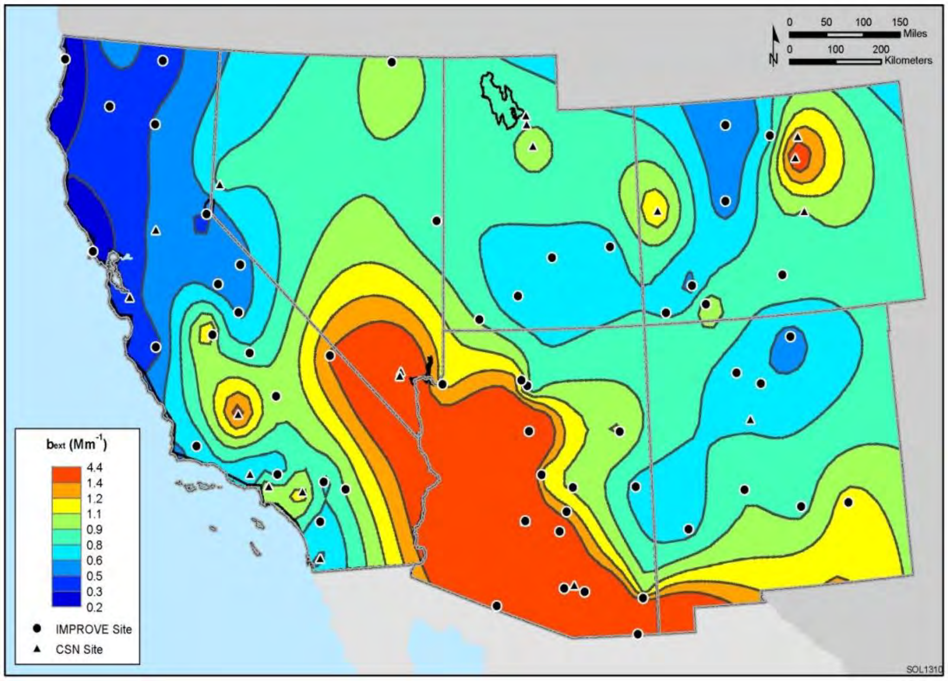
Dust sources vary greatly spatially and temporally but play a more important role in visibility degradation in the arid parts of the western United States than in the eastern United States due to the desert environment. Windblown dust, both local and regional, has been found to be a significant contributor to visibility impairment in the six-state study area. An attribution study found that on the majority of these "worst dust days," the dust event could largely be attributed to both local and regionally transported dust sources with some level of confidence (dust from Asian dust events made up a much smaller contribution) (Kavouras et al. 2009). Over the life of a solar facility, combustion-related emissions from the engine exhaust from heavy equipment and vehicles would be sizable during the construction phase and minimal during the operation phase. Fugitive dust from wind erosion and anthropogenic activities, including agriculture, construction, grazing, mining, and vehicle traffic on paved and unpaved roads would be a major concern in the arid desert environment where major solar development would occur.

Figure 4.11-6 based on aerosol measurements taken at IMPROVE and Chemical Speciation Network (CSN) sites shows the impact of fugitive dust on visibility. The IMPROVE sites, governed by a steering committee composed of representatives from federal and regional and state organizations, are mostly located in remote/rural settings, while CSN sites, operated by the EPA, are located in urban/suburban settings.

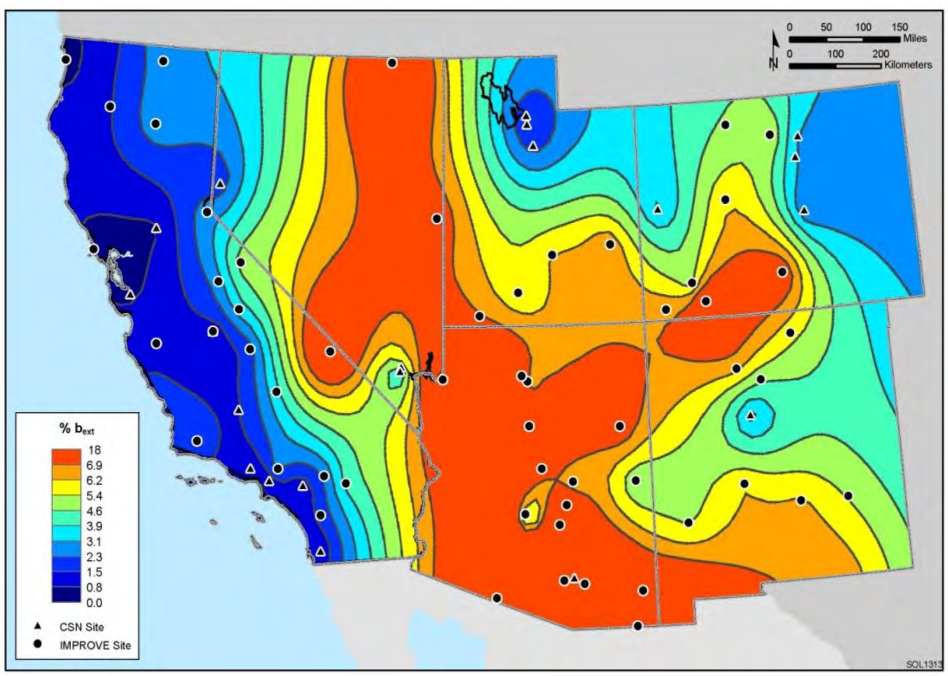
Figure 4.11-6(a) presents annual mean fine soil (FS) extinction coefficient (b_{ext})[1] spatial patterns for 2005–2008. These patterns are the same as the mass concentration patterns (not shown here) (Hand et al. 2011). In general, the southwestern states (in particular, Arizona, southeastern California, and southern Nevada) have higher FS b_{ext}, but their values are relatively low. The highest b_{ext} of 4.41 Mm^{-1} (corresponding to an annual average concentration of 4.41 $\mu g/m^3$) occurred in Douglas, Arizona, which is adjacent to the U.S.–Mexican border and has a semi-arid climate with a history of mining. The largest percent contributions to $PM_{2.5}$ aerosol b_{ext} from FS occurred in about half of the six-state study area, as shown in Figure 4.11-6(b). Percent contributions of FS were highest at 18.4% in Douglas, Arizona, but FS was not a major contributor to $PM_{2.5}$ aerosol b_{ext} at urban CSN sites (less than 10%).

As shown in Figure 4.11-7(a), the highest b_{ext} of 12.67 Mm^{-1} (corresponding to an annual average concentration of 21.12 $\mu g/m^3$) from CM occurred at Douglas, Arizona, which was most likely associated with mineral dust (Hand et al. 2011). CM b_{ext} values higher than 10 Mm^{-1} occurred in southern Arizona and Fresno, California. As shown in Figure 4.11-7(b), the annual mean fractional contributions of b_{ext} of CM to total aerosol b_{ext} was higher (20% or higher) in about two-thirds of Arizona and south-central New Mexico, with a peak of about 34.5% in Douglas, Arizona. The contributions of CM to total aerosol b_{ext} were typically more than 10% in most of six-state study area. (CM is not measured by the CSN network.)

[1] The extinction coefficient (b_{ext}) represents the ability of the atmosphere to scatter and absorb light primarily by particles and, to some extent, by gases, and has unit of inverse length (inverse megameters, Mm^{-1}). The b_{ext} is related to visual range and deciview (a haziness index designed to be linear with respect to human perception of visibility, analogous to the decibel scale in acoustics). A higher b_{ext} corresponds to a lower visual range and higher deciview values.

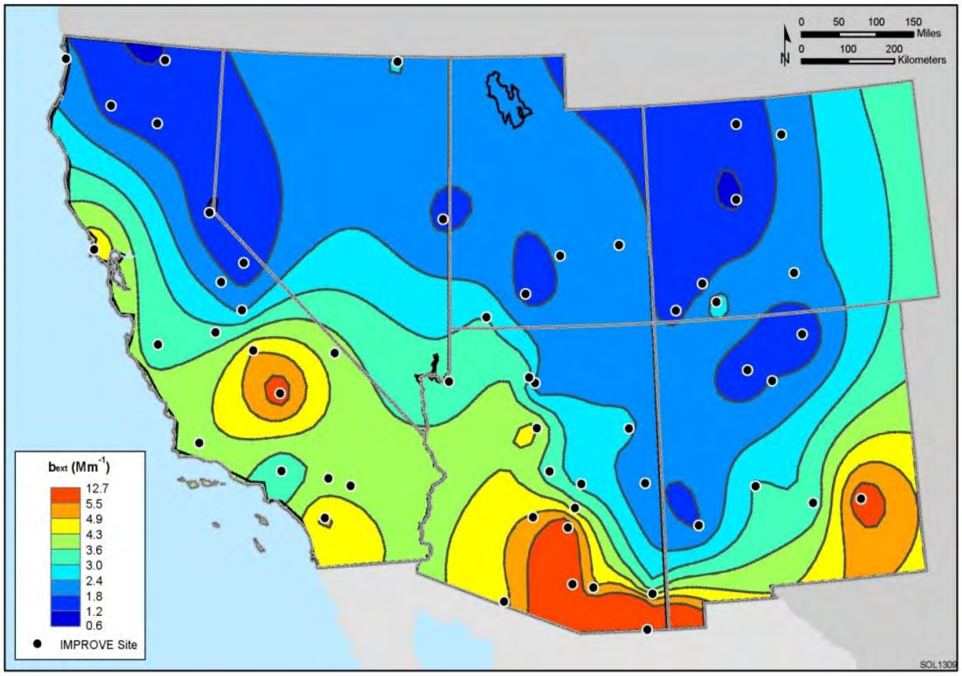


(a)

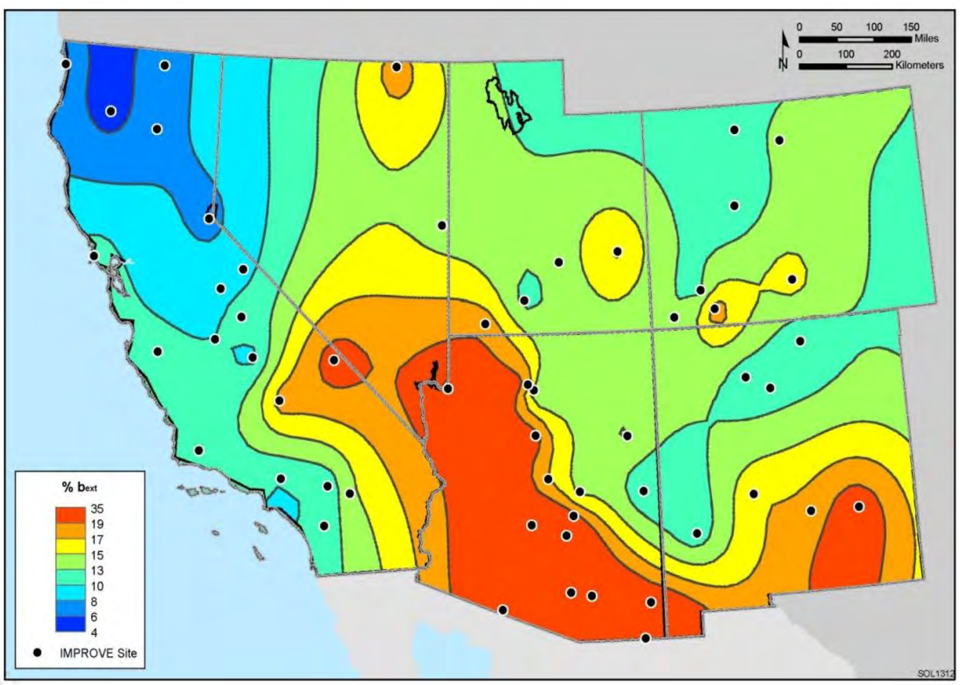


(b)

FIGURE 4.11-6 (a) $PM_{2.5}$ Reconstructed Ambient Annual Mean Light Extinction Coefficient for Soil (b_{ext_soil}, Mm^{-1}) and (b) Annual Mean Percent (%) Contribution of Ambient Soil Light Extinction Coefficient (b_{ext}) to $PM_{2.5}$ Reconstructed Aerosol b_{ext} for 2005–2008 for Rural IMPROVE and Urban CSN Sites in the Six-State Study Area (Wavelength corresponds to 550 nm.) (Source: Adapted from Hand et al. 2011)



(a)



(b)

FIGURE 4.11-7 (a) Annual Mean Light Extinction Coefficient for Coarse Mass (b_{ext_CM}, Mm^{-1}) and (b) Annual Mean Percent (%) Contribution of Coarse Mass Light Extinction Coefficient to Total Reconstructed Aerosol b_{ext} for 2005–2008 for Rural IMPROVE Sites in the Six-State Study Area (Wavelength corresponds to 550 nm.) (Source: Adapted from Hand et al. 2011)

4.11.4 Update to Section 4.11.2.5 of the Draft Solar PEIS: General Conformity

- As requested by comments, the discussion of General Conformity in Section 4.11.2.5 of the Draft Solar PEIS has been updated and the new regulations have been referenced.

Federal departments and agencies are prohibited from taking actions in nonattainment and maintenance areas unless they first demonstrate that the actions would conform to the SIP as it applies to criteria pollutants. Transportation-related projects are subject to requirements for transportation conformity. General conformity requirements apply to stationary sources. Conformity addresses only those criteria pollutants for which the area is in nonattainment or maintenance (e.g., VOCs and NO_x for O_3). If annual source emissions are below specified threshold levels, no conformity determination is required. If the emissions exceed the threshold, a conformity determination must be undertaken to demonstrate how the action will conform to the SIP. Nonattainment and maintenance designations change over time, and, when a specific project is proposed, BLM must conduct a conformity analysis of the proposed action as specified in the General Conformity regulations found in Volume 75, page 17254 of the *Federal Register,* April 5, 2010.

4.11.5 Addition of New Section 4.11.4: Toxic Dust and Snowmelt

A discussion of toxic dust and snowmelt is being added in response to comments; this information did not appear in the Draft Solar PEIS.

> Dust particles can travel great distances from their sources, even going across oceans and continents (Husar et al. 2001; Joy 2005; McCarthy 2004; McClure 2009). Larger particles quickly fall near their sources, but most smaller particles remain airborne for long periods of time before being removed by dry or wet deposition. These dusts could transport fungi, disease-causing organisms, metals, chemicals, and pesticides, which could sometimes have adverse impacts on human health and welfare, the economy, and/or distant ecosystems. Well-known global dust source areas include the arid deserts and loess areas of Mongolia and northern and western China and the Sahara Desert and Sahel regions in Africa. In recent decades, increases in dust in these areas have been observed, primarily related to climate change, regional meteorology, and, above all, land use changes caused by population growth (e.g., deforestation, overgrazing, and disturbances on fragile desert soils by vehicles). In spring, the Asian dust originating from China or Mongolia can be transported by the prevailing westerlies to East Asia and the Pacific Ocean and can be observed as a spike in many monitoring stations in the United States. In addition, the Saharan dust can be transported not only to the Caribbean and the U.S. Continent by trade winds blowing from east to west but also north to Europe and Asia. In North America, the southwestern deserts such as the Great Basin, Colorado Plateau, Mojave, and Sonoran Deserts are the sources of the majority of mineral aerosol emissions (Neff et al. 2008). Human activities in these regions have significantly increased the amount of wind erosion

and, hence, dust production and deposition, with broad implications with regard to biogeochemical cycling and impacts on arctic and mountain snowpack depths and melt rates.

As the effects of global climate change continue to affect the six-state region, it is very likely that, associated with northward migration of storm tracks (USGCRP 2009), desertification will intensify; thus, it will be more likely that more dust will be produced as vegetative cover decreases and as soils dry (Morman 2010). USGS scientists have been studying the sources and compositions of dust across the southwest deserts, from both natural and anthropogenic sources, including the dust in terminal lake valleys in southern California and Nevada in which solar developments are being contemplated in this PEIS (Reheis et al. 2009). The studies are finding that dust from terminal lake basins could be transported hundreds of miles and could be a global source of metal-bearing and potentially toxic dust. Not only are the dusts readily available, but they are also easily respired and highly bioaccessible (Morman 2010; Reheis et al. 2003). While there is some variability among dust sources, all include a mixture of arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which are potentially toxic to humans (Morman 2010; Reheis et al. 2003, 2009).

It is widely understood that impurities in snow, such as dust or soot, decrease snow albedo and enhance solar radiation absorption and melt rates. Dust may shorten snow cover duration by as much as a month (Painter et al. 2007). Earlier spring snowmelt has broad implications with regard to water resources in southwestern states that are already strapped for water, especially during the summer when peak demand is higher, and it leads to an increased number of forest fires (USGCRP 2009). The problem of disturbed desert dust causing regional climate change and early snowmelt is discussed in numerous recent scientific articles. Neff et al. (2008) documented how the phenomenon of dust causing snowmelt was largely coincidental with increased settlement of the American West. The deposition of this disturbed desert dust on snow leads to early snow melt (Painter et al. 2007). In the Colorado River Basin, these effects are significant. Painter et al. (2010) estimated that the landing of disturbed desert soils traceable to settlement of the American West on mountain snowpack in the Upper Colorado River Basin has resulted in a net loss of approximately 5% of the annual flow of the Colorado River as measured at Lees Ferry, Arizona. It is likely that most of this dust on mountain snowpack is coming from nearby lands where soil-disturbing activity has made the land susceptible to wind erosion. Activities such as energy development, off-road vehicle use, and grazing serve to destabilize soils, making them more susceptible to wind erosion (Belnap et al. 2009).

4.12 VISUAL RESOURCES

Section 4.12 of the Draft Solar PEIS described BLM’s responsibilities for managing scenic resources on public lands, briefly described BLM’s VRM program, and provided a more detailed description of BLM's visual resource inventory process. The section included a discussion of the wide range of landscape types found in the six-state PEIS study area, and it also discussed the use of ecoregions as a basis for describing landscape characteristics at a level of detail suitable for a programmatic assessment.

Information provided in Section 4.12 of the Draft Solar PEIS remains valid with the following update:

- Table 4.12.1 has been updated, as shown.

TABLE 4.12-1 Summary of Selected Potentially Sensitive Visual Resource Areas within the Six-State Study Area[a]

Potentially Sensitive Visual Resource Areas	Arizona	California	Colorado	Nevada	New Mexico	Utah
National Parks[b]	3	8	4	2	2	5
National Monuments[c]	19	10	6	0	11	7
Wilderness Areas	87	130	38	70	25	32
Wilderness Study Areas	8	80	48	57	67	99
National Recreation Areas[d]	2	5	2	2	1	2
National Conservation Areas[e]	3	3	2	3	1	1
Other National Park Service areas[f]	4	9	3	1	2	1
National Natural Landmarks	9	32	11	6	12	4
National Historic Landmarks	9	63	4	2	11	4
National Scenic Trails	0	1	1	0	1	0
National Historic Trails	2	4	3	3	2	4
National Scenic Highways[g]	5	7	10	3	8	7
National Scenic Areas	0	1	0	0	0	0
National Scenic Research Areas	0	0	0	0	0	1
National Wild and Scenic Rivers[h]	1	14	2	0	4	0
National Wildlife Refuges	9	35	7	8	7	4
State totals	161	402	141	157	154	171

[a] Includes features wholly or partly within state boundaries.

[b] Does not include national historical parks.

[c] Includes national monuments managed by the NPS, USFS, BLM, and USFWS.

[d] Includes National Recreation Areas managed by the NPS and USFS.

[e] Includes Headwaters Forest Reserve.

[f] Includes National Historical Parks, National Preserves, National Reserves, National Seashores, National Historic Sites, National Battlefields, National Memorials, National Memorial Parkways, and the San Francisco Presidio.

[g] Includes All-American Roads and National Scenic Byways.

[h] The congressionally authorized wild and scenic study rivers are not included. See Section 4.9.1.2 for details on this classification.

4.13 ACOUSTIC ENVIRONMENT

The information provided in Section 4.13 of the Draft Solar PEIS remains valid, with the following update to Section 4.13.1 (Noise):

- Authorized military training flights (MTRs) pass directly over or proximal to the Amargosa Valley, Dry Lake, Dry Lake Valley North, Gold Point, and Millers SEZs. Noise and associated overpressures from these flights may affect the noise levels, solar technologies, and infrastructure in these SEZs. See Section 4.6 for additional information on these potential impacts.

4.14 PALEONTOLOGICAL RESOURCES

As discussed in Section 4.14 of the Draft Solar PEIS, paleontological resources are fossilized remains, imprints, and traces of plants and animals preserved in rocks and sediments. There is a potential for paleontological resources (either individual specimens or larger assemblages of multiple fossils) to be present in sedimentary formations within the areas potentially suitable for solar development. Various statutes, regulations, and policies govern the management of paleontological resources on public lands. In short, these policies protect paleontological resources for scientific, educational, and preservation purposes and provide civil and criminal penalties for theft and vandalism of these resources. The goal of the BLM program is to locate, evaluate, manage, and protect paleontological resources on public lands.

The Potential Fossil Yield Classification (PFYC) system is used to classify geologic units at the formation or member level according to their probability of yielding paleontological resources of concern to land managers. Under the PFYC system, geologic units are classified from Class 1 to Class 5 on the basis of the relative abundance of vertebrate fossils or uncommon invertebrate or plant fossils and their sensitivity to adverse impacts. A higher classification number indicates a higher fossil yield potential and greater sensitivity to adverse impacts. BLM paleontologists have completed PFYC mapping in Colorado, Utah, and New Mexico and will continue to refine those maps as more information is collected. There are no completed PFYC maps of Arizona, California, and Nevada at this time. Site-specific information regarding paleontological resources would need to be collected to define the affected environment for an individual project.

The data provided in Section 4.14 remain valid, except for Table 4.14-1, which has been updated as a result of the revisions to lands available for application through the variance process, and based on updates to the Taos Field Office RMP (changes are in bold).

4.15 CULTURAL RESOURCES

As discussed in Section 4.15 of the Draft Solar PEIS, cultural resources include archaeological sites, historic structures and features, and traditional cultural properties that are addressed under the National Historic Preservation Act (NHPA), as amended (P.L. 89-665).

TABLE 4.14-1 ACECs Designated for Protection of Paleontological Resource Values That Are near BLM-Administered Lands Available for Application through the Variance Process

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Carrow Stephens Ranches	Arizona	Kingman	Historic sites and paleontological resources	Adjacent
Bear Springs Badlands	Arizona	Safford	Paleontological resources, scenic	Adjacent
111 Ranch RNA	Arizona	Safford	Paleontological	Adjacent
Manix	California	Barstow	Paleontological and cultural	Adjacent
Mountain Pass Dinosaur Trackway	California	Barstow	Historic and paleontological values	**>6 mi (10 km)**[a]
Rainbow Basin/Owl Canyon	California	Barstow	Outstanding scenery, unique geology and paleontology, prehistoric archaeology	**>6 mi (10 km)**
Marble Mountain Fossil Bed	California	Needles	Paleontological	**3.6 mi (5.7 km)**
Mountain Pass Dinosaur Trackway	California	Needles	Paleontological	Adjacent
Garden Park	Colorado	Royal Gorge	Paleontological, historical	**Adjacent**
Stewart Valley	Nevadab	Carson City	Paleontological	Adjacent
Arrow Canyon	Nevadab	Las Vegas	Paleontological, geological, cultural	Adjacent
Alamo Hueco Mountains	New Mexico	Las Cruces	Biological, scenic, cultural, paleontological, special status species	0.2 mi (0.3 km)
Robledo Mountains	New Mexico	Las Cruces	Paleontological, cultural, and scenic values, endangered plant species	Adjacent
Ball Ranch	New Mexico	Rio Puerco	Special status plant habitat, paleontological	Adjacent
Ojito	New Mexico	Rio Puerco	Geological, paleontological, cultural, wildlife, rare plant habitat, geologic hazard	Adjacent
Pronoun Cave	New Mexico	Rio Puerco	Paleontological, cultural	Adjacent
Torreon Fossil Fauna East	New Mexico	Rio Puerco	Paleontological, natural system	Adjacent
Torreon Fossil Fauna West	New Mexico	Rio Puerco	Paleontological, natural system	Adjacent
Sombrillo[b]	**New Mexico**	**Taos**	**Paleontological, cultural**	**Adjacent**
Fossil Mountain	Utah	Fillmore	Prehistoric life form	**0.4 mi (0.6 km)**

a No data available for Battle Mountain, Ely, or Winnemucca District Offices.

b Bold text represents updated information.

Cultural resources that meet the eligibility criteria for listing in the *National Register of Historic Places* (NRHP) are formally referred to as historic properties. The types of sites listed on or eligible for listing in the NRHP in the broad six-state study area for this PEIS include, but are not limited to, archaeological sites and features, historic buildings, bridges, trails, prehistoric dwellings, historic districts, water features (e.g., canals and ditches), traditional cultural properties, and cultural landscapes. Traditional cultural properties and other areas of concern to various cultural groups, including Native Americans, can include a wide range of tangible and intangible resources (e.g., archaeological sites, funerary objects, places of religious ceremony, medicinal plants, and sacred landscapes). Federal agencies must take into consideration the effects on historic properties of any undertakings under their direct or indirect jurisdiction before they approve expenditures or issue permits, ROWs, or other land use authorizations.

Various laws, statutes, and policies in addition to the NHPA concern cultural resources. These laws require federal agencies to consider resources important to Native Americans for religious purposes, protect cultural resources from looting and vandalism, and provide for the repatriation of Native American burials and items of cultural patrimony. These laws are applicable to any project undertaken on federal land or requiring federal permitting or funding.

Consultation with the appropriate State Historic Preservation Officer(s) and affected federally recognized Native American governments is required. A National Solar Programmatic Agreement is being finalized; it details the specifics of how the BLM will comply with the Section 106 process for the Solar Energy Development Program.

The data provided in Section 4.15 remain valid, with the following updates:

- The 1997 National PA has been updated and the text should now refer to the 2012 National PA.

- Table 4.15-3 has been updated as a result of the revisions to lands available for application through the variance process and based on updates to the Taos Field Office RMP (changes are in bold).

4.16 NATIVE AMERICAN CONCERNS

As discussed in Section 4.16 of the Draft Solar PEIS, the federal government is required to take into account, via government-to-government consultation, the interests of federally recognized Native American tribes when proposing actions that could affect those interests. Interests of Native Americans include not only those topics covered under cultural resources but also economic development, access to energy resources, health and safety, environmental justice, and protection of the environment. Appendix K contains a list of all federally recognized tribes in the six-state study area that were contacted and documentation of the various interactions with these tribes over the course of the development of this PEIS.

In general, resources located on federal lands that are important to tribes are to be managed by federal agencies in consultation with affected federally recognized tribes. These

TABLE 4.15-3 ACECs Designated for Protection of Cultural Resource Values That Are near BLM-Administered Lands Available for Application through the Variance Process

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Johnson Spring	Arizona	Arizona Strip	Cultural resources, Siler pincushion cactus, scenic	Adjacent
Kanab Creek	Arizona	Arizona Strip	Cultural resources, endangered bird species, riparian, scenic	Adjacent
Little Black Mountains	Arizona	Arizona Strip	Cultural resources	**1.8 mi**[a,b]
Lost Spring Mountain	Arizona	Arizona Strip	Cultural resources, Siler pincushion cactus	Adjacent
Marble Canyon	Arizona	Arizona Strip	Cultural resources, Brady pincushion cactus, raptors, scenic	**>6 mi**
Moonshine Ridge	Arizona	Arizona Strip	Cultural resources, Siler pincushion cactus, scenic	Adjacent
Virgin River Corridor	Arizona	Arizona Strip	Cultural resources, endangered fish, riparian, scenic	**Adjacent**
Black Butte	Arizona	Hassayampa	Cultural resources, raptor habitat, scenic	Adjacent
Harquahala	Arizona	Hassayampa	Cultural resources, biological resources	Adjacent
Tule Creek	Arizona	Hassayampa	Cultural resources, Sonoran Desert riparian environment	**>6 mi**
Beale Slough	Arizona	Lake Havasu	Cultural resources, riparian habitat	Adjacent
Bullhead Bajada	Arizona	Lake Havasu	Cultural resources, desert tortoise	Adjacent
Crossman Peak	Arizona	Lake Havasu	Cultural resources, traditional cultural properties, scenic, bighorn sheep	Adjacent
Swansea Historic District	Arizona	Lake Havasu	Cultural resources	Adjacent
Black Mountains Ecosystem Management	Arizona	Kingman	Bighorn sheep and wild burro habitat, federal candidate plant species habitat, outstanding scenic values, open space near major population centers, rare and outstanding cultural resources, high locatable mineral potential	Adjacent
Burro Creek	Arizona	Kingman	Outstanding riparian resources, rare and outstanding cultural resources, important threatened and endangered species	Adjacent
Carrow Stephens Ranches	Arizona	Kingman	Historic site and paleontological resources	Adjacent
Joshua Tree Forest-Grand Wash Cliffs	Arizona	Kingman	Unique vegetation, outstanding scenic values, rare cultural resources, peregrine falcon aerie	Adjacent
Wright-Cottonwood Creeks	Arizona	Kingman	Rare and outstanding cultural resources, outstanding potential riparian resources	Adjacent

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
San Pedro Riparian	Arizona	Phoenix/ Tucson	Riparian vegetation and wildlife, significant archaeological, historic, and paleontological resources	Adjacent
White Canyon	Arizona	Phoenix/ Tucson	Outstanding scenic, wildlife and cultural resources	**Adjacent**
Bowie Mountain Scenic	Arizona	Safford	Scenic backdrop to historic Fort Bowie	**Adjacent**
Dos Cabezas Peaks	Arizona	Safford	Historic landmark, scenic	**Adjacent**
Swamp Springs Hot Springs Watershed	Arizona	Safford	Riparian areas, threatened and endangered species, bighorn sheep, native fish, cultural resources	**3 mi**
Big Marias	Arizona/ California	Yuma	Cultural resources, riparian habitat	Adjacent
Dripping Springs	Arizona	Yuma	Perennial spring, desert bighorn sheep, cultural resources	**2.9 mi**
Sears Point (Gila River Cultural Area)	Arizona	Yuma	Cultural resources, historic and prehistoric trails, migratory birds, riparian habitat	Adjacent
Calico Early Man Site	California	Barstow	Prehistoric human occupation	**Adjacent**
Clark Mountain	California	Barstow	Prehistoric and historic values, outstanding scenery, wildlife habitat	Adjacent
Cronese Basin	California	Barstow	Cultural resources, wildlife habitat	Adjacent
Dead Mountains	California	Barstow	Native American values	Adjacent
Manix	California	Barstow	Paleontological values, cultural resources	Adjacent
Mesquite Lake	California	Barstow	Prehistoric values	Adjacent
Mountain Pass Dinosaur Trackway	California	Barstow	Historic and paleontological values	**>6 mi**
Rainbow Basin/Owl Canyon	California	Barstow	Outstanding scenery; unique geology and paleontology; prehistoric archaeology	6 mi
Rodman Mountains Cultural Area	California	Barstow	Cultural resources	**3.7 mi**
Salt Creek Hills	California	Barstow	Wildlife; prehistoric and historic values	Adjacent
Bodie Bowl	California	Bishop	Historic resources, wildlife, mining deposits, livestock grazing	**>6 mi**
Cerro Gordo	California	Bishop	Prehistoric and historic values, vegetation	**Adjacent**
Travertine Springs	California	Bishop	Recreation use, cultural and Native American values, wildlife habitat, geologic features	**>6 mi**
East Mesa	California	El Centro	Prehistoric values; wildlife habitat	Adjacent

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Gold Basin/Rand Intaglios	California	El Centro	Prehistoric values	Adjacent
Indian Pass	California	El Centro	Prehistoric values	Adjacent
Lake Cahuilla A	California	El Centro	Prehistoric values	Adjacent
Lake Cahuilla B	California	El Centro	Prehistoric values	**1.3 mi**
Lake Cahuilla C	California	El Centro	Prehistoric values	Adjacent
Lake Cahuilla D	California	El Centro	Prehistoric values	Adjacent
Pilot Knob	California	El Centro	Prehistoric and Native American values	**5.6 mi**
Plank Road	California	El Centro	Unique historic road	**Adjacent**
San Sebastian Marsh/San Fellipe Creek	California	El Centro	Prehistoric values, historic and Native American resources, riparian and wildlife values	**Adjacent**
West Mesa	California	El Centro	Wildlife and cultural values	**0.9 mi**
Mesquite Hills/Crucero	California	Needles	Prehistoric values	Adjacent
Mopah Spring	California	Needles	Outstanding scenery; cultural resources	**4.9 mi**
Patton's Iron Mountain Division Camp	California	Needles	Historic military camp	**0.9 mi**
Haloran Wash	California	Needles	Prehistoric values	**1.8 mi**
Whipple Mountains	California	Needles	Native American values	**0.8 mi**
Alligator Rock	California	Palm Springs/ South Coast	Archaeological resources	**Adjacent**
Corn Springs	California	Palm Springs/ South Coast	Outstanding scenery; prehistoric/historic values; wildlife habitat; vegetation	**4.4 mi**
Mule Mountain	California	Palm Springs/ South Coast	Prehistoric values	Adjacent
Palen Dry Lake	California	Palm Springs/ South Coast	Prehistoric values	Adjacent
Cumbres & Toltec Railroad Corridor	Colorado	La Jara	Historic, scenic	Adjacent
Cucharas Canyon	Colorado	Royal Gorge	Scenic, cultural	2 mi
Garden Park	Colorado	Royal Gorge	Historic, paleontology	**Adjacent**
Cane Man Hill	Nevada	Battle Mountain	Cultural	Adjacent[b]
Rhyolite	Nevada	Battle Mountain	Historic	Adjacent[b]

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Tybo-McIntyre Charcoal Kilns	Nevada	Battle Mountain	Historic	3 mi[c]
Pah Rah High Basin Petroglyph	Nevada	Carson City	Cultural, scenic	Adjacent (0.1 mi)
Baker Archaeological Site	Nevada	Ely	Cultural	**2.5 mi**[c]
Honeymoon Hill/City of Rocks	Nevada	Ely	Cultural	Adjacent[c]
Mount Irish	Nevada	Ely	Cultural	**Adjacent**[c]
Pahroc Rock Art	Nevada	Ely	Cultural	Adjacent[c]
Shooting Gallery	Nevada	Ely	Cultural	**Adjacent**[c]
Snake Creek Indian Burial Cave	Nevada	Ely	Zooarchaeology, geology, archaeology	**0.9 mi**[c]
Swamp Cedar	Nevada	Ely	Special plant species, prehistoric sites, historic site	Adjacent[c]
Arden	Nevada	Las Vegas	Historic	Adjacent
Arrow Canyon	Nevada	Las Vegas	Paleontological, geological, cultural	Adjacent
Bird Springs	Nevada	Las Vegas	Cultural	**Adjacent**
Crescent Townsite	Nevada	Las Vegas	Historic	**Adjacent**
Gold Butte Part A	Nevada	Las Vegas	Cultural, scenic, wildlife habitat, sensitive species	Adjacent
Hidden Valley	Nevada	Las Vegas	Cultural	**Adjacent**
Rainbow Gardens		Las Vegas	Geological, scientific, scenic, cultural, sensitive plants	Adjacent
Sloan Rock	Nevada	Las Vegas	Cultural	**1.1 mi**
Stump Springs	Nevada	Las Vegas	Cultural, historic	Adjacent
Virgin River	Nevada	Las Vegas	Threatened and endangered species, riparian habitat, cultural resources	Adjacent
Pecos River/Canyons Complex	New Mexico	Carlsbad	Scenic, cultural, natural	7 mi
Adams Canyon	New Mexico	Farmington	Cultural	**Adjacent**
Ah-shi-sle-pah Road	New Mexico	Farmington	Cultural	**1 mi**
Albert Mesa	New Mexico	Farmington	Cultural	**0.8 mi**
Andrews Ranch	New Mexico	Farmington	Cultural	**Adjacent**
Ashii Nala'a' (Salt Point)	New Mexico	Farmington	Cultural	Adjacent
Bee Burrow	New Mexico	Farmington	Cultural	**2.6 mi**
Bis sa'ani	New Mexico	Farmington	Cultural	Adjacent
Bi Yaazh	New Mexico	Farmington	Cultural	Adjacent
Blanco Mesa	New Mexico	Farmington	Cultural	**Adjacent**
Blanco Star Panel	New Mexico	Farmington	Cultural	**Adjacent**

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Cagle's Site	New Mexico	Farmington	Cultural	**Adjacent**
Canyon View	New Mexico	Farmington	Cultural	Adjacent
Casa del Rio	New Mexico	Farmington	Cultural	**0.4 mi**
Cedar Hill	New Mexico	Farmington	Cultural	**Adjacent**
Chacra Mesa	New Mexico	Farmington	Cultural	Adjacent
Cho'li'l (Gobernador Knob)	New Mexico	Farmington	Cultural	**0.5 mi**
Christmas Tree	New Mexico	Farmington	Cultural	**Adjacent**
Church Rock Outlier	New Mexico	Farmington	Cultural	**1 mi**
Cottonwood Divide	New Mexico	Farmington	Cultural	**Adjacent**
Crow Canyon	New Mexico	Farmington	Cultural	**Adjacent**
Crown Point Steps and Herradura	New Mexico	Farmington	Cultural	**0.3 mi**
Deer House	New Mexico	Farmington	Cultural	0.5 mi
Delgadita/Pueblo Canyons	New Mexico	Farmington	Cultural	**Adjacent**
Devils Spring Mesa	New Mexico	Farmington	Cultural	Adjacent
Dogie Canyon School	New Mexico	Farmington	Cultural	**0.4 mi**
Dzil'na'oodlii	New Mexico	Farmington	Cultural	Adjacent
East Rincon	New Mexico	Farmington	Cultural	**0.5 mi**
Encierro Canyon	New Mexico	Farmington	Cultural	**Adjacent**
Encinada Mesa- Carrizo Canyon	New Mexico	Farmington	Cultural	**Adjacent**
Farmer's Arroyo	New Mexico	Farmington	Cultural	**0.5 mi**
Four Ye'i	New Mexico	Farmington	Cultural	**Adjacent**
Frances Mesa	New Mexico	Farmington	Cultural	**Adjacent**
Gonzales Canyon–Vigil Homestead	New Mexico	Farmington	Cultural	0.2 mi
Gould Pass Camp	New Mexico	Farmington	Cultural	**Adjacent**
Halfway House	New Mexico	Farmington	Cultural	Adjacent
Haynes Trading Post	New Mexico	Farmington	Cultural	Adjacent
Holmes Group	New Mexico	Farmington	Cultural	**Adjacent**
Hummingbird	New Mexico	Farmington	Cultural	Adjacent
Hummingbird Canyon	New Mexico	Farmington	Cultural	**0.6 mi**
Jacques Chacoan Community	New Mexico	Farmington	Cultural	**0.5 mi**

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Kachina Mask	New Mexico	Farmington	Cultural	**Adjacent**
Kin Nizhoni	New Mexico	Farmington	Cultural	0.5 mi
Kin Yazhi	New Mexico	Farmington	Cultural	Adjacent
Kiva	New Mexico	Farmington	Cultural	**0.4 mi**
Lake Valley	New Mexico	Farmington	Cultural	**1.3 mi**
Largo Canyon Star Ceiling	New Mexico	Farmington	Cultural	**Adjacent**
Margarita Martinez Homestead	New Mexico	Farmington	Cultural	**0.5 mi**
Martin Apodaco Homestead	New Mexico	Farmington	Cultural	0.7 mi
Martinez Canyon	New Mexico	Farmington	Cultural	**Adjacent**
Morris 41	New Mexico	Farmington	Cultural	**0.3 mi**
Moss Trail	New Mexico	Farmington	Cultural	**0.3 mi**
Muñoz Canyon	New Mexico	Farmington	Cultural	**Adjacent**
North Road	New Mexico	Farmington	Cultural	Adjacent
Pierre’s Site	New Mexico	Farmington	Cultural	Adjacent
Pointed Butte	New Mexico	Farmington	Cultural	Adjacent
Pork Chop Pass	New Mexico	Farmington	Cultural	**Adjacent**
Pregnant Basketmaker	New Mexico	Farmington	Cultural	**Adjacent**
Pretty Woman	New Mexico	Farmington	Cultural	Adjacent
Rincon Largo District	New Mexico	Farmington	Cultural	Adjacent
Rincon Rockshelter	New Mexico	Farmington	Cultural	**Adjacent**
Rock House- Nestor Martin Homestead	New Mexico	Farmington	Cultural	Adjacent
San Rafael Canyon	New Mexico	Farmington	Cultural	Adjacent
Santos Peak	New Mexico	Farmington	Cultural	**0.9 mi**
Shield Bearer	New Mexico	Farmington	Cultural	**0.3 mi**
Simon Canyon	New Mexico	Farmington	Natural, wildlife habitat, cultural, scenic	**Adjacent**
Shield Bearer	New Mexico	Farmington	Cultural	2 mi
Star Rock	New Mexico	Farmington	Cultural	**Adjacent**
Star Spring-Jesus Canyon	New Mexico	Farmington	Cultural	**Adjacent**
String House	New Mexico	Farmington	Cultural	0.3 mi
Superior Mesa Community	New Mexico	Farmington	Cultural	Adjacent

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Tapacito and Split Rock District	New Mexico	Farmington	Cultural	**Adjacent**
Truby's Tower	New Mexico	Farmington	Cultural	Adjacent
Twin Angels	New Mexico	Farmington	Cultural	**1.3 mi**
Alamo Hueco Mountains	New Mexico	Las Cruces	Biological, scenic, cultural, paleontological, special status species	0.2 mi
Apache Box	New Mexico	Las Cruces	Biological, scenic, cultural, special status species, riparian	**Adjacent**
Cooke's Range	New Mexico	Las Cruces	Biological, scenic, cultural, historic, recreation	Adjacent
Cornudas Mountain	New Mexico	Las Cruces	Visual, cultural, sensitive plants	**1 mi**
Dona Ana Mountains	New Mexico	Las Cruces	Scenic, recreation, biological, cultural	**0.9 mi**
Los Tules	New Mexico	Las Cruces	Cultural	Adjacent
Old Town	New Mexico	Las Cruces	Cultural, recreation	**1 mi**
Organ/Franklin Mountains	New Mexico	Las Cruces	Biological, scenic, cultural, special status species, riparian, recreation	Adjacent
Rincon	New Mexico	Las Cruces	Cultural	Adjacent
San Diego Mountain	New Mexico	Las Cruces	Cultural	**Adjacent**
Three Rivers Petroglyph	New Mexico	Las Cruces	Cultural	Adjacent
Wind Mountain	New Mexico	Las Cruces	Visual, cultural, unique wildlife	**1.5 mi**
Cabezon Peak	New Mexico	Rio Puerco	Scenic, cultural, rare plant habitat, natural system, geologic feature	**Adjacent**
Casamero Community	New Mexico	Rio Puerco	Cultural	**Adjacent**
Jones Canyon	New Mexico	Rio Puerco	Cultural, scenic, riparian	Adjacent
Ojito	New Mexico	Rio Puerco	Geological, paleontological, cultural, wildlife, rare plant habitat, geologic hazard	Adjacent
Mescalero Sands	New Mexico	Roswell	Biological, archaeological, scenic	**Adjacent**
Agua Fria	New Mexico	Socorro	Biological, scenic, cultural, geological, recreation	Adjacent
Tinajas	New Mexico	Socorro	Cultural, recreation, scenic	Adjacent
Copper Hill	**New Mexico**	**Taos**	**Cultural, watershed, scenic, recreation, riparian, fish and wildlife**	**2 mi**
La Cienga	**New Mexico**	**Taos**	**Cultural, riparian, wildlife, scenic**	**2 mi**
Sombrillo	**New Mexico**	**Taos**	**Paleontological, cultural**	**Adjacent**

TABLE 4.15-3 (Cont.)

ACEC	State	BLM Field Office	ACEC Values	Distance from Nearest Solar-Suitable Area
Cottonwood Canyon	Utah	Kanab	Scenic, cultural, wildlife, natural processes, plant, geologic, Fredonia surface water watershed	**1 mi**
Ten-Mile Wash	Utah	Moab	Cultural, wildlife	2 mi
Alkali Ridge	Utah	Monticello	Archaeological	**4 mi**
Cedar Mesa	Utah	Monticello	Archaeological, scenic, primitive recreation	Adjacent
Hovenweep	Utah	Monticello	Archaeological, riparian	**>6 mi**
San Juan River	Utah	Monticello	Scenic, archaeological, wildlife	**>6 mi**
Shay Canyon	Utah	Monticello	Archaeological, riparian	1 mi
Dry Lake Archaeological District	Utah	Price	Archaeological, geologic	>6 mi
Muddy Creek ACEC	Utah	Price	Scenic, mining, riparian	>6 mi
Pictographs	Utah	Price	Archaeological	>6 mi
Swasey Cabin	Utah	Price	Historic ranching	>6 mi
Temple Mountain Historic District	Utah	Price	Mining, historic	>6 mi
Canaan Mountain	Utah	St. George	Scenic, cultural	0.5 m
Little Creek Mountain	Utah	St. George	Archaeological	Adjacent
Lower Virgin River	Utah	St. George	Endangered fish, archaeological	2.5 mi
Santa Clara Gunlock	Utah	St. George	Riparian, archaeological	1.8 mi

[a] Bold text represents updated information.

[b] To convert from mi to km, multiply by 1.609.

[c] Nevada ACEC distances to lands available for application through the variance process for Battle Mountain and Ely Field/District Offices are approximate and based on GIS data available at the time of preparation.

types of resources include cemeteries, campsites, and dwelling places associated with tribal ancestors; traditional hunting, fishing, and gathering places; traditionally important plant and animal species and their habitats; traditional water and mineral sources; and sacred places, trails, landscapes, and resources important to the free practice of traditional Native American religions and the preservation of traditional Native American cultures.

Information provided in the Draft Solar PEIS remains valid; there are no further updates for this section.

4.17 SOCIOECONOMICS

This section describes current socioeconomic conditions and local community services within the region of influence (ROI), which encompasses the area in which workers are expected to spend most of their salaries and in which a portion of site purchases and non-payroll expenditures from the construction, operation, and decommissioning phases of proposed solar developments are expected to take place. Socioeconomic resources described are employment and income, direct sales and income taxes, population, local housing markets, and local public service and educational employment. Because higher levels of population in-migration may produce social change (with the breakdown of traditional rural community structures) and social disruption (with potential increases in crime, alcoholism, depression, and other social impacts) data for these measures are also described.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.18 ENVIRONMENTAL JUSTICE

The assessment of environmental justice issues associated with the development of solar facilities considered information on minority and low-income populations for each SEZ and an associated 50-mi (80-km) radius around the boundary of the SEZ based on demographic data from the 2000 Census. The following definitions were used to define minority and low-income population groups:

- **Minority.** Persons who identify themselves as belonging to any of the following racial groups: (1) Hispanic, (2) Black (not of Hispanic origin) or African American, (3) American Indian or Alaska Native, (4) Asian, or (5) Native Hawaiian or Other Pacific Islander.

  The CEQ guidance proposed that minority populations should be identified where either (1) the minority population of the affected area exceeds 50% or (2) the minority population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

This PEIS applies both criteria in using the Census data for census block groups, wherein consideration is given to the minority population that is both greater than 50% and 20 percentage points higher than in the state (the reference geographic unit).

- **Low-Income.** Individuals who fall below the poverty line. The poverty line takes into account family size and age of individuals in the family. In 1999, for example, the poverty line for a family of five with three children below the age of 18 was $19,882. For any given family below the poverty line, all family members are considered as being below the poverty line for the purposes of analysis.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

4.19 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

ADEQ (Arizona Department of Environmental Quality), 2012, *Welcome to the Air Quality Division*. Available at http://www.azdeq.gov/environ/air/. Accessed Jan. 9, 2012.

Belnap, J., et al., 2001, *Biological Soil Crusts: Ecology and Management*, Technical Reference 1730-2.

Belnap, J., et al., 2009, "Sediment Losses and Gains across a Gradient of Livestock Grazing and Plant Invasion in a Cool, Semi-Arid Grassland, Colorado Plateau, USA," *Aeolian Research* 1:27–43.

BLM (Bureau of Land Management), 2008, *Special Status Species Management*, BLM Manual 6840, Release 6-125, U.S. Department of the Interior, Dec. 12.

BLM, 2011, *Herd Area Statistics, FY 2011*. Available athttp://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/wild_horses_and_burros/statistics_and_maps.Par.67883.File.dat/HAHMA_stats2011.pdf.

BLM, 2012, *San Pedro Riparian National Conservation Area—BLM Arizona.* Available at http://www.blm.gov/az/st/en/prog/blm_special_areas/ncarea/sprnca.html. Accessed March 29, 2012.

Burden, C.B., et al., 2011, *Groundwater Conditions in Utah, Spring of 2011*, Cooperative Investigations Report No. 52, U.S. Geological Survey in cooperation with Utah Division of Water Rights and Utah Division of Water Quality.

CARB (California Air Resources Board), 2012, *Ambient Air Quality Standards*. Available at http://www.arb.ca.gov/research/aaqs/aaqs2.pdf (02/17/12). Accessed April 9, 2012.

CDPHE (Colorado Department of Public Health and Environment), 2010, *Air Quality Control Commission*, *Ambient Air Quality Standards*, 5 CCR 1001-14. Available at http://www.cdphe.state.co.us/regulations/airregs/5CCR1001-14.pdf. Accessed Jan. 10, 2012.

EPA (U.S. Environmental Protection Agency), 2006, *How Air Pollution Affects the View*, EPA-456/F-06-001, April. Available at http://www.epa.gov/air/visibility/pdfs/haze_brochure_20060426.pdf.

EPA, 2011, *National Ambient Air Quality Standards (NAAQS)*. Last updated Nov. 8, 2011. Available at http://www.epa.gov/air/criteria.html. Accessed Nov. 23, 2011.

EPA, 2012, *The Green Book Nonattainment Areas for Criteria Pollutants*. Last updated March 30, 2012. Available at www.epa.gov/oaqps011/greenbk/. Accessed April 13, 2012.

Graham, T.B., 2001, *Survey of Ephemeral Pool Invertebrates at Wupatki NM: An Evaluation of the Significance of Constructed Impoundments as Habitat*, final report for Wupatki National Monument, WUPA-310, and Southwest Parks and Monuments Association Contract No. 97-13.

Hand, J.L., et al., 2011, *Spatial and Seasonal Patterns and Temporal Variability of Haze and Its Constituents in the United States*, Interagency Monitoring of Protected Visual Environments (IMPROVE) Report V, June. Available at http://vista.cira.colostate.edu/improve/publications/Reports/2011/PDF/Cover_TOC.pdf. Accessed May 4, 2012.

House, P.K., 2005, "Using Geology to Improve Flood Hazard Management on Alluvial Fans—An Example from Laughlin, Nevada," *Amer. Water Res. Assn*. 41(6):1431–1447.

Husar, R.B., et al., 2001, "Asian Dust Events of April 1988," *J. Geophys. Res.* 106(D16):18,317–18,330, Aug. 27.

Interagency Wild & Scenic Rivers Council, 2012, various documents and pages, National Wild & Scenic Rivers Web site, Bureau of Land Management, Washington, D.C.; National Park Service, Washington, D.C.; U.S. Fish and Wildlife Service, Arlington, Va.; U.S. Forest Service, Washington, D.C. Available at www.rivers.gov. Accessed March 28, 2012.

Joy, P., 2005, "Global Dust-up: Scientists Profile Vast Cloud of Dust from Sahara Desert," *Virgin Islands Daily News*, July 31.

Kavouras, I.G., et al., 2009, “Source Reconciliation of Atmospheric Dust Causing Visibility Impairment in Class I Areas of the Western United States,” *Journal of Geophysical Research* 114(D2):1–18.

Lake, P.S., 2003, “Ecological Effects of Perturbation by Drought in Flowing Waters,” *Freshwater Biology* 48:1161–1172.

Levick, L., et al., 2008, *The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest*, U.S. Environmental Protection Agency and USDA/ARS, Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, Nov.

Lytle, D.A., et al., 2008, “Drought-Escape Behaviors of Aquatic Insects May Be Adaptations to Highly Variable Flow Regimes Characteristic of Desert Rivers,” *The Southwestern Naturalist* 53:399–402.

McCarthy, M., 2004, “ ‘Toyota-ization’ Is Latest Global Threat as Desert Dust Storms Spread,” *Independent Digital (UK) Ltd*, Aug. 20.

McClure, R., 2009, “African Dust Bringing Toxic Chemicals to U.S., Caribbean; Is It Killing Corals? Hurting People?” *Investigate West*, Nov. 24.

Mormon, S.A., 2010, “Arsenic: A Detective Story in Dusts,” *Earth* 55(6):40–47, June.

NDEP (Nevada Division of Environmental Protection), 2010, *Ambient Air Quality Monitoring Program—Pollutants of Concern*. Last updated June 1, 2010.Available at http://ndep.nv.gov/baqp/monitoring/aaqstd.html, Accessed April 9, 2012.

Neff, J.C., et al., 2008, “Increasing Eolian Dust Deposition in the Western United States Linked to Human Activity,” *Nat. Geosci.* 1:189–195.

NMED (New Mexico Environment Department), 2009, *20.11.8. 13 New Mexico Administration Code, Summary of Federal and State Ambient Air Quality Standards*. Available at http://www.nmcpr.state.nm.us/nmac/parts/title20/20.011.0008.pdf. Accessed Jan. 3, 2012.

NPS, 2006, *2005 Statistical Abstracts*, National Park Service Social Science Program, Public Use Statistics Office, Denver, Colo.

Painter, T.H., et al., 2007, “Impact of Disturbed Desert Soils on Duration of Mountain Snow Cover,” *Geophys. Res. Lett.* 34, L12502.

Painter, T.H., et al., 2010, “Response of Colorado River Runoff to Dust Radiative Forcing in Snow,” *Proceedings of the National Academy of Sciences* 107(40):17,125–17,130. Available at www.pnas.org/cgi/doi/10.1073/pnas.0913139107.

Planert, M., and J.S. Williams, 1995, *Ground Water Atlas of the United States: California, Nevada*, HA 730-B, U.S. Geological Survey.

Reheis, M., et al., 2003, "Potential Health Hazards of Owens Lake Dust?" poster. Available at http://esp.cr.usgs.gov/info/sw/swdust/toxic_dust_poster.pdf.

Reheis, M.C., et al., 2009, "Compositions of Modern Dust and Surface Sediments in the Desert Southwest, United States," *J. Geophys. Res.* 114, F01028.Robson, S.G., and E.R. Banta, 1995, *Ground Water Atlas of the United States: Arizona, Colorado, New Mexico, Utah*, HA 730-C, U.S. Geological Survey.

Sponseller, R.A., et al., 2010, "Responses of Macroinvertebrate Communities to Long-Term Flow Variability in a Sonoran Desert Stream," *Global Change Biology* 16:2891–2900.

Stanley, E.H., et al., 1994, "Invertebrate Resistance and Resilience to Intermittency in a Desert Stream," *American Midland Naturalist* 131:288–300.

UDEQ (Utah Department of Environmental Quality), 2012, *Air Quality Board*. Available at http://www.airquality.utah.gov/Air-Quality-Board/index.htm. Accessed Jan. 10, 2012.

URS Corporation, 2006, *Aquatic Communities of Ephemeral Stream Ecosystems. Arid West Water Quality Research Project*, prepared for Pima County Wastewater Management Department, with funding by U.S. Environmental Protection Agency Region IX.

USGCRP (U.S. Global Change Research Program), 2009, *Global Climate Change Impacts in the United States*, T.R. Karl et al. (editors), Cambridge University Press. Available at http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

Upper San Pedro Water District, 2010, *Comprehensive Water Resources Plan*, Sept.

USGS (U.S. Geological Survey), 2003, *Principal Aquifers in the 48 Conterminous United States, Hawaii, Puerto Rico, and the U.S. Virgin Islands*, Madison, Wisc., Oct.

USGS, 2008, *Water Resources of the United States—Hydrologic Unit Maps*. Available at http://water.usgs.gov/GIS/huc.html. Accessed Nov. 3, 2008.

Utah DWR, (Utah Division of Water Resources), 2001, *Utah's Water Resources, Planning for the Future*, Utah State Water Plan, May.

Utah DWR, 2005, *Conjunctive Management of Surface and Ground Water in Utah*, Utah State Water Plan, July.

Utah DWR, 2012, *Groundwater Policy Map.* Available at http://www.waterrights.utah.gov/gisinfo/maps/agwpol.pdf. Accessed March 27, 2012.

Wiele, S.M., et al., 2008, *Update of the Accounting Surface along the Lower Colorado River U.S. Geological Survey*, Scientific Investigations Report, 2008–5113.

Wilson, R.P., and Owen-Joyce, S. J., 1994, *Method to Identify Wells That Yield Water That Will Be Replaced by Colorado River Water in Arizona, California, Nevada, and Utah*, U.S. Geological Survey, Water Resources Investigations Report, 94-4005.

4.20 ERRATA TO CHAPTER 4 OF THE DRAFT SOLAR PEIS

This section presents corrections to material presented in the Draft Solar PEIS. The need for these corrections was identified in several ways: through comments received on the Draft Solar PEIS and the Supplement to the Draft (and verified by the authors), through new information obtained by the authors subsequent to publication of the Draft and Supplement to the Draft, or through additional review of the original material by the authors. Table 4.20-1 provides corrections to information presented in the Draft Solar PEIS.

TABLE 4.20-1 Errata to Chapter 4 (Affected Environment) of the Draft Solar PEIS

Section No.	Page No.	Line No.	Figure No.	Table No.	Correction
4.7.1	4-20			4.7-1	In the last column of the Basin and Range entry (under Rock Types), there should be a space between the words “Cenozoic” and “volcanic.”
4.10.2.3	4-87	18–19			The sentence should read, “These include the moose (*Alces americanus*) in Colorado and Utah; American bison (*Bos bison*) in Arizona, California, New Mexico, and Utah (primarily in privately or publicly held herds);”
4.11.1.1	4-115	39			“Arizona with daily ranges as large as 50 to 60°F (10 to 16°C).” should read “Arizona with daily ranges as large as 50 to 60°F (28 to 33°C).”
4.11.1.2	4-117	13			“is heavy (in excess of 50 in. [130 cm] per year)” should read “is heavy (in excess of 50 in. [127 cm] per year)”
4.11.1.2	4-117	15			“Range and the Sierra Nevada and lighter on the eastern slopes (under 9 in. [20 cm] in some” should read “Range and the Sierra Nevada and lighter on the eastern slopes (under 9 in. [23 cm] in some”
4.11.1.4	4-118	10			“30 to 35F° (17 to 19C°). Summer temperatures” should read “30 to 35°F (17 to 19°C). Summer temperatures”
4.11.2.5	4-130	9–10			The following text should be deleted: “The EPA proposed new general conformity regulations on January 8, 2008 (58 FR 1402); there will be changes to the applicable general conformity requirements upon promulgation.”
4.11.3	4-130	23			“surface temperature has increased 0.74 ± 0.18C° (1.33 ± 0.32F°) during the last 100 years,” should read “surface temperature has increased 0.74 ± 0.18°C (1.33 ± 0.32°F) during the last 100 years,”
4.13.2	4-140	22			“church), the criteria range from 72 to 80 VdB and from 75 to 83 VdB, respective, depending on” should read “church), the criteria range from 72 to 80 VdB and from 75 to 83 VdB, respectively, depending on”

This page intentionally left blank.

5 UPDATE TO IMPACTS OF SOLAR ENERGY DEVELOPMENT AND POTENTIAL MITIGATION MEASURES

5.1 INTRODUCTION

Chapter 5 of the Draft Solar PEIS (BLM and DOE 2010) discussed potential positive and negative environmental, social, and economic impacts of utility-scale solar energy development. The assessment considered both direct and indirect impacts. The impact assessment was discussed in terms of common impacts (impacts that occur for all types of solar energy facilities) and for technology-specific impacts. The types of solar technologies evaluated included those considered to be most likely to be developed at the utility scale during the 20-year study period evaluated in this PEIS, considering technological and economic limitations (i.e., parabolic trough, power tower, dish engine, and PV technologies). In this Final Solar PEIS, information on the impacts of solar energy development that has become available subsequent to publication of the Draft Solar PEIS is presented in this section. In addition, corrections to incorrect information on the impacts of solar energy development and potential mitigation measures in the Draft Solar PEIS are provided via the errata table in Section 5.23.

For each resource, potential mitigation measures that could be used to avoid, minimize and/or mitigate impacts from solar energy development were identified in the Draft Solar PEIS. The potential mitigation measures described in Sections 5.2 through 5.21 of the Draft Solar PEIS were further evaluated by the BLM to identify those appropriate for adoption as required design features for inclusion in BLM's Solar Energy Program. The BLM's proposed final list of required design features is included in Section A.2.2 of Appendix A of this Final Solar PEIS. Changes to the mitigation measures presented in the Draft Solar PEIS (made in response to comments and with additional analysis as needed) are not presented in this Section 5 update; rather, all appropriate changes have been made to the required design features that are presented in Section A.2.2 of Appendix A.

Chapter 5 of the Draft Solar PEIS also discussed potential impacts from the construction and operation of new transmission lines. The impacts were described generically, without assumptions on the length of the new transmission lines or new roadways that would be required for solar energy facilities. Land disturbance impacts from transmission line upgrades were assumed to be similar to those from new transmission line construction (this could be the case if it is a large upgrade; for example, from a 69-kV line to a 230-kV or larger line). In this Final Solar PEIS, new information on the impacts of transmission line construction and operation is presented where available.

5.2 LANDS AND REALTY

Utility-scale solar energy facilities would affect lands and realty uses and activities on and near BLM-administered public lands. The average solar energy facilities considered in this Final Solar PEIS are large (e.g., up to several thousand acres), and they will exclude most other surface uses of the land. Additional issues include the creation of an industrial landscape in stark contrast to surrounding undeveloped lands that would likely have an adverse impact on the recreational, wilderness, and visual quality of those undeveloped lands such as historic trails, Native American sacred sites, traditional cultural properties, and traditional use areas; development of additional transmission lines; fragmentation of large blocks of public land, which will affect existing access routes; development of public lands that may induce development of adjacent or nearby state or private lands; impacts on land values (both positive and negative); and increased vehicle traffic.

Information provided in the Draft Solar PEIS remains valid, with the following update:

- The total area disturbed for solar energy projects is quite variable, and while the average size of projects as presented in Section 3.5 of the Draft Solar PEIS is generally accurate, the maximum size of utility-scale solar energy projects is not yet known. As of late 2011, the largest approved project on BLM-administered land, the Solar Millennium Blythe project (which was approved as a 1,000-MW solar trough facility but for which a post-authorization request has been received to change the technology to PV) was estimated to disturb about 7,030 acres (28.5 km^2), which includes the final transmission line route, temporary construction areas for the transmission line, and disturbance for a telecommunication line.

5.3 SPECIALLY DESIGNATED AREAS AND LANDS WITH WILDERNESS CHARACTERISTICS

The BLM has excluded many specially designated areas with sensitive resources from application for solar development, and these areas would not incur direct impacts from solar energy development; however, these areas may incur indirect impacts from solar energy development on BLM-administered lands adjacent to and/or within the viewshed of the excluded areas. These impacts could include adverse visual effects on the viewshed of these areas (including impacts on the night sky viewing), adverse impacts on wilderness characteristics, reduced recreational use, fragmentation of biologically linked areas, and loss of public access. Specially designated areas managed by other federal agencies and state and local governments would also be subject to indirect impacts.

A category of lands available for application for solar energy development is land that has been recognized by the BLM as possessing wilderness characteristics, but which has not been identified as a WSA and for which planning decisions have not been made to protect those wilderness characteristics. Utility-scale solar energy development activities and the development of associated transmission facilities, within, adjacent to, or near these areas likely would adversely affect or eliminate the wilderness characteristics in all or portions of these areas depending on site- and project-specific conditions.

Information provided in the Draft Solar PEIS remain valid, with the following updates:

- The BLM-administered public lands that are excluded from application for solar energy development are generally described in Section 5.3; the final detailed list of exclusions is included in Table 2.2-2 in Chapter 2 of this Final Solar PEIS.

- The description in Section 5.3.1 regarding lands with wilderness characteristics is generally accurate; however, after the Draft Solar PEIS was published, guidance on how these lands will be addressed and managed has been formalized in Secretarial Order 3310 (Secretary of the Interior 2010) and in BLM Manuals 6302 and 6303 (BLM 2011a,b).

- The NPS provided comments on the Draft Solar PEIS indicating that there are 52 NPS units, not including 5 national trails, in the six-state area that are within 25 mi (40 km) of the program alternative lands identified in the Draft Solar PEIS. For the Final Solar PEIS, the program alternative lands (those available for solar energy ROW application under the variance process) have been reduced by about 1 million acres (4,047 km^2). The removal of many of the lands from the program alternative lands was in response to NPS comments requesting that lands close to NPS units be removed.

5.4 RANGELAND RESOURCES

5.4.1 Livestock Grazing

Livestock grazing activities would be excluded from areas developed for utility-scale solar energy production. Because grazing is the main source of livelihood for many public land ranchers, significant reductions in permitted grazing would adversely affect the economic value of ranches and could threaten their continued viability. Indirect impacts on livestock grazing, such as loss of forage due to spread of noxious weeds, increased operating costs, and increases in occurrence of wildland fire, could also occur. In addition, cultural or social impacts may also result from the modification or loss of grazing privileges, since for many permittees and their families having grazing allotments on public lands has been a longstanding and important tradition.

Information provided in the Draft Solar PEIS remains valid, with the following update:

- General information included in Section 5.4.4.1.1 of the Draft Solar PEIS indicated that reductions in BLM-authorized grazing on public land grazing allotments would adversely affect the economic value of ranches and could threaten their continued viability. Comments on the Draft Solar PEIS suggested that additional information on these impacts should be noted. The following updates address these comments:
  - While most public land ranches are largely made up of BLM-administered public lands, there can also be private lands and water rights tied to these

ranches. In many cases, state land grazing permits/leases are also held by the permittees and are integrally tied to the BLM permit. Losses of BLM-authorized grazing associated with utility-scale solar energy facilities likely would reduce the value of the private lands, the value of both BLM and state grazing permits, and in some cases, the value of water rights held by the grazing permittees. Laws and regulations do not require the mitigation of this loss of value for permittees.

5.4.2 Wild Horses and Burros

As discussed in Section 5.4.2 of the Draft Solar PEIS, areas available for application for solar energy development may overlap with BLM wild horse or burro HMAs. The management of these animals is not compatible with areas of solar development. Wild horses and burros would be displaced from the areas of solar energy development and, depending on the conditions of the HMA, it might be necessary to reduce the appropriate management level (AML; the maximum number of animals sustainable on a yearlong basis) to match forage availability on the remaining portions of the HMA. A reduction of AML could necessitate the gathering, care, and holding of animals in excess of the revised AML.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

5.4.3 Wildland Fire

Electrical substations associated with solar energy facilities present a potential fire hazard due to the modification of the voltage and current phase of the generated electrical power. In addition, any solar facility can indirectly create increased fire risk because of the operation of internal combustion vehicles and equipment in dry desert environments or if invasive species are allowed to become established within the facility's footprint from improper vegetation management.

Information provided in the Draft Solar PEIS remains valid, with the following addition:

- Section 5.4.3.1.2 of the Draft Solar PEIS discussed potential adverse impacts of new roads to support transmission facilities with respect to increased wildland fire occurrences. This Final Solar PEIS also notes that there can be a benefit from roads, in that they can act as firebreaks that can help stop the spread of wildland fires.

5.5 RECREATION

Recreational use would be excluded from all areas developed for solar energy facilities, including areas currently designated for OHV use. There may also be adverse impacts on recreational use of lands located nearby, including lands not administered by the BLM. Indirect effects on recreational use would occur primarily on lands near the solar facilities and would result from the change in the overall character of undeveloped BLM-administered lands to an industrialized, developed area that would displace people who are seeking more rural or primitive surroundings for recreation. Changes to the visual landscape, impacts on vegetation, development of roads, and displacement of wildlife species resulting in reduction in recreational opportunities could degrade the recreational experience near where solar development occurs.

Information provided in the Draft Solar PEIS remains valid, with the following update:

- A factor not discussed in the Draft Solar PEIS is the lack of recreational use data in many BLM-administered areas. Generally, this is a result of the very dispersed nature of the use of public lands, which makes it extremely difficult to gather good use data. Also, for many, if not all, western communities, recreational use of nearby public lands is considered to be an important amenity, and this use can be quite spontaneous because the lands are close and are open to use. Some public comments on the Draft Solar PEIS and the Supplement to the Draft provide support to the importance of recreational use of public lands. The lack of good recreational use data has complicated the understanding of the potential impacts on recreation, especially in the consideration of the impacts of SEZs. In this Final Solar PEIS, a more thorough discussion of potential impacts on recreational use has been included in the analyses for the proposed SEZs (Chapters 8 through 13). Site- and project-specific analysis of impacts on recreational use of potential solar development project sites should include a thorough review of both on- and off-site impacts associated with the proposed development.

The impacts on recreation described in the Draft Solar PEIS omitted any discussion of recreational impacts that might be associated with the acquisition of mitigation lands acquired to offset losses to other resources caused by solar energy development. An example of this would be lands acquired for the mitigation of wildlife losses. Management of mitigation lands will be determined on a case-by-case basis, but mitigation lands likely would be managed primarily for the benefit of the resource for which they are acquired (e.g., endangered species habitat), and recreation and other uses likely would be considered secondary uses. The actual level of this secondary use would be dependent on the specific situation. Any losses of recreation or other uses (e.g., grazing) on mitigation lands would be considered in the environmental analysis of the project for which mitigation is required.

5.6 MILITARY AND CIVILIAN AVIATION

Development of utility-scale solar facilities has the potential to affect both military and civilian aircraft operations, radar use, and airport operations. Numerous civilian airfields, military training routes (MTRs), and special use airspace (SUA) areas are located within the six-state study area. The military airspace in the study area is intensively used and is important to maintaining overall training and readiness for all branches of the military. Intrusion of solar energy facilities into low-level airspace in military training areas and near military and civilian airports can pose safety issues.

Information provided in the Draft Solar PEIS remains valid, with the following updates:

- The discussion of potentially “displacing” sensitive species onto military reservations generated several public comments. As a clarification, actual “displacement” of species would only apply to highly mobile species and in that instance would require that the habitat on the military reservation be suitable and open to the species use. The more likely impact is to increase the importance of habitat for a particular species found on a military reservation, as was discussed in Section 5.6.1 of the Draft Solar PEIS. Because of the amount of land that could be committed to utility-scale solar energy development, lands where sensitive species are found will likely increase in importance, and such an increase could bring pressure to bear on military uses of existing military reservations. This likely would be an incremental, cumulative process that may be difficult to assess on a project-by-project basis.

- A potential impact on military aviation not discussed in the Draft Solar PEIS is impacts on some operations resulting from electromagnetic interference (EMI) from new substations and transmission lines in locations used by the military for certain types of testing that require no EMI to be present. Such impacts would be addressed during pre-application coordination with federal, state, and local agencies.

5.7 GEOLOGIC SETTING AND SOIL RESOURCES

As discussed in Section 5.7.1 of the Draft Solar PEIS, impacts on soil resources encompass a range of effects that would be expected to occur mainly as a result of ground-disturbing activities, especially during the construction phase of a solar energy project, regardless of the type of facility under development. Impacts include soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff, sedimentation, and soil contamination. These impacts could in turn affect other resources, such as air, water, vegetation, and wildlife.

Data provided in the Draft Solar PEIS remain valid, with the following updates:

- For Section 5.7.1 (Common Impacts), it is noted that soil disturbance may also reduce the carbon-fixing function of biological soil crusts and may potentially increase the release of carbon to the atmosphere, especially if large expanses of playa crusts (with caliche) are disturbed.

- In Section 5.7.1 (Common Impacts), it is also noted that indirect effects on human health (due to soil-borne diseases and/or toxins such as fungal spores) and the water cycle (due to mineral dust deposition on alpine snowpack) are also possible.

- Section 5.7.4 (Potentially Applicable Mitigation Measures) should include a citation of DOI's technical reference on biological soil crust management (Belnap et al. 2001). The report provides information on management techniques to maintain or improve biological soil crusts and descriptions of monitoring methods to assess their health as well as landscape-level changes and trends.

5.8 MINERALS

Utility-scale solar energy development would be incompatible with most mineral development activities and would preclude these activities once solar energy facilities are constructed. An exception to this could occur if oil and gas or geothermal resources could be accessed under a solar energy facility utilizing offset drilling technologies. Existing valid mining claims, oil and gas leases, or other types of mineral leases would preclude or affect solar energy development.

Information provided in the Draft Solar PEIS remains valid, with the following update:

- Several public comments were provided on proposed SEZs analyzed in the Draft Solar PEIS regarding the need for congressional approval of mineral withdrawals of public lands that exceed 5,000 acres (20 km^2). Mineral reports have been prepared for the SEZs proposed to be designated in the Final Solar PEIS. For those SEZs larger than 5,000 acres (20 km^2) that are designated in the ROD, mineral reports will be submitted to Congress as required under Section 204 of FLPMA.

5.9 WATER RESOURCES

Impacts on surface water and groundwater resources from utility-scale solar energy development are primarily the result of stressors that include water use and surface disturbances, which can both impair water quality and limit water quantity. The information in Section 5.9 of the Draft Solar PEIS describes potential impacts from these stressors that could occur during the site characterization, construction, operation, and decommissioning phases, for the four utility-scale solar energy technologies evaluated.

The information in Section 5.9 of the Draft Solar PEIS remains valid. The following paragraphs provide a summary and some additional information regarding the major potential impacts on water resources from solar energy development. It should be noted that Native American tribes may have concerns about the impacts on water discussed in the Solar PEIS, as brought to the attention of the BLM through recent ethnographic studies (SWCA and University of Arizona 2011). Features of tribal importance identified during the studies included playas, Pleistocene lakes and wetlands, rivers, washes, and springs.

Water Management. Water use is one of the major issues with solar energy development, because all projects will require varying amounts of consumptive water use, and the regions being considered are all in semiarid to arid desert valleys where water resources are limited. The processes involved in obtaining water rights for solar energy development vary at the state and local levels, and most of the regions being considered for solar energy development are already fully allocated with respect to water rights. The transfer of water rights for solar energy development may result in land use changes, which would affect basin hydrology. For example, in the San Luis Valley in Colorado, the potential transfer of irrigation water rights for solar energy development would most likely result in a reduction of agricultural lands, along with a potential reduction in localized groundwater recharge that would have occurred below the agricultural field. In many regions in the six-state study area, groundwater basins are adjudicated such that there are restrictions in what water can be used for, along with restrictions on the magnitude, timing, and location of water withdrawals. All state and local water right and water management considerations must be examined at the project-specific scale; however, it is very likely that solar energy projects that seek low water use requirements through technology choices and water conservation measures will have a higher probability of successfully securing water rights.

One of the main water conservation practices that can be used to reduce water demand is through the use of degraded water sources that include reclaimed municipal wastewater, produced water from oil and gas operations, and brackish groundwater. For example, the CEC discourages the use of freshwater sources for power plant cooling purposes for desert renewable energy projects. The CEC recognizes that in many regions in the desert southwest, groundwater quality can be brackish and not suitable for potable uses, and that these non-potable water sources should be considered first for operational water needs at solar energy facilities. Similar water conservation strategies have been developed in Arizona where the Arizona Department of Water Resources (ADWR) requires that the maximum amount of reclaimed wastewater be used for power plant cooling purposes (ADWR 2012). The potential use of degraded water sources, along with other water conservation practices, needs to be considered on a project-specific basis, because it is often the case that the needed infrastructure (e.g., pipelines to transport reclaimed wastewater) or technologies for water conservation are not in place. Several programs under the Bureau of Reclamation's WaterSMART program should be considered by solar energy developers, along with state agencies and regulators, which include grants pertaining to the development of technologies, infrastructure, and conservation practices that include water and energy efficiency, advanced water treatment, and water reclamation and reuse (BOR 2012).

Update for Section 5.9.1.2.2, Streams: Perennial, Intermittent, and Ephemeral. Surface disturbances associated with the solar facility footprint and related infrastructure have the potential to disturb natural hydrologic processes relevant to surface waters and groundwater. In desert valley regions, surface hydrologic features included intermittent and ephemeral stream channels, wetlands, alluvial fans, springs and seeps, playas, and dry lakebeds, which all have functional value to both surface water and groundwater resources. Grading of the surface and vegetation removal for solar facilities disturbs these water features and can affect groundwater recharge processes, disrupt flows in ephemeral stream channels, and alter drainage patterns with potential adverse impacts resulting from either an increase (e.g., erosion) or a decrease (e.g., loss of water delivery) in runoff. Ephemeral and intermittent streams represent more than 81% of all streams in the six-state study area, and their hydrologic and ecological significance has been documented in several studies (e.g., Levick et al. 2008). Siting of solar energy facilities needs to consider these important ecological and hydrologic functions of water features in desert valleys; however, it is not feasible to avoid all water features because of their ubiquitous nature in desert regions. Consideration of water features that require avoidance or mitigation needs to be conducted on a project-specific basis and include stakeholder involvement, along with regulators at the federal, state, and local levels.

Federal laws such as the CWA will require a permitting process for any jurisdictional water bodies affected by a solar development. The determination of jurisdictional waters is made on a case-by-case basis by the USACE and EPA. Draft guidance regarding the identification of jurisdictional waters was proposed by the USACE and EPA in April 2011; the final version of the guidance has not yet been released. The draft guidance document suggests that the number of water bodies that would be jurisdictional would increase, but that jurisdictional determinations would still be handled on a case-by-case basis (EPA 2012). States can also have laws and management programs that aim to protect surface water features. The CDFG manages the Lake and Streambed Alteration Program, which is a permitting program like the CWA but specifically includes all water features, including intermittent and ephemeral water bodies (CDFG 2012). The Utah Division of Water Rights (Utah DWR) manages a stream alteration permitting program where a natural stream is defined primarily by patterned ecosystems, notably by vegetation patterns (Utah DWR 2004) that would typically include ephemeral water features.

The protection of water resources from overuse and from surface disturbances requires the involvement of solar developers, land managers, and regulators at the federal, state, and local levels. Protection from water overuse is primarily dealt with in the securing of water rights, which varies at the state and local levels. It is often desirable to limit groundwater extractions in a basin to the sustainable yield, which has various definitions but is generally considered the withdrawal amount that does not produce any undesirable results. With such a generic definition, a variety of rules-of-thumb have been developed to quantify the sustainable yield of groundwater basins, such as limiting withdrawals to some fraction of the natural recharge. However, balancing the complex processes of groundwater recharge and capture (increased recharge and decreased discharge induced by pumping), the long temporal scales needed to achieve dynamic equilibrium conditions within a groundwater basin, and the potential for groundwater withdrawals to include water from surface water bodies (an undesirable result) makes quantifying a sustainable yield very challenging (Bredehoeft and Durbin 2009; Zhou 2009). Ultimately, the best way to prevent groundwater overdraft is through the iterative process of groundwater monitoring and numerical modeling to help guide adaptive management strategies. This is not an easy process to implement given that water right allocations, transfers, and adjudications often involve several management agencies and judicial systems. As stated previously, laws for protecting surface water features, primarily intermittent and ephemeral water bodies, are not fully established or implemented in a fashion that is suitable for considering potentially large surface disturbances in desert valleys. Land managers and stakeholders need to use all available information regarding the ecological and hydrologic functions of surface water features in order to properly site solar energy facilities, which needs to be considered at the project-specific scale. However, even with careful siting designs, the protection of water resources will require monitoring and modeling to assess resulting impacts and to inform adaptive management strategies.

5.10 ECOLOGICAL RESOURCES

5.10.1 Vegetation

As discussed in Section 5.10.1 of the Draft Solar PEIS, impacts on vegetation that could result from utility-scale solar energy development include those associated with initial site characterization, facility construction, operations, and decommissioning. The potential impacts would be directly related to the amount of land disturbance, the duration and timing of construction and operation periods, and the habitats affected by development (i.e., the location of the project). Potential impacts on terrestrial and wetland plant communities and habitats from the development of utility-scale solar energy projects would include direct impacts from habitat removal as well as a wide variety of indirect impacts on or off the project site. Indirect effects, may be associated with invasive species, groundwater withdrawal, erosion, sedimentation, alteration of drainage patterns, habitat fragmentation, fugitive dust, spills, soil compaction, topsoil removal, vegetation maintenance, air emissions, or increased human access.

Plant communities and habitats affected by direct or indirect impacts from project activities could incur short- or long-term changes in species composition, abundance, and distribution. Some impacts may also continue after the decommissioning of a solar energy project. Direct impacts would primarily include the destruction of habitat during initial land clearing on the solar energy project site, as well as habitat losses resulting from the construction of access roads, natural gas pipelines, and electric transmission lines. As identified in the recent ethnographic studies, Native American tribes are concerned about impacts on traditionally used plants (SWCA and University of Arizona 2011). Restoration of plant communities on temporarily disturbed land or following decommissioning may result in plant communities that are different from native communities in terms of species composition and representation of particular vegetation types, such as shrubs. The establishment of mature native plant communities may require decades, and some community types may never fully recover from disturbance. Restoration of plant communities in areas with arid climates would be especially difficult and may be unsuccessful in some areas. However, the BLM is committed to the oversight of restoration efforts and ensuring that the Vegetation Management Plan for the site is followed.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

5.10.2 Wildlife

As discussed in Section 5.10.2 of the Draft Solar PEIS, impacts on wildlife that would result from utility-scale solar energy development include those associated with initial site characterization, facility construction, operations, and decommissioning. The potential impacts would be directly related to the amount of land disturbance, the duration and timing of construction and operation periods, and the habitats affected by development (i.e., the location of the project). Indirect effects, such as those resulting from the erosion of disturbed land surfaces and disturbance and harassment of animal species, are also possible, but their magnitude is considered proportional to the amount of land disturbance. Recent ethnographic studies indicated that Native American tribes have concerns about impacts on traditionally important wildlife species, such as bighorn sheep and horned toads (SWCA and University of Arizona 2011).

The impacts on wildlife remain the same as presented in Section 5.10.2 of the Draft Solar PEIS. However, comments on the Draft Solar PEIS raised concerns that the impacts of noise on wildlife (particularly behavioral impacts) were not adequately addressed. Therefore, the following text replaces the text on page 5-78 and the first paragraph on page 5-79 of the Draft Solar PEIS:

> Excessive noise levels can alter wildlife habitat use and activity patterns (e.g., exacerbating fragmentation impacts), increase stress levels, decrease immune response, reduce reproductive success, increase predation risk, degrade communication, and cause hearing damage (Habib et al. 2007; Manci et al. 1988; Pater et al. 2009). Generally, deleterious physiological responses to noise occur at exposure levels of 55 to 60 dB(A) or more (see Barber et al. 2010). Noise levels tend to be lower than this at distances greater than 500 ft (152 m) from the noise source. The response of wildlife to noise would vary by species; physiological or reproductive condition; distance; and the type, intensity, and duration of the disturbance. Brattstrom and Bondello (1983) reported that peak sound pressure levels reaching 95 dB resulted in a temporary shift in the hearing sensitivity of kangaroo rats (*Dipodomys* spp.), and that at least 3 weeks was required for the recovery of hearing thresholds. The authors postulated that such hearing shifts could affect the ability of the kangaroo rat to avoid approaching predators.
>
> Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use by wildlife in those areas. Herrera–Montes and Aide (2011) noted that bird species richness and occurrence were significantly lower at sites near a highway, while anurans (frogs and toads) were not affected. This was due to birds calling during the day when high levels of traffic occur. Also, some anurans occur at high densities and form noisy choruses (e.g., >80 dB), which allows them to tolerate anthropogenic noise. However, Sun and Narins (2005) reported that man-made acoustic interference may affect anuran calling in some species by modulating their call rates or by suppressing calling behavior (in turn, this may stimulate calling in other species). Some species can overcome interference from intermittent anthropogenic noise by timing their calls to coincide with periods of silence (Egnor et al. 2007). Noise

can exacerbate impacts on wildlife caused by habitat fragmentation and human presence (Barber et al. 2010).

Wildlife can habituate to noise (Krausman et al. 2004). However, this is likely to occur only with frequently repeated, predictable exposures, and acclimation can be lost if enough time passes between repeat exposures (Wright et al. 2007). Also, it could be the visual element of the event rather than, or in addition to, the auditory component that causes the observed reaction in wildlife (AMEC Americas Limited 2005). Acclimation to a noise stimulus does not prevent other effects such as hearing loss. The apparent tolerance to noise stress could be the result of the animal or population having to remain in the area because of the absence of alternative habitats, high energetic costs associated with avoidance, or even reduced hearing from the frequency of the noise stimulus (Wright et al. 2007). Also, acclimation could cause possible sensitization, such that the animal may demonstrate an enhanced stress response when exposed to a different new stressor (Wright et al. 2007).

Much of the research on wildlife-related noise effects has focused on birds. Responses of birds to disturbance often involve activities that are energetically costly (e.g., flying) or affect their behavior in a way that might reduce food intake (e.g., shift away from a preferred feeding site) (Hockin et al. 1992). A variety of adverse effects of noise on raptors has been demonstrated, but for some species, the effects were temporary, and the raptors became habituated to the noise (Brown et al. 1999; Delaney et al. 1999). A review of the literature by Hockin et al. (1992) showed that the effects of disturbance on bird breeding and breeding success include reduced nest attendance, nest failures, reduced nest building, increased predation on eggs and nestlings, nest abandonment, inhibition of laying, increased absence from the nest, reduced feeding and brooding, exposure of eggs and nestlings to heat or cold, retarded chick development, and lengthening of the incubation period. The most adverse impacts associated with noise could occur if critical life-cycle activities were disrupted (e.g., mating and nesting). For instance, disturbance of birds during the nesting season could result in nest or brood abandonment. The eggs and young of displaced birds would be more susceptible to cold or predators.

More recently, concerns are beginning to focus on the impacts of chronic anthropogenic noise exposure on wildlife (Barber et al. 2010; Bayne et al. 2008). Noise exposure can cause physiological stress either directly (as described above) or indirectly through secondary stressors such as annoyance. These secondary stressors can increase the ambiguity in received signals or cause animals to leave a preferred resource area (Wright et al. 2007). Noise can inhibit (mask) the perception of sounds. Masking can affect the ability of wildlife to use sound for spatial orientation, for example, to detect potential mates, detect predators or prey, respond to begging calls from young, defend territories, maintain pair bonds, hear alarm calls, interfere with feeding, and reduce breeding

(Quinn et al. 2006; Swaddle and Page 2007; Leonard and Horn 2008; Parris and Schneider 2008; Schaub et al. 2008; Slabbekoorn and Ripmeester 2008; Francis et al. 2009; Barber et al. 2010; Chan et al. 2010: Halfwerk et al. 2011; Lackey et al. 2011). Some wildlife species shift their vocalization to reduce masking effects (Barber et al. 2010). For birds, this can include singing earlier in the morning or singing louder (Rheindt 2003; Brumm 2004).

5.10.3 Aquatic Biota and Habitats

5.10.3.1 Common Impacts

Utility-scale solar energy facilities that would be constructed and operated have the potential to affect aquatic biota and habitats. Section 5.10.3.1 of the Draft Solar PEIS provided an overview of the potential impacts on aquatic ecosystems that could occur from site characterization, construction, operation, and decommissioning of a solar energy project. Impacts on aquatic biota and habitats from solar energy projects could occur in a number of ways, including (1) habitat loss, alteration, or fragmentation; (2) disturbance and displacement of aquatic organisms; (3) mortality; and (4) increase in human access. Aquatic biota and habitats may also be affected by human activities not directly associated with a solar energy project or its workforce, but associated with the potentially increased access by the public to areas that had previously received little use.

The impact descriptions provided in the Draft Solar PEIS remain valid; however, the following updates for the construction and operations development phases have been added in response to comments received on the Draft Solar PEIS.

5.10.3.1.1 Construction. The impact descriptions provided in the Draft Solar PEIS remain valid, with the following update.

- In addition to the potential for introducing non-native aquatic species (e.g., fish and mussels), microbes such as chytrid fungus could also be introduced via construction or maintenance equipment.

5.10.3.1.2 Operations. During the operations and maintenance phase of a utility-scale solar energy facility, aquatic habitats and aquatic biota may be affected by water withdrawn from aquatic habitats for cooling purposes, continued erosion and sedimentation due to altered land surfaces, exposure to contaminants, and continued increases in public access. The impact descriptions provided in the Draft Solar PEIS remain valid; however, a discussion of the potential impacts of polarized light and an expanded discussion of the impacts of water withdrawal on aquatic biota are being added, as follows.

Recently, concern has been expressed about the impacts of polarized light on aquatic insects. Water bodies have the ability to polarize light. Consequently, light that has been polarized by reflecting off smooth dark surfaces, such as solar panels, can act as an "ecological trap" in which aquatic insects mistake solar panels for open water and lay eggs on the surface of the panel (Horváth et al. 2009). In fact, insects can be more attracted to the highly polarized light reflected off solar panels than they are to natural water bodies (Horváth et al. 2010). Although high numbers of insects may be killed in this way, the significance of the resulting waste of reproductive effort on insect populations is unknown, as is the potential for adverse impacts on higher trophic levels that depend on these insects as food sources.

If the solar energy technology used by a particular project requires water for producing steam for driving turbines or for cooling the produced steam during operation, there is a potential for water depletion impacts on aquatic habitats within the vicinity. Changes in the flow patterns of streams and the depletion of surface water resulting from surface or groundwater withdrawal could affect the quality of aquatic habitats and the survival of populations of aquatic organisms within affected bodies of water. For example, prolonged or frequent drying can reduce species diversity (McCluney and Sabo 2011; Datry 2011) and ultimately alter or eliminate species through physiological stress or habitat loss (Stanley et al. 1994; Sponsellor et al. 2010). In the case of aquatic invertebrates, the most sensitive species (i.e., Hydrosychidae) would be replaced by more tolerant species such as Chironomidae and Oligochaetae (Stanley et al. 1994; Sponseller et al. 2010). A reduction in water depths can also increase the susceptibility of some fish species to predation from avian and terrestrial predators. In intermittent habitats, water withdrawal could reduce the frequency and duration of wet periods, which could ultimately increase fragmentation of stream networks as streams become pools connected by dry reaches. In addition to a spatial and temporal reduction in available aquatic habitat, the water quality of the remaining habitat could decrease as temperature and solute concentrations increase and dissolved oxygen levels decrease. With regard to water quality, aquatic organisms have specific physiological tolerances within which survival is possible. Under natural conditions, many aquatic species in arid aquatic habitats may be at their physiological limit and an increase in stressful water quality conditions could significantly alter species composition (Stanley et al. 1994; Lake 2003; Archer and Predick 2008). In addition to stress or mortality at the level of the individual, water withdrawals could reduce genetic diversity as populations were eliminated by habitat loss or were reproductively isolated by habit fragmentation (Larned 2010; McCluney and Sabo 2011). Extinction of local populations under natural conditions can take longer than 5 years to recover (Lake 2003).

Water depletions are of particular concern if protected species would be affected because the potential for negative population-level effects for rare organisms would be greater than for common and widespread organisms. Thus, water withdrawal concerns are particularly relevant in aquifers supporting endangered species. Many endangered aquatic biota exist in relatively few populations or are naturally endemic to a particular spring. For example, the Devils Hole pupfish (*Cyprinodon diabolis*) is endemic to Devils Hole, a spring-fed pool in Death Valley NP. Populations of the Devils Hole pupfish underwent significant declines beginning in the 1960s in response to water withdrawals for irrigation (Riggs and Deacon 2002).

5.10.3.2 Technology-Specific Impacts

The general types of impacts on aquatic habitats and biota from site characterization, construction, operation, and decommissioning of a solar energy project described in Section 5.10.3.1 and Table 5.10-3 of the Draft Solar PEIS remain valid; thus no updates are needed.

5.10.4 Special Status Species

As discussed in Section 5.10.4 of the Draft Solar PEIS, impacts on special status species that could result from utility-scale solar energy development include those associated with initial site characterization, facility construction, operations, and decommissioning. The potential impacts would be directly related to the amount of land disturbance, the duration and timing of construction and operation periods, and the habitats affected by development (i.e., the location of the project). Indirect effects, such as those resulting from the erosion of disturbed land surfaces and disturbance and harassment of animal species, are also possible, but their magnitude is considered proportional to the amount of land disturbance.

Impacts on special status species are fundamentally similar to or the same as those described for impacts on plant communities and habitats, wildlife, and aquatic resources (Sections 5.10.1, 5.10.2, and 5.10.3, respectively, of the Draft Solar PEIS). However, because of their small population sizes and often specialized habitat needs or dependence on rare habitats, special status species may be more vulnerable to impacts than common and widespread species. Small population size makes them more vulnerable to the effects of habitat fragmentation, habitat alteration, habitat degradation, human disturbance and harassment, mortality of individuals, and the loss of genetic diversity. Specific impacts associated with development would depend on the locations of projects relative to species populations and the details of project development.

The impacts on special status species remain the same as presented in Section 5.10.4 of the Draft Solar PEIS, with the following update based on comments received.

- Comments from the USFWS on the Draft Solar PEIS requested additional discussion of the potential adverse impacts of translocation for desert tortoise. There are inherent dangers to tortoises associated with their capture, handling, and translocation. These actions, if conducted improperly, can result in injury or death. To minimize these risks, a desert tortoise translocation plan should be developed in consultation with the USFWS and should follow the *Guidelines for Handling Desert Tortoises during Construction Projects* (Desert Tortoise Council 1994) and other current translocation guidance provided by the USFWS. Consultation will identify potentially suitable recipient locations, density thresholds for tortoise populations in recipient locations, and procedures for pre-disturbance clearance surveys and tortoise handling, as well as disease-testing and post-translocation monitoring and reporting requirements. Despite some risk of mortality or decreased fitness, translocation is widely accepted as a useful strategy for the conservation of the desert tortoise (Field et al. 2007).

5.11 AIR QUALITY AND CLIMATE

Solar energy development could affect air quality in the areas where it occurs as well as in areas that would benefit from reductions in emissions due to reduced use of fossil energy. During construction, fugitive dust from soil disturbances and engine exhaust from heavy equipment and commuter/delivery/support vehicular traffic within and around the facility would contribute to air emissions of criteria pollutants, VOCs, greenhouse gases (GHGs; e.g., carbon dioxide [CO_2]), and a small amount of hazardous air pollutants (HAPs; e.g., benzene). Typically, potential impacts of fugitive dust emissions on ambient air quality would be higher than those of engine exhaust emissions.

With the possible exception of windblown dust from disturbed soils, operations air emissions associated with generating electricity from solar technologies are small. Emissions from the solar fields would include fugitive dust and engine exhaust emissions from vehicles and heavy equipment associated with regular site inspections, infrequent maintenance activities (e.g., mirror washing, replacement of broken mirrors), and wind erosion from bare grounds and access roads. Once disturbed, areas with biological soil crusts and desert pavement can become long-term dust sources and thus may require special consideration during the ROW application process or during the air permit application process.

For operating parabolic trough and solar power tower technologies, power block emissions would include criteria pollutants and HAPs from small-scale boilers for processing (e.g., for maintaining heat transfer fluid [HTF] temperatures) and particulate matter (PM) as drift from wet-cooling towers, if in use. Other combustion sources common among solar technologies would include space-heating boilers, diesel-fueled emergency power generators (typically operating only a few hours per month), and emergency fire-water pump engines. Storage tanks, including fuel tanks, would emit VOCs and a small amount of HAPs. Engine exhaust from commuter, delivery, and support vehicular traffic would also contribute emissions within and around the solar facility. These air emissions during operation would be minimal in comparison with those from fossil fuel–fired power plants. Impacts on climate would primarily be associated with reductions in CO_2 emissions from avoided fossil energy sources.

The information presented in the Draft Solar PEIS remains valid, with the following updates.

5.11.1 Common Impacts

5.11.1.1 Construction: Update to Section 5.11.1.2 of the Draft Solar PEIS

- Section 5.11.1.2 of the Draft Solar PEIS lists construction activities (i.e., mobilization/staging, land clearing [grubbing and tree removal], topsoil stripping, cut-and-fill operations [i.e., earthmoving], road construction, ground excavation, drilling and blasting if required, and foundation treatment). An updated list also includes disposal of cleared biomass by various methods, which could include on-site burning of the biomass.

- The text of Section 5.11.1.2 of the Draft Solar PEIS discussing air quality impacts associated with highly erodible soils (beginning at line 30 on p. 5-146) is being updated to acknowledge the need to avoid desert pavement and biological soil crusts. Disturbance of areas with biological soil crusts and desert pavement should be avoided whenever possible, since once disturbed, these areas can become dust sources. In addition, this update notes that visibility modeling for construction activities may be required, at BLM's discretion, as part of the ROW application process or as part of the air permit application process with the appropriate regulatory agency.

5.11.1.2 Operations: Update to Section 5.11.1.3 of the Draft Solar PEIS

- The discussion of fugitive dust emissions from wind erosion and vehicle travel during operations (beginning at line 27 on p. 5-147 of the Draft PEIS) is being updated to address the potential for dust generation from disturbed desert pavement and fragile biological soil crusts, to note that, once disturbed, these soils can become a major windblown dust source for long periods of time, and to note that visibility modeling may be required. As stated in the Draft Solar PEIS, because of the large area that could be disturbed and the fact that stabilization is never fully effective, wind erosion during operation needs to be addressed in site-specific assessments during the ROW application process to assess the severity of these impacts. Visibility modeling may be required, at BLM's discretion, as part of the ROW application process or as part of the air permit application process with the appropriate regulatory agency.

  In addition, in response to comments, it is acknowledged that low probability events such as explosions, natural disasters (fires, tornadoes, earthquakes, and severe storms), and terrorism could affect solar facilities. Consequences could include injuries, loss of life, and the release of hazardous materials. Fires at PV facilities could release cadmium into the atmosphere, but research has indicated that less than 0.04% of the cadmium would be released in fires (Fthenakis et al 2004). A terrorist attack would probably have impacts similar to those just noted for natural events. Additional discussion of the events, the regulatory setting, and planning to reduce impacts are discussed in Section 5.21.3 of the Draft Solar PEIS. The impacts of these events would need to be evaluated and plans developed to deal with the impacts on a project-specific basis.

5.11.1.3 Decommissioning and Reclamation: Update to Section 5.11.1.4 of the Draft Solar PEIS

- Section 5.11.1.4 of the Draft Solar PEIS is being updated to note that visibility modeling for decommissioning and reclamation may be required at BLM's discretion. This modeling may be part of the ROW application process or part of the air permit application process with the appropriate regulatory agency.

5.11.1.4 Impacts of GHG Emissions: Update to Section 5.11.4 of the Draft Solar PEIS

- Section 5.11.4 of the Draft Solar PEIS did not account for vehicle and construction equipment emissions in the discussion of emissions avoided through solar generation of electricity. Vehicle and construction emissions represent fossil fuel combustion emissions; however, CO_2 emissions associated with construction equipment and vehicle use during the construction and operation of a solar plant would be limited and much smaller than the estimated CO_2 emissions avoided (716 kg [1,578 lb] annually per megawatt-hour of solar energy produced; see Table 5.11-1 of the Draft Solar PEIS). Therefore, quantification of vehicle and construction equipment emissions in the PEIS analyses is not needed.

- Section 5.11.4 is being supplemented to address potential emissions of sulfur hexafluoride (SF_6). SF_6 is a GHG used as a dielectric in electrical equipment such as transformers. One pound of SF_6 has the same global warming potential as about 12 tons of CO_2. There is concern that if SF_6 were used in electrical equipment at solar facilities, accidental spills of the powerful GHG would offset the benefits of avoided emissions from generating electricity through solar power. Under design feature HS1-1, the BLM is directing developers to consider use of alternative dielectric fluids that do not contain SF_6 at solar facilities on BLM-administered lands (Section A.2.2.22.2 of Appendix A of this Final Solar PEIS). The BLM does not have jurisdiction over transmission lines, and thus SF_6 use associated with transmission lines would need to be considered by other agencies.

5.12 VISUAL RESOURCES

Regardless of the technologies employed for solar energy collection and electricity production, the construction and operation of utility-scale solar energy facilities would introduce major visual changes into non-industrialized landscapes. Solar facilities would normally be expected to attract attention, and, in many cases, would be expected to dominate nearby views. Impacts at longer distances could still be substantial, depending on project size and type, viewer location, and other visibility factors. Mitigation measures would reduce contrasts somewhat; however, in many cases, the contrasts from the strong, regular geometry of the solar collector/reflector arrays, combined with the large size of the facilities, and in some instances, strong reflections or glare from reflective surfaces could not be mitigated effectively. This would be especially true when the facilities were viewed from elevated locations, where the geometry and size of the facilities would be more apparent. Sensitive visual resource areas close to the major facility components with open lines of sight to the facilities could be subject to large impacts from the visual contrasts that would result. Beyond the impacts of a single solar facility, in some locations, viewscapes could include multiple projects with large solar arrays that vary in size, layout, and collector type. Depending on the circumstances, the variety of project sizes and layouts could result in "visual clutter" that would detract from the scenic qualities of the viewed landscape.

The information on visual impacts of solar energy development presented in the Draft Solar PEIS remains valid, with the following updates:

- The list of direct and indirect actions or activities associated with utility-scale solar energy development that can produce visual changes in Section 5.12 of the Draft Solar PEIS is being updated with the addition of the following items.
  - The presence of litter or debris could produce visual changes.
  - Lighting at some facilities could also potentially cause substantial impacts on night skies in non-industrialized landscapes.
  - During site characterization (discussed in Section 5.12.1.1 of the Draft Solar PEIS), fencing around meteorological stations could be a source of visual contrasts.
  - During construction (discussed in Section 5.12.1.2 of the Draft Solar PEIS), fencing around construction areas could be a source of visual contrasts.
  - The discussion of lighting impacts in Section 5.12.1.3.4 of the Draft Solar PEIS is being updated with information published after the Draft Solar PEIS was published, as follows. The discussion of the impacts of aircraft warning lights should note that such lights mounted on wind turbines are easily visible at a distance of 36 mi (58 km) (Sullivan et al. 2012a).
  - Construction of transmission lines and roads (discussed in Section 5.12.1.5 of the Draft Solar PEIS) could result in litter, an additional source of visual contrasts.

- With respect to the impacts of glare from parabolic trough collector arrays discussed in Section 5.12.2.1.1 of the Draft Solar PEIS, Sullivan et al. (2012b) routinely observed strong glare from two solar trough facilities during three site visits between April 2010 and January 2012. Glare was observed from the front, sides, and tops of parabolic trough arrays from mid-morning through late-afternoon, at distances ranging from 0.1 to approximately 3.6 mi (0.16 to 5.8 km) from the facilities. The occurrence of glare was highly variable, with it appearing and disappearing suddenly in some instances, while in others, it varied greatly in intensity over a short period of time. Glare was observed on both the east and west sides of the facilities, and from viewpoints to the northwest and northeast of the facilities, but not south of the facilities.

- Figure 5.12-9 in Section 5.12.2.2 of the Draft Solar PEIS depicts a close-up of a portion of a commercial compact linear Fresnel reflector (CLFR) solar array. In response to comments, it is being clarified that the height of the top of the CLFR array is 60 ft (18 m).

- With respect to the discussion of visibility of power tower receivers in Section 5.12.2.3 of the Draft Solar PEIS, the Torresol Gemasolar 19.9 MW (tower height of 140 m [459 ft]) was observed in September 2011 and found to be visible as a bright white light on the horizon at a distance of approximately 20 mi (32 km) (Sullivan 2012b). The author suggested it would have been visible at longer distances if topography had allowed unobstructed views at greater distances.

- The discussion of PV facility impacts in Section 5.12.2.5 of the Draft Solar PEIS is being augmented as follows. Sullivan (2012b) repeatedly observed that at two thin-film facilities in Nevada, apparent panel color varied from black through a range of dark to light blue to nearly white as the observer passed from north to south (and vice versa) on either the west or east side of the facilities on sunny days. Both facilities had nontracking south-facing panels. The effect was visually striking, particularly when viewed from an automobile at highway speeds. In the space of approximately one minute, the entire collector field transitioned from black to deep blue to white, and as the viewer passed the north–south midpoint of the facility, the color sequence reversed, so that the white collectors appeared to be light blue, then dark blue, and eventually appeared black again. The phenomenon was observed at distances up to approximately 2 mi (3 km); the maximum distance from which this phenomenon might be visible is unknown.

- Section 5.12.3 of the Draft Solar PEIS presented a list of BLM and DOI publications pertinent to mitigation for impacts on visual resources. BLM IM 98-164 contains policy requirements and clarifications (BLM 1998). The following IM issued after publication of the Draft Solar PEIS are also relevant: IM 2008-204, IM 2009-167, and IM 2011-061 (BLM 2008, 2009, 2011c).

5.13 ACOUSTIC ENVIRONMENT

Solar energy facilities could produce noise impacts on nearby residents or wildlife in the areas where they are built. In addition, recent ethnographic studies confirmed that spiritual, religious, and medical practices and ceremonies are ongoing within the desert southwest and such uses could be adversely affected by a change in the acoustic environment (SWCA and University of Arizona 2011). Construction noise impacts would be short term and distinct from noise impacts from facility operations. For operations, noise generation differs by technology, with power block areas (primarily from cooling systems) being the largest noise sources. Individual dish engines also produce high noise levels; thus utility-scale dish engine facilities with thousands of dish engines would require special consideration of potential noise impacts.

In general, the information presented in the Draft Solar PEIS remains valid. The largest change in assessment of noise impacts is associated with potential impacts on terrestrial wildlife. On the basis of comments received and recent references, as applicable, this Final Solar PEIS assumes an updated approximate significance threshold of 55 dBA to correspond to the onset of adverse physiological impacts (Barber et al. 2010) on terrestrial wildlife in areas of special concern. However, there is also the potential for other effects to occur at lower noise levels (Barber et al. 2011). Additional details and discussion can be found in Section 5.10.2 of this Final Solar PEIS.

Additional updates are as follows:

5.13.1 Common Impacts

5.13.1.1 Construction: Update to Section 5.13.1.2 of the Draft Solar PEIS

- Section 5.13.1.2 of the Draft Solar PEIS is being updated to note that noise for solar energy facilities could affect soundscapes in National Parks and trails. Noise from construction would change the soundscape[1] of remote areas, including National Parks and trails, and could affect recreational uses and park visitor experiences. The NPS is charged with evaluating, protecting, and enhancing park soundscapes (NPS 2000). Given the proximity of some proposed SEZs to National Park units (e.g., Joshua Tree NP to the Riverside East SEZ, California; Death Valley NP to Amargosa Valley SEZ, Nevada), potential impacts on park soundscapes should be part of the ROW evaluation process. Site-specific assessment of noise impacts from construction activities would be required as a part of ROW application processing. Appropriate NPS personnel should be consulted during assessment of impacts on the soundscapes of NPS units.

[1] The NPS defines a soundscape as “the total ambient acoustic environment associated with a given environment (sonic environment) in an area such as a National Park. It is also refers to the total ambient sound level for the park. In a National Park setting, it is usually composed of both natural ambient sounds and a variety of human-made sounds” (NPS 2000).

5.13.1.2 Operations: Update to Section 5.13.1.3 of the Draft Solar PEIS

- Section 5.13.1.3 of the Draft Solar PEIS is being updated to note that noise for solar energy facilities could affect soundscapes in National Parks and trails. Noise from operations would change the soundscape of remote areas, including National Parks and trails and could affect recreational uses and park visitor experiences. The NPS is charged with evaluating, protecting, and enhancing park soundscapes (NPS 2000). Given the proximity of some proposed SEZs to National Park units (e.g., Joshua Tree NP to the Riverside East SEZ, California; Death Valley NP to Amargosa Valley SEZ, Nevada), potential impacts on park soundscapes should be part of the ROW evaluation process. Site-specific assessment of noise impacts from operations activities would be required as a part of ROW application processing. Appropriate NPS personnel should be consulted during assessment of impacts on the soundscapes of NPS units.

5.14 PALEONTOLOGICAL RESOURCES

As discussed in Section 5.14.1 of the Draft Solar PEIS, impacts on paleontological resources that could result from utility-scale solar energy development include those associated with initial site characterization, facility construction, operations, and decommissioning. Complete destruction of paleontological resources could result from clearing, grading, and excavation of the project area, and the construction and operation of facilities and associated infrastructure. Destruction and/or degradation of paleontological resources are possible within the project footprint downslope or downstream from the alteration of topography; the alteration of hydrological patterns; the removal of soils; the erosion of soils; runoff into and sedimentation of adjacent areas; and oil or other contaminant spills. Impacts are also possible from increased human access and subsequent disturbance (e.g., looting and vandalism) from the establishment of corridors or facilities in otherwise intact or inaccessible areas. The potential for impacts on paleontological resources would be directly related to the location of the project, the presence of significant paleontological resources, and the amount of associated land disturbance.

Information provided in Section 5.14 of the Draft Solar PEIS remains valid; there are no updates for this section.

5.15 CULTURAL RESOURCES

As discussed in Section 5.15.1 of the Draft Solar PEIS, impacts on significant cultural resources that could result from utility-scale solar energy development include those associated with initial site characterization, facility construction, operations, and decommissioning. Complete destruction of historic resources could occur from clearing, grading, and excavation of the project area, and the construction and operation of facilities and associated infrastructure. Destruction and/or degradation of cultural resources are possible within the project footprint downslope or downstream from the alteration of topography; the alteration of hydrological patterns; the removal of soils; the erosion of soils; runoff into and sedimentation of adjacent areas; and oil or other contaminant spills. Impacts are also possible from increased human access and subsequent disturbance (e.g., looting and vandalism) from the establishment of corridors or facilities in otherwise intact or inaccessible areas. The visual degradation of a landscape caused by the presence and associated land disturbance of utility-scale solar energy facilities could affect those cultural resources for which visual integrity is a component of a site's significance. The potential for impacts on significant cultural resources would be directly related to the location of the project, the presence of historic properties, and the amount of associated land disturbance.

5.15.1 Common Impacts

The information provided in Section 5.15 remains valid, with the following updates:

- Section 5.15.1, Common Impacts, second bullet on visual degradation, is being updated as follows to include impacts on settings from noise:
  - Degradation of settings associated with significant cultural resources could result from the presence of a utility-scale solar energy facility and associated land disturbances and ancillary facilities from both visual and auditory impacts. This could affect significant cultural resources for which visual integrity and/or a quiet setting is a component of the sites' significance, such as for trails, sacred sites and landscapes, historic structures, traditional cultural properties, and historic landscapes.

- Section 5.15.1, Common Impacts, third bullet on impacts from increased human access, is being updated to add the following text: "In addition, sensitive cultural resources, such as rock art, can be exposed to impacts from dust and vibrations caused by vehicular traffic and the use of heavy machinery."

- The closing paragraph on cultural resource impacts in Section 5.15.1 is being revised for clarification as follows: Cultural resources are nonrenewable and, once damaged or destroyed, are not recoverable. Therefore, if a cultural resource is damaged or destroyed during solar energy development, this particular cultural location, resource, or object would be irretrievable. Cultural resources can have different values for different groups. For example, for cultural resources that are significant for their scientific value, data recovery is one way in which some information can be salvaged should a cultural resource site be adversely affected by development activity. Certain contextual data would be invariably lost, but new cultural resources information would be made available to the scientific community. Cultural resources can also be valuable for their benefit to education, heritage tourism, or for traditional uses. These types of impacts are less easily mitigated; however, by initiating consultation with SHPOs, affected Native American tribes, and other stakeholders early in the planning process, the impact may be lessened or avoided.

- Discussion of the 1997 BLM National PA is being revised to acknowledge that this PA has been updated with the 2012 National PA.

5.16 NATIVE AMERICAN CONCERNS

As discussed in Section 5.16.1 of the Draft Solar PEIS, impacts on resources important to Native Americans (including, but not limited to, cultural sites and landscapes, traditional use areas, culturally important plants and wildlife, geographic features, and water sources) that could result from utility-scale solar energy development include those associated with initial site characterization, facility construction, operations, and decommissioning. The complete destruction of resources of significance to Native Americans could occur from the clearing, grading, and excavation of the project area, and the construction of facilities and associated infrastructure. Destruction and/or degradation of resources of significance to Native Americans is possible within the project footprint downslope or downstream from the alteration of topography; the alteration of hydrological patterns; the removal of soils; the erosion of soils; runoff into and sedimentation of adjacent areas; and oil or other contaminant spills. Impacts are also possible from the modification of natural flow systems and possible degradation of surface water quality as a result of construction activities and water withdrawals for a solar energy development project; increased human access and subsequent disturbance (e.g., looting, vandalism, and trampling) from the establishment of corridors or facilities in otherwise intact or inaccessible areas; visual degradation of a landscape caused by the presence and associated land disturbance of utility-scale solar energy facilities could affect those resources for which visual integrity is a component of a site's significance; and the pristine nature and peacefulness of a culturally significant location could be affected by noise degradation caused by utility-scale solar energy development. The potential for impacts on resources of significance to Native Americans would be directly related to the amount of land disturbance, the presence of significant resources of concern, and the location of the project.

The information provided in Section 5.16 remains valid, with the following update:

- Reference to IM 2012-032 (BLM 2011d) is being added as additional guidance for conducting Native American consultations.

5.17 SOCIOECONOMICS

Socioeconomic resources could be affected by the construction and operation of utility-scale solar energy facilities through the creation of direct and indirect employment and income, the generation of direct sales and income taxes, SEZ acreage rental and capacity payments to the BLM, the in-migration of solar facility workers and their families, and impacts on local housing markets and on local public service and educational employment. Higher levels of population in-migration may also produce social change, with the breakdown of traditional rural community structures, and social disruption, with potential increases in crime, alcoholism, depression and other social impacts, depending on the residential location of solar workers and their families, and the extent to which in-migration is temporary or permanent.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

5.18 ENVIRONMENTAL JUSTICE

Potential impacts from noise and dust during construction and operations, visual impacts, cultural impacts, and effects on property values could be incurred as a result of the construction and operation of solar facilities, and could affect environmental justice if impacts are high, adverse, and disproportionately affect low-income and minority populations. Higher levels of population in-migration may also produce social change, with the breakdown of traditional rural community structures, and social disruption, with potential increases in crime, alcoholism, depression, and other social impacts, which might disproportionately affect low-income and minority population groups, depending on the residential location of solar workers and their families, and the extent to which in-migration is temporary or permanent.

Information provided in the Draft Solar PEIS remains valid; there are no updates for this section.

5.19 TRANSPORTATION

Potential impacts on transportation near solar facilities are related to the specific project location, the project size, the delivery of equipment, materials, and supplies; and the daily commute of workers, as was discussed in Section 5.19 of the Draft Solar PEIS.

The potential general transportation impacts as discussed in the Draft Solar PEIS remain valid, with the following updates:

- It is recognized that site planning and the incorporation of site access into the local and regional road network must be conducted under the supervision of local, county, state, and federal agencies with jurisdiction over relevant matters such as road maintenance and repair, road improvements, requirements for and construction of new roads, if necessary, and traffic management. Dependent on the agencies with jurisdiction and the actual site location and existing roads and traffic patterns, approval of any site access proposal, including any mitigation measures, could require traffic studies, analyses of existing and proposed new roads to handle the added load from increased construction, commuter, and truck traffic, and possibly other environmental studies.

- In addition to potential impacts on aviation from glare from solar facility operation, improper facility design could also result in impacts from glare to motorists on nearby roads and the operation of nearby railroads.

5.20 HAZARDOUS MATERIALS AND WASTE

Section 3.5 of the Draft Solar PEIS provided a discussion of the amounts and types of hazardous materials that would be present at a solar facility during its construction, operation, decommissioning, and reclamation phases. Section 5.20 discussed the possible adverse impacts resulting from the presence and use of hazardous materials and the generation, management, and disposal of wastes. For example, the potential for contamination of environmental media from accidental releases was discussed.

Information provided in Section 5.20 of the Draft Solar PEIS remains valid; there are no updates for this section.

5.21 HEALTH AND SAFETY

As discussed in Section 5.21 of the Draft Solar PEIS, impacts on public and worker health could result from utility-scale solar energy development during initial site characterization, facility construction, operations, and decommissioning. For workers, the primary concerns are associated with injuries or fatalities from physical hazards (e.g., electrical hazards, exposure to weather extremes, and retinal damage from exposure to glare). Health and safety risks to the general public can include physical hazards from unauthorized access to construction or operational areas of solar facilities; increased risk of traffic accidents in the vicinity of solar facilities; risk of eye damage from glare from mirrors, heliostats, and power tower receivers; and aviation safety interference. Because of the remote nature of most solar facilities, these health and safety risks are generally low. Health and safety risks to both workers and the public would be addressed in project-specific health and safety plans for solar facilities.

The information provided in the Draft Solar PEIS remains valid, with the following updates:

- A potential hazard, particularly during construction, is the possible increased release of spores of the fungus that causes valley fever, a condition characterized by cold- or flu-like symptoms, which in infrequent cases also spreads through the bloodstream resulting in a more serious condition called disseminated coccidioidomycosis (named for the fungal organism causing the condition) (A.D.A.M. 2011). The best method to prevent exposure to the organism is to reduce fugitive dust emissions using best available practices as required under a facility's Dust Abatement Plan and described in various design features included for the protection of soil, water, and air resources (see Section A.2 of Appendix A). The Health and Safety plans for solar facilities in areas endemic to the coccidioides fungus should also include requirements for construction workers with exposure potential to wear dust masks.

- With respect to proper siting and design of solar facilities to eliminate glint and glare effects, it is noted that consideration of potential impacts on nearby railroad staff and passengers needs to be considered, in addition to impacts on roadway users, nearby residences, commercial areas, or other highly sensitive viewing locations. As stated in the design features for the Final Solar PEIS (see Section A.2.2.13.2 of Appendix A), efforts to eliminate glint and glare impacts or reduce them to the lowest achievable levels will be required. Regardless of the solar technology proposed, potential glint and glare effects will be assessed and potential health, safety, and visual impacts associated with glint and glare effects will be addressed.

5.22 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

A.D.A.M., 2011, "Valley Fever: San Joaquin Valley Fever, Coccidioidomycosis," in *ADAM Medical Encyclopedia*, *PubMed Health*. Available at http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002299. Last reviewed Aug. 29, 2011.

ADWR (Arizona Department of Water Resources), 2012, *Water Management Requirements for Solar Power Plants in Arizona*. Available at http://www.azwater.gov/azdwr/WaterManagement. Accessed March 28, 2012.

AMEC Americas Limited, 2005, *Mackenzie Gas Project Effects of Noise on Wildlife*, prepared for Imperial Oil Resources Ventures Limited, July. Available at http://www.ngps.nt.ca/Upload/Proponent/Imperial%20Oil%20Resources%20Ventures%20Limited/birdfield_wildlife/Documents/Noise_Wildlife_Report_Filed.pdf. Accessed Feb. 19, 2010.

Archer, S.R., and K.I. Predick, 2008, "Climate Change and Ecosystems of the Southwestern United States" *Rangelands* 30:23–28.

Barber, J.R., et al., 2010, "The Costs of Chronic Noise Exposure for Terrestrial Organisms," *Trends in Ecology and Evolution* 25(3):180–189.

Barber, J.R., et al., 2011, "Anthropogenic Noise Exposure in Protected Natural Areas: Estimating the Scale of Ecological Consequences," *Landscape Ecology* 26:1281–1295.

Bayne, E.M., et al., 2008, "Impacts of Chronic Anthropogenic Noise from Energy-Sector Activity on Abundance of Songbirds in the Boreal Forest," *Conservation Biology* 22(5):1186–1193.

Belnap, J., et al., 2001, *Biological Soil Crusts: Ecology and Management,* Technical Reference 1730-2.

BLM (Bureau of Land Management), 1998, *Instruction Memorandum 98-164, Visual Resource Management Restatement*, U.S. Department of the Interior, Washington, D.C., Sept. 8.

BLM, 2008, *Instruction Memorandum 2008-204, Offsite Mitigation*, U.S. Department of the Interior, Washington, D.C., Sept. 30.

BLM, 2009, *Instruction Memorandum 209-167, Application of the Visual Resource Management Program to Renewable Energy*, U.S. Department of the Interior, Washington, D.C., July 7**.**

BLM, 2011a, *Consideration of Lands with Wilderness Characteristics in the Land Use Planning Process (Public)*, BLM Manual 6302, Release 6-127, U.S. Department of the Interior, Washington, D.C., Feb. 25. Available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_manual.Par.46960.File.dat/6302.pdf.

BLM, 2011b, *Consideration of LWCs for Project-Level Decisions in Areas Not Analyzed in Accordance with BLM Manual 6302 (Public)*, BLM Manual 6303, Release 6-128, U.S. Department of the Interior, Washington, D.C., Feb. 25. Available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_manual.Par.36094.File.dat/6303.pdf.

BLM, 2011c, *Instruction Memorandum 2011-060, Solar and Wind Energy Applications—Due Diligence*, U.S. Department of the Interior, Washington, D.C., Feb. 7.

BLM, 2011d, *Instruction Memorandum No. 2012-032, Native American Consultation and Section 106 Compliance for the Solar Energy Program Described in Solar Programmatic Environmental Impact Statement*, U.S. Department of the Interior, Washington, D.C., Dec. 1.

BLM and DOE (BLM and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BOR (U.S. Bureau of Reclamation), 2012, *WaterSMART*. Available at http://www.usbr.gov/WaterSMART/water.html. Accessed March 28, 2012.

Brattstrom, B.H., and M.C. Bondello, 1983, "Effects of Off-Road Vehicle Noise on Desert Vertebrates," pp. 167–206 in *Environmental Effects of Off-Road Vehicles, Impacts and Management in Arid Region,* R.H. Webb and H.G. Wilshire (editors), Springer-Verlag, New York, N.Y. (as cited in Larkin 1996).

Bredehoeft, J., and T. Durbin, 2009, “Ground Water Development—The Time to Full Capture Problem,” *Ground Water* 47(4):506–514.

Brown, B.T., et al., 1999, “The Influence of Weapons-Testing Noise on Bald Eagle Behavior,” *Journal of Raptor Research* 33:227–232.

Brumm, H., 2004, “The Impact of Environmental Noise on Song Amplitude in a Territorial Bird,” *Journal of Animal Ecology* 73:434–440.

CDFG (California Department of Fish and Game), 2012, *Lake and Streambed Alteration Program.* Available at http://www.dfg.ca.gov/habcon/1600. Accessed March 28.

Chan, A.A.Y.-H., et al., 2010, “Anthropogenic Noise Affects Risk Assessment and Attention: The Distracted Prey Hypothesis,” *Biology Letters* 6(4):458–461.

Datry, T., 2011, “Benthic and Hyporheic Invertebrate Assemblages along a Flow Intermittence Gradient: Effects of Duration of Dry Events,” *Freshwater Biology* 57(3):563–574.

Delaney, D.K., et al., 1999, “Effects of Helicopter Noise on Mexican Spotted Owls,” *Journal of Wildlife Management* 63(1):60–76.

Desert Tortoise Council, 1994 (revised 1999), *Guidelines for Handling Desert Tortoises during Construction Projects*, E.L. LaRue, Jr. (editor), Wrightwood, Calif.

Egnor, S.E.R., et al., 2007, “Tracking Silence: Adjusting Vocal Production to Avoid Acoustic Interference,” *Journal of Comparative Physiology A* 193:477–483.

EPA (U.S. Environmental Protection Agency), 2012, *Clean Water Act Definition of “Waters of the United States*.” Available at http://water.epa.gov/lawsregs/guidance/wetlands/CWAwaters.cfm. Accessed March 28, 2012.

Field, K.J., et al., 2007, “Return to the Wild: Translocation as a Tool in Conservation of the Desert Tortoise (*Gopherus agassizii*),” *Biological Conservation* 136:232–245.

Francis, C.D., et al., 2009, “Noise Pollution Changes Avian Communities and Species Interactions,” *Current Biology* 19:1415–1419.

Fthenakis, V.M., et al., 2004, “Experimental Investigation of Emissions and Redistribution of Elements in CdTe PV Modules during Fires,” presented at the Nineteenth European PV Solar Energy Conference, Paris, France, June 7–11.

Habib, L, et al., 2007, “Chronic Industrial Noise Affects Pairing Success and Age Structure of Ovenbirds *Seiurus aurocapilla*,” *Journal of Applied Ecology* 44:176–184.

Halfwerk, W., et al., 2011, “Negative Impact of Traffic Noise on Avian Reproductive Success,” *Journal of Applied Ecology* 48:210–219.

Herrera–Montes, M.I., and T.M. Aide, 2011, “Impact of Traffic Noise on Anuran and Bird Communities,” *Urban Ecosystems* 14:415–427.

Hockin, D., et al., 1992, “Examination of the Effects of Disturbance on Birds with Reference to Its Importance in Ecological Assessments,” *Journal of Environmental Management* 36:253–286.

Horváth, G., et al., 2009, “Polarized Light Pollution: A New Kind of Ecological Photopollution,” *Frontiers in Ecology* 7(6):317–325.

Horváth, G., et al., 2010, “Reducing the Maladaptive Attractiveness of Solar Panels to Polarotactic Insects,” *Conservation Biology* 24:1644–1653.

Krausman, P.R., et al., 2004, “Effects of Military Operations on Behavior and Hearing of Endangered Sonoran Pronghorn,” *Wildlife Monographs* 157:1–41.

Lackey, M.L., et al., 2011, “Effects of Road Construction Noise on the Endangered Golden-Cheeked Warbler,” *Wildlife Society Bulletin* 35(1):15–19.

Lake, P.S, 2003, “Ecological Effects of Perturbation by Drought in Flowing Waters,” *Freshwater Biology* 48:1161–1172.

Larkin, R.P., 1996, *Effects of Military Noise on Wildlife: A Literature Review*, Technical Report 96/21, U.S. Army Construction Engineering Research Laboratory, Champaign, Ill.

Larned, S., et al. 2010, “Emerging Concepts in Temporary-River Ecology, “ *Freshwater Biology* 55:717–738.

Leonard, M.L., and A.G. Horn, 2008, “Does Ambient Noise Affect Growth and Begging Call Structure in Nestling Birds?” *Behavioural Ecology* 19:502–507.

Levick, L., et al., 2008, *The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest*, EPA/600/R-08/134, ARS/233046, U.S. Environmental Protection Agency and USDA/ARS, Southwest Watershed Research Center, Nov.

Longcore, T., and C. Rich, 2004, “Ecological Light Pollution,” *Frontiers in Ecology and the Environment* 2(4):191–198.

Manci, K.M., et al., 1988, *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis*, NERC-88/29, U.S. Fish and Wildlife Service, National Ecology Research Center, Ft. Collins, Colo.

McCluney, K.E., and J.L. Sabo, 2011, “River Drying Lowers the Diversity and Alters the Composition Assemblage of Desert Riparian Arthropods,” *Freshwater Biology* 57(1):91–103.

Navara, K.J., and R.J. Nelson, 2007, "The Dark Side of Light at Night: Physiological, Epidemiological, and Ecological Consequences," *Journal of Pineal Research* 43(3):215–224.

NPS (National Park Service), 2000, *Director's Order #47: Soundscape Preservation and Noise Management*, approved by Robert Stanton, Director, Dec. 1. Available at http://www.nps.gov/policy/DOrders/DOrder47.html. Accessed May 7, 2012.

Parris, K.M., and A. Schneider, 2008, "Impacts of Traffic Noise and Traffic Volume on Birds of Roadside Habitats," *Ecology and Society* 14(1):20. Available at http://www.ecologyandsociety.org/vol14/iss1/art29. Accessed Feb. 22, 2012.

Pater, L.L., et al., 2009, "Recommendations for Improved Assessment of Noise Impacts on Wildlife," *Journal of Wildlife Management* 73(5):788–795.

Quinn, J.L., et al., 2006, "Noise, Predation Risk Compensation and Vigilance in the Chaffinch *Fringilla coelebs*," *Journal of Avian Biology* 37:601–608.

Rheindt, F.E., 2003, "The Impact of Roads on Birds: Does Song Frequency Play a Role in Determining Susceptibility to Noise Pollution?" *Journal of Ornithology* 144:295–306.

Riggs, A.C., and J.E. Deacon, 2002, "Connectivity in Desert Aquatic Ecosystems: The Devils Hole Story," *Conference Proceedings, Spring-Fed Wetlands: Important Scientific and Cultural Resources of the Intermountain Region*, May 7–9, Las Vegas, Nev.

Schaub, A., et al., 2008, "Foraging Bats Avoid Noise," *The Journal of Experimental Biology* 211:3174–3180.

Secretary of the Interior, 2010, "Protecting Wilderness Characteristics on Lands Managed by the Bureau of Land Management," Secretarial Order 3310, Dec. 22. Available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/news_release_attachments.Par.26564.File.dat/sec_order_3310.pdf.

Slabbekoorn, H., and E.A.P. Ripmeester, 2008, "Birdsong and Anthropogenic Noise: Implications and Applications for Conservation," *Molecular Ecology* 17(1):72–83.

Sponseller, R.A., et al., 2010, "Responses of Macroinvertebrate Communities to Long-term Flow Variability in a Sonoran Desert Stream," *Global Change Biology* 16:2891–2900.

Stanley, E.H., et al., 1994, "Invertebrate Resistance and Resilience to Intermittency in a Desert Stream, *American Midland Naturalist* 131:288–300.

Sullivan, R.G., et al., 2012a, "Wind Turbine Visibility and Visual Impact Threshold Distances in Western Landscapes," *Proceedings, National Association of Environmental Professionals 2012 Annual Conference,* Portland, Ore., May 21–24.

Sullivan, R.G., et al., 2012b, “Visual Impacts of Utility-Scale Solar Energy Facilities on Southwestern Desert Landscapes,” *Proceedings, National Association of Environmental Professionals 2012 Annual Conference,* Portland, Ore., May 21–24.

Sun, J.W.C., and P.M. Narins, 2005, “Anthropogenic Sounds Differentially Affect Amphibian Call Rate,” *Biological Conservation* 121:419–427.

Swaddle, J.P., and L.C. Page, 2007, “High Levels of Environmental Noise Erode Pair Preferences in Zebra Finches: Implications for Noise Pollution,” *Animal Behaviour* 74:363–368.

SWCA and University of Arizona (SWCA Environmental Consultants and Bureau of Applied Research in Anthropology), 2011, *Ethnographic and Class I Records Searches for Proposed Solar Energy Zones in California, Nevada, and Utah for the Bureau of Land Management’s Solar Programmatic Environmental Impact Statement*, prepared by SWCA Environmental Consultants, Albuquerque, N.M., and Bureau of Applied Research in Anthropology, University of Arizona, Tucson, Ariz., Dec.

Utah DWR (Utah Division of Water Rights), 2004, *Stream Alteration Program Fact Sheet, SA-1*, 2nd ed. Available at http://www.waterrights.utah.gov/strmalt/whitepapers/default.asp. Accessed March 28, 2012.

Wright, A.J., et al. 2007, “Anthropogenic Noise as a Stressor in Animals: A Multidisciplinary Perspective,” *International Journal of Comparative Psychology* 20:250–273.

Zhou, Y., 2009, “A Critical Review of Groundwater Budget Myth, Safe Yield and Sustainability,” *Journal of Hydrology* 370:207–213.

5.23 ERRATA TO CHAPTER 5 OF THE DRAFT SOLAR PEIS

This section presents corrections to material presented in the Draft Solar PEIS. The need for these corrections was identified in several ways: through comments received on the Draft Solar PEIS and the Supplement to the Draft (and verified by the authors), through new information obtained by the authors subsequent to publication of the Draft Solar PEIS and the Supplement to the Draft, or through additional review of the original material by the authors. Table 5.23-1 provides corrections to information presented in the Draft Solar PEIS.

TABLE 5.23-1 Errata to Chapter 5 (Impacts of Solar Energy Development and Potential Mitigation Measures) of the Draft Solar PEIS

Section No.	Page No.	Line No.	Figure No.	Table No.	Correction
5.4.2.1.1	5-12	32			The following sentence should be added to the end of the paragraph: "The effects of these construction activities include potential loss of forage and displacement of wild horses and burros from preferred habitats."
5.4.2.3	5-13	15–16			"access to water sources" should read "retention of wild horse and burro access to water resources."
5.7.1	5-20 to 5-21			5.7-1	Note that for each entry in this table, all of the resources listed in the last column, "Resources Affected by Soil Impact," are affected by all the activities listed in the second column, "Impacting Project Activities." The format in the Draft Solar PEIS is somewhat misleading in that it appears that one activity affects only one resource (because each line is separated by a space).
5.7.2	5-27	23			A parenthetical phrase "(for the same electricity production)" should be added to the end of the sentence on this line.
5.7.4.2	5-35	28			The ")." at the end of the sentence has no meaning and should be deleted.
5.10.2.1.1	5-73	45			The word "could" should be replaced with "would."
5.10.2.1.2	5-74	24			The word "animals" should be replaced with "species."
5.10.2.1.3	5-81	2			The following sentence should be added to the end of the paragraph: "Section 5.10.3.1.3 discusses the potential impact of polarized light reflected off of solar panels on aquatic insects."
5.10.2.1.3	5-82	23			The first sentence should read: "Night lighting could also disturb wildlife in the solar energy project area (e.g., alter reproductive activities, predator/prey interactions, and orientation capabilities) (Longcore and Rich 2004; Navara and Nelson 2007)."

TABLE 5.23-1 (Cont.)

Section No.	Page No.	Line No.	Figure No.	Table No.	Correction
5.10.2.1.4	5-85	28			Delete: "In the extreme."
5.10.2.1.5	5-85	35			The section title should read as, "5.10.2.1.5 Transmission Lines."
5.10.2.1.6	5-90 to 5-96			5.10-2	The column heading "Expected Relative Impact for Different Plant Communities" should read as, "Expected Relative Impact for Different Wildlife Groups."
5.10.5	5-126 to 5-144				Each mention of "crucial wildlife habitats" should be followed by "and linkages." The resulting phrase should state "crucial wildlife habitats and linkages."
5.10.5.1	5-127	9			"and linkages" should be added after "wildlife habitats."
5.10.5.1	5-127	23			The following sentence should be added: "Pre-disturbance surveys should be designed with seasonal and other life-history constraints in mind to ensure that they are conducted during periods of optimum detection of the ecological resources being investigated."
5.10.5.1	5-128	23			The following mitigation measure should be deleted: "Plant species that would attract wildlife should not be planted along high-speed or high-traffic roads."
5.10.5.1	5-128	31–34			The following mitigation measure should be deleted: "If cattle guards are identified for the design for new roads, they should be wildlife friendly. To the extent practicable, improvements should be made to existing ways and trails that require cattle to pass through existing fences, fence-line gates, new gates, and standard wire gates alongside them."
5.10.5.3	5-137	23			Species that would attract wildlife should not be planted along high-speed or high-traffic roads.
5.10.5.3	5-137	19			"sage-grouse" should be changed to "sage grouse."

TABLE 5.23-1 (Cont.)

Section No.	Page No.	Line No.	Figure No.	Table No.	Correction
5.11	All				In discussing CO_2 emissions, the Draft Solar PEIS used terminology referring to "displaced" emissions, e.g.: "CO_2 emissions from fossil-fuel-fired power plants could be *displaced* by solar facilities." Throughout Section 5.11, the term "displaced" should be replaced with "avoided", e.g.: "CO_2 emissions from fossil-fuel-fired power plants could be *avoided* by solar facilities."
5.11.4	5-157	45			The following should be added to the end of the paragraph, "The actual magnitude of emissions avoided would depend on many factors influencing the generation and distribution of electricity. The estimates presented in this Final Solar PEIS approximate the maximum values that could be achieved, because they assume full build-out of each proposed SEZ."
5.12	5-160	Text box			The following should be added to the last sentence under *Viewer Distance and Angle*: ", and the full size, geometry, and various components of the project may be more apparent."
5.12	5-162	46			"Light pollution" should be changed to "Facility and vehicle lighting that causes light pollution at night."
5.12	5-163	28–30			"This zone includes areas beyond 15 mi [24 km] or where only the form or outline of the project can be seen or the project cannot be seen at all (BLM 1986a) should read as, "This zone includes areas that are not visible within the foreground-middleground and background zones, and areas beyond the background zone (BLM 1986a)."
5.12	5-164	6			"and omissions" should be added.
5.12	5-164	8			"Detailed" should be changed to "More detailed."
5.12	5-164	19			"would include" should be changed to "could account for."
5.12	5-165	21			"the distance to the facilities were short" should be deleted.

TABLE 5.23-1 (Cont.)

Section No.	Page No.	Line No.	Figure No.	Table No.	Correction
5.12.1.3.1	5-169	15			", making the facility's size and strong regular geometry more apparent" should be added after "visible."
5.12.1.5	5-174	14			"if they exceeded 200 ft (m) in height, although towers this tall are unusual" should be added after "lights."
5.12.2.1.1	5-176	22			"2010" should be "2012b."
5.12.2.1.1	5-179	16			"2010" should be "2012b."
5.12.2.1.1	5-179	21			"2010" should be "2012b."
5.12.2.1.1	5-179	23			"2010" should be "2012b."
5.12.2.1.1	5-182	9			"2010" should be "2012b."
5.12.2.3	5-184	4			"potentially" should be added after "are."
5.12.2.3	5-186	9			"2010" should be "2012b."
5.12.2.3	5-186	20			"2010" should be "2012b."
5.12.2.3	5-187	5			"up to" should be changed to "more than."
5.12.2.5	5-191	12			"2010" should be"2012b."
5.12.2.5	5-191	13			"thin film" should be added before "PV."
5.12.2.5	5-191	15–16			The following should be deleted: "In addition, the apparent color of the panels varied from black to gray to silvery white, depending on viewer location and other visibility factors."

TABLE 5.23-1 (Cont.)

Section No.	Page No.	Line No.	Figure No.	Table No.	Correction
5.15.3	5-220	Footnote 7			The footnote on the PA incorrectly states that the National Council of State Historic Preservation Officers (SHPOs) is a party to the Solar Programmatic Agreement; the text should be revised to state "A PA specific to solar development on BLM-administered lands is being negotiated among the BLM, the six individual SHPOs, and the Advisory Council on Historic Preservation (ACHP).

6 ANALYSIS OF BLM'S SOLAR ENERGY DEVELOPMENT ALTERNATIVES

Through this PEIS, the BLM is evaluating three alternatives for managing utility-scale solar energy development on BLM-administered lands in the six-state study area. These alternatives, which are described in Chapter 2, include two action alternatives—a solar energy development program alternative and an SEZ program alternative—and a no action alternative.

Under both action alternatives, the BLM would establish a comprehensive Solar Energy Program to replace certain elements of its interim Solar Energy Policies (see Section A.1 of Appendix A of this Final Solar PEIS for a list of the interim policies). Under the action alternatives, the BLM proposes to exclude categories of lands from utility-scale solar energy development[1] and identify specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM would prioritize development. The BLM will emphasize and incentivize development within SEZs and proposes a collaborative process to identify additional SEZs. To accommodate the flexibility described in the BLM's program objectives, the program alternative allows for utility-scale solar development in variance areas outside of SEZs in accordance with the proposed variance process. The SEZ alternative, in contrast, would only allow development within SEZs. Both BLM action alternatives would also establish authorization policies for utility-scale solar energy development on BLM-administered lands, as well as required programmatic design features that would apply to all utility-scale solar energy projects on BLM-administered lands (see Section 2.2.2 and Section A.2 of Appendix A).[2] These design features represent accepted methods to avoid, minimize, and/or mitigate potential adverse impacts from solar energy development including associated facilities such as transmission, roads, and other infrastructure.

Under both action alternatives, the elements of the BLM's proposed Solar Energy Program would be implemented through amendment of the land use plans within the six-state study area (see Appendix C). Programs similar to the Solar Energy Program have been established and have proven useful for other types of renewable energy development, specifically for wind and geothermal energy development, and for the identification of energy corridors (more information about these and other BLM energy programs is available at http://www.blm.gov/wo/st/en/prog/energy.html).

---

[1] The exclusions proposed under the action alternatives would apply only to the siting of utility-scale solar energy generation facilities and not to any required supporting linear infrastructure, such as roads, transmission lines, and natural gas or water pipelines. Management decisions for supporting linear infrastructure, including available lands, are defined in existing applicable land use plans. Siting of supporting infrastructure would be analyzed in project-specific environmental reviews.

[2] As discussed in Section 2.2.2, design features are mitigation measures that have been incorporated into the proposed action or alternatives to avoid or reduce potential adverse impacts. The proposed programmatic design features of the Solar Energy Program would apply to all utility-scale solar energy ROWs on BLM-administered lands under both action alternatives. Additional SEZ-specific design features have been proposed for individual SEZs.

Under the no action alternative, the BLM would continue to develop solar energy resources under its existing policies. The agency would not take further steps to programmatically or comprehensively identify lands excluded and lands available for solar energy development and would not establish programmatic policies or required design features.

Table 6.1-1 lists the approximate amount of land that would be available for utility-scale solar ROW applications in each state under the three alternatives. Maps showing the distribution of these lands are included at the end of Chapter 2 (see Figures 2.2-1 through 2.2-6).

This chapter presents an analysis of BLM's three management alternatives in terms of their effectiveness in meeting the objectives outlined as part of BLM's purpose and need for action (see Section 1.3.1 of this Final Solar PEIS). These objectives include the following:

- Facilitate near-term utility-scale solar energy development on public lands;
- Minimize potential negative environmental impacts;
- Minimize potential negative social and economic impacts;
- Provide flexibility to the solar industry to consider a variety of solar energy projects (e.g., location, facility size, and technology);
- Optimize existing transmission infrastructure and corridors;
- Standardize and streamline the authorization process for utility-scale solar energy development on BLM-administered lands; and
- Meet projected demand for solar energy development (as estimated by the RFDS developed for this PEIS [see Section 2.4]).

This chapter also considers the extent to which each option would assist the BLM in meeting the mandates of the Energy Policy Act of 2005 (P.L. 109-58) and Secretarial Order 3285A1 (Secretary of the Interior 2010) (see Section 1.1), including but not limited to the mandate to identify and prioritize specific locations best-suited for utility-scale solar energy development on public lands.

For each of the alternatives, this chapter includes a summary of programmatic-level information on the potential impacts on resources and resource uses from solar energy development. The generally qualitative level of detail presented for individual alternatives is commensurate with the programmatic decisions to be made, which are primarily planning-level decisions (i.e., allocation and exclusion decisions); however, some impacts have been quantified.

The summary of impacts of the alternatives given in Table 6.1-2 is based on the detailed discussion of the affected environment and impacts of solar energy development provided in

TABLE 6.1-1 Summary of Potentially Developable BLM-Administered Land under the No Action Alternative, the Solar Energy Development Program Alternative, and the SEZ Program Alternative[a]

State	Total State Acreage[b]	BLM-Administered Lands Constituting No Action Alternative (acres)	BLM-Administered Lands Constituting Solar Energy Development Program Alternative (acres)[c]	BLM-Administered Lands Constituting SEZ Program Alternative (acres)
Arizona	72,700,000	9,181,178	3,380,877	5,966
California	100,200,000	10,815,285	766,078	153,627
Colorado	66,500,000	7,282,258	95,128	16,308
Nevada	70,300,000	40,760,443	9,07,145	60,395
New Mexico	77,800,000	11,783,665	4,184,520	29,964
Utah	52,700,000	18,098,240	1,809,759	18,658
Total	440,200,000	97,921,069	19,312,506	284,918

[a] To convert acres to km^2, multiply by 0.004047.

[b] From Table 4.2-1 of the Draft Solar PEIS.

[c] The acreage estimates were calculated on the basis of the best available GIS data. GIS data were not available for the entire set of exclusions; thus the exact acreage could not be calculated. Exclusions that could not be mapped would be identified during the ROW application process.

Chapters 4 and 5 of the Draft and Final Solar PEIS.[3] The in-depth analyses of potential impacts of development in the proposed SEZs as presented in Chapters 8 through 13 of the Draft and Final Solar PEIS provided an additional basis for the summary of impacts of the SEZ alternative that is provided in Table 6.1-2. The SEZ analyses included an assessment of cumulative impacts, considering ongoing and reasonably foreseeable actions specifically for the vicinity of each SEZ.

The impacts of solar development itself are largely similar across the program alternatives. However, because the alternatives represent planning-level decisions (i.e., allocation and exclusion decisions), differences between the alternatives are found in the location, pace, and concentration of solar energy development.

Sections 6.1 through 6.3 discuss the potential effectiveness of each of the alternatives at meeting the described objectives and their potential environmental impacts. Section 6.4 compares the alternatives and identifies BLM's preferred alternative. Section 6.5.1 provides an update of the ongoing and reasonably foreseeable activities in the six-state study area, and Section 6.5.2 includes an update of the cumulative impacts assessment that was provided in the

[3] Appendix J also provides a comparison of potential species effects by alternative.

TABLE 6.1-2 Summary-Level Assessment of Potential Environmental Impacts of Utility-Scale Solar Energy Development by Alternative[a]

Resource	Program Alternative (approximately 285,000 acres[b] in priority areas, and approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Lands and Realty	Solar energy development would preclude other land uses within the project footprint and could alter the character of largely rural areas. Development of supporting infrastructure (e.g., new transmission lines and roads) would also locally affect land use. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could potentially be more dispersed. There would be no specific design features to reduce impacts.
Specially Designated Areas and Lands with Wilderness Characteristics	Specially designated areas and lands with wilderness characteristics could be significantly affected through direct and indirect impacts (e.g., visual impacts, reduced access, noise impacts, and fugitive dust) during both the construction and operations phases. Similar impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. All NLCS lands would be excluded. Also excluded would be ACECs; SRMAs (except in Nevada and portions of the Yuma East SRMA in Arizona); DWMAs; National Recreation Trails and National Backcountry Byways; National Historic and Scenic Trails; Wild, Scenic, and Recreational Rivers, and segments of rivers determined to be eligible or suitable for Wild and Scenic River status; and lands within the proposed Mojave Trails National Monument. All areas where there is an applicable land use plan decision to protect lands with wilderness characteristics would be excluded.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This concentration of development could increase the magnitude of potential impacts but affect a smaller number of areas.	Same impacts as program alternative, except that only most NLCS lands are excluded from solar energy development and other exclusions do not apply. There would be no specific design features to reduce impacts. Impacts could potentially be more dispersed and greater on specially designated lands and lands with wilderness characteristics due to few exclusions under the no action alternative.

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Rangeland Resources	Some livestock grazing allotments may be affected by solar energy development through reductions in acreage and/or loss of AUMs. Wild horses and burros also could be affected, with animals displaced from the development area; the number of wild horse and burro HMAs overlapping with or in the vicinity of lands available for ROW application would be less than under the no action alternative. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller geographic area within a known set of grazing allotments and HMAs (there is very little overlap of SEZs with wild horse and burro HMAs).	Same impacts as program alternative, except impacts could potentially be more dispersed, and there is less certainty about which grazing allotments and HMAs potentially could be affected. There would be no specific design features to reduce impacts.
Recreation	Recreational uses would be precluded within lands used for solar energy development. Recreational experiences could be adversely affected in areas proximate to solar energy projects and related transmission. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. All SRMAs are excluded from solar energy development (except in Nevada and portions of the Yuma East SRMA in Arizona). Also excluded are developed recreational facilities and special-use permit recreation sites.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect fewer recreational resources.	Same impacts as program alternative. There would be no explicit exclusions to avoid SRMAs, recreational facilities, and special-use permit recreation sites. There would be no specific design features to reduce impacts. Impacts could potentially be more dispersed and greater on those recreational areas that would be excluded under the action alternatives.

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Military and Civilian Aviation	Military and civilian aviation impacts would be identified and adequately avoided, minimized and/or mitigated prior to the BLM's issuance of a ROW authorization.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could potentially be more dispersed.
Soil Resources and Geologic Hazards	Development of large tracts of land up to several thousand acres for solar energy facilities and related infrastructure would result in impacts on soil resources in terms of soil compaction and erosion, although these impacts could be effectively avoided, minimized and/or mitigated. Impacts on biological soil crusts would be long term and possibly irreversible. These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could potentially be more dispersed. There would be no specific design features to reduce impacts.
Mineral Resources	Mineral development within the project footprint for solar energy development would generally be an incompatible use; however, some resources underlying the project area might be developable (e.g., directional drilling for oil and gas or geothermal resources, underground mining). These impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could be potentially more dispersed.
	Lands within SEZs may be withdrawn from location and entry under the mining laws.	Lands within SEZs may be withdrawn from location and entry under the mining laws.	No SEZs would be identified or withdrawn.

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Water Resources	Solar thermal projects with wet-cooling systems require large volumes of water, with potentially significant environmental impacts. Solar thermal projects with dry-cooling systems need less than one-tenth of the amount of water required for wet-cooling systems. Projects would necessarily be limited to locations with sufficient groundwater supplies where water rights and the approval of water authorities could be obtained. All solar energy facilities require smaller volumes of water for mirror or panel washing and potable water uses, which would result in relatively minor impacts on water supplies. Other potential impacts, including modification of surface and groundwater flow systems, water contamination resulting from chemical leaks or spills, and water quality degradation by runoff or excessive withdrawals, can be effectively avoided, minimized and/or mitigated. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect fewer water resources.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.
Vegetation	Solar development will typically require the total removal of vegetation at most facilities, which could result in significant direct impacts in terms of increased risk of invasive species introduction, changes in species composition and distribution, habitat loss (e.g., dune or riparian areas), and damage to biological soil crusts. Indirect impacts also likely in terms of dust deposition, altered drainage patterns, runoff, and sedimentation. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts but affect a smaller number of areas.	Same impacts as program alternative. There would be no explicit exclusions to avoid known sensitive vegetation resources and no specific design features to reduce impacts.

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Vegetation *(Cont.)*	Design features could effectively avoid or minimize many impacts.		Impacts could potentially be more dispersed and greater on those vegetation resources excluded under the action alternatives.
	Less than 14% each of the Central Basin and Range and Chihuahuan Deserts Ecoregions, and less than 7% each of the Madrean Archipelago, Mojave Basin and Range, and Sonoran Basin and Range Ecoregions are located within the lands that would be available for application. Other ecoregions coincide with these lands at levels below 5%.	Of the five ecoregions that coincide with SEZs, less than 1% of each ecoregion would be available for ROW application.	Lands available for ROW application span 22 ecoregions. More than 50% of 2 ecoregions (Central Basin and Range, Northern Basin and Range) would be available for application.
	The land cover types for the following example species overlap with variance areas available for ROW application by the percentages shown: Joshua tree – less than 7% Saguaro – less than 7%	Less than 1% of the land cover type for Joshua tree and saguaro species is located within the SEZs.	The land cover types for the following example species overlap with the lands that would be available for ROW application by the percentages shown: Joshua tree – about 31% Saguaro – about 26%

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Wildlife and Aquatic Biota	Numerous wildlife species would be adversely affected by loss of habitat, disturbance, loss of food and prey species, loss of breeding areas, effects on movement and migration, introduction of new species, habitat fragmentation, and changes in water availability. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. Exclusion of ACECs, Research Natural Areas, big game migratory corridors and winter ranges, and lands with seasonal restrictions as identified in applicable land use plans would avoid impacts on wildlife in specific areas The following example species' habitats overlap with variance areas available for ROW application by the percentages shown:	Same impacts as program alternative, except the potential area of impact would be limited to a smaller, known geographic area.	Same impacts as program alternative. There would be no explicit exclusions to avoid known sensitive wildlife resources, and no specific design features to reduce impacts. Impacts could potentially be more dispersed and greater on those wildlife resources excluded under the action alternatives. The following example species' habitats overlap with the lands that would be available for ROW application by the percentages shown:
	Western rattlesnake – less than 6% Golden eagle – less than 6% Black-tailed jackrabbit – less than 6% Pronghorn – less than 5% Mule deer – less than 6% Mountain lion – less than 5%	Less than 1% of the habitats for western rattlesnake, golden eagle, black-tailed jackrabbit, pronghorn, mule deer, and mountain lion are located within the SEZs.	Western rattlesnake – about 27% Golden eagle – about 23% Black-tailed jackrabbit – about 24% Pronghorn – about 22% Mule deer – about 22% Mountain lion – about 21%

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Special Status Species	Special status species and critical habitats would be protected in accordance with ESA requirements either through avoidance, translocation (plants), or acquisition and protection of compensatory habitat. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. Critical habitat designated or proposed by the USFWS would be excluded. All ACECs designated for habitat would be excluded along with identified desert tortoise translocation sites and other areas where the BLM has made a commitment to protect sensitive species (including Mohave ground squirrel and flat-tailed horned lizard habitat in California, greater sage-grouse habitat in California, Nevada, and Utah, and Gunnison's sage-grouse habitat in Utah). Variance areas for ROW application include areas of potentially suitable habitat for special status species (see Appendix J of this Final Solar PEIS). For example, the following species' habitats overlap by the percentages shown:	Special status species and critical habitats would be protected as under program alternative. Lands available for ROW application within SEZs include areas of potentially suitable habitat for special status species (see Appendix J of this Final Solar PEIS).	Special status species and critical habitats would be protected as under program alternative. There would be no specific design features to reduce impacts. In some cases, habitat identified by state fish and game agencies would be excluded, as identified through applicable land use plan decisions. Critical habitat, ACECs designated for habitat value, and other areas where the BLM has made a commitment to protect sensitive species would not be excluded. Lands available for ROW application include areas of potentially suitable habitat for special status species (see Appendix J). For example, the following species' habitats overlap by the percentages shown:

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Special Status Species *(Cont.)*	Plants: Nevada dune beardtongue – less than 61% White-margined beardtongue – less than 8% Munz's cholla – less than 16% Animals: Desert tortoise – less than 12% Western burrowing owl – less than 8% Greater sage-grouse – less than 7% Gunnison prairie dog – less than 3% Gunnison sage-grouse – less than 1% Northern aplomado falcon – less than 11% Southwestern willow flycatcher – less than 1% Townsend's big-eared bat – less than 6% Utah prairie dog – less than 11%	For example, about 1% or less of the habitat for two plant species (Nevada dune beard tongue, white-margined beard tongue) and nine animal species (desert tortoise, western burrowing owl, greater sage-grouse, Gunnison prairie dog, Gunnison sage-grouse, northern aplomado falcon, and southwestern willow flycatcher, Townsend's big-eared bat, and Utah prairie dog) are located within the SEZs; less than 4% of Munz's cholla habitat is located within the SEZs.	Plants: Nevada dune beardtongue – 66% White-margined beardtongue – 34% Munz's cholla – 45% Animals: Desert tortoise – 29% Western burrowing owl – 27% Greater sage-grouse – 54% Gunnison prairie dog – 15% Gunnison sage-grouse – 24% Northern aplomado falcon – 26% Southwestern willow flycatcher – 7% Townsend's big-eared bat – 23% Utah prairie dog – 36%

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Air Quality and Climate	Air quality would be adversely affected locally and temporarily during construction by fugitive dust and vehicle emissions, although impacts would be relatively minor and could be mitigated (e.g., dust control measures, emissions control devices, and vehicle maintenance). Operations would result in few air quality impacts. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. Climate Change: Relatively minor CO_2 emissions would be generated by the use of heavy equipment, vehicles, and backup generators. Overall, CO_2 emissions could be reduced if solar energy production avoids fossil fuel energy production.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas. Climate Change: Same impacts as program alternative, assuming level of development is the same.	Same impacts as program alternative, except impacts could be potentially more dispersed and of smaller magnitude locally. There would be no specific design features to reduce impacts. Climate Change: Same impacts as program alternative, assuming level of development is the same.
Visual Resources	Solar energy projects and associated infrastructure introduce strong contrasts in forms, line, colors, and textures of the existing landscape, which may be perceived as negative visual impacts. Suitable development sites typically located in basin flats surrounded by elevated lands where sensitive viewing locations exist. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Various potentially sensitive visual resource areas, including National Historic and Scenic Trails, National Historic and Natural Landmarks, properties designated or eligible for the *National Register of Historic Places*, and areas with important cultural resources that possess historical vistas may be impacted.	Same impacts as program alternative, except the impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas. SEZs are visible from approximately	Same impacts as program alternative. Some NLCS lands are excluded from solar energy development under the no action alternative. There would be no specific design features to reduce impacts. Impacts could be potentially more dispersed and greater on those areas excluded under the action alternatives.

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Visual Resources *(Cont.)*	Design features could effectively avoid or minimize many impacts but some large impacts cannot be avoided. All NLCS lands and ACECs are excluded. All SRMAs are excluded (except in Nevada and portions of the Yuma East SRMA in Arizona). Developed recreational facilities, special-use permit recreation sites, National Recreation Trails, and National Backcountry Byways are excluded. Approximately 995 potentially sensitive visual resource areas (not including ACECs) are located in or within 25 mi[c] of the lands available for ROW viewsheds.	105 potentially sensitive visual resource areas (not including ACECs) within 25 mi.	About 1,473 potentially sensitive visual resource areas (not including ACECs) are located in or within 25 mi of the lands available for ROW application and could be affected by solar development within their viewsheds.
Acoustic Environment	Construction-related noise could adversely affect nearby residents and/or wildlife, and would be greatest for concentrating solar power projects requiring power block construction. Operations-related noise impacts would generally be less significant than construction-related noise impacts but could still be significant for some receptors located near power block or dish engine facilities. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.
Paleonto-logical Resources	Paleontological resources subject to loss during construction, but impacts also possible during operations. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.

TABLE 6.1-2 (Cont.)

Resource	Program Alternative (approximately 285,000 acres in priority areas) (approximately 19 million acres subject to variance process)	SEZ Alternative (approximately 285,000 acres in priority areas)	No Action Alternative (approximately 98 million acres available for application)
Cultural Resources and Native American Concerns	Cultural resources subject to loss during construction, but impacts also possible during operations. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts. ACECs designated for cultural or historic resource values, National Historic and Scenic Trails, National Historic and Natural Landmarks, properties designated or eligible for the *National Register of Historic Places,* and areas with important cultural and archaeological resources would be excluded.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. Same exclusions as program alternative.	Same impacts as program alternative. There would be no explicit exclusions to avoid known sensitive cultural resources. There would be no specific design features to reduce impacts. Impacts could be potentially more dispersed and greater on those cultural resources excluded under the action alternatives.
Transportation	Local road systems and traffic flow could be adversely affected during construction. Impacts during operations would be minor. Impacts potentially could be dispersed across the 19 million acres of variance areas; however, impacts would be minimized due to the required variance process. Design features could effectively avoid or minimize many impacts.	Same impacts as program alternative, except impacts would be concentrated into a smaller, known geographic area. This could increase the magnitude of potential impacts, particularly during construction, but affect a smaller number of areas.	Same impacts as program alternative, except impacts could be potentially more dispersed. There would be no specific design features to reduce impacts.

Abbreviations: ACEC = Area of Critical Environmental Concern; AUM = animal unit month; BLM = Bureau of Land Management; CO_2 = carbon dioxide; DWMA = Desert Wildlife Management Area; ESA = Endangered Species Act; HMA = herd management area; NLCS = National Landscape Conservation System; ROW = right-of-way; SRMA = Special Recreation Management Area; USFWS = U.S. Fish and Wildlife Service.

Footnotes on next page.

1

TABLE 6.1-2 (Cont.)

---

[a] The lands composing the no action alternative have not changed significantly since release of the Draft Solar PEIS; thus, the habitat overlap values (percentages) presented remain valid.

[b] To convert acres to km^2, multiply by 0.004047.

[c] The acreage estimates were calculated on the basis of the best available GIS data. GIS data were not available for the entire set of exclusions; therefore, the acreages cannot be quantified at this time.

[d] To convert mi to km, multiply by 1.609.

Draft Solar PEIS. Section 6.6 discusses the other NEPA considerations related to the preferred alternative, including unavoidable adverse impacts, short-term uses of the environment and long-term productivity, irreversible and irretrievable commitment of resources, and mitigation of adverse impacts.

6.1 IMPACTS OF THE SOLAR ENERGY DEVELOPMENT PROGRAM ALTERNATIVE

As discussed, not all BLM-administered lands are appropriate for utility-scale solar energy development. Under the solar energy development program alternative (referred to as the "program alternative"), certain categories of land that are known to be unsuitable for utility-scale solar development would be excluded from solar energy development. Changes in proposed exclusions have been made to reflect new information and comments received on the Draft Solar PEIS (BLM and DOE 2010) and the Supplement to the Draft Solar PEIS (BLM and DOE 2011). The complete set of exclusions is presented in Table 2.2-2 of this Final Solar PEIS. On the basis of these exclusions, approximately 79 million acres (319,701 km^2) of BLM-administered lands that would otherwise be eligible for utility-scale solar energy development would be excluded from solar energy development under the program alternative.

BLM-administered lands outside of exclusion areas would be identified as variance areas for utility-scale solar energy development. Variance areas would be open to ROW application but would require developers to adhere to the variance process detailed in this Final Solar PEIS (see Section 2.2.2.3.1). A subset of these variance areas, approximately 285,000 acres (1,153 km^2), would be identified as SEZs where the agency would prioritize solar energy and associated transmission infrastructure development.[4]

The program alternative would also establish comprehensive ROW authorization policies and programmatic design features to be applied to utility-scale solar energy projects on BLM-administered lands in the six-state study area. The proposed ROW authorization policies and programmatic design features have been updated as part of this Final Solar PEIS (see Section 2.2.1.1 and Section A.2.2 of Appendix A, respectively). The BLM has also identified SEZ-specific design features in some cases to address SEZ-specific resource conflicts. These SEZ-specific design features are based on the in-depth analyses of SEZs that have been conducted as part of the Solar PEIS and included in Chapters 8 through 13.

4 As discussed in Section 2.2.2.2, in the future, the BLM will conduct periodic assessment of need related to SEZs and may decide to expand SEZs, add SEZs, or remove or reduce SEZs. Changes to SEZs would have to go through a land use planning process, which would be subject to the appropriate environmental analysis.

The elements of the BLM's proposed program under this alternative would be implemented through the amendment of the land use plans within the six-state study area and other applicable policy-making tools.[5]

Under the program alternative, ROW applications would continue to be authorized on an individual project basis; however, these evaluations would tier to the programmatic analyses presented in the Solar PEIS and the decisions implemented in the resultant ROD and land use plan amendments to the extent appropriate. Site- and project-specific data would be assessed in the individual project reviews, and impacts not adequately mitigated by the program's authorization policies and design features would be addressed through the implementation of additional mitigation requirements incorporated into the project POD and ROW authorization stipulations.

As a critical element of the proposed program, the BLM would develop and implement a monitoring and adaptive management strategy for solar energy development in coordination with other federal, state and local partners, and interested stakeholders (see Section 2.2.1.2 and Section A.2.2 of Appendix A). The BLM will use information and lessons learned derived from these monitoring efforts to adaptively manage projects and Solar Energy Program elements such as exclusions and design features. Changes to BLM's Solar Energy Program will be subject to appropriate environmental analysis and land use planning.

The following subsections discuss the effectiveness of the program alternative in meeting BLM's established program objectives and describe the potential environmental impacts of the alternative.

6.1.1 Facilitate Near-Term Solar Energy Development (Pace of Development)

Under the program alternative, the BLM would establish a set of programmatic authorization policies and design features that would facilitate development by establishing a clear, consistent, and unambiguous process and set of conditions for utility-scale solar energy development on BLM-administered lands. A number of program elements would contribute to these efficiencies, as follows:

- By excluding lands with known sensitive resources, resource uses, and special designations, the agency would accept ROW applications for utility-scale

[5] Under this alternative, most of the land use plans in the six-state study area would be amended. Section 2815(d) of the National Defense Authorization Act (NDAA) for Fiscal Year 2000 (P.L. 106-65) placed a moratorium on planning efforts on BLM-administered lands "adjacent to, or near the Utah Test and Training Range (UTTR) and Dugway Proving Grounds or beneath Military Operating Areas, Restricted Areas, and airspace that make up the UTTR" (NDAA § 2815(a), 113 Stat. 512, 852 [1999]). This area encompasses a portion of the lands within the boundaries of the Box Elder, Pony Express, House Range, Warm Springs, and Pinyon land use plans. Within these areas, decisions related to whether lands would be available for ROW application, and adoption of the policies and design features of the PEIS, cannot be implemented via land use plan amendments at this time. Solar energy development ROW applications would be deferred until such time when plan amendments or new land use plan(s) address solar energy development. No SEZs are located within the UTTR affected areas.

solar energy development only where such development may be expected to encounter fewer potential resource conflicts. Time and effort would be directed to those projects with the fewest resource constraints, and away from projects with high resource conflicts.

The BLM has taken a number of important steps through the Solar PEIS to facilitate future development in SEZs in a streamlined and standardized manner. The level of effort required to review applications for projects in SEZs would be reduced because these areas have undergone intensive site-specific analyses and consultations as part of the Solar PEIS. For some of the SEZs, it is expected that development could proceed with limited additional environmental analysis.[6] In addition to this upfront work in SEZs, the BLM is proposing additional incentives that will help steer future utility-scale solar energy development to the SEZs. For example, regional mitigation plans for SEZs will be developed simplify and improve the mitigation process for future projects in these priority areas.

- The identification of variance areas for utility-scale solar energy development and the associated variance process detailed in this Final Solar PEIS is expected to help applicants formulate projects outside of SEZs that have a greater chance for success. Evaluation of projects through the proposed variance process will require upfront effort on the part of the BLM and applicants. BLM staff will be required to coordinate with federal, state, tribal, and local stakeholders and evaluate site-specific resource conflicts as part of the assessment of ROW applications in variance areas.

- To the extent that decisions about future solar energy projects could be tiered to the analyses in the Solar PEIS or decisions in the resultant ROD, project review and approval time lines would be shortened. The proposed ROW authorization policies and programmatic design features are comprehensive and address the majority of design, construction and operational requirements for most projects. The range of issues that would be evaluated in detail at the project level would be reduced to site-specific and species-specific issues and concerns.

- Amending the land use plans within the six-state study area to implement the new program would facilitate individual project approvals and would ensure that multiple individual plan amendments would not be required.

It is anticipated that these program elements would collectively reduce the amount of time and resources required to obtain ROW authorizations and would speed up the pace of utility-scale solar energy development in the six-state study area without compromising the level of protection for natural and cultural resources. Shortened development time lines, particularly

---

6 For all proposed SEZs, government-to-government consultation and interagency consultation are still ongoing and could result in the identification of additional concerns.

for projects proposed within SEZs, would reduce the cost to the government, developers, and stakeholders. These outcomes would likely increase the agency's ability to meet the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.1.2 Minimize Environmental Impacts

Utility-scale solar energy facilities are industrial facilities that require large tracts of land up to several thousand acres and can cause substantial impacts on a variety of natural and cultural resources. Proper consultation, siting and design, and application of design features can avoid, minimize, or mitigate many of these impacts. The proposed ROW authorization policies updated as part of this Final Solar PEIS and the required design features under the program alternative would ensure that potential environmental impacts are addressed thoroughly and consistently for all utility-scale solar energy projects on BLM-administered lands. Specific program elements have been developed to address the many aspects of managing environmental impacts, as follows:

- The elements of the proposed Solar Energy Program establish numerous requirements for coordination and/or consultation with other federal and state agencies and for government-to-government consultation, and establish requirements for public involvement. Collectively, these policies ensure that all projects are thoroughly reviewed; input is collected from all potentially affected federal, state, tribal, and local stakeholders; and any project proposals that are anticipated to result in unacceptable adverse impacts are eliminated early in the application process and SEZ identification process.

- The proposed ROW exclusions would avoid impacts of utility-scale solar energy development on known sensitive resources, resource uses, and specially designated areas.

- By restricting development to lands with solar insolation levels greater than or equal to 6.5 kWh/m^2/day, the BLM would be making available those lands where utility-scale development is assumed to be most efficient. These proposed restrictions allow the BLM to support the highest and best use of public lands in accordance with FLPMA by avoiding potential resource conflicts and reserving for other uses public lands that are not well suited for utility-scale solar energy development.[7]

- The proposed programmatic design features, developed on the basis of extensive impact analyses conducted in the Solar PEIS, address the full array of potential impacts associated with each phase of development (i.e., site

[7] Under BLM's proposed Solar Energy Program, areas with direct normal solar insolation levels less than 6.5 kWh/m^2/day would not be available for individual applications (i.e., excluded). In light of expected technological advances, shifting market conditions and evolving state and Federal policies however, the BLM will allow new SEZs in areas with insolation levels lower 6.5 kWh/m^2/day as appropriate.

evaluation, construction, operation, and decommissioning). For many project locations, the majority of potential impacts would be addressed by these requirements. Individual project environmental reviews would be required to address any additional site-specific and species-specific issues and concerns.

- The proposed variance process would provide flexibility to industry to request utility-scale solar development projects outside of SEZs in areas determined to be economically and technically viable. Projects in variance areas would be thoroughly reviewed through the proposed variance process to ensure that only those applications which can demonstrate that they are in an area with low or comparatively low resource conflicts and where conflicts can be resolved will be processed. BLM staff will be required to coordinate with federal, state, tribal, and local stakeholders as part of the review of ROW applications in variance areas. Analysis of an application may result in a decision to deny the application.

- By allowing appropriate development in variance areas, the BLM would provide opportunities to site solar energy projects on lands that are, or are near to, degraded, disturbed, or previously disturbed sites.

- The prioritization of development in SEZs could limit some environmental impacts. These areas were selected as lands well suited for utility-scale solar development (i.e., lands with fewer potential resource conflicts). Although some potentially significant resource and resource use conflicts have been discovered for some SEZs, SEZ-specific design features have been identified to address those potential impacts. The concentration of development in the SEZs could also allow for the consolidation of related infrastructure (e.g., roads, transmission lines) and less total land disturbance.

- The proposed monitoring and adaptive management strategy would ensure that new data and lessons learned about the impacts of solar energy development are incorporated into future programmatic and project-specific requirements.

- Implementing a comprehensive program would allow the BLM to better assess potential cumulative impacts of solar energy development across the six-state study area over time.

- A program that would facilitate solar energy development on BLM-administered lands (as compared to private lands) would ensure that the development would be subjected to rigorous environmental review, including a thorough public involvement process.

Table 6.1-2 includes a summary of the environmental impacts that might be associated with solar energy development under the program alternative and the ways in which the impacts would be avoided, minimized, and/or mitigated by the programmatic exclusions, policies, and design features. As reflected in that table, for several resource and impact areas, implementation of the proposed design features is expected to ensure that impacts would be negligible or minor. For certain resource areas (e.g., hazardous materials and waste, health and safety), there are few, if any, unique site- or project-specific issues that would not be fully addressed by the programmatic requirements. For other resource areas (e.g., lands and realty, rangeland resources, military and civilian aviation, geologic setting and soils, mineral resources, air quality, acoustic environment, paleontological resources, and transportation), the programmatic requirements are comprehensive and broad enough to address most issues even though there could be some site- and project-specific variables. For example, although paleontological resources vary in occurrence and density by site, impacts on these resources can be mitigated, and the design feature would ensure that potential impacts are identified and addressed. Similarly, although traffic patterns and local road use vary by location, the design features would ensure that local issues are identified and addressed.

For other resource and impact areas, the full effectiveness of the proposed design features intended to reduce potential impacts may need to be assessed through the additional project-specific analyses that would be required under the proposed program. These resource areas will vary by project, but may include specially designated areas and lands with wilderness characteristics, recreation, military aviation, water resources, vegetation, wildlife and aquatic biota, special status species, visual resources, cultural resources, Native American concerns, and environmental justice. For example, the magnitude of potential impacts of a given project on water resources would depend on project-specific parameters and site-specific conditions. The water requirements would depend on the size of the project and the technology used (e.g., CSP versus PV, and wet cooling versus dry cooling systems). The nature of the impacts would depend on the amount of locally and regionally available water, the source of water supply, and other water uses, including requirements to support sensitive species and/or their critical habitats. These types of impacts cannot be assessed fully until project- and site-specific information is known.

BLM's intent in identifying SEZs has been to find areas well suited to utility-scale solar energy production, with few impediments to solar facility construction and operation, where the BLM would prioritize solar energy and associated transmission infrastructure development. In identifying the SEZs evaluated in the Draft Solar PEIS, the BLM targeted areas with low slope, near existing transmission or designated corridors and near existing roads, and with a minimum area of 2,500 acres (10 km^2). The SEZs also were subject to all the exclusion criteria listed in Table 2.2-2 of this Final Solar PEIS that are applicable for variance lands (e.g., solar and insolation criteria, and exclusion of NLCS lands, critical and sensitive habitat, ACECs, no surface occupancy areas, ROW exclusion and avoidance areas from applicable land use plans).[8]

Through the SEZ-specific analyses completed as part of the Draft Solar PEIS, the BLM has discovered some potentially significant impacts on various resources and resource uses that

[8] Although these classes of lands will be excluded from the proposed SEZs, some may not yet have been identified because of incomplete information on the locations of these areas and incomplete GIS data. Additional applicable non-development areas within SEZs may be identified during project-specific investigations when additional data have been collected.

could result from solar energy development in the SEZs as proposed in the Draft Solar PEIS. The modifications made to the SEZs through the Supplement to the Draft Solar PEIS and this Final Solar PEIS (i.e., dropping SEZs from further consideration, reducing the area of other SEZs, and identifying non-development areas within SEZs), along with implementation of ROW authorization policies and design features, would minimize environmental impacts of development in the SEZs. The BLM has also proposed SEZ-specific design features that would further avoid and/or minimize potential impacts in these areas. These additional requirements could result in more restrictions in the amount of developable land within some SEZs.

It is anticipated that these program elements would collectively allow the BLM to effectively identify and avoid, mitigate, and minimize potential adverse environmental impacts.

6.1.3 Minimize Social and Economic Impacts

Utility-scale solar energy development under this alternative is expected to result in economic benefits in terms of both jobs and income created. These benefits would occur as both direct impacts, resulting from the wages and salaries, procurement of goods and services, and collection of state sales and income taxes, and indirect impacts, resulting from new jobs, income, expenditures, and tax revenues subsequently created as the direct impacts circulate through the economy. These benefits occur during both the construction and operations phases, with the construction phase benefits being temporary and the operations phase benefits being more long term. The specific benefits vary by technology, because some technologies generate more jobs than other technologies. For example, a 100-MW parabolic trough facility would create an estimated 350 new direct construction jobs and 43 new direct operations jobs, whereas a PV facility of comparable generation capacity would create an estimated 30 new direct construction jobs and very few direct operations jobs (see Tables 5.17.2-1 through 5.17.2-4 in the Draft Solar PEIS for detailed information about the economic impacts of construction and operation of solar energy facilities by technology type).[9] The benefits in terms of indirect jobs and total income also vary by state, because the extent of in-state spending and economic multiplier effects vary by state.

Because utility-scale solar energy development would be accompanied by transmission system development and new access road construction in many locations, potential economic benefits also result from the direct and indirect jobs associated with this infrastructure construction. These impacts are discussed in Section 5.17.1.2 of the Draft Solar PEIS.

The BLM would incur agency-related costs associated with developing, implementing, and managing solar energy development on BLM-administered lands. This is particularly true in SEZs where the BLM has committed to undertaking upfront site-specific analyses and consultations as well as incentives. In contrast, a substantial portion of the costs for processing ROW applications in variance areas, including environmental review requirements, would be paid for by developers through cost recovery. For all projects on BLM-administered lands, the

[9] The estimate provided in the text here for number of PV construction jobs is based on an extrapolation of data in Table 5.17.2-4 of the Draft Solar PEIS.

federal government will collect income from ROW rental payments, which include an acreage component and capacity fee component. Further, the BLM is proposing to offer lands within SEZs through a competitive process (see Section 2.2.2.2.1 of this Final Solar PEIS), which could result in increased revenue to the federal government. A competitive process, however, could increase costs for developers of solar facilities.

As discussed in Section 5.17.1.1 of the Draft Solar PEIS, there would be some adverse economic impacts on displaced public land users associated with solar development (e.g., loss of grazing allotments). There may also be adverse social impacts resulting from changes in recreation, property values, and environmental amenities (e.g., environmental quality, rural community values, or cultural values). There could also be beneficial social impacts associated with solar development resulting from economic growth and a positive reception to the presence of a renewable energy industry. At the programmatic level, it is difficult to quantify these impacts.

6.1.4 Provide Flexibility to Solar Industry

As compared to the SEZ alternative, the program alternative provides a greater degree of flexibility to developers in identifying appropriate locations for utility-scale development (i.e., economically attractive locations with minimal environmental or cultural resource conflicts), by identifying lands outside of exclusion areas and SEZs as potentially developable through the associated variance process.

Concerns were expressed in comments on the Supplement to the Draft Solar PEIS that by excluding lands with slopes greater than 5% and with solar insolation levels below 6.5 $kWh/m^2/day$, the BLM could be removing lands that some developers may find both technically and economically feasible to pursue in the future. Consistent with existing regulations, applicants may request that the BLM amend a land use plan to allow for an otherwise nonconforming proposal (BLM Land Use Planning Handbook H-1601-1, Section VII(B) [BLM 2005]).[10] For example, an applicant may request a land use plan amendment for development in areas with higher slope or lower insolation than previously identified in order to avoid a potential resource conflict or maximize the use of existing transmission. Further, in this Final Solar PEIS, the BLM has indicated that it will consider development on slopes of up to 10% provided that all other development requirements are met and a land use plan amendment is undertaken. In addition, the BLM's proposed SEZ identification protocol would allow future expanded or new SEZs to be located in areas excluded for slope and/or insolation, provided that the areas are otherwise well suited for development (see Section A.2.6 of Appendix A).

[10] The decision to amend a land use plan is within the BLM's discretion. Denial of a request to amend a plan is a plan-level decision made by a BLM State Director and may be protested to the BLM Director under 43 CFR 1610.5-2(a).

6.1.5 Optimize Existing Transmission Infrastructure and Corridors

The proposed variance process provides developers with the flexibility to identify and propose projects that optimize existing transmission infrastructure and designated transmission corridors. In addition, the BLM's proposed SEZ identification protocol (see Section A.2.5 of Appendix A) will consider proximity to existing infrastructure such as transmission lines and corridors as an important factor in locating new or expanded SEZs. As part of that process, the BLM will catalog the existing and proposed transmission lines in relation to the power generation from a proposed SEZ location. The BLM will also consult with state and regional transmission planning and coordination authorities, state energy offices, and transmission system operators to evaluate available capacity on the existing and proposed lines and whether transmission access issues might create barriers to development in a specific area.

Although it is likely that most new utility-scale solar energy development will require new transmission capacity, projects that can be located near existing transmission lines would likely result in fewer environmental impacts associated with connecting to and/or upgrading the existing lines. Similarly, solar projects that utilize existing corridors would result in reduced environmental impacts, assuming the corridor designation process factored potential environmental and other siting concerns into the corridor alignment. The use of existing transmission infrastructure and corridors could also reduce cost, time, and controversy.

6.1.6 Standardize and Streamline the Authorization Process

The program alternative would standardize requirements and reduce uncertainty for project applications both in SEZs and in variance areas. It would streamline project review and approval processes, and ensure consistency in the way utility-scale ROW applications are managed. Individual ROW applications would continue to be authorized on an individual project basis; however, these evaluations would tier to the programmatic analyses presented in the Solar PEIS and the decisions implemented in the resultant ROD and land use plan amendments to the extent appropriate.

6.1.7 Meet Projected Demand for Solar Energy Development

On the basis of the RFDS for solar energy development (which is assumed to be the same for each alternative), the estimated amount of solar energy generation on BLM-administered lands in the study area over the 20-year study period (through approximately 2030) would be about 24,000 MW, with a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands. The comparison of the area projected to be needed for solar development under the RFDS with the lands available for application under the two BLM action alternatives is presented in Section 2.4, Table 2.4-2 of this Final Solar PEIS. Under the program alternative, the land area in SEZs (285,000 acres [1,153 km^2]) with an assumed build-out of 80% would be sufficient to meet the RFDS. The additional lands available for application in variance areas (about 19 million acres [82,964 km^2]) would provide additional available acreage as well as flexibility in terms of where the projected 24,000 MWs would be constructed. With some development assumed to occur on the variance lands, the program alternative meets the projected demand for solar energy development.

6.2 IMPACTS OF THE SEZ PROGRAM ALTERNATIVE

Under the SEZ program alternative (hereafter referred to as the "SEZ alternative"), the BLM would adopt the same set of programmatic ROW authorization policies and design features for utility-scale solar energy development as proposed under the program alternative, but would authorize such solar energy development only within SEZs. Unlike the program alternative, lands outside of SEZs would be excluded from utility-scale solar energy ROW applications. Under this alternative, about 285,000 acres (1,153 km^2) of BLM-administered lands would be available for ROW applications. As part of this Final Solar PEIS, the BLM has also proposed a protocol to identify new or expanded SEZs (see Section A.2.6 of Appendix A). Per the proposed protocol, new SEZs would be relatively large areas that provide highly suitable locations for utility-scale solar development: locations where solar development is economically and technically feasible, where there is good potential for connecting new electricity-generating plants to the transmission distribution system, and where there is generally low resource conflict. The identification of new or expanded SEZs would have to go through a land use planning process and would be subject to the appropriate environmental analysis.

Under the SEZ alternative, the elements of the BLM's new program under this alternative would be implemented through amendment of the land use plans within the six-state study area and other applicable policy-making tools.

The following subsections discuss the effectiveness of the SEZ alternative in meeting the BLM's established program objectives and describe the potential environmental impacts of the alternative.

6.2.1 Facilitate Near-Term Solar Energy Development (Pace of Development)

The impacts on the pace of development under the SEZ alternative would be much the same as those described for the program alternative in Section 6.1.1. Elements of the authorization process (including the proposed competitive process) and incentives for projects in SEZs described in this Final Solar PEIS (Section 2.2.2.2.3) could reduce the amount of time and resources allocated by government, developers, and stakeholders to obtain ROW authorizations. As with the program alternative, these outcomes would likely increase the agency's ability to meet the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.2.2 Minimize Environmental Impacts

Similar to the program alternative, environmental impacts under the SEZ alternative would be minimized in the following ways:

- SEZs have been identified as areas where there is generally low resource conflict. Because the land area for utility-scale solar energy development would be restricted to SEZs, known sensitive resources would be avoided for the most part, SEZ-specific design features would protect sensitive resources identified in SEZs, and uncertainty regarding the distribution of impacts, including possible fragmentation of habitat, would be reduced.

- The proposed programmatic and SEZ-specific design features would address the full array of potential impacts associated with each phase of development. In addition, regional mitigation plans for SEZs would be developed to address unavoidable resource impacts.

- The concentration of development in the SEZs could allow for the consolidation of related infrastructure (e.g., roads, transmission lines) and less total land disturbance.

- Additional environmental analysis, and the coordination and/or consultation with other federal and state agencies, government-to-government consultation, and public input required prior to authorization of individual projects in SEZs would ensure thorough review of the proposed locations of development.

- The requirement to implement a monitoring and adaptive management strategy would ensure that appropriate mitigation measures would be implemented if unforeseen impacts were identified during project planning, construction, and/or operations.

- Because of the closer proximity of individual solar development projects to one another that could occur under the SEZ alternative, cumulative impacts for some resources (e.g., water, visual, and socioeconomics) in localized areas around the SEZs could be high; however, the certainty of the project locations might allow these impacts to be more easily addressed. An analysis of the potential cumulative impacts for each SEZ was included in Chapters 8 through 13 of the Draft Solar PEIS and has been updated as necessary for the Final Solar PEIS.

By making a specific set of lands available for ROW application (285,000 acres [1,153 km^2]), the BLM may limit opportunities to site solar energy projects on lands determined to be degraded or previously disturbed. However, the BLM's proposed protocol to identify new SEZs emphasizes the use of degraded, disturbed, or previously disturbed areas, including possible partnerships with nonfederal landowners, as appropriate places to site new SEZs (see Section A.2.6 of Appendix A).

Table 6.1-2 summarizes the environmental impacts that might be associated with solar energy development under the SEZ alternative and the extent to which the impacts would be mitigated by the programmatic exclusions, policies, and design features. As reflected in that table, it is not possible to fully assess the impacts on some resources (e.g., specially designated areas and lands with wilderness characteristics, recreation, military aviation, water resources, vegetation, wildlife and aquatic biota, special status species, visual resources, cultural resources, Native American concerns, and environmental justice), because they are dependent on specific project details not defined at the programmatic level. This type of analysis would be conducted through additional project-specific analyses that would be required prior to the development of projects in SEZs.

Through the SEZ-specific analyses completed as part of the Draft Solar PEIS, the BLM discovered some potentially significant impacts on various resources and resource uses that could result from solar energy development in the SEZs. As discussed in detail in Section 6.1.2 on the program alternative, modifications made to the SEZs, along with implementation of ROW authorization policies and programmatic and SEZ-specific design features would minimize environmental impacts of development in the SEZs.

It is anticipated that the program elements that make up the SEZ alternative would collectively allow the BLM to effectively identify and avoid, mitigate, and minimize potential adverse environmental impacts.

6.2.3 Minimize Social and Economic Impacts

The potential socioeconomic impacts of the SEZ alternative would be similar to those described for the program alternative; however, both the economic benefits and the potential adverse economic and social impacts would be concentrated solely in the vicinity of the SEZs.

The BLM would incur agency-related costs associated with developing, implementing, and managing solar energy development on BLM-administered lands. This is particularly true in SEZs where the BLM has committed to undertaking upfront site-specific analyses and consultations as well as incentives. For all projects in SEZs, the federal government will collect income from ROW rental payments, which include an acreage component and capacity fee component. Further, as discussed in Section 2.2.2.2.1 in this Final Solar PEIS, the BLM is proposing to offer lands within SEZs through a competitive process (see Section 2.2.2.2.1 of this Final Solar PEIS), which could result in increased revenue to the federal government. A competitive process, however, could increase costs for developers of solar facilities.

6.2.4 Provide Flexibility to Solar Industry

By making fewer BLM-administered lands available for utility-scale solar energy development as compared to the program alternative, the SEZ alternative could reduce the flexibility of both the agency and developers in terms of identifying appropriate locations for utility-scale development. There are likely to be economically attractive sites for solar energy development outside of the SEZs that can meet the environmental protection measures outlined in the Solar PEIS. It is important to note, however, that the BLM is committed to evaluating the need for new or expanded SEZs in each of the six states a minimum of every 5 years as described in the proposed SEZ identification protocol (see Section A.2.6 of Appendix A). The

BLM will also allow petitions for new or expanded SEZs to consider solar energy development in specific areas of interest to industry. Consistent with existing regulations, applicants may request that the BLM amend a land use plan to allow for an otherwise nonconforming proposal (BLM Land Use Planning Handbook H-1601-1, Section VII(B) [BLM 2005]). While this may allow for some flexibility to develop outside of the currently proposed SEZs, it does not provide the same level of flexibility as the variance process proposed under the program alternative (because a land use plan amendment would be required for development outside of SEZs in all cases under the SEZ alternative).

6.2.5 Optimize Existing Transmission Infrastructure and Corridors

Under the SEZ alternative, future solar energy development would be limited to SEZs. All of the proposed SEZs are located near existing transmission lines and/or corridors, and development in the SEZs is expected to make use of this existing transmission infrastructure. Under the SEZ alternative, however developers would have fewer opportunities to take advantage of other existing transmission infrastructure as compared to the program alternative.

The BLM is proposing to undertake a variety of activities that will help steer future utility-scale solar energy development to the SEZs (see Section 2.2.2.2.3 of this Final Solar PEIS). These include an evaluation of the transmission needs and impacts to support anticipated solar development within SEZs and a commitment to engage in ongoing and comprehensive transmission planning efforts to ensure the recognition of SEZs as a priority in transmission development. The BLM will also offer incentives to developers willing to build transmission to SEZs. In addition, the BLM's proposed SEZ identification protocol takes into account proximity to existing transmission infrastructure (see Section A.2.6 of Appendix A). Further, the BLM will allow petitions for new or expanded SEZs to consider solar energy development in specific areas of interest to industry such as in proximity to new foundational transmission lines.

6.2.6 Standardize and Streamline the Authorization Process

The SEZ alternative would standardize requirements and reduce uncertainty for project applicants. It would streamline project review and approval processes, and ensure consistency in how utility-scale ROW applications are managed. Because the SEZ alternative would limit utility-scale development to those areas most intensively studied in the Solar PEIS, it is likely that BLM staff efforts to review and approve ROW applications would be reduced under this alternative (due to the opportunity for extensive tiering to the analyses presented in the Solar PEIS and the decisions implemented in the resultant ROD and land use plan amendments).

6.2.7 Meet Projected Demand for Solar Energy Development

Assuming a build-out of 80% of the total land area within the currently proposed SEZs over the 20-year study period, the amount of land available for development under the SEZ alternative would be about 228,000 acres [923 km^2]). Across all six states, the total lands available within the SEZs would slightly exceed the amount of land required to support the RFDS projected development of 24,000 MW (which corresponds to about 214,000 acres [866 km^2]). However, as shown in Table 2.4-2 of this Final Solar PEIS, in two states (Arizona and Colorado), the amount of land that would be available for ROW application would not be enough to support the total state-specific development projected in the RFDS. Specifically, in Arizona, the projected RFDS development would require 21,816 acres (88.3 km^2), which exceeds the 5,966 acres (24 km^2) that would be available under the SEZ alternative. In Colorado, 19,746 acres (80 km^2) would be developed under the RFDS, which exceeds the 16,308 acres (66 km^2) that would be available under the SEZ alternative. In addition, in California, a projected 138,789 acres (562 km^2) would be developed under the RFDS, which constitutes 90% of the 153,627 acres (622 km^2) that would be available.

Potential resource conflicts and constraints on development within some SEZ areas are known to exist; these constraints are discussed in each of the SEZ-specific analyses presented in Chapters 8 through 13 of the Draft Solar PEIS and updated in the Final Solar PEIS. The SEZ-specific analyses discuss areas within many of the SEZs that either should not be developed or should have development restrictions (e.g., areas with ephemeral stream channels or floodplains, areas with military flight restrictions for facilities with tall structures, areas with potential visual resource conflicts, and areas close to residences for noisy technologies). It is also recognized that some SEZ areas will likely require additional exclusions or restrictions, the extent of which may not be known until site- and project-specific environmental analyses can be completed. Given these factors, it is possible that, even in states other than Arizona and Colorado, the amount of land that would be available under the SEZ alternative might not be enough to support full development.

Because this alternative may not make an adequate amount of land available to support the RFDS projections, at least in some states, it is possible that the total amount of utility-scale solar energy developed on BLM-administered lands over the 20-year study period could be constrained unless the BLM identifies additional SEZs (as described in Section 2.2.2.2.6 of this Final Solar PEIS).

6.3 IMPACTS OF THE NO ACTION ALTERNATIVE

Under the no action alternative, solar energy development would continue on BLM-administered lands in accordance with the terms and conditions of the existing Solar Energy Policies (See Section A.1 of Appendix A). The BLM would not implement a comprehensive program to provide guidance to BLM field staff, developers, and other stakeholders in the six-state study area. Specifically, the required ROW authorization policies and design features, and land use plan amendments proposed in this PEIS would not be implemented. Future solar energy projects and land use plan amendments would continue to be evaluated solely on an individual, case-by-case basis.

The following subsections discuss the effectiveness of the no action alternative in meeting the BLM's established program objectives.

6.3.1 Facilitate Near-Term Solar Energy Development (Pace of Development)

The pace of solar energy development on BLM-administered lands would not be enhanced by the no action alternative:

- Developers and stakeholders would have less direction from the BLM as to which lands (other than NLCS lands) would be excluded from or, conversely, available and appropriate for utility-scale solar development, and thus could spend time and resources investigating inappropriate locations.

- There would be no comprehensive design features to implement. BLM field staff, developers, and stakeholders would be required to identify appropriate mitigation measures on a case-by-case basis.

- The BLM would not identify SEZs to facilitate and prioritize utility-scale solar energy development in those areas well suited for such development.

- Individual land use plans would have to be amended for individual projects as a part of project evaluation and approval, which could delay development.

The extended development time lines likely to result under the no action alternative could jeopardize developers' business agreements, potentially putting any given project at risk of abandonment. In addition, extended time lines could increase the costs for all concerned parties, including the government, developers, and stakeholders. Furthermore, developers could elect to avoid delay and uncertainty by shifting their projects to state, tribal, and private land with potentially less federal environmental oversight (Section 6.3.2). If this shift were to occur, resulting in less development of solar energy on BLM-administered lands, this outcome would be in conflict with the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.3.2 Minimize Environmental Impacts

In general, direct and indirect environmental impacts associated with individual utility-scale solar energy projects under the no action alternative could be similar to those under the proposed action alternatives (see Sections 6.1.2 and 6.2.2), because the BLM is required to identify and address environmental impacts of all ROW authorizations and conform to existing land use plan decisions. However, the no action alternative would do little to avoid impacts on sensitive resources, resource uses, and special designations by way of programmatic exclusions. Instead, BLM field staff would be required to review applications to ensure that these areas are properly addressed. In addition, without programmatic guidance on design features, the potential for field staff to require varying mitigation measures from project to project would be high. Lack of consistency could translate into inadequate mitigation of impacts for some projects and overly onerous mitigation requirements for other projects. Furthermore, the comprehensive monitoring and adaptive management strategies regarding solar energy development as suggested under the action alternatives would not necessarily be part of the no action alternative. Table 6.12

summarizes the environmental impacts that might be associated with solar energy development under this alternative.

If the absence of a comprehensive program were to result in delays in processing ROW applications on BLM-administered lands or in increases in the cost of developing solar power on BLM-administered lands, developers could respond by focusing their development efforts on state-owned, tribal, and private lands. While solar energy development on nonfederal lands is subject to a wide array of environmental reviews and approvals by virtue of state and local permitting processes, it may not be subject to NEPA requirements if federal funding or permitting is not required for the project.

By maintaining access to the 98 million acres (400,000 km^2) of land currently available for ROW application, the BLM would provide ample opportunities to site solar energy projects on lands that are, or are near, degraded, disturbed, or previously disturbed sites.

6.3.3 Minimize Social and Economic Impacts

If the pace of utility-scale solar energy development under the no action alternative were slower than under the action alternatives, there could be a delay in the economic benefits from the development in the six-state study area, in terms of direct and indirect jobs created and income in the communities.

Under current policy, all solar projects on BLM-administered lands require ROW rental payments to the federal government, which include an acreage component and capacity fee component. Under the no action alternative, however, the BLM would not conduct competitive leasing in SEZs as proposed under the action alternatives. As a result, potential revenues to the government related to utility-scale solar energy development on BLM-administered lands may be lower under this alternative.

In addition, it is anticipated that the no action alternative would cause BLM staff to spend additional time and resources on the reviews and approvals of utility-scale ROW applications, and this will incur greater costs to the agency and the applicants. Developers might propose projects in inappropriate locations, opportunities to tier analyses from this programmatic evaluation would not exist, and ROW authorizations would require individual land use plan amendments.

6.3.4 Provide Flexibility to Solar Industry

The relatively large amount of land available for utility-scale ROW applications under the no action alternative, particularly when compared to the amount of land that would be needed to support the projected RFDS, provides a great degree of flexibility in identifying appropriate locations for utility-scale development (i.e., economically attractive locations with minimal environmental or cultural resource conflicts). However, under the no action alternative, programmatic guidance would not be provided to developers with respect to lands and projects that ultimately may not be approvable by the BLM.

6.3.5 Optimize Existing Transmission Infrastructure and Corridors

The relatively large amount of land available for utility-scale ROW applications under the no action alternative provides a great degree of flexibility in identifying locations for utility-scale development that optimize existing transmission infrastructure and designated transmission corridors. However, under the no action alternative, little guidance would be provided to developers with respect to lands and projects that ultimately may not be approvable by the BLM.

6.3.6 Standardize and Streamline the Authorization Process

Under the no action alternative, the BLM would not implement a comprehensive program to standardize and streamline the agency's review and approval of utility-scale solar energy ROW authorizations, including policies, exclusions, design features, and associated land use plan amendments. The BLM would continue to address issues as they arise through individual policy statements and guidance.

6.3.7 Meet Projected Demand for Solar Energy Development

Under the no action alternative, lands currently off-limits to utility-scale solar energy development (i.e., the NLCS lands, as identified in Table 2.2-2 of this Final Solar PEIS) would remain unavailable for ROW application. Applications for utility-scale solar development would be accepted in all other areas and reviewed in the context of existing land use plan decisions. Under the no action alternative, approximately 98 million acres (400,000 km^2) of BLM-administered lands could be considered for ROW application. This amount of land is several orders of magnitude greater than the amount of land likely to be developed during the 20-year study period on the basis of the RFDS projections (214,000 acres [866 km^2]), although ROW applications likely would not be approved on a large percentage of these lands because of conflicts with known resources, resource uses, and existing special designations.

6.4 COMPARISON OF ALTERNATIVES AND SELECTION OF PREFERRED ALTERNATIVE

Table 6.4-1 provides a summary-level comparison of the alternatives with respect to the objectives established for the action and the extent to which each alternative would assist the BLM in meeting the projected demands for solar energy development (as presented in Sections 6.1 through 6.3).

TABLE 6.4-1 Comparison of BLM's Alternatives with Respect to Objectives for the Agencies' Action

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Facilitate near-term utility-scale development on public land	Increased pace of development Development in the prioritized SEZs likely to occur at an even faster pace due to detailed analyses of SEZs Reduced costs to the government, developers, and stakeholders Effective in assisting the BLM in meeting its mandates[a]	Increased pace of development likely due to detailed analyses of SEZs Reduced costs to the government, developers, and stakeholders Effective in assisting the BLM in meeting its mandates[a]	No discernible effect on pace of development Development could shift toward nonfederal lands due to delays, making it more difficult for the BLM to achieve its mandates[a]
Minimize potential environmental impacts	Comprehensive program to identify and avoid, mitigate, or minimize potential adverse impacts Protection of resources, resource uses, and special designations through combination of exclusions, variance areas and associated variance process, and mitigation Prioritization of development in SEZs, which have been identified as lands well-suited for solar energy development where most potential resource conflicts and appropriate required mitigation have been identified Potentially would allow a greater degree of development on previously disturbed lands due to 19 million acres of variance areas being open to application	Comprehensive program to identify and avoid, mitigate, or minimize potential adverse impacts Development limited to the SEZs, protecting more resources, resource uses, and special designations Additional mitigation required in SEZs Limits possibilities for focusing development on previously disturbed lands outside SEZs; however, this will be given consideration in the identification of new SEZs	Environmental impacts evaluated project-by-project with potential for inconsistencies in the type and degree of required mitigation If development shifts to nonfederal lands, such development would not be subject to the same level of federal environmental oversight and public involvement Potentially would allow a greater degree of development on previously disturbed lands due to 98 million acres of BLM-administered lands being open to application

TABLE 6.4-1 (Cont.)

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Minimize potential social and economic impacts	Economic benefits in terms of (1) direct and indirect jobs and income created and (2) ROW rental payments to the federal government Potential adverse and beneficial social impacts Prioritization of development in the SEZs could concentrate benefits and adverse impacts in a smaller number of local economies	Economic benefits in terms of (1) direct and indirect jobs and income created and (2) ROW rental payments to the federal government Potential adverse and beneficial social impacts With development limited to the SEZs, benefits and adverse impacts would be concentrated in a smaller number of local economies	Potential economic benefits essentially the same as under the action alternatives, although realized at a slower rate if pace of development is slower Potential adverse and beneficial social impacts Less potential for benefits and adverse impacts to be concentrated in specific areas
Provide flexibility to solar industry	A great degree of flexibility in identifying appropriate locations for utility-scale development due to 19 million acres of variance areas being open to application	Limited flexibility in identifying appropriate locations for utility-scale development	Maximum degree of flexibility in identifying appropriate locations for utility-scale development Limited guidance to developers on which lands and projects would ultimately be approvable
Optimize existing transmission infrastructure and corridors	Greater opportunities for developers to identify and propose projects that utilize existing transmission infrastructure and/or designated corridors due to 19 million acres of variance areas being open to application Opportunities to consolidate infrastructure required for new solar facilities in SEZs	Opportunities for developers to identify and propose projects that utilize existing transmission infrastructure and/or designated corridors limited to SEZs Proximity to existing transmission infrastructure and corridors will be given consideration in the identification of new SEZs Opportunities to consolidate infrastructure required for new solar facilities in SEZs	Maximum opportunities for developers to identify and propose projects that utilize existing transmission infrastructure and/or designated corridors

TABLE 6.4-1 (Cont.)

Objective	Program Alternative	SEZ Alternative	No Action Alternative
Standardize and streamline authorization process	Streamlining of project review and approval processes; more consistent management of ROW applications With prioritization of development in the SEZs, additional streamlining of opportunities over development on other available lands	Streamlining of project review and approval processes; more consistent management of ROW applications With development limited to the SEZs, streamlining maximized	No discernible effect in terms of standardizing and streamlining the authorization process
Meet projected demand for solar energy development as estimated by the RFDS	About 19 million acres[b] open to ROW application, which is more than adequate to support the RFDS projected level of development	About 285,000 acres open to ROW application, which may not be enough land to support the RFDS projected level of development in some states BLM identification of additional SEZs in the future would make additional land available but would require additional environmental review and land use plan amendments	About 98 million acres open to ROW application, which is more than adequate to support the RFDS projected level of development

[a] These mandates are established by the Energy Policy Act of 2005 (P.L. 109-58) and Secretarial Order 3285A1 (Secretary of the Interior 2010) (see Section 1.1 of this Final Solar PEIS).

[b] To convert acres to km^2, multiply by 0.004047.

The BLM has selected the program alternative as the preferred alternative for this Final Solar PEIS. On the basis of the comparisons presented in Table 6.4-1, it appears that the program alternative would best meet the BLM's objectives for managing utility-scale solar energy development on BLM-administered lands. It would likely result in a high pace of development at a low cost to the government, developers, and stakeholders. At the same time, it would provide a comprehensive approach for ensuring that potential adverse impacts would be minimized. The expected increased pace of development would accelerate the rate at which the economic benefits would be realized at the local, state, and regional levels. This alternative would make an adequate amount of suitable lands available to support the level of development projected in the RFDS and would provide flexibility in siting both solar energy facilities and associated transmission infrastructure. In addition, the program alternative would be effective at facilitating development on BLM-administered lands in accordance with the mandates of the Energy Policy Act of 2005 and Secretarial Order 3285A1 (Secretary of the Interior 2010).

6.5 CUMULATIVE IMPACTS

The cumulative impact assessment in the Draft Solar PEIS described how the environmental, social, and economic conditions within the six-state study area may be incrementally affected over the next 20 years by utility-scale solar energy development that is likely to take place on BLM-administered lands consistent with the proposed action. The Council on Environmental Quality (CEQ), in its regulations implementing the procedural provisions of NEPA (40 CFR 1500-1508), defines cumulative effects as follows:

> ...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7).

The discussions of cumulative impacts in this section and in the Draft Solar PEIS describe the impacts of solar energy development in the context of other activities that also could affect environmental resources over the next 20 years. Cumulative impact analyses have also been developed for individual SEZs as part of Chapters 8 through 13; these SEZ-specific assessments have been updated for this Final Solar PEIS. The SEZ-specific cumulative impact analyses evaluate the impacts of a maximum development scenario for each SEZ, regardless of the state-specific RFDS projections, at a level of detail suitable for supporting analyses of specific projects proposed within and near the SEZs.

The cumulative analysis in this section encompass the same resources analyzed in Chapter 5 and considers the impacts that could occur as a result of solar energy development over the next 20 years, assuming that the proposed policies and programmatic design features common to both action alternatives are adopted. Individual projects will include an environmental monitoring requirement to evaluate environmental conditions and adjust mitigation requirements as necessary. As a result, the BLM's Solar Energy Program would be expected to continue to provide needed impact mitigation over time, consistent with an adaptive management approach (see Section 2.2.1.2.1 and Section A.2.3 of Appendix A).

The scope of the cumulative impact analysis in this section and in the Draft Solar PEIS assumes solar energy development at the level projected in the RFDS (the RFDS is presented in Section 2.4 of this Final Solar PEIS). Potential differences in cumulative impacts between alternatives are highlighted as appropriate. In applying the RFDS to all alternatives, the following caveats must be considered.

As discussed in Section 6.2, there is the possibility that the total level of development could be curtailed under the SEZ alternative, at least in some states, because this alternative may not make enough lands available for ROW application. The extent to which this might occur cannot be quantified, at least in part because the BLM is likely to identify additional SEZs in the future to make more land available. Furthermore, because the RFDS is based on the state-specific RPSs, which are mandatory in each of the six states except Utah, it was assumed that development in that state that would not occur on BLM-administered lands would be made up for by development on non-BLM-administered lands.

As discussed in Section 6.3, the no action alternative would make ample lands available for ROW application to support the projected RFDS development levels on BLM-administered lands. Although this alternative would not likely enhance the pace of utility-scale development over the next 20 years (see Section 6.3.1), the extent to which development would occur on BLM-administered lands cannot be quantified. Solar development that did not occur on BLM-administered lands would be assumed to be made up for by development on non-BLM-administered lands. This programmatic cumulative impact assessment assumes that solar development will occur up to the level of the total RFDS (i.e., approximately 32,000 MW on both BLM-administered and other lands), regardless of the portion of that development that occurs on BLM-administered lands.

By restricting and/or prioritizing development in the SEZs under the two action alternatives, cumulative impacts may be more concentrated and/or severe within individual SEZs than described in this section. On the other hand, the concentration of development in the SEZs may also allow for the consolidation of related infrastructure (e.g., roads and transmission lines) and less total land disturbance. Cumulative impacts analyses for individual SEZs are presented in Chapters 8 through 13.

An updated overview of ongoing and reasonably foreseeable activities in the six-state study area is presented in Section 6.5.1, including energy production and distribution (Section 6.5.1.1), and other activities such as recreation, mineral production, military operations, grazing and rangeland management, fire management, forestry, transportation, and industrial development (Section 6.5.1.2.1). An update for general trends in population growth, energy demand, water availability, and climate change is provided in Section 6.5.1.2.2. An updated discussion of cumulative impacts for the resource areas is provided in Section 6.5.2.

6.5.1 Overview of Activities in the Six-State Study Area

Activities in the six-state study area considered in the cumulative impact analysis described in the Draft Solar PEIS remain valid overall, but some information has been updated since the Draft was issued based on the availability of newer data or in response to public comments on the Draft Solar PEIS. Tables presented in Draft Solar PEIS are updated in the following sections. For tables in the Draft that are affected, either a revised table is presented or a description of changes is provided. Tables with no changes are also identified.

Tables 6.5-1 and 6.5-2 in the Draft Solar PEIS present the types of future actions and trends that have been identified in the study area as part of the cumulative impact analysis. These table are not repeated here. In Table 6.5-1, under Type of Action – Transportation, the following associated activity should be added: "Aircraft operations (i.e., commercial and general aviation)." No changes are required for Table 6.5-2.

Updated programmatic-level actions on federal lands are presented in Table 6.5-3 of this Final Solar PEIS.

6.5.1.1 Energy Production and Distribution

6.5.1.1.1 Oil and Gas Production

Table 6.5-4 has been updated to compare oil production in the study area between 2000 and 2010 and gas production between 2000 and 2009. Table 6.5-5 has been updated from fiscal year (FY) 2009 to show sales of oil and gas from BLM-administered lands in the six-state study area for FY 2010 (BLM 2011a).

6.5.1.1.2 Coal Production

Table 6.5-6 updates the comparison of coal production in the four producing states within the six-state study area from between 2002 and 2008 to between 2002 and 2010.

6.5.1.1.3 Nuclear Electricity Generation

There are no updates to this section.

6.5.1.1.4 Renewable Energy Development

Solar Energy. In 2009, solar energy accounted for about 1% of renewable electricity generation and about 0.10% of the total U.S. electricity supply (EIA 2012). As listed in Appendix B, as of May 31, 2012, there were 78 open pending applications for utility-scale solar power–generating facilities on BLM-administered public lands, with a total estimated capacity of approximately 33,000 MW. However, not all of the pending applications will result in ROW authorizations; applications are often terminated either because the developer decides to drop the

TABLE 6.5-3 Programmatic-Level Actions on Federal Land[a]

Description	Responsible Agency	Status	Primary Impact Location
Oil shale and tar sands development	BLM	**Record of Decision for initial PEIS published Nov. 19, 2008; Notice of Availability of draft 2012 PEIS published February 3, 2012, and Record of Decision is expected by Dec. 2012**	Colorado, Utah, and Wyoming
Wind energy development	BLM	Notice of Availability of Record of Decision published Jan. 11, 2006	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
West-wide energy corridors	DOE, BLM, FS	Notice of Availability of Final PEIS published Nov. 28, 2008, and Record of Decision published Jan. 14, 2009	Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming
Vegetation management	BLM	Notice of Availability of Record of Decision published Oct. 5, 2007	Alaska, Arizona, California, Colorado, Idaho, Montana, Nebraska, New Mexico, Nevada, North Dakota, South Dakota, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming
Geothermal energy development	BLM, FS	Notice of Availability of Final PEIS published Oct. 24, 2008, and Record of Decision published Dec. 17, 2008	Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming

[a] Updated programmatic-level actions are shown in bold text.

TABLE 6.5-4 Trends in Oil and Gas Production in the Six-State Study Area

State	Oil Production (tbbl)[a] 2000	Oil Production (tbbl)[a] 2011	Oil Production (tbbl)[a] Percentage Change	Gas Production (mcf)[b] 2000	Gas Production (mcf)[b] 2010	Gas Production (mcf)[b] Percentage Change
Arizona	59	37	–37.3	368	183	–50.2
California	271,132	195,718	–27.8	418,865	286,841	–31.5
Colorado	18,481	32,305	74.8	760,213	1,578,379	107.6
Nevada	621	408	–34.3	7	4	–42.9
New Mexico	67,198	70,764	-5.3	1,820,516	1,292,185	–29.0
Utah	15,636	26,276	68.0	281,117	432,045	53.7
Total	373,127	325,508	–12.8	3,281,086	3,589,637	9.4

[a] tbbl = thousand barrels. To convert bbl to L, multiply by 159.

[b] mcf = million cubic feet. To convert cf to m^3, multiply by 0.02832.

Sources: EIA (2001, 2011a,b).

TABLE 6.5-5 Oil and Gas Activities on Public Lands of the United States in FY 2010

State	Producible and Service Holes	Producing Leases	Acres[a] in Producing Status	Oil Sales Volume (bbl)[b]	Gas Sales Volume (mcf)[c]
Arizona	2	0	0	31,560	119,885
California	7,845	322	81,315	3,576,882	8,419,421
Colorado	6,482	2,174	1,467,839	3,968,467	311,724,278
Nevada	93	26	23,637	415,426	–[d]
New Mexico	34,018	6,556	3,688,759	31,056,750	594,608,604
Utah	7,542	1,460	1,107,185	17,229,310	275,515,303
Total	55,980	10,538	6,368,735	56,278,395	1,190,387,491

[a] To convert acres to km^2, multiply by 0.004047.

[b] bbl = barrels. To convert bbl to L, multiply by 159.

[c] mcf = million cubic feet. To convert cf to m^3, multiply by 0.02832.

[d] A dash indicates no activity.

Source: BLM (2011a).

TABLE 6.5-6 Coal Production in the Producing States within the Six-State Study Area in 2002 and 2010[a]

State	2002 (thousand short tons)	2010 (thousand short tons)	Percentage Change from 2002 to 2010
Arizona	12,804	7,752	–39.4
Colorado	35,103	25,163	–28.3
New Mexico	28,916	20,991	–27.4
Utah	25,304	19,351	–23.5
Total	102,127	73,257	–28.3

[a] To convert short tons to metric tons (MT), multiply by 0.9072.

Sources: EIA (2003, 2011c).

project or because the BLM determines that the application is not viable. In fact, several of the applications pending as of October 2011 have been closed (see Appendix B). The RFDS assumed for this PEIS estimates that solar development on BLM-administered lands over the 20-year study period will be only about 75% of that represented by the active BLM applications, or 24,000 MW. An additional 8,000 MW is projected to be developed on non-BLM lands in the study area.

Wind Energy. In 2009, wind energy accounted for about 9% of the renewable electricity generation and 0.76% of the total U.S. electrical supply (EIA 2012).

Geothermal Energy. Geothermal energy resources are the steam and hot water generated by heat from within the earth. In 2009, they accounted for about 5% of the renewable electricity generation and 0.4% of the total U.S. electricity supply (EIA 2012). Table 6.5-7 has been updated to compare the number and acreage of geothermal leases in FY 2002. The number of leases issued by the BLM in the study area nearly tripled between FY 2002 (255) and FY 2010 (702).

Hydroelectric Power. In 2009, hydroelectric power generation accounted for about 2.8% of the total U.S. electricity supply (EIA 2012).

Biomass Resources. In 2009, biomass resources accounted for about 50% of renewable electricity generation and about 4.1% of the total U.S. electricity supply (EIA 2012).

TABLE 6.5-7 Competitive and Noncompetitive Geothermal Leases on BLM Public Lands in FY 2002 and FY 2010

			FY 2010			
	FY 2002		Competitive[d]		Noncompetitive	
State	Acres[a,b]	Leases[c]	Acres	Leases	Acres	Leases
Arizona	0	0	0	0	2,084	1
California	100,766	72	90,003	72	21,573	20
Nevada	236,601	171	697,094	276	477,035	270
New Mexico	4,581[c]	4[e]	2,941	3	640	1
Utah	6,906	8	160,461	58	1,744	1
Total	348,854	255	950,499	409	503,076	293

[a] Number represents acreage for both competitive and noncompetitive leases.

[b] To convert acres to km^2, multiply by 0.004047.

[c] Number represents total for both competitive and noncompetitive leases.

[d] Includes both Energy Policy Act of 2005 leases and pre-act leases.

[e] There were only competitive geothermal leases in New Mexico in FY 2002.

Sources: BLM (2003, 2011b).

6.5.1.1.5 Transmission and Distribution Systems

Table 6.5-8 has been updated from FY 2009 data to show that in FY 2010, the BLM had a total of 63,694 existing ROWs for oil and gas pipelines and electricity transmission lines in the six-state study area (BLM 2011b). This represents a 20.8% increase over the number of ROWs (52,724) in existence in FY 2002.The largest increase in ROWs issued between FY 2002 and FY 2010 occurred in California (up 27.0%), Utah (up 25.5%), and New Mexico (up 23.9%). The BLM processed 2,736 ROW applications and issued or amended 1,723 ROWs in FY 2010 (BLM 2011d).

Transmission Line Projects

Transmission projects, including the expansion projects listed in the TEPPC study, are updated in Table 6.5-9; this table is not exhaustive. Other projects in the western states can be found in the WestConnect 2012 Final annual 10-Year Transmission Plan and Appendices (WestConnect 2012).

TABLE 6.5-8 Number of Existing Oil and Gas Pipeline and Transmission Line ROWs on BLM Public Lands in FY 2002 and FY 2010

State	Total ROWs in FY 2002	Total ROWs in FY 2010			Percentage Increase from FY 2002 to FY 2010
		MLA[a]	FLPMA[b]	Total	
Arizona	4,503	288	4,447	4,735	5.2
California	5,700	271	6,968	7,239	27.0
Colorado	5,836	1,412	5,326	6,738	15.5
Nevada	7,062	175	8,026	8,201	16.1
New Mexico	24,809	20,928	9,813	30,741	23.9
Utah	4,814	1,221	4,819	6,040	25.5
Total	52,724	24,295	39,399	63,694	20.8

[a] MLA = Mineral Leasing Act of 1920.

[b] FLPMA = Federal Land Policy and Management Act of 1976.

Sources: BLM (2003, 2011b).

Natural Gas Pipeline Projects

The following text updates the Rockies Express-West Pipeline project, one of six planned expansion projections on the interstate natural gas pipeline system in the Western Region described in the Draft Solar PEIS (text added since the Draft Solar PEIS shown in bold).

- *Rockies Express-West Pipeline.* In April 2007, the Federal Energy Regulatory Commission (FERC) approved the Rockies Express-West interstate pipeline project to transport more than 1.5 billion ft^3 (42.5 million m^3) per day of Rocky Mountain natural gas to supply states east of the Rockies. Two related components, proposed by TransColorado Gas Transmission Co. and Questar Overthrust Pipeline Co., were also approved. Together, these projects will consist of approximately 800 mi (1,287 km) of new pipeline and more than 237,000 horsepower (hp) of compression, meter stations, and other related facilities. The pipeline system will span portions of Colorado, Wyoming, Nebraska, Kansas, Missouri, and New Mexico (FERC 2008). **The first segment—a 136-mi (218-km), 36-in. (0.91-m) diameter pipeline that extends from Meeker Hub in Rio Blanco County, Colorado, to Wamsutter in Sweetwater County, Wyoming—has been completed and went into service in February. That portion of the line added 750 million ft^3/day (21.2 million m^3) of firm capacity to the region.**

An additional project, not included in the Draft Solar PEIS is the Calnev Pipeline Expansion Project. Calnev Pipe Line, LLC (Calnev), operating partnership for Kinder Morgan Energy Partners, LP, proposes to expand its refined petroleum products pipeline, the Calnev

TABLE 6.5-9 Planned Transmission Projects, Including Expansions, in the Six-State Study Area

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Chinook Project Montana–Las Vegas HVDC Line[a]	500-kV HVDC from Montana to Las Vegas, Nevada, following the SWIP corridor from Borah, Idaho	TransCanada	2020	2008 TEPPC study requested
TransWest Express Project	±600-kV HVDC from Powder River Basin, Wyoming, through Utah to Las Vegas, Nevada	National Grid, APS, PacifiCorp, Western, BLM, and WIA	2015	Initial feasibility studies completed; 2008 TEPPC study requested; NOI, Jan. 4, 2011[b]
Zephyr Project (formerly Northern Lights Inland Project)[a]	New 500-kV DC line from Medicine Bow area in Wyoming, through Midpoint, Idaho, southward down the eastern side of Nevada to the Las Vegas area	TransCanada	2016	2011 TEPPC study requested; preliminary application filed with BLM
SWIP	New 500-kV line from Twin Falls, Idaho, to Las Vegas, Nevada	LS Power and NV Energy		ROW approved in 1998; EA, Aug. 2007; Final EIS for South Portion, Jan. 2010[c]
Gateway South	500-kV AC double-circuit from Aeolus, Wyoming, to Mona, Utah	PacifiCorp, National Grid, APS, WIA, and BLM[d]		Initial feasibility studies completed; TEPCC study requested; NOI, April 1, 2011; ROD expected in 2015
Wyoming–Colorado Intertie Project	345-kV line connecting northeastern Wyoming to the Denver, Colorado, area	Trans-Elect, Inc., Western, and WIA	2014	Phase II status (WECC path rating process); TOT 3 (WECC Path 36) rating increase to 900 kV in 2007
Populus–Terminal Project	345-kV double-circuit from new substation in Idaho looping in various lines with connections at terminal substations in Utah	PacifiCorp	2010	Completed Nov. 2010[e]

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Midpoint–White Pine Project (SWIP North)	500-kV line, 275 mi[f] from Midpoint, Idaho, to White Pine, Nevada	LS Power and Great Basin Transmission, LLC	2014[g]	2008 TEPPC study requested
Wyoming–Colorado Intertie Project	345-kV line from northeastern Wyoming to Denver, Colorado, area (Pawnee)	TransElect, WIA, and Western	2012	
Powder River–Denver Project		North American Power Group	2003	Project dropped because of inactivity[h]
High Plains Express	500-kV AC (double-circuit) high-voltage backbone transmission path from Wyoming, across eastern Colorado and New Mexico to connect with facilities in Arizona	Colorado Springs Utilities, Platte River Power Authority, PNM, SRP, TransElect, TSG&T, Western, Xcel Energy, WIA, New Mexico Renewable Transmission Authority, and Colorado Clean Energy Authority	2019	Feasibility study completed; Stage 3 MOU executed[i]
Eastern Plains Project	500-kV line running south to north in the eastern plains region of Colorado	TSG&T and Xcel	2012–2013	
Devers–Palo Verde Project No. 2	Single-circuit, 500-kV AC line following the route of Devers–Palo Verde #1, from Devers, California, west to Colorado River Substation (midpoint) west of the City of Blythe, California, and from Devers to Valley substations in California, along the existing Devers–Valley #1 ROW	SCE	2013	ROD July 13, 2011[j]; authorization to begin construction Sept. 20, 2011[k]; the Arizona portion of the project was canceled

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
SunZia Project	Two 500-kV AC (or one AC and one DC)[l] from southern New Mexico to southern Arizona	Southwestern Power Group II, LLC	2016	DEIS May 2012[l]
Sonora–Arizona Interconnection Project	500-kV line from Palo Verde, Arizona, to Santa Ana, Mexico; other sources report two 345-kV circuits, approximately 300 mi[a] long	PNM	2004	
Palo Verde–Yuma West Project	500-kV, 115-mi line	APS	2014	Arizona Corporation Commission granted APS a Certificate of Environmental Compatibility on Jan. 15, 2008[m]
Canada–Northern California Transmission Project, Phase 1	500-kV line from British Columbia to Round Butte/Grizzly, Oregon, and ±500-kV HVDC from Round Butte/Grizzly, Oregon, to Tesla/Tracy, California	PG&E	2015	
Interconnection to California–Northern California Transmission Project	500/230-kV transformer at Devils Gap Substation in Spokane, Washington, area and possible phase shifters	Avista Corp.	2015	
Central California Clean Energy Transmission Project	500-kV double-circuit from Midway to Fresno, California	PG&E		
Lake Elsinore Advance Pumped Storage Project and Interconnection	500-kV line Talega Escondido/Valley Serrano, California	Nevada Hydro Company, Inc., and the Lake Elsinore Valley Municipal Water District	2012	

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
San Francisco Bay Area Bulk Transmission Reinforcement Project	500/230-kV substation and 500-kV and 230-kV lines with configuration changes	PG&E	2013	
Southern Navajo Path 51	Increase rating to 3,200 MW (upgrade of four existing series capacitors)	APS	2010	
TOT 3 (WECC Path 36) Upgrade Project (Miracle Mile)	230-kV line	Western	2019	WECC Phase II status
Navajo Transmission Project–Segment 1	500-kV line from Four Corners, New Mexico, to a point south of Navajo, Arizona, on Navajo–Moenkopi line and 500-kV line from Moenkopi to Mead/Marketplace area, Nevada	Dine Power Authority	2010	Pending ROD; access across Indian reservation is on hold
Sigurd to Red Butte to Crystal (Segment G) Project (part of the Gateway South Project, running from Wyoming to the desert Southwest)	345-kV, 164-mi line from Sigurd to Red Butte in southwest Utah and from Red Butte to the existing substation at Crystal	Rocky Mountain Power	2015	Scoping meetings were held in Oct. 2009; Draft EIS, May 27, 2011[n]; Final EIS expected in 2012
ON Line Project, formerly Ely Energy Center Project (SWIP South)	500-kV east of the Dry Lake Valley North SEZ	NV Energy LS Power	2013	Under construction

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Sunrise Powerlink Project	New line about 123 mi from the Imperial Valley Substation in Imperial County to the western part of San Diego County (in Imperial County the line is a 500-kV line extending to a new Suncrest Substation south of I-8; from there, the line proceeds as a 230-kV line to the Sycamore Canyon Substation on Marine Corps Air Station Miramar)	SDG&E	2012	Under construction
Path 27 Upgrade	Intermountain DC line (Utah)	Los Angeles Department of Water & Power	2009	
Southline Transmission Project[o]	345-kV double circuit, 350 mi from Afton, New Mexico, to Tucson, Arizona	Southline Transmission LLC, BLM, Western	2015	NOI April 4, 2012[p]
Energia Sierra Juarez Transmission Project[q]	230-kV double circuit or 500-kV single circuit, 1.65 mi (0.65 mi in the United States) across the United States–Mexico border near Jacumba, California	Sempra Generation, DOE	2014	DEIS Aug. 2010
Barren Ridge Renewable Transmission Project[r]	230-kV double-circuit, 75 mi from Barren Ridge Switching Station to Haskell Canyon and additional 12 mi to the Castaic Power Plant	Los Angeles Department of Water and Power , Forest Service, BLM	2016	DEIS Aug. 2011

TABLE 6.5-9 (Cont.)

Project Name	Description	Applicant/Sponsor	Planned In-service Date	Comments
Hidden Hills Transmission project[s]	230-kV single circuit, 9.7 mi from Hidden Hills Solar Electric Generating Facility to the Bright Source Energy (BSE) Tap Substation, 53.7 mi of new 500-kV single-circuit transmission line from the BSE Tap Substation to the existing Eldorado Substation; a 230-kV transmission line from the Tap Substation to Pahrump	Valley Electric Association, BLM	2015	NOI Oct. 11, 2011
Bordertown to California Transmission Line Project[t]	120 kV, 10.2 mi along the Nevada–California state line, 15 mi west of Reno Nevada	NV Energy, USFS, BLM		NOI Nov. 21, 2011
Sun Valley to Morgan Transmission Line Project[u]	500-kV single circuit and 230-kV single circuit, 38 mi from the Buckeye, Arizona, to Peoria, Arizona	APS, BLM	2016	NOI April 11, 2011
Central New Mexico Collector Expansion Project	345 kV from Guadalupe, New Mexico, to Belen, New Mexico	Public Service Company of New Mexico		
Indian Hills–Upland Project	500-kV line	Los Angeles Department of Water & Power; Imperial Irrigation District	2010	

Abbreviations: AC = alternating current; APS = Arizona Public Service; DC = direct current; BLM = Bureau of Land Management; EIS = environmental impact statement; HVDC = high-voltage direct current; I-8 = Interstate-8; MOU = Memorandum of Understanding; NOI = Notice of Intent; PNM = Public Service Company of New Mexico; ROD = Record of Decision; ROW = right-of-way; SDG&E = San Diego Gas & Electric; SEC = Southern California Edison; SRP = Salt River Project; SWIP = Southwest Intertie Project; TEPCC = Transmission Expansion Planning Policy Committee; TOT = time of transmission; TSG&T = Tri-State Generation & Transmission Association; WECC = Western Electricity Coordinating Council; Western = Western Area Power Administration; WIA = Wyoming Infrastructure Authority.

Foonotes on next page.

TABLE 6.5-9 (Cont.)

---

[a] TransCanada (2011).

[b] BLM (2011c).

[c] Western (2010).

[d] BLM (2012a).

[e] PacifiCorp (2011).

[f] To convert mi to km, multiply by 1.609.

[g] WECC (2011).

[h] WECC (2009).

[i] WIA (2012).

[j] BLM (2011d).

[k] CPUC (2011).

[l] BLM (2012g).

[m] APS (2012).

[n] BLM (2012b).

[o] Southline Transmission (2012).

[p] BLM (2012c).

[q] DOE (2010).

[r] LADWP (2011).

[s] BLM (2012d).

[t] USFS (2012).

[u] BLM (2012e).

Sources: TEPPC (2008); WECC (2012).

Pipeline System. The existing system extends from the North Colton Terminal in Colton, San Bernardino County, California to the North Las Vegas Terminal, in Las Vegas, Clark County, Nevada. The Calnev Pipeline Expansion Project would involve the construction, operation, and maintenance of 233 mi (377 km) of new 16-in. (0.41-m) diameter pipeline from the North Colton Terminal to the Bracken Junction near the McCarran International Airport in Las Vegas, Nevada, which would parallel the existing system for most of the route. In addition to the new pipeline, the Proposed Project would include a new pump station, electrical substation, and ancillary facilities near Baker, California; a new 3-mi (5-km) lateral from the Bracken Junction to McCarran International Airport; and new or modified connections to new or modified laterals, valves, and ancillary modifications. This would increase the existing Calnev system capacity from 156,000 barrels (24,800 m^3) to approximately 200,000 barrels (31,800 m^3) of petroleum products per day (BLM 2012f).

6.5.1.2 Other Activities and Trends

6.5.1.2.1 Other Activities

Recreation

Table 6.5-10 has been updated to list the number of recreational visits for the BLM and NPS in the six-state study area to data for FY 2000 and FY 2010; the BLM and NPS data for FY 2000 and FY 2005 were presented in the Draft Solar PEIS. The data for USFS visits in FY 2000 and FY 2005 have not been updated, since comparable statistics were not readily available. Between FY 2000 and FY 2010, visits to BLM lands in the study area increased by 4.9 million (about 15%), with the greatest increases occurring in Colorado and California. Visits to NPS sites decreased by 1.9 million (about 3%) between FY 2000 and FY 2010. The greatest declines occurred in Nevada and Arizona.

Minerals Production

Table 6.5-11 has been updated to show the number of leases and associated acres for sodium, potassium, phosphate, and gilsonite on BLM-administered land in FY 2002 and FY 2010 from FY 2002 and FY 2009. In FY 2010 in the six-state study area, about 8.4 million yd^3 (6.4 million m^3) of mineral materials was disposed of through exclusive and nonexclusive sales and free use permits, representing a decrease of about 3 million yd^3 (2.3 million m^3) (27%) from FY 2002 (BLM 2003, 2011b).

Military Operations

Table 6.5-12 has been updated from 2008 data to show that, as of 2011, the DoD owns and manages 231 installations occupying about 18 million acres (73,000 km^2) in the six-state study area, with the greatest acreages in New Mexico, California, and Nevada (DoD 2011). Table 6.5-12 shows a breakdown in the number and acreages of installations by military service.

Grazing and Rangeland Management

Table 6.5-13 has been updated from data in FY 2002 to show that in FY 2007, grazing land accounted for about 65% of the land area in the six-state study area. Grazing takes place on lands the Economic Research Service (ERS) categorizes as cropland pasture, grassland pasture and range, and forest land grazed. Cropland pasture is the smallest, but generally the most productive component of grazing acreage, accounting for only about 1% of the land area in the study area. Grassland pasture and range occupies the majority (78%) of the land area. Grazing is also high on forest land in the study area, accounting for about 21% of land area. New Mexico, Nevada, and Arizona have the greatest percentage of grazing land.

TABLE 6.5-10 Recreational Visits for the BLM and NPS in FY 2000 and FY 2010 and for USFS in FY 2000 and FY 2010

	Visits to BLM Lands			Visits to USFS Lands			Visits to NPS Lands[a]		
State	FY 2000	FY 2010	Percentage Change	FY 2000	FY 2005	Percentage Change	FY 2000	FY 2010	Percentage Change
Arizona	4,997,000	5,581,000	11.7	13,859,000	14,309,000	3.2	11,525,818	10,546,150	–8.5
California	8,400,000	10,160,000	21.0	32,403,000	29,786,000	–8.1	34,410,505	34,915,676	1.5
Colorado	4,756,000	6,448,000	35.6	27,948,000	25,728,000	–7.9	5,807,033	5,635,307	–3.0
Nevada	5,045,000	5,971,000	18.4	–[b]	7,188,000	–[b]	6,647,299	5,399,439	–18.8
New Mexico	2,380,000	2,371,000	-0.4	–[b]	2,912,000	–[b]	1,766,079	1,657,550	–6.1
Utah	6,169,000	6,090,000	-1.3	–[b]	10,620,000	–[b]	8,843,646	8,975,525	1.5
Totals	31,747,000	36,621,000	15.3	–[b]	90,543,000	–[b]	69,000,380	67,129,647	–2.7

[a] NPS data are reported for calendar year (January through December).

[b] Data for 2000 not available.

Sources: BLM (2001, 2011b); Parker (2007); NPS (2001, 2011).

TABLE 6.5-11 Solid Mineral Leases on BLM Public Lands in FY 2002 and FY 2010

Leasable Mineral Resource	Number of Leases		Acres[a]	
	FY 2002	FY 2010	FY 2002	FY 2010
Sodium				
Arizona	1	1	4	4
California	31	13	25,567	21,266
Colorado	8	8	16,674	16,675
New Mexico	4	3	2,000	1,560
Total	44	25	44,245	39,505
Potassium				
California	8	6	10,286	10,286
Nevada	0	1	0	2,500
New Mexico	111	117	134,396	143,833
Utah	18	18	34,612	34,612
Total	137	142	179,294	191,231
Phosphate				
Utah	7	4	13,028	8,312
Gilsonite				
Utah	13	14	3,640	3,680

[a] To convert acres to km^2, multiply by 0.004047.

Sources: BLM (2003, 2011b).

Table 6.5-14 has been updated from FY 2009 data to show that at the beginning of FY 2010, there were 7,215 permits and leases for livestock grazing, with a total of about 6.8 million active animal unit months (AUMs on BLM-administered land in the six-state study area. Of those, about 4.4 million AUMs (65%) were authorized and in use (BLM 2011b). About 80% of the authorizations were for the grazing of cattle, 10% for sheep and goats, and 10% for horses and burros. Table 6.5-14 shows the number of grazing permits and leases and AUMs by state for BLM-administered rangeland in FY 2002 and FY 2010. The number of permits and leases in FY 2010 was down about 3.7% compared to FY 2002; authorized AUMs were also down relative to FY 2002, by about 4.6%.

Fire Management

In FY 2010, fires on or threatening BLM-administered land in the six-state study area totaled 78,541 acres (318 km^2) (BLM 2011b).

TABLE 6.5-12 Number and Acreage of DoD Facilities by Military Service in the Six-State Study Area in FY 2011

	Military Service									
	Army		Navy		Air Force		Marine Corps		Total	
State	No.[a]	Acres[b]	No.	Acres	No.	Acres	No.	Acres	No.	Acres
Arizona	8	1,169,471	1	308	12	2,692,287	3	699,468	24	4,561,534
California	31	907,626	69	1,321,624	30	488,373	12	1,270,398	142	3,988,021
Colorado	7	400,409	1	17	10	76,768	0	0	18	477,194
New Mexico	4	3,317,421	1	84	8	296,306	0	0	13	3,613,811
Nevada	2	147,653	7	244,589	8	3,137,283	0	480	17	3,530,005
Utah	11	867,472	1	511	5	947,827	0	0	17	1,815,810
Total	63	6,810,052	80	1,567,133	73	7,638,844	15	1,983,410	231	17,986,375

[a] Numbers represent small, medium, and large installations with plant replacement values greater than zero. Includes facilities greater than 10 acres.

[b] Includes acreage not owned by DoD. To convert acres to km^2, multiply by 0.004047.

Source: DoD (2011).

TABLE 6.5-13 Grazing Land in the Six-State Study Area in 2007[a]

State	Cropland Pasture (1,000 acres[b])	Grassland Pasture and Range (1,000 acres)	Forest Land Grazed (1,000 acres)	Total Grazing Land (1,000 acres)	Percentage of State Land Area
Arizona	–	40,648	12,403	53,051	72.9
California	809	27,524	12,810	41,143	41.2
Colorado	1,242	28,871	10,026	40,139	60.5
Nevada	185	46,850	3,543	50,578	72.0
New Mexico	648	52,122	11,773	64,543	83.1
Utah	403	26,120	7,991	34,514	65.7
Total	3,287	222,135	58,546	283,968	64.6

[a] Includes both federal and nonfederal land.

[b] To convert acres to km^2, multiply by 0.004047.

Source: ERS (2012).

TABLE 6.5-14 Grazing Permits and Leases and AUMs on BLM Public Lands in FY 2002 and FY 2010

	FY 2002			FY 2010		
State	Permits or Leases	Active AUMs[a]	Authorized AUMs[b]	Permits or Leases	Active AUMs[a]	Authorized AUMs[b]
Arizona	767	676,970	469,833	766	640,111	404,677
California	593	316,971	199,383	529	316,853	202,693
Colorado	1,609	644,603	389,314	1,510	597,706	369,530
Nevada	661	2,221,140	1,295,744	677	2,150,302	1,138,171
New Mexico	2,312	1,872,958	1,463,818	2,283	1,850,229	1,488,824
Utah	1,550	1,236,840	758,984	1,450	1,195,958	763,176
Total	7,492	6,969,482	4,577,076	7,215	6,751,159	4,367,071

[a] An AUM (animal unit month) is the amount of forage needed by an "animal unit" (i.e., a mature 1,000-lb cow and her calf) for 1 month. The active AUMs reported are the total number that could be authorized on BLM public lands.

[b] For FY 2002, the authorized AUM count is for the period March 2001 through February 2002; for FY 2009, it is for March 2008 through February 2009.

Sources: BLM (2003, 2011b).

Forestry

This section and Table 6.5-15 of the Draft Solar PEIS remain unchanged and are not repeated here.

Transportation

This section remains unchanged.

Remediation

As of the end of FY 2010, the BLM reported a total of 3,231 sites on its public lands in the six-state study area that have had releases of hazardous substances and other pollutants, with the greatest number (1,261 sites, or 39%) in California. Two other states had release sites numbering more than 15% of the total: Arizona (673) and Nevada (623). Of the total sites, 2,491 (77%) have been closed and administratively archived with no further action planned. During FY 2010, 537 removal actions and 20 remedial actions were conducted on BLM lands in the study area (BLM 2011b).

6.5.1.2.2 General Trends

Population Trends

Table 6.5-16 has been updated to show population in each of the six states for 2011 instead of 2009 and to show the increase for each state between 2000 and 2011. Table 6.5-17 of the Draft Solar PEIS remains unchanged and is not repeated here.

Energy Demand

Tables 6.5-18 and 6.5-19 of the Draft Solar PEIS remain unchanged and are not repeated here.

Water Availability

Tables 6.5-20 and 6.5-21 of the Draft Solar PEIS remain unchanged and are not repeated here.

Climate Change

This section remains unchanged and the information is not repeated here.

TABLE 6.5-16 Population Change in the Six-State Study Area and the United States from 2000 to 2011

	Population		Percentage Increase
	2000	2011	2000 to 2011
State			
Arizona	5,130,632	6,482,505	26.3
California	33,871,648	37,691,912	11.2
Colorado	4,301,261	5,116,796	19.0
Nevada	1,998,257	2,723,322	36.3
New Mexico	1,819,046	2,082,224	14.5
Utah	2,233,169	2,817,222	26.2
Region			
West	63,197,932	72,864,748	15.3
Northeast	53,594,378	55,51,598	3.6
Midwest	64,392,776	67,158,835	4.3
South	100,236,820	116,046,736	15.8
Total for United States	281,421,906	311,691,017	10.7

Source: U.S. Bureau of the Census (2012).

6.5.2 Cumulative Impact Assessment for Solar Energy Development

Cumulative impacts on important resources that would result from the construction, operation, and decommissioning of solar energy development projects, when added to other past, present, and reasonably foreseeable future actions described in the previous section are discussed below. Although the locations and sizes of specific facilities are not known, on the basis of the RFDS developed for this PEIS (see Section 2.4 of this Final Solar PEIS), it is assumed that overall solar development in the six-state study area would be approximately 24,000 MW on BLM-administered lands, with an additional 8,000 MW on non-BLM lands. This level of development would require a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands and 71,000 acres (287 km^2) of non-BLM lands. As discussed in the introduction to the cumulative impacts section (Section 6.5), the RFDS is considered generally applicable to solar development occurring under any of the alternatives evaluated in this PEIS. Because of the uncertain nature of future projects in terms of size, number, location, and the types of technology that would be employed, the impacts are discussed qualitatively or semiquantitatively, with ranges given as appropriate. Detailed cumulative impact analyses are provided for individual SEZs in Chapters 8 through 13. More detailed analyses of cumulative impacts would be performed in the environmental reviews for specific projects in relation to all other existing and proposed projects in the relevant geographic area.

Cumulative impacts on affected resources from the construction, operation, and decommissioning of solar energy development projects, when added to other past, present, and reasonably foreseeable future actions would likely be the same as or less than those analyzed in the Draft Solar PEIS. Since the Draft Solar PEIS was issued, the expected impact from solar energy development on some public lands has been reduced due to the elimination of seven proposed SEZs and the reduction is size of several more. In addition, there are fewer pending solar ROW applications for public lands, falling from 129 pending applications as presented in the Draft Solar PEIS to 89 currently listed pending applications (some of these have been denied). Nonetheless, the BLM remains committed to facilitating solar energy development on public lands, which it proposes to do through the prioritized processing of ROW applications for lands within the proposed SEZ and through the identification of additional SEZs. Overall, the RFDS presented in Section 2.4 is still considered applicable to solar development occurring under any of the alternatives evaluated in this PEIS, and for use in assessing potential cumulative impacts of development.

In general, the cumulative impacts on resources discussed in Sections 6.5.2.1 through 6.5.2.18 of the Draft Solar PEIS remain valid for this Final Solar PEIS. There has been a major shift in technology preference, with many projects proposing to convert from CSP to PV, which would result in reduced impacts on water resources. This shift would lower the potential for cumulative water use impacts presented in Section 6.5.2.8 of the Draft Solar PEIS. Other specific updates for Section 6.5.2 of the Draft Solar PEIS are listed below:

6.5.2.1 Lands and Realty

Solar energy facilities, for the most part, would be built in rural areas within the six Western states covered by this PEIS in large tracks of flat, open, lands where high levels of solar insolation are present. Such lands are typically sparsely populated, often isolated, and typically lightly used, including for grazing, mineral production, limited recreation, and ROWs for wind energy development, transmission lines, other linear utilities, and roads. Placing solar energy facilities in these areas usually represents a new and different land use, creating areas of commercial/industrial character in rural environments. Utility-scale facilities would block out large tracks of land, cumulatively totaling approximately 285,000 acres (1,153 km^2) over the next 20 years, removing or limiting many current land uses. Primary effects would be on access for grazing and mining and road access for recreation or transport. Existing ROWs representing prior rights would be honored, however, and BLM land use plans would be revised to accommodate solar development.

Contributions of solar energy development to cumulative impacts on lands and realty would be in addition to those from other ROWs for transmission lines, roads, and other facilities on public lands and from other energy development on public and private lands that would further affect and limit other land uses within a given region. The intensive coverage of land surface required by solar facilities renders the land used incompatible for most other uses, including grazing, mineral development, and recreation. Although wind and geothermal facilities also encompass large areas, they are generally more compatible with such other uses, because they require less land and can accommodate multiple uses.

The magnitude of land use effects from solar development could be fairly large locally, but significantly smaller regionally, and small overall over the six-state region. On a local scale, solar facilities would dominate several square kilometers of land lying in basin flats and would introduce an industrial land use in typically an otherwise rural area. On a regional and statewide basis, while facilities would affect areas of similar topography, thus increasing their relative impacts on such land types, the percentage of such land types affected would remain quite small for the amount of land required to meet the RFDS.

Renewable energy development is by far the largest potential new future use of rural lands. No other major contributors to cumulative impacts on lands and realty are foreseeable, beyond perhaps additional energy transmission and other linear systems, some of which would be built to serve renewable energy development. Thus, renewable energy development would be the major contributor to cumulative impacts on land use in the affected regions. Solar energy development, because of its intensive land use, would be a major contributor to those impacts.

While the solar RFDS estimate has not changed since the Draft Solar PEIS was issued, seven proposed SEZs have been eliminated and several others reduced in size to address a variety of resource concerns. Contributions of solar development to cumulative impacts on land use might thus be somewhat less than those characterized in the Draft Solar PEIS as a result of reduced dispersion of solar projects in the regions affected by these changes. That is, solar projects more closely consolidated would tend to have lower overall impacts on land use factors such as access to recreation, changing the character of an area, or interfering with grazing than would the same projects more widely dispersed. However, the closely consolidated projects would likely have greater impacts on the water resources in the area.

6.5.2.2 Specially Designated Areas and Lands with Wilderness Characteristics

Lands suitable for solar energy development in the six-state area, whether public or private, are typically basin flats surrounded by mountains. As such, these lands are often located near one or more specially designated areas and lands with wilderness characteristics, which often lie in the surrounding mountains but also include protected desert areas. Potential effects of nearby solar facilities on these sensitive areas include visual impacts, noise impacts, reduced access, impacts on wildlife that use the developed areas, and fugitive dust during construction, which may affect visibility.

Cumulative impacts on these sensitive areas would be from increased development and visual clutter in general in the surrounding areas, reduced local and regional visibility due to construction-related air particulates, light pollution, road traffic, and impacts on wildlife and plants. As for land use noted above, renewable energy development is the major foreseeable contributor to cumulative impacts on these resources, with solar energy the primary contributor in many areas. Other future developments that could affect these areas include mining, OHV use, military and civilian aviation, and new transmission lines and other linear facilities. Most such developments would affect the viewshed and would produce fugitive dust emissions during construction, while mining and aviation would also have noise and vibration effects. While all solar technologies would produce visual effects, other impacts would depend on the employed solar technology; generally, PV would have the lowest overall impacts. Solar trough and power tower technologies including a power block would have the greatest impacts, while noise from dish engine facilities might affect some nearby areas. Cumulative effects would be dominated by solar facilities in favorable areas and by renewable energy development in general. Because of the general vastness of the affected area, foreseeable impacts on specially designated areas in the six-state region under the RFDS, assuming a total of approximately 285,000 acres (1,153 km^2) of land disturbance, would be relatively small overall, but moderate to large in localized areas for individual specially designated areas, especially with respect to visual impacts. Several design features required under the BLM action alternatives would minimize the impacts from solar development, including (1) siting solar facilities as far as possible from key observation points (KOPs) and (2) limiting fugitive dust generation during construction through best management practices and proper timing of work.

Elimination of and modifications to proposed SEZs would tend to reduce overall contributions to cumulative impacts on specially designated areas and lands with wilderness characteristics under the RFDS due to consolidation of solar facilities. While effects would increase in areas where projects are consolidated, eliminating the presence of facilities altogether in other potentially sensitive areas may, at a regional scale, result in impacts of lesser severity or magnitude overall.

6.5.2.3 Rangeland Resources

Solar facilities will be located in areas that are currently grazed, while some may also affect areas managed for wild horses and burros. However, the number of affected grazing allotments is generally small, and in many cases, the allotments would incur only a small reduction in size. Indirect impacts could result from disruption of livestock movement or access to water sources. A small number of permit holders could be significantly affected, although permit holders could be compensated for losses. Solar energy facilities would be a major contributor to foreseeable impacts on grazing, since wind and geothermal energy facilities and other foreseeable development are generally more compatible with grazing. Cumulative impacts on grazing would, however, be small.

Similarly, wild horse and burro management areas could be affected by solar facilities if management areas are located within the area of indirect effects, nominally within 5 mi (8 km) of the facilities. Solar facilities would generally not be sited directly within HMAs. Design features required under the BLM action alternatives would also require protective measures for wild horses and burros as needed, such as the provision of movement corridors, traffic management, and fencing. Cumulative impacts on wild horse and burro management areas would be small overall, as would any contributions from solar facilities. Wild horse and burro management areas encompass a small fraction of total available lands, and they also include lands not suitable for solar development because of topography and other factors, thus reducing conflicts.

Contributions to cumulative effects on grazing and on wild horse and burro management would be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS, due to the general consolidation of solar facilities.

6.5.2.4 Recreation

Under the BLM action alternatives, SRMAs have been excluded from solar development; thus these areas could be affected only indirectly by solar facilities located close to their boundaries. SRMAs identify public lands with many of the BLM's most well-known and highly used recreational opportunities, so excluding SRMAs from solar development would limit the significance of impacts on recreation. High levels of intensive recreational use generally do not occur within the basin flats suitable for solar development. The presence of solar facilities would affect mainly OHV use and low levels of hunting, camping, and photography, for example. In addition, access to recreational areas could be restricted by solar facilities. The level of solar energy development projected by the RFDS would occupy a relatively small portion of the BLM-administered lands in the six-state study area. Since alternative locations for such recreation are generally abundant within the six-state region, direct impacts from solar facilities on the overall availability of recreational opportunities are anticipated to be low. Future site-specific analyses of potential solar facilities would identify measures that would reduce anticipated impacts on local recreational use patterns and public access needs, which would further mitigate potential impacts on public land recreational opportunities. Other renewable energy facilities would also affect areas of low recreational use, as would most other types of foreseeable development in the region, including mining, agriculture, and linear transmission facilities. Thus, cumulative impacts on recreation from foreseeable development are expected to be small.

Contributions to cumulative effects on recreation would be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS, due to the general consolidation of solar facilities.

6.5.2.5 Military and Civilian Aviation

The air space above many of the areas suited to solar energy development is currently heavily used for MTRs. MTRs located over prospective solar facility locations have varying airspace authorizations (i.e., specific heights designated for military use), and coordination and/or consultation with the DoD may identify restrictions on the height of any facilities that might be constructed within these routes. Such restrictions could constrain the types of solar technologies that might be deployed. The construction of high-voltage transmission lines could also conflict with such military airspace use, which could constrain the size and routes of such lines. Glint and glare from solar facilities and any other facilities with reflective surfaces are an additional concern to military pilots. Small cumulative impacts on military aviation could occur from general development in the region, including that from solar facilities, even with established training routes and height restrictions, because of general infringement on formerly wide-open spaces. The military has expressed concerns regarding the possible effects of solar facilities on its training mission. A policy applicable to both BLM's action alternatives requires coordination with the military regarding the location of solar power projects early in the application process.

Civilian aviation would likely be much less affected than military aviation by solar development in the six-state region. Airports are generally located near towns or cities and at some distance from prospective solar development areas. Moreover, civilian aviation would not involve low-altitude flights and the attendant need for height restrictions on infrastructure. No cumulative effects on civilian aviation are expected.

Contributions to cumulative effects on military aviation would be reduced overall due to the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS, and due to specific modifications made to address such impacts. In addition, further coordination with DoD prior to authorizing solar projects in SEZs would be required to avoid, minimize and/or mitigate any outstanding issues or new issues with military aviation.

6.5.2.6 Geologic Setting and Soil Resources

The primary concern for geologic and soil resources from solar development is the large acreages that would be disturbed for the construction of utility-scale facilities. While the topography of suitable areas is necessarily flat in general, the entirety of areas where solar fields are built would have to be graded to produce a very smooth, very flat surface for solar collectors. Such grading would render large areas susceptible to soil erosion. This would be of particular concern in areas where biological soil crusts are present. While soil erosion mitigation measures would be in place, some soil loss would be unavoidable, given the large acreages disturbed, typically dry soil conditions, and occurrence of high winds in development areas. Solar energy development would be a major contributor to cumulative impacts on soil from foreseeable development in the six-state region. Other foreseeable actions that would contribute to soil erosion are road construction, including that associated with solar and other renewable energy development, transmission lines, pipelines, mining, agriculture, and OHV use. Overall foreseeable cumulative impacts on soil would be small to moderate with appropriate mitigations in place and given the relatively small fraction of total land area potentially affected by all development.

Contributions to cumulative effects on geology and soils would be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS due to the general consolidation of solar facilities, which would reduce total linear infrastructure requirements outside of SEZs and due to specific modifications of SEZs to avoid sensitive soils. Conversely, there may be small increases in soil impacts from the general trend in solar technologies from CSP to PV, which requires more land for the same amount of energy production.

6.5.2.7 Mineral Resources

Recoverable minerals that may occur in prospective solar energy development areas include oil and gas, coal, copper, silver, gold, sodium minerals, and sand and gravel. Numerous existing mining interests that represent prior existing rights lie within prospective solar development areas. Solar facilities would be incompatible with most types of mineral production because of the intensive land coverage required. Underground mining might remain viable beneath solar facilities, as would oil and gas recovery using directional drilling. Geothermal resources might also be recoverable in solar development areas. Other foreseeable development, which generally requires less land than solar development, would contribute small additional impacts on mineral resources.

Contributions to cumulative effects on mining could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft PEIS, due to the general consolidation of solar facilities and potential reduced interference with future mining claims.

6.5.2.8 Water Resources

Solar thermal energy technologies that employ a conventional steam turbine generator within a power block (mainly trough and power tower technologies) can require large quantities of water for cooling unless air cooling or hybrid cooling is employed. Far smaller quantities of water are required by all solar technologies for mirror or panel washing and for potable water uses. Water-cooled facilities would typically rely on groundwater within the six-state region, because surface water sources are scarce. Recirculating wet-cooled facilities would be practical only in locations with ample groundwater supplies of suitable water quality where water rights could be obtained, as well as the approval of state and local water authorities. SEZ-specific design features would not allow wet cooling at solar facilities on most of the SEZs, and it is unlikely that facilities using wet cooling would be permitted in most locations within the study area.

Where groundwater or surface water use for cooling is available, the operation of solar energy facilities could affect surface water flows and groundwater supplies and water levels. Environmental effects from such use could include effects on aquatic, riverine, and wetland habitats and communities, municipal and agricultural water supplies, and ground surface subsidence. Effects could occur at significant distances downgradient from the point of use, depending on local hydrology. A design feature under the BLM action alternatives would require developers to conduct hydrologic studies and avoid impacts on surface water features from groundwater use. Other design features would require long-term monitoring of groundwater resources. Overall, the impacts on water supplies from PV facilities and dish energy facilities would likely be minor, since such facilities typically do not require large quantities of water, except during construction. Wet-cooled or dry-cooled solar thermal facilities would not be permitted unless studies had shown that there would be no significant impacts on the hydrologic system.

Wind energy facilities would not require water for operation, but generally require water for construction with fugitive dust control and the frequent use of concrete batch plants. Water would be required for other energy generation and development activities, including coal, natural gas, and geothermal power plants, mining, oil shale and tar sands development in some of the affected states, and possibly biofuels production. All new construction would require water for fugitive dust control. Solar facilities, in particular, require large volumes of water during construction to control dust emissions over large acreages. An additional large increase in water use in the area would be associated with increased domestic use as the population increases.

Cumulative impacts on water supplies in the six-state region from foreseeable development could range from small to moderately high. Impacts will be constrained by the limited availability of water rights and via oversight by state and local water authorities. Large drawdowns due to solar energy demands are not expected under the RFDS, given state and locale oversight of groundwater supplies and fully allocated supplies in most regions. However, pressure on water supplies will continue to grow from multiple demands. In addition, changes in regional precipitation and temperature that have been attributed to global climate change are expected to reduce total water supplies in the southwestern United States (USGCRP 2009). Some water demand will be met by increased reuse of municipal wastewater, while water conservation measures will be increasingly applied. Effects of diversion of water use from agriculture to solar energy development could appear as effects on land use or as socioeconomic effects.

Contributions to cumulative effects on water resources would be reduced overall from those estimated in the Draft Solar PEIS, due to the general trend in solar technologies from CSP to PV since the Draft was issued.

6.5.2.9 Ecological Resources

6.5.2.9.1 Vegetation

The construction of solar energy facilities will require the total removal of vegetation over large portions of land. Most of this land is located in arid or semiarid regions where restoration of vegetation is difficult and where the introduction of invasive species is a significant concern. Development of an integrated vegetation management plan is a design feature applicable under both BLM action alternatives. This plan would require long-term control of invasive species through several means, including monitoring, seeding or planting of desirable species, use of certified weed-free seed and mulching, treating infestations, and integrated pest management.

The main cover types affected are typically abundant in the affected regions, thus impacts on these plant communities would not be large. However, a number of minor species, associated with rare or limited habitats, such as dunes, woodland, or riparian areas in desert regions, might incur greater impacts if not avoided or protected. Biological soil crusts also could incur greater impacts that would be long-term or possibly irreversible. Design features applicable under the BLM action alternatives require that projects not be sited in critical habitat or occupied habitat for sensitive plant species and that sensitive habitats be protected to the extent possible. Coordination with appropriate federal and state agencies to identify these habitats would be required. While solar facilities would avoid wash areas and wetlands to the extent practicable, some sensitive areas could still be affected by the facilities or by access roads, transmission lines, or pipelines that traverse them.

Cumulative direct impacts on plant communities from foreseeable development in the six-state region could be moderate for some sensitive species. Because of the large land areas disturbed and the presence of sensitive communities, solar energy facilities could be a significant contributor to such impacts. Mitigation measures, including avoidance, could protect most sensitive plant communities. Cumulative impacts on primary cover species would be small due to their abundance in the region and the relatively small portion of total lands required under the RFDS.

Plant communities outside of the areas directly affected by solar facilities could be indirectly affected by dust deposition from construction activities, increased surface water runoff and related erosion, or through the introduction of invasive species. Development of a dust abatement plan with extensive measures to limit dust generation during construction and operations is a design feature applicable under both BLM action alternatives. Similarly, multiple design features require the control of surface water runoff and erosion. Spread of invasive species would be addressed through integrated vegetation management as discussed above. With implementation of these measures, indirect cumulative impacts on vegetation are expected to be small.

Contributions to cumulative effects on vegetation could be reduced overall from the elimination and modification of proposed SEZs since issuance of the Draft Solar PEIS, due to the general consolidation of solar facilities, which would reduce total disturbance from external linear facilities and affect fewer areas where sensitive plant species might exist. The trend from CSP toward PV technologies might increase total land disturbance slightly, however.

6.5.2.9.2 Wildlife and Aquatic Biota

Potentially affected wildlife in solar development areas includes numerous species of amphibians and reptiles, birds, mammals, and aquatic biota. Species would be affected by loss of habitat, disturbance, loss of food and prey species, loss of breeding areas, effects on movement and migration, introduction of new species, noise, and habitat fragmentation. Solar facilities could affect bird migration patterns and attract birds to retention ponds. Transmission towers provide nesting and perching sites, while conductors present collision hazards to birds. Aquatic species could be affected by changes in drainage patterns due to site grading and the implementation of stormwater management systems that might divert flows. Groundwater drawdown could dry up wetlands or other areas hosting aquatic species. Design features to address these impacts include timing of activities to avoid affecting breeding seasons and winter use areas, use of noise reduction devices, use of fencing to protect wildlife, traffic control, and preservation of wetlands. These design features would reduce, but not eliminate, impacts.

Cumulative impacts on wildlife and aquatic biota from foreseeable development in the six-state region would be small, provided mitigation measures to preserve important habitat and migration corridors are implemented (or sufficient alternative lands are set aside as compensation). This assessment assumed that solar development would affect the largest amount of acreage in the study area in comparison with other activities, on the basis of the assessment of other foreseeable actions and projects in the study area (see Section 6.5.1). However, based on the RFDS land use projections, solar development would still affect a relatively small fraction of total BLM-administered lands in the study area, and solar facilities would affect mainly flat basin floors, habitat that is abundant in the region. Design features required under the BLM action alternatives would also require the avoidance of rare habitats. Effects on aquatic habitats from drainage changes and sedimentation from soil erosion would be mitigated but not eliminated. Effects from groundwater drawdown would depend largely on solar cooling technologies employed. Large drawdowns due to solar energy demands are not expected under the RFDS given state and local oversight of groundwater supplies and fully allocated supplies in most regions.

Contributions to cumulative effects on wildlife and aquatic biota could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS, due to the general consolidation of solar facilities, which would tend to reduce the number of facilities potentially lying within or near sensitive habitat or in migration corridors.

6.5.2.9.3 Special Status Species

Special status species, those given special protections under the ESA or identified as sensitive species by the affected states or the BLM, are present in much of the area suited for solar development. The ESA protects individual animals or plants, as well as critical habitat. The ESA requirements are reflected in and expanded on in the design features applicable for both BLM action alternatives. Design features include requirements for project developers to identify and protect listed and sensitive species through field surveys and other measures prior to breaking ground. Designated and proposed critical habitat should generally be avoided wherever feasible. In addition, wherever feasible, projects should avoid surface water or groundwater uses that affect habitats occupied by special status species. If avoiding or minimizing impacts on occupied habitats is not feasible, then translocation of individuals from areas of direct effect, compensatory mitigation of direct effects on occupied habitats, or other mitigation could reduce impacts. A comprehensive mitigation strategy for special status species that uses one or more of these options to offset the impacts of development should be developed in coordination with the appropriate federal and state agencies.

Cumulative impacts from foreseeable development in the six-state region could be small to moderate for some species, with solar development being a major contributor to cumulative impacts. A few species would be of concern in many areas, including the desert tortoise, Western burrowing owl, and ferruginous hawk. Impacts on individuals would be the most difficult to mitigate. Contributions to cumulative impacts from solar development are due to the large, continuous, areas disturbed, and disturbance from associated roads, transmission lines, and pipelines.

As for wildlife, contributions to cumulative effects on special status species could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS, due to the general consolidation of solar facilities, which would tend to reduce the number of facilities potentially lying within or near sensitive habitat or in migration corridors.

6.5.2.10 Air Quality and Climate

6.5.2.10.1 Local and Regional Impacts

Air quality would be affected locally and temporarily from fugitive dust emissions during construction of solar facilities; associated particulate matter concentrations could temporarily exceed ambient air quality standards near construction areas and possibly affect visibility in pristine areas such as National Parks or other Class I areas, especially in California, Colorado, and Nevada where multiple SEZs could affect such areas. In addition, long-distance transport of fugitive dust from SEZs could hasten snow melt in affected mountain areas. Application of measures included in an extensive dust abatement plan (a design feature for both BLM action alternatives) would substantially reduce the particulate matter levels generated during construction. The operation of solar facilities would produce very few emissions. Power-block facilities in solar thermal plants could produce some cooling tower drift if water cooling were used, as well as small levels of pollutants from natural gas or propane combustion from backup generators, and occasionally from emergency diesel generators. Portions of facilities that are maintained vegetation-free during operations could be a source of windblown fugitive dust, although design features requiring dust minimization would reduce this source. There also would be limited emissions from vehicles and natural gas–fired preheat boilers (if used).

Emissions from solar facilities would be mitigated and managed so that overall impacts on local or regional air pollution problems would be reduced. Contributions to cumulative effects on air quality would likewise be low, and cumulative effects from other foreseeable development in most solar development regions would be low, given that renewable energy facilities are the major type of new development expected to occur in the generally remote areas where solar facilities would be built. However, the potential exists for cumulative impacts from solar energy development on Class I areas. In addition, the cumulative impacts of long-range transport of fugitive dust from multiple SEZs could affect snowmelt in mountains. Portions of the study area have well-known ongoing air quality problems, primarily Southern California and Southern Nevada. Solar developments in such regions would not worsen air quality, except for particulate matter during construction. To the extent that solar facility operations avoid energy production from fossil fuels, pollutants loads would be reduced for combustion-related pollutants such as carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

Contributions to cumulative effects on air quality from fugitive dust emission would be reduced in some areas and increased somewhat in others from the consolidation of solar facilities, which could result from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS. Some areas would avoid effects while the effects in others could be intensified. Exceedances of particulate matter standards might increase slightly overall due to the combined effects of multiple projects in a localized area if construction were to occur at the same time.

6.5.2.10.2 Global Climate Change

As discussed in Section 6.5.1.2.2, increasing atmospheric levels of GHGs (primarily CO_2) are linked to global climate change (IPCC 2007; USGCRP 2009). Utility-scale solar energy development contributes relatively minor GHG emissions as a result of emissions from heavy equipment, primarily used during the construction phase; vehicular emissions; and natural gas or propane combustion from backup generators. The removal of plants from within the footprint of solar energy facilities would reduce the amount of carbon uptake by terrestrial vegetation, but only by a small amount (about 1% of the CO_2 emissions avoided by a solar energy facility compared to fossil-fuel generation facilities [see Section 5.11.4 of the Draft and Final Solar PEIS]).

Overall, CO_2 emissions could be reduced if solar energy production avoids fossil fuel energy production over the next 20 years. CO_2 emission reductions related to increased solar energy production could range from a few percentage points to more than 20% in some of the study area states if future fossil energy production were avoided by solar energy production. Table 6.5-22 of the Draft Solar PEIS remains unchanged but is repeated here for reader convenience; it provides a comparison of the CO_2 emissions of different generation technologies during facility operations.

In the near term, solar facilities would tend to reduce emissions from facilities serving peak loads rather than emissions from baseline loads served by large fossil fuel plants. Emissions from future fossil fuel plants serving peak loads, typically natural gas–fired plants, would nevertheless be avoided. The addition of thermal energy or electrical storage to solar facilities could allow avoidance of emissions from baseload fossil fuel plants in the long term.

Because GHG emissions are aggregated across the global atmosphere and cumulatively contribute to climate change, it is not possible to determine the specific impact on global climate from GHG emissions associated with solar energy development on BLM-administered lands over the next 20 years. It is possible to predict, however, that increased solar energy generation could cumulatively result in fewer GHG emissions if it avoids electricity generation from new fossil fuel facilities.

Cumulative effects on global climate change would not be significantly affected by the elimination or modification of SEZs, assuming no change in the RFDS.

6.5.2.11 Visual Resources

The introduction of solar facilities in remote rural areas would alter the landscape and produce dramatic changes in the visual character of many affected areas. In addition, suitable solar energy production locations are in basin flats surrounded by mountains or highlands where sensitive viewing locations exist. Thus, visual impacts could be acute for some observers, including hikers and park visitors, as well as for certain groups, including Native American tribes or other ethnic groups who live in affected areas.

TABLE 6.5-22 Comparison of CO_2 Emissions from Different Generation Methods per Average Megawatt

Type of Energy Generation	CO_2 Emissions (ton/MW)
Wind	0
Solar	0
Hydropower	0
Geothermal	636
Coal	7,551–8,843
Natural gas combined-cycle	3,313–5,142
Nuclear	0
Wood-fired co-generation	11,959
Solid-waste-fired co-generation	13,256

Source: BPA (2003).

In addition to visual impacts from solar facilities, impacts would accrue from associated transmission lines, roads, pipelines, and lighting—all of which can have high visual impacts over long distances. Thus, solar development would be a major contributor to cumulative visual impacts from foreseeable development in the six-state region. Overall, cumulative impacts for all development could be significant, including impacts from wind and geothermal development, new roads, transmission lines, pipelines, canals, fences, communication systems, mining, agriculture, commercial development, aviation, road traffic, and OHV use. Visual impacts from solar facilities would be mitigated to the extent practical through the implementation of design features and through careful siting of facilities relative to sensitive viewing sites. Concerns for visual impacts could also affect solar technology selection, including, for example, concerns related to the height of solar tower facilities.

Contributions to cumulative visual effects could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS, due to the general consolidation of solar facilities, which would tend to reduce the number of facilities potentially lying near sensitive viewing areas. However, locations where facilities are located would have greater visual effects from more facilities.

6.5.2.12 Acoustic Environment

Noise effects from heavy equipment and power tools during construction of solar facilities would be similar to those from any large construction project. Such impacts would depend on the type of solar technology being installed, with the lowest noise impacts for PV and dish engine installation and the greatest noise impacts and ground vibration associated with power block construction for solar energy facilities. Facility construction typically requires from 1 to 3 years, with intermittent noise nuisance effects possible on nearby residents and/or wildlife.

Facilities would generally not be located near sensitive noise receptors, including specially designated areas such as national park units and wilderness areas, schools, hospitals, or residential areas but could affect individual residences. Design features under the BLM action alternatives to address noise during construction include limiting the daily hours of activities, construction of noise barriers if needed and practicable, and coordination with nearby residents.

Noise for solar facility operations would be generally low and would depend on the solar technology. PV facilities would produce little or no noise. Solar thermal facilities would produce low levels of continuous noise from power blocks and from cooling towers or cooling fans in air-cooled plants. Power blocks represent a localized noise source typically located near the center of a solar facility and far from facility boundaries. Dish engine facilities present the greatest concern for noise, because each dish represents a single, distributed noise source. While a single dish engine produces modest noise levels, a solar facility might employ thousands of them, presenting a significant noise concern near facility boundaries. Careful siting would mitigate such impacts. For example, SEZ-specific design features generally require siting of dish engine solar fields from 1 to 2 mi (2 to 3 km) away from residential areas. Since noise impacts are short range and solar development areas are mainly sparsely populated and otherwise largely undeveloped, few cumulative noise impacts would occur.

Contributions to cumulative noise effects could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS due to the general consolidation of solar facilities, which would tend to reduce the number of facilities potentially lying within or near sensitive noise receptors. However, locations where facilities are located would have greater local noise effects from more facilities.

6.5.2.13 Paleontological Resources

Paleontological resources, mainly fossils, can be affected by construction excavation for solar facilities. Such effects can be mitigated by collecting or documenting fossils when encountered, with the aid of a paleontologist, or by avoiding areas rich in fossils. Many prospective solar areas have not been surveyed for fossils, and the presence of fossils can be inferred only by the types of geological deposits and soils present. Such areas would be surveyed prior to facility construction. Because of the vastness of the area, cumulative effects on paleontological resources in the six-state area from foreseeable development are expected to be small, while solar development could represent a major contribution to these small effects because of the large acreages disturbed for construction. However, while large in size, much of the area encompassed by solar arrays would not require deep excavation and thus would not likely disturb buried fossils. Foundations for solar collectors, reflectors, or dish engines typically involve minor or no excavation or employ a single piling driven into the ground. Deep excavations would occur for power block foundations, retention ponds, and other structures for some types of solar facilities. Shallow to moderately deep excavations for underground utilities and energy collector lines would be required at most facilities.

It is possible that cumulative effects on fossils would be reduced slightly as a result of the consolidation of solar facilities by reducing the number of different types of geological areas affected.

6.5.2.14 Cultural Resources

Cultural resources are subject to loss during construction of solar facilities and associated roads and transmission lines. Historic properties, including prehistoric and historic archaeological sites, structures, and features and traditional cultural properties, that have been listed in or are eligible for listing in the NRHP are of concern. Cultural resource surveys, evaluations, and any necessary mitigation of NRHP-eligible resources adversely affected by a project must be conducted prior to construction. Consultation with affected local Native American tribes regarding their knowledge of and/or concerns for cultural resources in a given project area must be implemented early and often throughout the project development process. In the event that cultural resources are unexpectedly encountered during construction activities, provisions should be in place to address the appropriate evaluation and treatment of such cultural resource discoveries. Areas rich in cultural resources would be avoided if possible. Cumulative effects on cultural resources from foreseeable development in the six-state region are expected to be small because of the relatively small fraction of total land disturbed. Solar energy development could be a major contributor to these impacts. However, for the most part, solar facilities could, and wherever possible would, be sited away from areas rich in cultural resources. Such areas would include individual properties (sites, structures, features, and traditional cultural properties) and districts listed in the NRHP, National Historic Landmarks, National Historic Trails, and prehistoric and historic sites possessing significant scientific, heritage, or educational values.

Contributions to cumulative effects on cultural resources could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS due to the general consolidation of solar facilities, which would tend to reduce the variety of types of areas that might be affected that contain cultural resources. In addition, reduced disturbance from linear facilities would be expected, while an increase in PV facilities would affect a larger surface area.

6.5.2.15 Native American Concerns

Solar development areas lie on or near lands of current and historical interest to numerous Native American tribes. Solar energy facilities could be of concern to tribes because of an array of potential impacts. Foremost among these would be impacts on the landscape, which would be dramatically altered by solar facilities. Other resources of concern include trails, sacred sites, and burial sites, as well as traditionally collected plants and game. Water bodies and aquatic habitats are also of concern. Consultation with affected tribes is required prior to siting and construction of solar facilities. Mitigations of impacts would involve any and all mitigations otherwise identified for the affected resources. Cumulative impacts on Native American concerns from foreseeable development in the six-state region are currently unknown, because consultation is still ongoing (see Appendix K for concerns that have been raised to date). Solar development could make a significant contribution to impacts, as would wind and geothermal development. Other future development that would affect the visual landscape, ecological communities, water resources, or cultural resources would also contribute to cumulative impacts.

Contributions to cumulative effects on resources of concern to Native American could be reduced overall from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS due to the general consolidation of solar facilities, which would tend to reduce the number of facilities potentially lying on or near sensitive resources. Localized effects would increase, however.

6.5.2.16 Socioeconomics

On the basis of the RFDS projection of 24,000 MW of solar energy generation on BLM-administered land, the number of construction jobs created would range from approximately 7,700 to 84,000, and the number of permanent operations jobs would range from about 450 to 10,000, depending on the mix of solar energy technologies employed. PV facilities require the fewest workers, and parabolic solar thermal trough technologies the most. The total income estimated to result from solar development under the RFDS varies by state. In California, the largest of the six states, total estimated construction income would be $2,544 million for build-out with PV technology and $28 billion for parabolic trough technology. Total operations annual income would be $750 million in California. Construction income would be realized over an assumed development period of 20 years (approximately through 2030), while operations income would be ongoing. These estimates would increase by about one-third when including an estimated additional 8,000 MW of solar generation on non-BLM lands in the study area.

As a point of comparison, the gross domestic product of California in 2008 was $1,545 billion, so the new income related to permanent operations jobs from solar development in the state over the study period would be a small percentage of the state's gross domestic product, roughly 0.05%. However, for all the states, the economic impact would occur in areas of low population, resulting in relatively larger local economic benefits. The relatively small operations workforce would not be expected to strain local services or cause significant social impacts in communities. During the build-out phase, however, large numbers of construction workers might cause temporary social disruption in small communities.

Cumulative social impacts for all development would likely be minor, due to the slow pace of other types of development in the rural areas that would be utilized for solar and other renewable energy development. However, the overall cumulative economic activity related to general development in the study area would benefit the economies of any of the affected localities.

Contributions to cumulative socioeconomic effects in some areas could be intensified somewhat overall due to the general consolidation of solar facilities resulting from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS. Other areas would be removed from effects, either positive or negative.

6.5.2.17 Environmental Justice

Environmental justice effects concern any disproportionately high and adverse human health or environmental effects of federal actions, programs, or policies on minority and low-income populations. Solar energy development has the potential for such effects where minority or low-income populations may be affected. Such effects may derive from air pollution, noise, land use, cultural, or socioeconomic impacts. These effects may be negative, as in the case of increased noise levels or altered land use patterns, or positive, as in the case of local or regional economic benefits resulting from increased jobs and revenue. Mitigation of effects would include surveys to identify potentially affected minority and low-income populations, direct mitigation of effects on natural resources, and social programs to mitigate economic and social effects. Cumulative effects on environmental justice from foreseeable development in the six-state study area are expected to be small. Contributions from solar development would likely be small, due to the low level of health and environmental effects associated with solar facilities, sparse populations in solar areas, and the availability of effective mitigation.

Contributions to environmental concern, likewise, could be intensified in some areas while eliminated in others owing to the general consolidation of solar facilities resulting from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS.

6.5.2.18 Transportation

Effects on transportation systems from solar development would occur mainly during construction of facilities and would affect primarily local road systems and traffic flow. Such effects would be temporary and could be mitigated through minor road improvements at access points and through reduction in traffic congestion through car pooling and coordination of shift changes. Only minor contributions to cumulative effects on transportation would be expected in the six-state study area during the development of solar facilities. Because of the small number of workers required to operate plants and the relatively low level of delivery traffic to and from facilities required for operation, cumulative impacts on transportation systems during facility operations would be minimal.

Contributions to cumulative effects on transportation could be increased slightly overall due to the general consolidation of solar facilities resulting from the elimination and modification of proposed SEZs since the issuance of the Draft Solar PEIS. Such effects would occur during the simultaneous construction of more than one solar facility in a given area.

6.6 OTHER NEPA CONSIDERATIONS

6.6.1 Unavoidable Adverse Impacts

Utility-scale solar development under the action alternatives and under the no action alternative would result in some unavoidable adverse impacts, as follows:

- Short-term air quality impacts due to dust generated during site-preparation and construction, and noise impacts due to the use of heavy construction equipment;

- Short-term influx of workers and transportation-related impacts (e.g., increased traffic) during the construction phase;

- Long-term loss of grazing allotments;

- Long-term reduction in available water supply (relatively insignificant for PV facilities);

- Long-term loss of soil, vegetation, and habitat for wildlife (including sensitive species), and potentially irreversible impacts on biological soil crusts;

- Long-term impacts on some species, both at the population level and on individual organisms;

- Long-term visual impacts on residents of communities near solar facilities, users of roads passing near solar facilities, and patrons of specially designated areas within the viewshed of solar facilities; and

- Long-term noise impacts for solar dish engine facilities and trough or power tower facilities employing TES.

The magnitude of these adverse impacts would to some degree depend on a specific project and would be decreased by implementing the programmatic design features required under the action alternatives (e.g., siting facilities away from the most sensitive resources), although the extent to which these impacts could be mitigated cannot be assessed, except at the project level, and it is possible these impacts could not be completely avoided.

6.6.2 Short-Term Use of the Environment and Long-Term Productivity

For this assessment, short-term uses are defined as those occurring over a 2- to 3-year period, generally applicable to site characterization/preparation and construction phases. Long-term uses and productivity are those that occur throughout the 20-year time frame considered in this PEIS.

Although land disturbance within the footprint of solar energy generation facilities would be long term, additional areas affected during the construction of the generation facilities and related infrastructure (e.g., roads, transmission lines, and natural gas or water pipelines) would result in relatively short-term disturbance. Land clearing and grading and construction and operation activities would disturb surface soils and wildlife and their habitats, and affect local air and water quality, visual resources, and noise levels within and around the solar facility areas and on additional lands used for project-related infrastructure. Short-term influxes of construction workers would affect the local socioeconomic setting.

The lands used long term for solar facilities would produce electricity generated from a renewable source and would result in reduced emissions of GHGs and combustion-related pollutants, assuming the solar facilities avoid electricity generated by fossil fuel power plants. These facilities would generate stable jobs and income for nearby communities (although at a lower rate than during the short-term construction phase), sales and income tax revenues, and income for the federal government in the form of ROW rental revenues over the life of the projects.

6.6.3 Irreversible and Irretrievable Commitment of Resources

Solar energy development on BLM-administered lands would result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials, some of them special-use materials (i.e., metals used in PV solar cells). At decommissioning, some of these materials would be available for reuse.

Water resources would be consumed during the construction phase and during operations, with the extent of water use varying by the technology selected; this would be an irreversible and irretrievable loss.

For most plant and animal species, population-level effects would be unlikely, based on the assumption that required design features are implemented; however, population-level effects are possible for some species. In addition, during construction, operation, and decommissioning, individual plants and animals would be affected. Site-specific and species-specific analyses conducted at the project level for all project phases would help ensure that the potential for such impacts would be minimized to the fullest extent possible. There would be long-term reductions in habitat due to fencing of large areas during the operational period; this impact would be partially mitigated through siting in locations that do not contain critical habitat. Additional programmatic policies (e.g., requiring long-term monitoring and related additional mitigation) and design features would reduce the impacts over time. However, it is unknown whether irreversible and irretrievable impacts on species would occur.

Biological soil crusts are fragile and damage to them could constitute an irreversible and irretrievable impact. When these biological soil crusts are removed, the underlying soils may be subject to increased erosion by both wind and water. Programmatic design features that minimize the amount of land disturbance could be applied to reduce the impacts on these resources.

Cultural and paleontological resources are nonrenewable. Impacts on these resources would constitute an irreversible and irretrievable commitment; however, implementation of the programmatic design features would minimize the potential for these impacts to the extent possible.

Impacts on visual resources in specific locations could constitute an irreversible and irretrievable commitment. Implementation of the programmatic design features would minimize the potential for these impacts to the extent possible; additional mitigation efforts would be undertaken at the project level with stakeholder input.

6.6.4 Mitigation of Adverse Effects

An extensive set of required programmatic design features addressing impacts on important resources and resource uses from solar development has been assembled and is presented in Section A.2.2 of Appendix A. These design features would be implemented for all solar facilities issued ROW authorizations on BLM-administered lands. In addition, SEZ-specific design features, presented in Section A.2.3 of Appendix A, would be implemented to ensure that unique issues and conditions are addressed. This comprehensive set of mitigation requirements would ensure that impacts from solar energy development on BLM-administered lands would be mitigated to the fullest extent possible. Any potential adverse impacts that could not be addressed at the programmatic level would be addressed at the project level, where resolution of site-specific and species-specific concerns is more readily achievable.

Under both action alternatives, the BLM would incorporate adaptive management strategies to ensure that new data and lessons learned about the impacts of solar energy projects would be used to avoid, minimize, or mitigate impacts to acceptable levels. The ROW authorization policies and design features would be updated and revised as new data on the impacts of solar power projects become available. At the project level, operators would be required to develop monitoring programs, to establish metrics against which monitoring observations can be measured, to identify additional potential mitigation measures, and to establish protocols for incorporating monitoring observations and additional mitigation measures into standard operating procedures and project-specific stipulations.

6.7 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

APS (Arizona Public Service), 2012, *Palo Verde Hub to North Gila 500 kV Transmission Line Project*. Available at http://www.aps.com/general_info/siting/siting_14.html. Accessed May 9, 2012.

BLM (Bureau of Land Management), 2001, *Public Land Statistics 2000*, Vol. 185, BLM/BC/ST-01/001+1165, March.

BLM, 2003, *Public Land Statistics 2002*, U.S. Department of the Interior, Washington, D.C. Available at http://www.blm.gov/public_land_statistics/pls02/index.htm.

BLM, 2005, *Land Use Planning Handbook*, H-1601-1, U.S. Department of the Interior, Washington, D.C., March.

BLM, 2011a, *Oil and Gas, Statistics*. Available at http://www.blm.gov/pgdata/content/wo/en/prog/energy/oil_and_gas/statistics.html. Accessed April 12, 2012.

BLM, 2011b, *Public Land Statistics 2010*, U.S. Department of the Interior, Washington, D.C., June. Available at http://www.blm.gov/public_land_statistics/pls10/pls10_combined.pdf. Accessed April 12, 2012.

BLM, 2011c, *Notice of Intent to Prepare an Environmental Impact Statement for the TransWest Express 600 kV Direct Current Transmission Line Project in Wyoming, Colorado, Utah and Nevada*, Jan. 4. Available at http://www.gpo.gov/fdsys/pkg/FR-2011-01-04/pdf/2010-33180.pdf. Accessed April 17, 2012.

BLM, 2011d, *Record of Decision for Devers–Palo Verde No. 2 Transmission Line Project*, July 13. Available at http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/palmsprings.Par.34144.File.dat/DPV2ROD.pdf. Accessed April 23, 2012.

BLM, 2012a, *Energy Gateway South Transmission Line Project*. Available at http://www.blm.gov/wy/st/en/info/NEPA/documents/hdd/gateway_south.html. Accessed April 18, 2012.

BLM, 2012b, *Sigurd to Red Butte No. 2 345 kV Transmission Project*. Available at http://www.blm.gov/ut/st/en/fo/cedar_city/planning/sigurd_to_red_butte.html. Accessed May 9, 2010.

BLM, 2012c, *Notice of Intent To Prepare an Environmental Impact Statement for the Proposed Southline Transmission Line Project in New Mexico and Arizona (DOE/EIS–0474) and Possible Land Use Plan Amendments*. Available at http://www.southlinetransmissionproject.com/files/Southline_NOI_04042012.pdf. Accessed May 23, 2012.

BLM, 2012d, *Valley Electric's Hidden Hills Transmission Project (NVN-089669) Federal Process and Documents*. Available at http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/energy/hidden_hills_transmission.html. Accessed May 23, 2012.

BLM, 2012e, *Sun Valley to Morgan Transmission Line*. Available at http://www.blm.gov/az/st/en/prog/energy/aps-sunvalley.html. Accessed May 24, 2012.

BLM, 2012f, *Calnev Pipeline Expansion Project Draft Environmental Impact Statement/Environmental Impact Report*, March. Available at http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/Barstow/calnev_pipeline.Par.95926.File.dat/DEIS-EIR%20for%20Calnev%20Pipeline%20Expansion%20Project_FOR%20CD3.pdf. Accessed May 24, 2012.

BLM, 2012g, *Draft Environmental Impact Statement and Resource Management Plan Amendments for the SunZia Southwest Transmission Project,* DES 12-26, May. Available at http://www.blm.gov/nm/st/en/prog/more/lands_realty/sunzia_southwest_transmission.html. Accessed May 31, 2012.

BLM and DOE (BLM and U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 10-59, DOE/EIS-0403, Dec.

BLM and DOE, 2011, *Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES 11-49, DOE/EIS-0403D-S, Oct.

BPA (Bonneville Power Administration), 2003, *Fish and Wildlife Implementation Plan, Final EIS, Appendix J: Typical Environmental Consequences of Potential Implementation Actions*, DOE/EIS-0312, Portland, Ore., April.

CPUC (California Public Utilities Commission), 2011, *SCE Devers-Palo Verde No 2 (DPV2) Transmission Line Project – Notice to Proceed*, Sept. 20. Available at http://www.cpuc.ca.gov/environment/info/aspen/dpv2/ntps/ntp04_092011.pdf. Accessed April 23, 2012.

DoD (U.S. Department of Defense), 2011, *Base Structure Report: Fiscal Year 2011 Baseline– A Summary of DOD's Real Property Inventory*, Office of the Deputy Under Secretary of Defense (Installations and Environment). Available at http://www.acq.osd.mil/ie/download/bsr/bsr2011baseline.pdf.

DOE (U.S. Department of Energy), 2010, *Draft Environmental Impact Statement Energia Sierra Juarez U.S. Transmission Line Project August.* Available at http://esjprojecteis.org/docs/deis/_ESJ_DEIS_Summary_Document_AUG25_FINAL_R1.pdf. Accessed May 23, 2012.

EIA (Energy Information Administration), 2001, *Historical Natural Gas Annual 1930 Through 2000*, DOE/EIS-E-0110(00), U.S. Department of Energy, Washington, D.C., Dec.

EIA, 2003, *Annual Coal Report 2002*, DOE/EIA-0584 (2002), U.S. Department of Energy, Washington, D.C.

EIA, 2011a, *Crude Oil Production, 2006 to 2011*, U.S. Department of Energy, Washington, D.C. Available at http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm. Accessed April 12, 2012.

EIA, 2011b, *Natural Gas Annual 2010*, U.S. Department of Energy, Washington, D.C., Dec. Available at http://www.eia.gov/naturalgas/annual/pdf/table_002.pdf. Accessed April 12, 2012.

EIA, 2011c, *Annual Coal Report 2010*, U.S. Department of Energy, Washington, D.C., Nov. Available at http://www.eia.gov/coal/annual/pdf/table2.pdf. Accessed April 12, 2012.

EIA, 2012, *Renewable Energy Trends in Consumption and Electricity 2009*, U.S. Department of Energy, Washington, D.C., Aug. Available at http://www.eia.gov/renewable/annual/trends. Accessed April 16, 2012.

ERS (Economic Research Service), 2012, *Major Land Uses Data Series–1045 through 2007*, U.S. Department of Agriculture, Feb 3. Available at http://www.ers.usda.gov/data/majorlanduses.

FERC (Federal Energy Regulatory Commission), 2008, *Commission Approves Rockies Express-West Pipeline; Project Will Supply Growing Demand East of the Rockies*, News Release, Docket No. CP06-354, April 19, 2007. Available at http://www.ferc.gov/news/news-releases/2007/2007-2/04-19-07-C-1.asp.

IPCC (Intergovernmental Panel on Climate Change), 2007, *Climate Change 2007: Synthesis Report,* Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the IPCC, R.K. Pachauri and A. Reisinger (eds.), Geneva, Switzerland. Available at http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm.

LADWP (Los Angeles Department of Water and Power), 2011, *Barren Ridge Renewable Transmission Project – Draft Environmental Impact Statement/Environmental Impact Report Documents*, Aug. Available at https://www.ladwp.com/ladwp/faces/wcnav_externalId/a-p-p-brrtp-docs?_adf.ctrl-state=qpvt16t3a_4&_afrLoop=38089390790000. Accessed May 23, 2012.

NPS (National Park Service), 2001, *2000 Statistical Abstract*, National Park Service, Public Use Statistics Office, Denver, Colo.

NPS, 2011, *2010 Statistical Abstract*, National Park Service Social Science Program, Public Use Statistics Office, Denver, Colo.

PacifiCorp, 2011, *Populus to Terminal.* Available at http://www.pacificorp.com/tran/tp/eg/gc/sbptt.html. Accessed April 20, 2012.

Parker, G., 2007, personal communication from Parker (U.S. Forest Service) to I. Hlohowskyj (Argonne National Laboratory, Argonne Ill.), April 21.

Secretary of the Interior, 2010, *Renewable Energy Development by the Department of the Interior*, Amendment No. 1 to Secretarial Order 3285A1, Feb. 22. Available at http://elips.doi.gov/app_so/act_getfiles.cfm?order_number=3285A1.

Southline Transmission, 2012, *The Southline Transmission Project*. Available at http://www.southlinetransmissionproject.com. Accessed May 23, 2012.

TEPPC (Transmission Expansion Planning Policy Committee), 2008, *2008 Synchronized Study Plan*, SWG-Version 7, Western Electricity Coordinating Council, June 12.

TransCanada, 2011, *Application to WECC TEPPC and NTTG for the Inclusion of TransCanada's Chinook Project in TEPPC 2011 Study Plan*. Available at http://www.wecc.biz/committees/BOD/TEPPC/EconomicPlanningStudies/Reports/2011/Zephyr%20Chinook_2011%20-%20Study%20Request.pdf. Accessed April 17, 2012.

U.S. Bureau of the Census, 2012, *National and State Population Estimates*. Available at http://www.census.gov/popest/index.html. Accessed April 15, 2012.

USFS (U.S. Forest Service), 2012, *Bordertown to California 120 kV Transmission Line*. Available at http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=36656. Accessed May 24, 2012.

USGCRP (U.S. Global Change Research Program), 2009, *Global Climate Change Impacts in the United States*, T.R. Karl et al. (eds.), Cambridge University Press. Available at http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts.

WECC (Western Electric Coordinating Council), 2009, *WECC Technical Studies Committee*, April 29.

WECC, 2011, *2011 WECC Annual Progress Report, Great Basin Transmission, LLCs, Southwest Intertie Project North and South*, Jan. 24. Available at http://www.wecc.biz/committees/StandingCommittees/PCC/TSS/Shared%20Documents/2011%20Annual%20Progress%20Reports/GBT_2011.pdf. Accessed May 9, 2012.

WECC, 2012, *Project Portal*. Available at http://www.wecc.biz/Planning/TransmissionExpansion/Transmission/Lists/Project%20Portal/AllItems.aspx. Accessed May 9, 2012.

WestConnect, 2012, *2012 WestConnect 10-Year Transmission Plan*, Feb. 16. Available at http://www.westconnect.com/planning_2012_final_report.php. Accessed May 9, 2012.

Western (Western Area Power Administration), 2010, *Final Environmental Impact Statement, Project Financing for Southwest Intertie Project South*. Available at http://www.wapa.gov/dsw/environment/SWIP.htm. Accessed April 17, 2012.

WIA (Wyoming Infrastructure Authority), 2012, *High Plains Express Project (HPX)*. Available at http://wyia.org/projects/transmission-projects/high-plains-express-project-hpx. Accessed April 18, 2012.

7 ANALYSIS OF DOE'S ALTERNATIVES

Through this PEIS, DOE is evaluating two alternatives: a proposed action (action alternative) and a no action alternative (see Section 2.3).

DOE developed the proposed environmental guidance presented in Section 2.3.2 of this Final Solar PEIS to facilitate the advancement of solar energy development. Under the proposed action, DOE would adopt this programmatic guidance, including recommended environmental practices and mitigation measures, for consideration in its investment and deployment strategies and decision-making process. This guidance would provide DOE with a tool for making more informed, environmentally sound decisions on DOE-supported solar projects. In the Final Programmatic EIS, DOE has identified the proposed action (action alternative) as its preferred alternative.

The proposed action has been developed to support DOE in meeting the mandates discussed in Section 1.1 of this Final PEIS that provide the purpose and need for agency action. Specifically, these mandates are established by E.O. 13212, "Actions to Expedite Energy-Related Projects" (*Federal Register*, Volume 66, page 28357, May 22, 2001); E.O. 13514, "Federal Leadership in Environmental, Energy, and Economic Performance" (*Federal Register*, Volume 74, page 52117, Oct. 5, 2009); and Section 603 of EISA (P.L. 109-58). Collectively, these mandates require DOE to promote, expedite, and advance the production and transmission of environmentally sound energy resources, including renewable energy resources and solar energy and, in particular, cost-competitive solar energy systems at the utility scale.

Under the no action alternative, DOE would continue to conduct environmental reviews of DOE-supported solar projects on a case-by-case basis. It would not adopt programmatic guidance regarding environmental practices and mitigation recommendations to apply to DOE-supported solar projects.

This chapter presents an analysis of DOE's two alternatives in terms of their effectiveness in meeting the mandates established for the agency. Specifically, the alternatives are analyzed in terms of their potential to affect the pace and cost of solar energy development, the environment, and socioeconomic setting.

Sections 7.1 and 7.2 present the analysis of the two alternatives. Section 7.3 discusses the cumulative impacts of the alternatives. Section 7.4 discusses the other NEPA considerations related to the proposed action, including unavoidable adverse impacts, short-term uses of the environment and long-term productivity, irreversible and irretrievable commitment of resources, and mitigation of adverse impacts.

7.1 IMPACTS OF DOE'S PROPOSED ACTION

The proposed guidance presented in Section 2.3 is intended to better enable DOE to comprehensively determine where to make technology and resource investments to minimize the environmental impacts of solar technologies for DOE-supported solar projects.

DOE could also consider the proposed guidance in establishing environmental mitigation recommendations to be considered by project proponents. The recommendations contained in the guidance, which are based upon the analysis of impacts of solar energy development and potentially applicable mitigation measures presented in Chapter 5 of the Draft and Final Solar PEIS, would help DOE ensure that adverse environmental impacts of DOE-supported solar projects would be avoided, minimized, or mitigated.

Collectively, streamlined environmental reviews and quicker project approval processes would likely increase the pace of DOE-sponsored development and reduce the costs to industry, regulatory agencies, and stakeholders. These outcomes would support the mandates of E.O.s 13212 and 13514 and Section 603 of EISA.

Increasing the pace of solar energy development would, in turn, translate into other benefits. Utility-scale solar energy development would result in reduced GHG emissions and combustion-related pollutants, if the development results in avoided electricity generation by fossil fuel power plants (see Section 5.11.4 of the Draft and Final Solar PEIS). If the pace of solar energy development is faster as a result of DOE's proposed action, the potential beneficial impacts of reduced GHG emissions would be realized at a faster rate.

Utility-scale solar energy development would result in local and regional economic benefits in terms of both jobs and income created (see Section 5.17.2 of the Draft Solar PEIS). The associated transmission system development and related road construction would also produce new jobs and income. These benefits would occur as both direct impacts, resulting from wages and salaries, procurement of goods and services, and collection of state sales and income taxes, and indirect impacts, resulting from new jobs, income, expenditures, and tax revenues subsequently created as the direct impacts circulate through the economy. Increasing the pace of solar energy development would cause these economic benefits to be realized at a faster pace as well.

As discussed in Section 5.17.1.1 of the Draft Solar PEIS, there may be some adverse socioeconomic impacts resulting from changes in recreation, property values, and environmental amenities (e.g., environmental quality, rural community values, or cultural values), and disruption potentially associated with solar development. There could also be beneficial socioeconomic impacts in these areas resulting from economic growth and a positive reception to the presence of a renewable energy industry. Increasing the pace of solar energy development would also speed up the pace of these types of socioeconomic changes. At the programmatic level, it is difficult to quantify these impacts.

In summary, the proposed programmatic guidance that DOE has developed under its proposed action would likely minimize the potential adverse environmental impacts of solar energy development for DOE-supported projects. As a result of adopting this guidance in various DOE solar-related programs, the pace of solar energy development could increase.

7.2 IMPACTS OF THE NO ACTION ALTERNATIVE

Under the no action alternative, DOE would continue its existing case-by-case process for addressing environmental concerns for DOE-supported solar projects. It would not adopt programmatic environmental guidance to apply to DOE-supported solar projects. As a result, DOE would not undertake any efforts (i.e., programmatic environmental guidance) to programmatically promote the reduction of environmental impacts of solar energy development or streamline environmental reviews for DOE-supported projects. Such achievements, and the potential benefits in terms of increased pace of solar energy development and decreased associated costs, might occur under the no action alternative, but they would not be programmatically promoted by DOE (by adoption of programmatic environmental guidance with recommended environmental practices and mitigation measures).

7.3 CUMULATIVE IMPACTS

As discussed in Section 6.5, the purpose of this cumulative impact assessment is to determine how the environmental, social, and economic conditions within the six-state study area may be incrementally affected by DOE's alternatives over the next 20 years. The CEQ, in its regulations implementing the procedural provisions of NEPA (40 CFR 1500–1508), defines cumulative effects as follows:

> "... the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

Typically, the "incremental impact of the action" is characterized in terms of a specific, quantifiable set of activities. In a programmatic impact analysis, this type of characterization might be based on a projected amount of development expected to occur as a result of the proposed action. DOE and the BLM developed an RFDS for solar energy development in the six-state study area over the next 20 years (see Section 2.4), which projects the amount of solar energy in megawatts that might be developed in each state by about 2030. The RFDS analysis also estimates how many acres of land might be required to support the projected development. The projected levels of development and estimated acres developed are presented in Table 2.4-1. Across the six-state study area, the RFDS projects that about 6,000 to 32,000 MW of solar energy capacity would be developed over the next 20 years on BLM-administered lands as well as other federal, state, tribal, or private lands. On the basis of the highest projection, assuming 9 acres/MW (0.04 km^2/MW), this amount of development could require approximately 285,500 acres (1,155 km^2) of land.

Although DOE certainly has an influence over the amount of solar energy development that occurs in the United States and has designed its proposed action specifically to shape some aspects of its influence, it is not possible to calculate how much of the projected RFDS development and associated land use would be directly attributable to DOE's proposed action. Conversely, because the BLM is evaluating a new Solar Energy Program that would determine how it manages such development on BLM-administered lands, including the identification of lands that would be excluded from and lands that would be available for development, the RFDS identifies which portion of the projected development might occur on BLM-administered lands over the next 20 years. It is assumed that this development would be facilitated in large measure by the BLM's new program, and therefore the development is considered to be a result of BLM's proposed action. Of the total 32,000 MW of solar capacity projected by the RFDS, 75%, or approximately 24,000 MW, is assumed to be developed on BLM-administered lands; this equates to about 214,000 acres (866 km^2) of land.

The cumulative impact analysis of BLM's alternatives, presented in Section 6.5.2, evaluates the full amount of development projected by the RFDS. It defines the "incremental impact" of the agency's action as that portion of the RFDS projected on BLM-administered lands (i.e., 24,000 MW of solar energy capacity and 214,000 acres [866 km^2]), and the rest of the RFDS projected development as "reasonably foreseeable" solar energy development resulting from the actions of others. Consequently, the full RFDS projected level of development is considered in the cumulative impact analysis of BLM's alternatives.

In all likelihood, only a small percentage of utility-scale solar energy development projected in the RFDS would be directly attributable to DOE's proposed action, in light of the anticipated limited availability of federal funds to support such projects in the six-state study area. As a result, the BLM cumulative impact analysis is considered to provide the upper bound description of potential cumulative environmental impacts. Consequently, a separate cumulative impact analysis has not been prepared for DOE's alternatives.

7.4 OTHER NEPA CONSIDERATIONS

7.4.1 Unavoidable Adverse Impacts

Utility-scale solar development would result in some unavoidable adverse impacts, as follows:

- Short-term air quality impacts due to dust generated during site preparation and construction, and noise impacts due to the use of heavy construction equipment;

- Short-term influx of workers and transportation-related impacts (e.g., increased traffic) during the construction phase;

- Long-term loss of grazing allotments;

- Long-term reduction in available water supply (relatively insignificant for PV facilities);

- Long-term loss of soil, vegetation, and habitat for wildlife (including sensitive species) and potentially irreversible impacts on biological soil crusts;

- Long-term impacts on some species, both at the population level and on individual organisms;

- Long-term visual impacts on residents of communities near solar facilities, users of roads passing near solar facilities, and patrons of specially designated areas within the viewshed of solar facilities; and

- Long-term noise impacts from solar dish engine facilities and trough or power tower facilities employing TES.

The magnitude of these adverse impacts would depend on a specific project and would be decreased through mitigation, although the extent to which this is possible cannot be assessed except at the project level, and it is possible that these impacts could not be avoided completely.

7.4.2 Short-Term Use of the Environment and Long-Term Productivity

For this assessment, short-term uses are defined as those occurring over a 2- to 3-year period, generally applicable to the site characterization, preparation, and construction phases. Long-term uses and productivity are those occurring throughout the 20-year time frame considered in this PEIS.

Although land disturbance within the footprint of solar energy generation facilities would be long term, additional areas affected during the construction of the generation facilities and related infrastructure (e.g., roads, transmission lines, and natural gas or water pipelines) would result in relatively short-term disturbance. Land clearing and grading and construction and operation activities would disturb surface soils and wildlife and their habitats, and affect local air and water quality, visual resources, and noise levels within and around the solar facility areas and on additional lands used for project-related infrastructure. Short-term influxes of construction workers would affect the local socioeconomic setting.

The lands used for solar facilities long term would produce electricity generated from a renewable source and would result in reduced GHG emissions and combustion-related pollutants, assuming the solar facilities offset electricity generated by fossil fuel power plants. These facilities would generate stable jobs and income for nearby communities (although at a lower rate than during the short-term construction phase), sales and income tax revenues, and income for the federal government in the form of ROW rental revenues over the life of the projects.

7.4.3 Irreversible and Irretrievable Commitment of Resources

Solar energy development would result in the consumption of sands, gravels, and other geologic resources, as well as fuel, structural steel, and other materials, some of them special-use materials (i.e., metals used in PV solar cells). At decommissioning, some of these materials would be available for reuse.

Water resources would be consumed during the construction phase and during operations, with the extent of water use varying by technology selected; this would be an irreversible and irretrievable loss.

For most plant and animal species, population-level effects would be unlikely, based on the assumption that mitigation measures would be implemented; however, population-level effects are possible for some species. In addition, during construction, operation, and decommissioning, individual plants and animals would be affected. Site-specific and species-specific analyses conducted at the project level for all project phases would help ensure that the potential for such impacts would be minimized to the fullest extent possible. There would be long-term reductions in habitat due to fencing of large areas during the operational period; this impact would be partially mitigated through siting in locations that do not contain critical habitat. Additional mitigation measures (e.g., conducting long-term monitoring and related additional mitigation) would reduce the impacts over time, if implemented. However, it is unknown whether irreversible and irretrievable impacts on species would occur.

Biological soil crusts are fragile, and damage to them could constitute an irreversible and irretrievable impact. When removed, the underlying soils may be subject to increased erosion by both wind and water. Mitigation measures that minimize the amount of land disturbance could be applied to reduce the impacts on these resources.

Cultural and paleontological resources are nonrenewable. Impacts on these resources would constitute an irreversible and irretrievable commitment; however, implementation of appropriate mitigation measures would minimize the potential for these impacts to the extent possible.

Impacts on visual resources in specific locations could constitute an irreversible and irretrievable commitment. Implementation of appropriate mitigation measures would minimize the potential for these impacts to the extent possible; additional mitigation efforts would be undertaken at the project level with stakeholder input.

7.4.4 Mitigation of Adverse Effects

Under the proposed action, DOE would adopt programmatic environmental guidance with recommended environmental best management practices and mitigation measures that could be applied to all DOE-supported solar projects. These recommended measures would likely be consistent with the mitigation requirements that would be adopted by the BLM under its action alternatives. BLM's proposed requirements are presented in Section A.2 of Appendix A. By recommending a comprehensive set of mitigation measures, DOE would help ensure that impacts from solar energy development would be mitigated to the fullest extent possible. Any potential adverse impacts that could not be addressed by DOE's programmatic guidance would be addressed at the project level, where resolution of site-specific and species-specific concerns is more readily achievable.

This page intentionally left blank.

14 UPDATE TO CONSULTATION AND COORDINATION UNDERTAKEN TO SUPPORT PREPARATION OF THE PEIS

Chapter 14 of the Draft Solar PEIS provided information on public scoping that was conducted for the Solar PEIS (Section 14.1); government-to-government consultation with tribes that was done prior to publication of the Draft Solar PEIS (Section 14.2); coordination with BLM state and field offices (Section 14.3); and other agency cooperation, consultation, and coordination (Section 14.4). The information presented in this update to Chapter 14 for the Final Solar PEIS summarizes and supplements, but does not replace, the information provided in the corresponding Chapter 14 in the Draft Solar PEIS. Information on the topics listed above that has become available subsequent to publication of the Draft Solar PEIS is presented in this section, including a summary of the public outreach that has been conducted subsequent to publication of the Draft Solar PEIS.

14.1 PUBLIC SCOPING AND PUBLIC OUTREACH

This section updates the information regarding public scoping and outreach provided in the Draft Solar PEIS.

The Notice of Availability (NOA) of the Draft Solar PEIS was published in Volume 75, page 78980, of the *Federal Register* on December 17, 2010. The public comment period for the Draft Solar PEIS that was originally announced was 90 days; however, in response to stakeholder requests, the comment period was extended to May 2, 2012. Fourteen public meetings were held during the comment period for the Draft Solar PEIS. Comments on the Draft Solar PEIS were submitted via the Solar PEIS project Web site (http://solareis.anl.gov), by mail, and orally at public meetings. Several nongovernmental organizations submitted comments in the form of standardized campaign letters from their constituents. Six campaigns on the Draft PEIS were submitted, with more than 86,000 individuals represented. In addition, approximately 1,950 comment documents on the Draft Solar PEIS were received, and about 150 comments were received orally at public meetings. Comments were received from individual members of the public; federal, state, and local governmental agencies; tribes; solar companies and solar industry organizations; environmental organizations; utilities; ranchers; water districts; and many other types of organizations. Comments were primarily received from organizations and individuals within the six-state study area.

In response to comments on the Draft Solar PEIS that provided suggestions on how the BLM and DOE could increase the utility of the analysis, strengthen elements of BLM's proposed Solar Energy Program, and increase certainty regarding solar energy development on BLM-administered lands, the Agencies published a Supplement to the Draft Solar PEIS. As part of the Supplement, the BLM made significant changes to the proposed program, including eliminating seven SEZs from further consideration and reducing the size of several of the remaining SEZs, adding variance areas and a variance process, and creating an identification protocol for new SEZs. The NOA of the Supplement was published on page 66958 in Volume 76 of the *Federal Register* on October 28, 2011. The public comment period for the Supplement to the Draft Solar

PEIS ran from October 28, 2011, to January 27, 2012. The agencies convened five public meetings on the Supplement; one meeting in the San Luis Valley of Colorado was not originally planned but was added in response to stakeholder requests. Comments on the Supplement to the Draft Solar PEIS were received from the same broad cross-section of entities that commented on the Draft Solar PEIS. Comments were submitted via the Solar PEIS project Web site, by mail, and orally at public meetings. Six campaigns on the Supplement to the Draft PEIS were submitted, with more than 134,000 individuals represented. In addition, approximately 250 comment documents were received from individuals and organizations, and about 64 comments were received orally at public meetings.

The agencies have offered other opportunities for public involvement throughout the process of preparing the Solar PEIS. The Solar PEIS project Web site (http://solareis.anl.gov) was made available to the public to provide access to relevant project information, and the opportunity to subscribe through the Web site to receive e-mail updates of important project milestones was provided as well. In response to requests to provide the public with an opportunity to review key new or revised materials prior to release of the Final Solar PEIS, several key elements of BLM's Solar Energy Program were made available through the project Web site in April 2012 (i.e., proposed programmatic design features, the proposed Solar LTMP, and the proposed Regional Mitigation Framework). The BLM has continued to work closely with cooperating agencies and other stakeholders throughout the preparation of the Final Solar PEIS.

14.2 GOVERNMENT-TO-GOVERNMENT CONSULTATION

The federal government works on a government-to-government basis with Native American tribes. Government-to-government consultation efforts undertaken through the publication of the Draft Solar PEIS were described in Section 14.2 of the Draft and are not repeated here.

Since release of the Draft Solar PEIS, the BLM has sent 314 federally recognized tribes, bands, and chapters copies of the Draft Solar PEIS, the Supplement to the Draft Solar PEIS, and supporting materials, such as the Draft Solar PA and a question and answer (Q&A) fact sheet related to the solar energy program. These were transmitted in February and October of 2011, and copies of those cover letters are available in Appendix K of this Final Solar PEIS. The BLM also issued IM 2012-032 in December 2011, which established the schedule and procedure for ongoing government-to-government consultation in connection with the solar energy program (BLM 2011). The IM directed field offices to take additional steps to explain to Native American tribes how their input was taken into account during the preparation of the Final Solar PEIS and how consultation will continue upon the receipt of project-specific solar applications. This IM is provided in Section K.1.3 of Appendix K.

Consultation in the form of correspondence, phone conversations, e-mails, and transmissions of maps, documents, and reports has taken place with more than 65 tribes. Face-to-face meetings with 18 tribes have led to the exchange of information and discussion of concerns that have shaped the outcome of this PEIS process. Fifteen federally recognized tribes commented on the Draft Solar PEIS and the Supplement to the Draft. All this information is summarized in Appendix K, particularly in Table K-2.

Consultation between the BLM and the tribes is ongoing and will continue to take place after the release of the Final Solar PEIS.

14.3 COORDINATION OF BLM STATE AND FIELD OFFICES

The coordination with BLM state and field office staff as described in Section 14.3 of the Draft Solar PEIS continued throughout preparation of the Supplement to the Draft Solar PEIS and the Final Solar PEIS. Conference calls and other communications took place to review comments received and to review requests for additional exclusions to lands available for solar ROW application in light of the region-specific knowledge held by the BLM staff in those offices. State and field office staff provided GIS data that allowed revised mapping of the lands available under the various BLM alternatives. The BLM Washington Office staff will continue to work with state and field office staff following the release of the ROD for the Solar PEIS to facilitate implementation of the new Solar Energy Program.

14.4 AGENCY COOPERATION, CONSULTATION, AND COORDINATION

As stated in Section 14.4 of the Draft Solar PEIS, a total of 19 agencies, listed in Section 1.5 of this Final Solar PEIS, are working with the BLM and/or DOE as cooperating agencies. These agencies include six federal agencies, six state agencies, and seven counties. Interactions with the cooperating agencies have continued throughout preparation of the Final Solar PEIS through reviews of draft sections of text prior to issuance of the Final.

In accordance with the requirements of Section 106 of the NHPA, coordination with SHPOs in each of the six states in the study area and with the ACHP has continued throughout preparation of the Final Solar PEIS. In particular, consultation has continued on the content of a Solar PA. The Solar PA will provide for a phased consultation process related to historic, traditional, and cultural resources for the Solar PEIS and subsequent activities that could tier from the Solar PEIS ROD. Updated information regarding the consultation process is provided in Section K.2 of Appendix K of this Final Solar PEIS.

In addition, the BLM has continued consultation with the USFWS in accordance with the requirements of Section 7 of the ESA to ensure that BLM's proposed action would not jeopardize the continued existence of any listed threatened or endangered species. The BLM, in consultation with the USFWS, is undertaking a conservation review pursuant to Section 7(a)(1) of the ESA on the overall Solar Energy Program. This consultation on the overarching program will provide guidance for subsequent solar projects by ensuring that the appropriate conservation measures for listed species are incorporated into project-level actions. The BLM is also engaged in programmatic consultation with the USFWS on the identification of SEZs under Section 7(a)(2) of the ESA, initiated through the submission of a programmatic BA. This BA describes potential effects on ESA-listed species and designated critical habitat from expected solar development in SEZs and any appropriate mitigation, minimization, and avoidance measures. Additional Section 7(a)(2) consultation will occur, as necessary, at the level of individual solar energy projects and will benefit from the preceding programmatic consultation and resulting programmatic BO for SEZs.

ESA consultation was initiated by providing a review copy of the Draft Conservation Assessment and of the Draft BA to the USFWS in January 2012. Comments provided by the USFWS were addressed by the BLM in the final versions of both documents. The USFWS is expected to issue a Conservation Review and Programmatic Biological Opinion that addresses each of the proposed SEZs prior to the publication of the ROD for this Solar PEIS (expected in the late fall of 2012). The results of this consultation will be reflected in the ROD for the Solar PEIS.

The BLM has continued activities to coordinate and consult with the governors in each of the six states and with state agencies through the development of the Supplement to the Draft PEIS and the Final Solar PEIS. Prior to approval of the proposed plan amendments presented in Appendix C of this Final Solar PEIS, the BLM will undertake a Governor's Consistency Review (as required under CFR 43 1610.3-2[e]), in which the governors of each state will be given the opportunity to identify any inconsistencies between the proposed plan amendments and state or local plans and to provide recommendations in writing (during the 60-day consistency review period). Coordination with state agencies is expected to continue through implementation of the new Solar Energy Program.

14.5 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this Final Solar PEIS. It is likely that at the time of publication of this Final Solar PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this Final Solar PEIS.

BLM 2011, *Instruction Memorandum 2012-032, Native American Consultation and Section 106 Compliance for the Solar Energy Program Described in Solar Programmatic Impact Statement*, U.S. Department of the Interior, Washington, D.C., Dec. 1.

15 LIST OF PREPARERS

Table 15-1 lists the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and U.S. Department of Energy (DOE) management team members for the Draft and Final Solar Programmatic Environmental Impact Statement (Solar PEIS). Table 15-2 lists the names, education, and expertise of the Solar PEIS preparers.

TABLE 15-1 Agency Management Team

Name	Office/Title
Bureau of Land Management	
Ray Brady	Minerals and Realty Management Directorate, Manager, Energy Policy Team
Stephen Fosberg	Renewable Resources and Planning Directorate, Solar Project Archaeologist
Linda Resseguie	Minerals and Realty Management Directorate, Realty Specialist, PEIS Document Manager
Jessica Rubado	Renewable Resources and Planning Directorate, Wildlife Biologist
Shannon Stewart	Renewable Resources and Planning Directorate, Senior Planning and Environmental Analyst, PEIS Document Manager
Kim Tripp	Division of Fish and Wildlife Conservation, Threatened and Endangered Species Specialist
U.S. Department of Energy	
Jenn Decesaro	Office of the Secretary
Mark Lausten	Senntech
Caroline Mann	Office of Energy Efficiency and Renewable Energy
Carredin Moeller	Office of NEPA Policy and Compliance
Dr. Jane Summerson	Energy Efficiency and Renewable Energy, PEIS Document Manager
Mark Wieringa	Western Area Power Administration, Environmental Protection Specialist
Frank Wilkins	Concentrating Solar Power, Solar Energy Technologies Program, Team Leader

TABLE 15-2 Solar PEIS Preparers

Name	Education/Expertise	Contribution
Argonne National Laboratory		
Timothy Allison	M.S., Mineral and Energy Resource Economics; M.A., Geography; 22 years of experience in regional analysis and economic impact analysis.	Technical lead for socioeconomic and environmental justice analysis
Lynn Almer	Bachelor of Science, Chemistry, and Earth Science; 19 years of experience working with the National Environmental Policy Act.	Comment processing; water resources assessment
Georgia Anast	B.A., Mathematics/Biology; 18 years of experience in environmental assessment.	Comment processing manager
Halil Avci	Ph.D., Nuclear Engineering; 27 years of experience in environmental assessment, waste management, and project management.	Cumulative impact analysis—Colorado and Utah
Kevin J. Beckman	B.S., Mathematics and Computer Science; 3 years of experience in Web programming and visual impact analysis.	Public Web site development and technical support for visual impact analysis
Bruce Biwer	Ph.D., Chemistry; 22 years of experience in environmental assessment and transportation risk analysis.	Transportation impacts
Matthew Braun	B.S., Anthropology and Psychology; 5 years of archaeological field experience.	Cultural resources analysis
Brian L. Cantwell	B.S., Forestry; 27 years of experience in cartography and GIS mapping.	Technical lead for GIS mapping
Adrianne Carr	Ph.D., Geological and Environmental Sciences; 6 years of experience in hydrological studies and impact analysis.	Water resources analysis
Youngsoo Chang	Ph.D., Chemical Engineering; 22 years of experience in air quality and noise impact analysis.	Technical lead for air quality and emissions, noise
Roberta S. Davidson	M.S., Forest Biometrics; 18 years of experience in environmental assessment, environmental and logistics modeling, and software verification and validation.	Socioeconomics and cumulative impact analysis
John DePue	M.S., Biology; 38 years of experience in technical editing and environmental assessment document production.	Editor

TABLE 15-2 (Cont.)

Name	Education/Expertise	Contribution
John Gasper	M.S., M.P.H., Environmental Health Science; 33 years of experience in environmental and energy assessment and program management.	Project management; document review
Linda Graf	Desktop publishing specialist; 41 years of experience in creating, revising, formatting, and printing documents.	Lead for document processing and formatting
Hal P. Greenwood	B.S., Geography; 14 years of experience in cartography and GIS mapping.	GIS mapping
Mark A. Grippo	Ph.D., Biology; 6 years of experience in aquatic resource studies and impact analysis.	Ecological resources analysis (aquatic)
Antonio C. Guerrero	Certificate in Geographic Information Analysis; 3 years of experience in GIS analysis.	Technical support for visual impact analysis
Yuki Hamada	B.A., Geography; M.S., Geography; Ph.D, Geography; 12 years of experience in remote sensing applications for quantification, monitoring, and analysis of terrestrial ecosystems.	Water resources analysis; GIS/remote sensing specialist
Heidi M. Hartmann	M.S., Environmental Toxicology and Epidemiology; 25 years of experience in environmental assessment, exposure and risk analysis, and environmental impact assessment.	Project Manager; programmatic analysis, health and safety assessment
John Hayse	Ph.D., Zoology; 25 years of experience in ecological research and environmental assessment.	Ecological resources analysis (aquatic)
Elizabeth Hocking	J.D.; 19 years of experience in regulatory and policy analysis.	Regulatory requirements
Irene Hogstrom	M.A., Geography and Environmental Studies; B.L.A., Landscape Architecture; 23 years of experience in landscape architecture, including design, regional planning, and ecological restoration.	Visual resources research analysis, public comment review
Amanda Hollingsworth	B.A.; 6 years of experience in GIS analysis and mapping.	GIS mapping
Patricia Hollopeter	B.A., Religion; M.A., Philosophy; 27 years of experience in technical editing and environmental assessment document production.	Lead editor

TABLE 15-2 (Cont.)

Name	Education/Expertise	Contribution
Leslie Kirchler	B.A., Ph.D., Archaeology; 5 years of experience in environmental assessment.	Visual impact analysis
Ronald Kolpa	M.S., Inorganic Chemistry; B.S., Chemistry; 38 years of experience in environmental regulation, auditing, and planning.	Technical lead for hazardous materials and waste management and technology overview
Thomas J. Kotek	M.S., Computer Science; 37 years of experience in data management and database-driven Web applications.	Webmaster and data management for PEIS online comment submissions
Kirk E. LaGory	Ph.D., Zoology, M.En., Environmental Science; 35 years of experience in ecological research, 24 years in environmental assessment.	Technical lead for ecological resources analyses; threatened and endangered species assessments
Janet M. Lyons	Records management specialist; 12 years of experience in records management for environmental programs and projects.	Administrative records management
Gary Marmer	Ph.D., Physics; 40 years of experience in environmental assessment.	Cumulative impact analysis
Tony Martinez	J.D., Law; 29 years of experience in the practice of law, with an emphasis on water law.	Water demand assessment—Colorado
James E. May	M.S., Water Resources Management; B.A., Zoology; 34 years of experience in natural resources management; 4 years of consulting experience in land use planning and NEPA compliance.	Technical lead for lands and realty, specially designated areas and lands with wilderness characteristics, livestock grazing, wildland fire, recreation, military and civilian aviation, and minerals assessments
Mary Moniger	B.A., English; 35 years of experience in technical editing and writing.	Editor
H. Robert Moore	B.S., Forest Management and Engineering; 40 years of experience in natural resource management; 15 years in natural resource program management and coordination.	Management team consultation
Michele Nelson	Graphic designer; 34 years of experience in graphic design and technical illustration.	Graphics

TABLE 15-2 (Cont.)

Name	Education/Expertise	Contribution
Lee Northcutt	A.A., General Studies/English; 24 years of experience in providing program/editorial and environmental impact statement assistance.	Glossary, list of preparers
Katherine Obmascik	M.B.A., Marketing Communications Management; B.A., Journalism; 29 years of experience in technical writing and editing.	Editor
Ben L. O'Connor	Ph.D., Civil Engineering; 6 years of experience in hydrological studies and impact analysis.	Technical lead for water resources analyses
Terri Patton	M.S., Geology; 24 years of experience in environmental research and assessment.	Technical lead for geological resources; mineral potential assessments, contributor to cumulative impact analysis
Edwin D. Pentecost	Ph.D., Zoology, Ecology; M.S., Biology; 34 years of experience in environmental assessment and ecological impact evaluation.	Cumulative impact analysis
Cathy Peters	B.A., Physical Geography and GIS; 8 years of experience in environmental research, writing, and data management.	Comment processing and records management
Kurt Picel	Ph.D., Environmental Health Sciences; 33 years of experience in environmental health analysis and 17 years in environmental assessment.	Technical lead for cumulative impact analysis
Edgar Portante	M.S., Electrical Engineering (power systems); M.E.C.E, Electrical and Computer Engineering (power markets); 25 years of experience in analysis, modeling, simulation, and performance evaluation of power systems.	Transmission (Appendix G, Methodology; and SEZ dedicated-line transmission analyses)
John Quinn	Ph.D, Hydrogeology; 24 years of experience in environmental and hydrogeological analysis.	Groundwater analysis
Pamela Richmond	M.S., Computer Information Systems; 17 years of experience in Web site development and related technology.	Public Web site development and technical support for visual impact analysis
Judy Robson	Desktop publishing specialist; 32 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production

TABLE 15-2 (Cont.)

Name	Education/Expertise	Contribution
Katherine Rollins	M.S., Biology; 3 years of experience in ecological research and environmental assessment.	Ecological resources analysis support, GIS mapping, public comment review
Barbara Salbego	Desktop publishing specialist; 33 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production
Lorenza Salinas	Desktop publishing specialist; 30 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production
Kerri Schroeder	Desktop publishing specialist; 32 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production
Barbara Simmons	B.A., technical writing; E.L.S. certification by the Board of Editors in the Life Sciences; Fellow of the Society for Technical Communication; 47 years of experience in technical editing and publications management.	Editor
Vicki Skonicki	Desktop publishing specialist; 18 years of experience in creating, revising, formatting, and printing documents.	Document assembly and production
Albert E. Smith	Ph.D., Physics; 38 years of experience in policy analysis, air and noise impact assessment, and regulatory analysis.	Air quality analysis
Karen P. Smith	M.S., B.A., Geology; B.S., Anthropology; more than 23 years of experience in energy and environmental regulatory and policy analysis.	Program Manager, programmatic analysis; Appendix C (Proposed BLM Land Use Plan Amendments), Appendix D (Related Programs), and Appendix G (Transmission Constraints)
Carolyn M. Steele	B.A., English; B.A., Rhetoric; 7 years of experience in technical writing and editing.	Editor
Robert Sullivan	M.L.A., Landscape Architecture; 23 years of experience in visual impact analysis and simulation; 13 years in Web site development.	Technical lead for visual impact analysis; public Web site development

TABLE 15-2 (Cont.)

Name	Education/Expertise	Contribution
David Tomasko	Ph.D., Civil Engineering–Water Resources; 35 years of experience doing water-related studies.	Groundwater analysis
Jack C. VanKuiken	M.S., Systems Science; 37 years of experience in electrical power systems modeling, optimization, and analysis.	Analysis for Appendix D (Related Programs), Appendix E (RPS-Based RFDS), transmission (Appendix G and SEZ dedicated-line transmission analysis)
Robert A. Van Lonkhuyzen	B.A., Biology; 22 years of experience in ecological research and environmental assessment.	Ecological resources analysis (plant communities/habitats)
Bruce Verhaaren	Ph.D., Archaeology; 22 years of experience in archaeological analysis; 18 years in environmental assessment and records management.	Native American concerns analysis; records management
William S. Vinikour	M.S., Biology with environmental emphasis; 36 years of experience in ecological research and environmental assessment.	Ecological resources analysis (wildlife, wild horses and burros)
Leroy J. Walston, Jr.	M.S., Biology; 7 years of experience in ecological research and environmental assessment.	Technical lead for special status species assessments, Appendix J
Cory Weber	M.S., Operations Management and Information Systems; 7 years of experience in research software and visualization development.	Computer programming
Patricia Weikersheimer	M.F.A., English–Writing; 24 years of experience in technical editing.	Editor
Konstance L. Wescott	M.A., Anthropology; 25 years of experience in archaeological research and 22 years of experience in environmental assessment.	Technical lead for paleontology, cultural resources, and Native American concerns
Ellen White	M.P.P., Public Policy; B.A., Environmental Studies; 8 years of experience in environmental assessment.	Comment response management; document management; technology overview analysis

TABLE 15-2 (Cont.)

Name	Education/Expertise	Contribution
Suzanne Williams	B.S., Communication Studies with concentration in English; 28 years of experience in technical communications.	Editor
C. Ron Yuen	Ph.D., Geology; 23 years of experience in engineering and hydrogeology.	Surface water resources, water demand analysis
Emily A. Zvolanek	B.A., Environmental Science; 4 years of experience in GIS mapping.	Assistant technical lead for GIS mapping
Argonne Student Interns: Renee R. Francese, Texas A&M; Alexander Jamerson, Syracuse University; Catherine Krygeris, Indiana University of Pennsylvania; William Sterne, Colorado State University; Gerina Tsosie, Arizona State University		
Aerotek		
Esther Bowen	M.S., Geophysical Sciences; 3 years of experience in watershed-based environmental analysis and biogeochemical cycles.	Technical analyst for hydrology and water resources assessment
Laura Fox	B.S., Biology; 10 years of experience in wildlife biology/ecology.	Public comment review
Maureen McHugh	B.S., Environmental Policy and Mathematics; M.E.M., Environmental Economics and Policy; 3 years of experience in environmental research and assessment.	Public comment review; water resources assessment
Angela Ziech	M.P.P., Public Policy; B.A., Chemistry; 5 years of experience in environmental research and assessment.	Public comment review
National Renewable Energy Laboratory		
Nate Blair	MBA, Tech. Management; M.S., Mechanical Engineering; B.A., Physics; 18 years of experience in system modeling and simulation in renewable energy.	RFDS using ReEDs model (Appendix E)
Doug Dahle	B.S., Mechanical Engineering; 10 years of experience in solar power project development.	RFDS using ReEDs model (Appendix E)
Donna Heimiller	M.F., Spatial Data Analysis; B.S., Natural Resources; 12 years of experience in geospatial analysis and electric sector modeling.	RFDS using ReEDs model (Appendix E)
Matthew Mowers	M.S., Mechanical Engineering–Energy Systems; B.S., Mechanical Engineering; 1.5 years of experience in electric sector modeling.	RFDS using ReEDs model (Appendix E)

16 GLOSSARY

For reader convenience, the entire glossary from the Draft Solar PEIS is presented in full in this section, with updates and appropriate corrections.

100-year floodplain: The area that would be inundated by water during a flood event, having a one-percent chance of being equaled or exceeded in magnitude, in any given year.

AADT: *See* Average Annual Daily Traffic.

Abiotic: Non-living or non-biological; includes chemical and physical environments and processes.

AC: *See* Alternating current.

Acceleration (peak horizontal): A measure of earthquake acceleration (i.e., shaking) on the ground surface expressed in g, the acceleration due to the Earth's gravity.

Access roads: Gravel or dirt roads (rarely paved) that provide overland access to transmission line and pipeline rights-of-way (ROWs) and facilities for construction, inspection, maintenance, and decommissioning. Access roads have an average distance of 5 mi or less, have a nominal width of 15 ft, and exist within the center of a nominal 25-ft-wide ROW.

Acid deposition: A comprehensive term for the various ways acidic compounds precipitate from the atmosphere and deposit onto surfaces. It can include wet deposition by means of acid rain, fog, and snow; and dry deposition of acidic particles (aerosols).

Active Management Areas (AMAs): Active Management Areas were established in Arizona to provide long-term management and conservation of limited groundwater supplies. In order to accomplish this, the AMAs administer state laws, explore ways of augmenting water supplies to meet future needs, and routinely work to develop public policy to promote efficient use and an equitable allocation of available water supplies.

Active volcano: A volcano that is erupting. Also, a volcano that is not presently erupting, but that has erupted within an historical time and is considered likely to erupt in the future.

Acute: Resulting in immediate impacts; short-term.

Adequate Water Supply Program: The Arizona Adequate Water Supply Program requires anyone who offers subdivided land outside of an Active Management Area for sale or lease to obtain a determination from the Arizona Department of Water Resources regarding the availability of water supplies before the land may be marketed to the public as defined in *Arizona Administrative Code* R12-15-715 et seq.

Adverse environmental impacts: Impacts that are determined to be harmful to the environment. *See also* Effects.

AERMOD: A refined, steady-state plume model that incorporates air dispersion on the basis of a state-of-the-art planetary boundary layer turbulence structure and scaling concepts, and that builds wake effects and plume downwash for point sources. AERMOD is one of the EPA's preferred and recommended models for many regulatory applications.

Affected Environment: For an environmental impact statement, a description of the existing environment covering information necessary to assess or understand the impacts. It must contain enough detail to support the impact analyses and must highlight environmentally sensitive resources (e.g., floodplains, wetlands, threatened and endangered species, and archeological resources).

Aftershocks: Earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the main shock and within one to two rupture lengths distance from the main shock. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the main shock, the larger, and more numerous the aftershocks, and the longer they will continue.

Aggregate: The sum total.

Agricultural fires: Fires ignited to meet specific management objectives on agricultural lands.

Air pollutant: Any substance in the air which could, if in high enough concentration, harm humans, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne.

Air quality: Measure of the health-related and visual characteristics of the air to which the general public and the environment are exposed.

Air Quality Control Region (AQCR): An interstate or intrastate area designated by the U.S. Environmental Protection Agency for the attainment and maintenance of National Ambient Air Quality Standards.

Air quality standards: The legally prescribed level of constituents in the outside air that cannot be exceeded during a specific time in a specified area.

Albedo (effects): The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Snow-covered surfaces have a high albedo; the albedo of soils ranges from high to low; vegetation-covered surfaces and oceans have a low albedo. The Earth's albedo varies mainly through varying cloudiness, snow, ice, leaf area, and land-cover changes.

Aliquot (parts): The standard subdivisions of a section (usually 640 acres [2.6 km^2]) of land, such as a half section, quarter section, or quarter-quarter section.

Alkali: Carbonates or hydroxides of an alkali metal (e.g., sodium, potassium, calcium, lithium among others) found in some arid soils and playa lakes; detrimental to agriculture.

Alkali sink: A land basin in which water evaporation produces high salt concentrations that may, or may not, support salt marsh vegetation.

All-American Canal: The All-American Canal System, located in the southeastern corner of California, consists of the Imperial Diversion Dam and Desilting Works, the 80-mile-long All-American Canal, the 123-mile-long Coachella Canal, and appurtenant structures. The system has the capacity, through water diversions from the Colorado River at Imperial Dam, to provide irrigation water for nearly 600,000 acres of land in the Imperial and Coachella Valleys. No power is developed on the system by the Federal Government. The Imperial Irrigation District (IID), which operates the All-American Canal, has constructed small hydroelectric power plants at several locations along the canal to provide electricity throughout the IID service area.

All-American Roads: A National Scenic Byway is a road recognized by the U.S. Department of Transportation for its archeological, cultural, historic, natural, recreational, and/or scenic qualities. The most scenic of the roads are called All-American Roads. The designation means they have features that do not exist elsewhere in the United States and are scenic enough to be tourist destinations unto themselves. As of September 2005, there are 99 National Scenic Byways and 27 All-American Roads located in 44 states.

Allotment: An area of land where one or more livestock operators graze their livestock. Allotments generally consist of BLM lands but may also include other federally managed, state owned, and private lands. An allotment may include one or more separate pastures. Livestock numbers and periods of use are specified for each allotment.

Alluvial: Formed by the action of running water; of or related to river and stream deposits.

Alluvial fan: A fan-shaped depositional landform consisting of alluvial deposits that formed where a flowing stream slows and spreads out (depositing its load), typically at the base of a mountain range where there is a marked change in slope. Fan deposits tend to be coarse-grained at their mouths, but grade to finer-grained material toward their edges.

Alluvian fan terrace: A relict landform consisting of thick gravel, sand, and boulder deposits occurring along mountain fronts. Fan terraces are no longer areas of deposition as active alluvial fans are (due either to tectonic uplift or entrenchment of main washes).

Alluvial flats: Small flat areas or plains (with slopes of less than 5 or 10 feet per mile) built of fine sediments deposited during flooding events. *See also* Alluvial plains.

Alluvial plains: Small flat areas or plains (with slopes of less than 5 or 10 feet per mile) built of fine sediments deposited during flooding events. *See also* Alluvial flats.

Alluvial valley: An alluvium-filled basin, usually occurring between mountain ranges.

Alluvium: Deposits of clay, silt, sand, gravel, or other particulate materials that have been deposited by a stream or other body of running water in a streambed, on a flood plain, on a delta, or at the base of a mountain.

Alpine: Refers to high mountain areas above the timberline (where trees cease to inhabit extremely cold environments).

Alpine tundra: Vegetation in montane habitats above the tree line. Vegetation consists of perennial forbs, grasses, sedges, and short woody shrubs. Alpine tundra is distinguished from Arctic tundra, because alpine tundra typically does not have permafrost, and alpine soils are generally better drained than arctic soils.

Alquist-Priolo Earthquake Fault Zoning Act: California seismic zoning act passed in 1972, in response to the 1971 San Fernando earthquake, to prevent building across the traces of active faults.

Alternating current (AC): An electric current that reverses its direction at regularly recurring intervals.

Alternative: A mix of management prescriptions applied to specific land areas to achieve a set of goals and objectives. Each alternative represents a different way of achieving a set of similar management objectives. Sometimes the term "action alternative" is used when it is desirable to recognize that there is a "no action" alternative under which the proposed activity would not take place.

Ambient air: The surrounding atmosphere as it exists around people, plants, and structures.

Ambient Air Quality Standards: Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time in a defined area.

American Indian Religious Freedom Act of 1978 (AIRFA): Act requiring federal agencies to consult with tribal officials to ensure protection of religious cultural rights and practices.

Amphibian: A cold-blooded, smooth-skinned vertebrate of the class Amphibia, such as a frog, toad, or salamander, that characteristically hatches as an aquatic larva with gills. The larva then transforms into an adult with air-breathing lungs.

Andesite: Volcanic rock (or lava), characteristically medium dark in color and containing 54 to 62 percent silica and moderate amounts of iron and magnesium (intermediate composition).

Angle of view: The angle, both vertical and horizontal, between a viewer's line of sight and the landscape being viewed. *See also*: Horizontal angle of view; Vertical angle of view.

Animal unit: A unit of measure for rangeland livestock equivalent to one mature cow or five sheep or five goats, all over 6 months of age. An animal unit is based on average daily forage consumption of 26 pounds of dry matter per day.

Animal Unit Month (AUM): A standardized unit of measurement of the amount of forage required by an animal unit for one month. Also, the measurement of the privilege of grazing one animal for one month.

Anthropogenic emissions: Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities.

Anthropomorphic: Described or thought of as having human form or human attributes.

Anthropomorphism: Ascribing human qualities, characteristics, or behavior to inanimate objects, animals, or natural phenomena.

Application for Certification (AFC): Document required for submission to the California Energy Commission by proponents of power-generating facilities in California that have nameplate ratings of 50 MW or greater and that utilize steam.

Appropriate Management Level (AML): The maximum number of animals (wild horses or burros) sustainable on a yearlong basis.

Appropriation Doctrine: The system of water law primarily used in the western United States under which: 1. The right to water is acquired by diverting water and applying it to a beneficial use; and 2. An existing right to water use is superior to a right developed later in time.

Appropriations: Refers to the process of divvying out water right allotments and beneficial uses within a water management district.

Aquaculture: Farming of plants and animals that live in water, such as fish, shellfish, and algae.

Aquatic biota: Collective term describing the organisms living in or depending on the aquatic environment.

Aquatic ecosystem: The distinctive ecosystem dominated by water, aquatic plants, or aquatic animals. Usually the substrate for plant and microorganism growth is water, not soil in the usual sense. This is distinct from the riparian ecosystem, which is a terrestrial ecosystem, and water-dependent, but where the substrate is soil. In the aquatic ecosystem, producers include phytoplanktonic algae, and autotrophic consumers include crustaceans, rotifers, and fish. Heterotrophic consumers include benthic insects, mollusks, and crustaceans.

Aquatic habitats: Areas associated with water that provide food and cover and other elements critical to the completion of an organism’s life cycle (e.g., bogs, swamps, riparian areas and streams).

Aquatic opportunists: Species that occupy both temporary and permanent waters.

Aquifer: A water-bearing rock that readily transmits water to a well or spring.

Aquifer–basin fill: An aquifer located in a basin surrounded by mountains and composed of sediments and debris shed from those mountains. Sediments are typically sand and gravel with some clay.

Aquifer–carbonate rock: An aquifer found in limestone and dolomite rocks. Carbonate aquifers typically produced hard water, that is, water containing relatively high levels of calcium and magnesium.

Aquifer–confined: Soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

Aquifer–unconfined: An aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.

Aquifer–volcanic rock: An aquifer in which the rock matrix is composed of volcanic rocks, (e.g., tuffs or basalt flows).

Arable lands: Refers to all lands generally under rotation whether it is under temporary crops, temporarily fallowed, or used as temporary meadows.

Archaeological site: Any location where humans have altered the terrain or discarded artifacts during prehistoric or historic times.

Arctic tundra: A treeless area between the icecap and the tree line of Arctic regions that has permanently frozen subsoil and supports low-growing vegetation such as lichens, mosses, and stunted shrubs.

Area of Potential Effect (APE): The geographic area or areas within which an undertaking (project, activity, program, or practice) may cause changes in the character or use of any cultural resources that are present.

Area sources (emissions): Any source of air pollution that is released over a relatively small area but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources such as a forest that releases hydrocarbons.

Areas of Critical Environmental Concern (ACECs): These areas are managed by the Bureau of Land Management and are defined by the Federal Land Policy and Management Act of 1976 as having significant historical, cultural, and scenic values, habitat for fish and wildlife, and other public land resources, as identified through the Bureau of Land Management's land-use planning process.

Arid: A region that receives too little water to support agriculture without irrigation. Less than ten inches of rainfall a year is typically considered arid.

Arizona Water Banking Authority (AWBA): The AWBA was established in 1996 to increase utilization of the state's Colorado River entitlement and to develop long-term storage credits for the state. AWBA stores or "banks" unused Colorado River water to be used in times of shortage to firm (or secure) water supplies for Arizona. These water supplies help to benefit municipal and industrial users and communities along the Colorado River, fulfill the water management objectives of the state, store water for use as part of water rights settlement agreements among Indian communities, and assist Nevada and California through interstate water banking.

Arrays: *See* Photovoltaic (PV) array.

Arroyo: A Spanish word for brook that refers to a dry river, creek, or stream bed that temporarily or seasonally fills and flows after sufficient rain. Also referred to as a wash.

Artesian water (artesian pressure): Groundwater that is under pressure when tapped by a well and is able to rise above the level at which it is first encountered. It may or may not flow out at ground level. The pressure in such an aquifer commonly is called artesian pressure, and the formation containing artesian water is an artesian aquifer or confined aquifer.

Artifact: An object produced or shaped by human beings and of archaeological or historical interest.

Atlatl: A wood or bone shaft implement, held in one hand, and used to throw a spear. The tool functions as a lever, giving greater thrust and distance.

Atmosphere: The gaseous envelope surrounding the Earth, which consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio), and air pollutants such as ozone. In addition, the atmosphere contains water vapor, whose amount is highly variable (up to 4% volume mixing ratio), clouds, and aerosols.

Atmospheric absorption: Attenuation of sound during its passage through air, during which its sound energy is gradually converted into heat by a number of molecular processes in the air. The attenuation depends strongly on frequency and relative humidity, less strongly on temperature, and slightly on the ambient pressure.

Attainment: An area considered to have air quality as good as or better than the National Ambient Air Quality Standards for a given pollutant. An area may be in attainment for one pollutant and in nonattainment for others. *See also* In attainment.

Attenuation: The reduction in level of sound.

Augmentation Plan: A court-approved plan that allows a junior water user to divert water out of priority so long as adequate replacement is made to the affected stream system, preventing injury to the water rights of senior users.

Augmentation water: Water used for the replacement of out of priority depletions.

Average Annual Daily Traffic (AADT): A measurement representing the total number of vehicles passing a given location, based upon 24-hour counts taken over an entire year. Mechanical counts are adjusted to an estimate of annual average daily traffic figures, taking into account seasonal variance, weekly changes, and other variables.

Background level noise: Noise in the environment (other than noise emanating from the source of interest).

Bajada: A broad sloping deposit caused by the joining together of alluvial fans. These occur on the lower slopes of mountains and are often characterized by loose sediment and poor soil development.

Bald and Golden Eagle Protection Act: This Act was originally enacted in 1940 as the Bald Eagle Protection Act to protect bald eagles and later amended to include golden eagles. It prohibits the taking or possession of and commerce in bald and golden eagles, parts, feathers, nests, or eggs, with limited exceptions. The definition of take includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. Bald eagles may not be taken for any purpose unless a permit is issued prior to the taking. Permits must be obtained from the U.S. Department of the Interior to relocate nests that interfere with resource development or recovery.

Base camp: A site occupied by several families or more on either a year round or a seasonal basis. Identified archaeologically by primary and secondary tools and other artifacts, as well as floral and faunal remains from subsistence activities. Characterized by extensive scatters and quantities of debris such as potsherds, fire-cracked rock, whole and broken flaked stone tools, chipping waste, charred bone, milling tools, house structures, hearths, rock rings, and sometimes rock art or burials.

Basalt: Volcanic rock (or lava), characteristically dark in color and containing 45 to 54% silica and generally rich in iron and magnesium (mafic composition).

Basement complex: The suite of mostly crystalline igneous and/or metamorphic rocks that generally underlies the sedimentary rock sequence.

Basement rock: The oldest rocks in a given area; a complex of metamorphic and igneous rocks that underlies the sedimentary deposits. Usually Precambrian or Paleozoic in age.

Basin: (1) A depression in the Earth's surface that collects sediment. (2) The area of land that drains to a particular river.

Basin-fill aquifer: *See* Aquifer–basin fill.

Battery: Two or more electrochemical cells enclosed in a container and electrically interconnected in an appropriate series and/or parallel arrangement to provide the required operating voltage and current levels. Under common usage, the term battery also applies to a single cell if it constitutes the entire electrochemical storage system.

Battery capacity: The maximum total electrical charge, expressed in ampere-hours, which a battery can deliver to a load under a specific set of conditions.

Bedrock: General term referring to the solid rock or ledge underlying other unconsolidated material, i.e., soil, loose gravel, etc.

Bench: A relatively level step, excavated into a slope on which fill is to be placed. Its purpose is to provide a firm stable contact between the existing material and the new fill which is to be placed.

Beneficial use of water: A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial: domestic, municipal, and industrial uses; irrigation; mining; hydroelectric power; navigation; recreation; stock raising; public parks; and wildlife and game preserves.

Benthic: Living in or occurring at the bottom of a body of water.

Best Management Practice (BMP): A practice or combination of practices that are determined to provide the most effective, environmentally sound, and economically feasible means of managing an activity and mitigating its impacts.

Biface: A stone tool that has been flaked on both sides.

Big game: Those species of large mammals normally managed as a sport-hunting resource.

Biogenic source (emissions): Biological sources such as plants and animals that emit air pollutants such as volatile organic compounds. Examples of biogenic sources include animal management operations, and oak and pine tree forests.

Biological soil crusts: Commonly found in semiarid and arid environments, biological soil crusts are formed by living organisms and their by-products, creating a crust of soil particles bound together by organic materials. Crusts are predominantly composed of cyanobacteria (formerly called blue-green algae), green and brown algae, mosses, lichens, and bryophytes, which live within or on top of the uppermost millimeters of soil. Biological soil crusts are also known as cryptogamic, microbiotic, cryptobiotic, and microphytic crusts.

Biomass: Combustible solid, liquid, or gas that is derived from biological processes.

Biota: Plants and animals.

BLM: The Bureau of Land Management.

BLM land: Land administered by the Bureau of Land Management.

Block-faulted (mountains): Landforms formed by the movement (uplift and tilting) of large crustal blocks during an extensional episode. Such mountains often have a steep front side and a sloping back side.

Block Groups (BGs): A cluster of census blocks having the same first digit of their four-digit identifying numbers within a census tract. For example, block group 3 (BG 3) within a census tract includes all blocks numbered from 3000 to 3999. BGs generally contain between 600 and 3,000 people, with an optimum size of 1,500 people. Most BGs were delineated by local participants as part of the U.S. Census Bureau's Participant Statistical Areas Program. The U.S. Census Bureau delineated BGs only where a local, state, or tribal government declined to participate or where the U.S. Census Bureau could not identify a potential local or tribal participant.

Blowdown: Periodic removal of water from an evaporative cooling system (also known as a wet closed-cycle cooling system) to control the buildup of impurities and maintain the concentration of dissolved minerals in the circulating water. Blowdown typically involves the release of less than 10% of the total water volume in the cooling system and typically occurs after completion of as many as five cycles. Blowdown is either discharged to a surface water body under a permit that limits both chemical content and temperature, or directed to an evaporation pond where mineral residues are later collected and removed for disposal.

Blowdown waste: *See* Blowdown.

Blowdown water: *See* Blowdown.

Blowout: A wind-eroded section of a sand dune caused by a disturbance or removal of the vegetation.

Bolson (floor): A term applied to an internally drained (closed) intermontane basin in arid regions where drainages from adjacent mountains converge toward a central depression.

Boreal: Living in and adapted for living in the extreme northern areas of the world. This area is located just below tundra conditions.

Boron: The chemical element commonly used as the dopant in a photovoltaic device or cell material.

Borrow material: Material such as soil or sand that is removed from one location and used as fill material in another location.

Borrow pit: A pit or excavation area used for gathering earth materials (borrow) such as sand or gravel.

B.P.: Before present year.

Braided streams: Braided streams have multiple channels that are interlaced in a braided pattern, with very low stream gradient (<0.5% channel slope) and high sediment loading. Braided streams generally have broad, shallow valleys, with well-defined floodplains.

Broadband noise: Noise that has a continuous spectrum, that is, energy is present over a wide range of frequencies.

Breccia: A sedimentary rock formed of coarse-grained material consisting of sharp fragments embedded in clay or sand.

Browse: Twigs, leaves, and young shoots of trees and shrubs that animals eat.

Bryozoan: Aquatic colonial animals with branching, mossy or fan-like growth. They resemble corals but have more complex nervous, muscular, and digestive systems.

Build out: The estimated extent of residential, commercial, and industrial development in a given geographic area; usually related to the upper limit of the population to be served by water resource development.

Build-out capacity: The maximum total percentage of development in a watershed; typically determined assuming current zoning holds indefinitely into the future.

Bunchgrass: A grass having a bunched growth form and lacking rhizomes.

Burrow: A hole made by an animal, usually for shelter or to move through by digging.

Bureau of Land Management: An agency of the U.S. Department of the Interior that is responsible for managing public lands.

Cadastral survey system: A survey that creates, marks, defines, retraces, or re-establishes the boundaries and subdivisions of the public land of the United States.

Cadmium (Cd): A chemical element used in making certain types of solar cells and batteries.

Cadmium telluride (CdTe): A polycrystalline thin-film photovoltaic material.

Cairn: A mound of stones erected as a memorial or marker.

Calcareous: Of, containing, or like calcite (calcium carbonate).

Caldera: A large, usually circular depression at the summit of a volcano, formed when magma is erupted from a shallow underground magma reservoir. The removal of large volumes of magma may result in loss of structural support for the overlying rock, thereby leading to collapse of the ground and formation of a large depression (called a collapsed caldera). Calderas are different from craters, which are smaller circular depressions created primarily by explosive excavation of rock during eruptions.

Caliche: A sedimentary deposit, commonly made of calcium carbonate, and formed from the leaching of minerals from the top layers of soil. Caliche deposits characterize arid and semi-arid environments.

California Ambient Air Quality Standard (CAAQS): A legal limit that specifies the maximum level and time of exposure in the outdoor air for a given air pollutant and which is protective of human health and public welfare (Health and Safety Code section 39606b). CAAQSs are recommended by the California Office of Environmental Hazard Assessment and adopted into regulation by the California Air Resources Board. CAAQSs are the standards which must be met per the requirements of the California Clean Air Act (CCAA).

Cancer: A group of diseases characterized by uncontrolled cellular growth. Increased incidence of cancer can be caused by exposure to radiation and some chemicals.

Candidate Species: Plants and animals for which the U.S Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a listing regulation is precluded by other higher priority listing activities.

CAP: *See* Central Arizona Project (CAP) Aqueduct.

Capacity factor: An empirical dimensionless number that represents the ratio of the amount of power produced by a generating facility over a given period of time, to the amount of power that would have been produced over that time period had the facility operated at its rated capacity.

Carbon dioxide (CO_2): A colorless, odorless, nonpoisonous gas that is a normal part of the Earth's atmosphere. Carbon dioxide is a product of fossil fuel combustion as well as other processes. It is the most prominent greenhouse gas that traps heat radiated into the atmosphere.

Carbon monoxide (CO): A colorless, odorless gas that is toxic if breathed in high concentrations over an extended period of time. Carbon monoxide is listed as a criteria air pollutant under Title I of the Clean Air Act.

Carbon sink: A reservoir that absorbs or takes up released carbon from another part of the carbon cycle. The four sinks, which are regions of the Earth within which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually including freshwater systems), oceans, and sediments (including fossil fuels).

Carbonate rock: Rocks (such as limestone or dolostone) that are composed primarily of minerals (such as calcite and dolomite) containing the carbonate ion (CO_3^{2-}).

Carbonate-rock aquifer: See Aquifer–carbonate rock.

Carrying capacity: The maximum density of wildlife that a particular area or habitat can sustain without deterioration of the habitat.

Catchment basin: A topographic region in which all water drains to a common outlet; a watershed.

Cavity: A hole or hollow area, especially inside a tree. Many animals, such as woodpeckers and raccoons, live in them.

Cell (solar): *See* Photovoltaic (PV) cell.

Cenozoic: An era of geologic time from the beginning of the Tertiary period (65 million years ago) to the present. Its name is from the Greek and it means "new life."

Census block: Census blocks are defined by the U.S. Bureau of Census and are the smallest geographic unit for which the Census Bureau tabulates data. Blocks contain data from the 2000 Census of Population, including total population, population by race and ethnicity, age, marital status, population density, and the number and composition of households, and information on housing unit types. Many blocks correspond to individual city blocks bounded by streets, but blocks – especially in rural areas – may include many square miles and may have some boundaries that are not streets. The Census Bureau established blocks covering the entire nation for the first time in 1990. More than 8 million blocks are identified for Census 2000.

Census block groups: Geographic entities consisting of groups of individual census blocks. Census blocks are grouped together so that they contain between 250 and 550 housing units.

Center pivot irrigation: A form of sprinkler irrigation consisting of several segments of pipe (usually galvanized steel or aluminum) that are joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned along its length. The system moves in a circular pattern and is fed with water from the pivot point at the center of the arc. These systems are found and used in all parts of the nation and allow irrigation of all types of terrain.

Central Arizona Project (CAP) Aqueduct: A 336-mi (541-km) long diversion canal operated by the Central Arizona Water Conservation District that diverts water from the Colorado River into central and southern Arizona. The CAP is the largest and most expensive aqueduct system ever built in the United States.

CEQ: *See* Council on Environmental Quality.

CERCLA: *See* Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

Change-out: The routine replacement of chemicals contained in process equipment, in accordance with schedules established by the manufacturer, or as a result of inspections and evaluations of equipment, as a means of preserving or guaranteeing performance.

Channel incision: The process of downcutting into a stream channel leading to a decrease in the channel bed elevation. Incision is often caused by a decrease in sediment supply and/or an increase in sediment transport capacity. A decrease in base level can cause headcutting that migrates upstream and produces incision upstream and initiating aggradation downstream.

Chaparral: A plant community of shrubs and low trees adapted to annual drought and often extreme summer heat and also highly adapted to fires recurring every 5 to 20 years.

Chert: A hard, dense, fine-grained type of sedimentary rock; a microcrystalline aggregate of silica (quartz). It was formed from deposits of silica-based skeletons of microscopic marine organisms (including zooplankton, and other organic matter). Also referred to as flint. Native Americans shaped chert by carefully striking it with stone or bone hammers.

Chronic effects: Effects resulting from exposure to low levels of a stressing factor (e.g., contaminant, disease, electromagnetic field, noise, and radionuclides) over long periods.

Cienega: A perennially wet area supported by a spring or other water source; also called wetland, marsh, or swamp.

Cinder cone: A conical hill formed around a volcanic vent by the accumulation of loose cinders and other pyroclastics ejected during a volcanic eruption, normally basaltic or andesitic in composition. Slopes generally exceed 20 percent.

Class I Area: As defined in the Clean Air Act, the following areas that were in existence as of August 7, 1977: national parks with more than 6,000 acres, national wilderness areas, national memorial parks with more than 5,000 acres, and international parks.

Class II Area: Areas of the country protected under the Clean Air Act, but identified for somewhat less stringent protection from air pollution damage than a Class I area, except in specified cases.

Clay: A very fine-grained rock or mineral fragment of any composition that has a diameter of less than 0.002 mm. Moist clay is sticky and forms a ribbon when pressed between the thumb and forefinger.

Clean Air Act (CAA): The comprehensive federal law which regulates air emissions. The goal of the law was to develop a national ambient air quality standard (NAAQS) that protects public health and the environment. The original CAA was passed in 1963, but the national air pollution control program is actually based on the 1970 version of the law. The 1990 CAA Amendments, in large part, were intended to deal with previously unaddressed or under-addressed problems such as acid rain, ground level ozone, ozone depletion, and air toxics.

Clean Water Act (CWA): Requires National Pollutant Discharge Elimination System (NPDES) permits for discharges of effluents to surface waters, permits for storm water discharges related to industrial activity, and notification of oil discharges to navigable waters of the United States.

Clearing and grubbing: Cleaning a site to prepare it for construction. Involves removing debris, structures, shrubbery, trees, obstructions, and objectionable and unsuitable materials. It may also involve handling and disposing of non-hazardous and hazardous waste.

CLFR: *See* Compact Linear Fresnel Reflector.

Climate: The composite or generally prevailing weather conditions of a region throughout the year, averaged over a series of years.

Closed basin: A basin draining to some depression or a pond within its area, from which water is lost only by evaporation or percolation. A basin without a surface outlet for flowing into another body of water.

Closed-loop cooling system: Also known as a wet closed-cycle cooling system, a system that circulates water between a steam condenser and a cooling tower to cool steam condensate at a thermoelectric power plant; the circulating water interacts with a counterflow (or crossflow) of ambient air at the cooling tower and is cooled through the principle of evaporation where a small fraction of the water is evaporated. The evaporated amount is continually replaced to maintain the total volume of water in the system. *See also* Blowdown.

Clovis Complex: Characteristic of Paleoindian finds located near Clovis, New Mexico, such as specific fluted points.

CO: *See* Carbon monoxide.

CO_2: *See* Carbon dioxide.

***Code of Federal Regulations* (CFR):** A compilation of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the United States. It is divided into 50 titles that represent broad areas subject to federal regulation. Each volume of the CFR is updated once every calendar year.

Collection: The capture or obtaining of plant or animal specimens. This can include obtaining specimens for scientific study, pets, or illegal trade.

Collector: *See* Solar collector.

Color: The property of reflecting light of a particular intensity and wavelength (or mixture of wavelengths) to which the eye is sensitive. It is the major visual property of surfaces.

Colluvium: A general term to include loose rock and soil material that accumulates at the base of a slope as the result of mass wasting processes.

Community: An assemblage of plant and animal populations occupying a given area.

Compact: An agreement between states apportioning the water of a river basin to each of the signatory states.

Compact Linear Fresnel Reflector (CLFR): A type of concentrated solar power (CSP) technology similar to a parabolic trough design, where the sun's heat energy is reflected onto a receiver positioned above the mirrors and containing water; the water is converted to steam and delivered to a Rankine cycle steam turbine-generator (STG) for production of electricity.

Compensation: A type of mitigation in which the impacts to a species or habitat are offset by protecting, restoring, or creating suitable habitat elsewhere.

Compensatory mitigation: (For purposes of the Clean Water Act Section 404 and Rivers and Harbors Act Section 10 regulatory programs), compensatory mitigation is the restoration, creation, enhancement, or, in exceptional circumstances, preservation of wetlands and/or other aquatic resources for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Composite noise level: A single noise level summed on an energy basis from many noise sources (e.g., Stirling engine, electric generator, cooling fan, and air compressor for a Stirling dish engine).

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): An Act providing the regulatory framework for the remediation of past contamination from hazardous waste. If a site meets the Act's requirements for designation, it is ranked along with other Superfund sites on the National Priorities List. This ranking is the U.S. Environmental Protection Agency's way of determining the priority of sites for cleanup.

Concentrating PV (CPV): *See* Photovoltaic (PV) module; Photovoltaic (PV) facility.

Concentrating solar collector: A solar collector that uses reflective surfaces to concentrate sunlight onto a small area, where it is absorbed and converted to heat or, in the case of solar photovoltaic (PV) devices, into electricity. Concentrators can increase the power flux of sunlight hundreds of times. The principal types of concentrating collectors include: compound parabolic, parabolic trough, fixed reflector moving receiver, fixed receiver moving reflector, Fresnel lens, and central receiver. A PV concentrating module uses optical elements (Fresnel lens) to increase the amount of sunlight incident onto a PV cell. Concentrating PV modules/arrays track the sun and use concentrating devices to reflect direct sunlight onto the solar cell to produce electricity directly. Concentrating solar collectors in Concentrated Solar Power (CSP) facilities concentrate sunlight onto a receiver where it heats a heat transfer fluid that subsequently exchanges its absorbed heat to water to produce steam to power a steam turbine-generator (STG) to produce electricity.

Concentrating solar power (CSP): *See* Concentrating solar power (CSP) technologies.

Concentrating solar power (CSP) technologies: Any of a family of solar energy technologies that reflect and concentrate the sun's energy to produce heat that is subsequently used to produce steam to power a steam turbine-generator (STG), or drive a reciprocating engine, to produce electricity. There are three different types of CSP systems: parabolic trough systems, power tower systems, and solar dish engine systems. Parabolic trough and power tower systems convert sunlight to heat to produce steam, while the solar dish engine system converts sunlight to heat to drive a reciprocating engine.

Concentration: Amount of a chemical in a particular volume or weight of air, water, soil, or other medium.

Concentrator: A photovoltaic module, which includes optical components such as lenses (Fresnel lens) to direct and concentrate sunlight onto a solar cell. Most concentrator arrays must directly face or track the sun. They can increase the power flux of sunlight hundreds of times, allowing greatly increased amounts of power to be generated from relatively small areas of solar cells.

Conditional Use Permit (CUP): In California, this is a permit that is required to be obtained from the county government authority in which a solar energy facility is to be located.

Cone of depression: A depression in the water table that develops around a pumped well.

Confined aquifer: *See* Aquifer–confined.

Conglomerate: A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix. To call the rock a conglomerate, some of the constituent pebbles must be at least 2 mm (about 1/13th of an inch) across.

Conifer: A plant commonly having needlelike, persistent leaves and a woody cone for a fruit.

Consumptive use: (1) Any use of water that permanently removes water from the natural stream system. (2) Water that has been evaporated, transpired, incorporated into products, plant tissue, or animal tissue and is not available for immediate reuse. (3) Consumption of water for residential, commercial, institutional, industrial, agricultural, power generation, and recreational purposes. Naturally occurring vegetation and wildlife also consumptively use water. Water consumed is not available for other uses within the system.

Contrast: Opposition or unlikeness of different forms, lines, colors, or textures in a landscape.

Contrast level: A description of the relative amount of visual contrast resulting from a change in the visible landscape. Contrast levels define the degree to which a management activity affects the visual quality of a landscape and provides a means for determining visual impacts and for identifying measures to mitigate these impacts. Contrast levels are determined as part of the Visual Contrast Rating procedures BLM utilizes to analyze potential visual impacts of proposed projects and activities. In the Visual Contrast Rating process, contrast levels are defined as None, Weak, Moderate, or Strong. In this PEIS, an additional contrast level (minimal) is used.

Corona/corona noise: The electrical breakdown of air into charged particles. The phenomenon appears as a bluish-purple glow on the surface of and adjacent to a conductor when the voltage gradient exceeds a certain critical value, thereby producing light, audible noise (described as crackling or hissing), and ozone.

Corona discharge: Electrical discharge accompanied by ionization of surrounding atmosphere around high-voltage transmission lines, occurring mostly under wet conditions.

Corridor: A strip of land through which one or more existing or potential facilities may be located.

Corridor-transmission: *See* Transmission corridor.

Corridor-wildlife: *See* Wildlife corridor.

Council on Environmental Quality (CEQ): Established by National Environmental Policy Act (NEPA), CEQ regulations (40 CFR Parts 1500-1508) describe the process for implementing NEPA, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation.

Cover: Vegetation, rocks, or other materials used by wildlife for protection from predators or weather.

Crater: A steep-sided, usually circular depression formed by either explosion or collapse at a volcanic vent.

Creep (rate): Relatively slow movement along a fault. It is sometimes called "seismic creep" to distinguish it from the slumping of rock or soil on slopes (which is also known as creep). Creep is only known to occur on strike-slip faults.

Crescents: Quarter-moon-shaped (hence crescent) artifacts that may have been in the form of blades, scrapers, or projectile points.

Criteria air pollutants: Six common air pollutants for which National Ambient Air Quality Standards (NAAQS) have been established by the U.S. Environmental Protection Agency under Title I of the Clean Air Act (CAA). They are sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, particulate matter ($PM_{2.5}$ and PM_{10}), and lead. Standards were developed for these pollutants on the basis of scientific knowledge about their health effects.

Critical habitat: The specific area within the geographical area occupied by the species at the time it is listed as endangered or threatened. The area in which physical or biological features essential to the conservation of the species is found. These areas may require special management or protection.

Crucial winter range: The portion of the winter range to which a wildlife species is confined during periods of heaviest snow cover or that portion of the year-long range which is crucial to survival because it is where big game find food and/or cover during the most inclement and difficult winter weather.

Crustaceans: Aquatic animals with hard external skeletons and segmented limbs, belonging to the class Crustacea; include cladocerans, shrimp, crayfish, fairy shrimp, isopods, amphipods, lobsters, and crabs.

Crustal spreading center: A linear zone in the Earth's crust whose opposite sides are moving away from one another.

Cryptogamic soil crusts: A soil crust dominated by a community of algae, lichens, or mosses. *See also* Biological soil crusts.

Cryptobiotic: *See* Biological soil crusts.

CSP: *See* Concentrating solar power.

Cuesta: An elongated ridge formed by gently tilting sedimentary strata. The landform has a steep slope (escarpment or cliff) where the strata are exposed on their edges and a gentle slope (dip slope) on the other side of the ridge.

Cultural disturbance: *See* Cultural modification.

Cultural modification: Any human-caused change in the land form, water form, vegetation, or the addition of a structure which creates a visual contrast in the basic elements (e.g., form, line, color, or texture) of the naturalistic character of a landscape.

Cultural resources: Archaeological sites, structures, or features; traditional use areas; and Native American sacred sites or special use areas that provide evidence of the prehistory and history of a community.

Cumulative impacts: The impacts assessed in an environmental impact statement that could potentially result from incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal), private industry, or individual undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Cut-and-fill: The process of earth grading by excavating part of a higher area and using the excavated material for fill to raise the surface of an adjacent lower area.

Cyanobacteria: Blue-green algae, prokaryotic, photosynthetic organisms that generally have a blue-green tint and lack chloroplasts.

Day-night average noise level: Twenty-four-hour average noise level, obtained after the addition of a 10-dB penalty for environmental noise occurring from 10 p.m. to 7 a.m. to account for the increased annoyance at night. This 10-dB penalty means that one nighttime noise event is equivalent to 10 daytime noise events of the same level.

Daytime mean rural background level: Daytime (7 a.m. to 10 p.m.) average sound level in the rural environment, from all sources other than a particular noise that is of interest.

DC: *See* Direct current.

Debris flow: A mixture of water-saturated rock debris that flows downslope under the force of gravity (also called lahar or mudflow).

Debris flow fans: Alluvial fans prone to debris flows; a mixture of water and debris, such as mudslides, mudflows, or debris avalanches. Debris flow fans are created by the deposits of repeated debris flows at the mouth of the canyon.

Decibel (dB): A standard unit for measuring the loudness or intensity of sound. In general, a sound doubles in loudness with every increase of 10 decibels.

Decibel, A-weighted (dBA): A measurement of sound approximating the sensitivity of the human ear and used to characterize the intensity or loudness of a sound.

Deciduous: Plants that shed their leaves annually. Not evergreen.

Decommissioning: All activities necessary to take out of service and dispose of a facility after its useful life.

Deep-cycle battery: A battery with large plates that can withstand many discharges to a low state of charge.

Delta: An alluvial deposit at the mouth of a river, usually triangular in shape. An area formed from the deposition of sediments at the mouth of a river.

Demand-side management: Specific actions taken by utility companies, their regulators, and other entities to induce, influence, or compel consumers to reduce their energy consumption, particularly during periods of peak demand.

Demographic: Related to the vital statistics of human populations (size, density, growth, distribution, etc.) and the effect of these on social and economic conditions.

Depletion: Net loss of water through consumption, export, and other uses to a given area, river system, or basin. The terms *consumptive use* and *depletion*, often used interchangeably, are not the same.

Deposit: Earth material that has accumulated by some natural process. For example, a flowing mixture of water and rock debris is called a debris flow, but when the flow ceases to move, a layer of fine and coarse rock is left, which is called a debris-flow deposit.

Desert: Arid region receiving less than 10 inches of precipitation annually.

Desert bench: A relatively flat terrace elevated above the surface of a desert alluvial feature, such as an ephemeral stream or wash.

Desert dune: A wind-created ridge or mound of sand that is found in deserts or near oceans and lakes.

Desert floor: The land surface in a desert valley.

Desert focal bird species: Bird species whose requirements define spatial attributes, habitat characteristics, and management regimes representative of a healthy desert system.

Desert pavement: A surface layer of closely packed, loosely cemented pebbles. *See also* Pediment.

Desert riparian habitat: Habitats characterized as dense groves of low shrublike trees, or tall shrubs to woodlands of small to medium-sized trees. These habitats are found adjacent to permanent surface water, such as streams and springs.

Desert scrub: The desert scrub community is characterized by plants adapted to seasonally dry climate.

Desert varnish: The thin red to black coating found on exposed rock surfaces in arid regions. Varnish is composed of clay minerals, oxides, and hydroxides of manganese and/or iron, as well as other particles, such as sand grains and trace elements. The distinctive elements are manganese (Mn) and iron (Fe).

Desert wash: A usually dry desert streambed that flows only after periods of heavy rain.

Desiccation: Dryness resulting from the removal of water. Vegetation lost through erosion or desiccation.

Design basis: The set of conditions, dimensions, needs, and requirements used to design a solar energy facility.

Design features: Measures or procedures incorporated into the proposed action or alternatives which could avoid or reduce adverse impacts. Potential mitigation measures selected as required are then considered to be design features.

Designated Roads and Trails: Specific roads and trails identified by the agencies where some type of motorized vehicle use is appropriate and allowed, either seasonally or yearlong.

Detritus: Loose natural materials, such as rock fragments or organic particles, that result directly from disintegration of rocks or organisms.

Dewatering: The removal or separation of a portion of the water in a sludge or slurry to dry the sludge so that it can be handled and disposed of; removal or draining the water from a tank or a trench.

Diagnostic: An item that is indicative of a particular time and/or cultural group.

Differential compaction: May occur over a large area when the compaction of soil or deeper sediments occurs at different rates and degrees. Differential compaction may result in different rates and degrees of land subsidence, causing damage to structures on the ground surface.

Diorite: A coarse-grained intrusive (or plutonic) igneous rock, less mafic than gabbro, but more mafic than granite and granodiorite; the plutonic equivalent of andesite.

Dip: The angle that a planar geologic surface, for example, a fault, is inclined from the horizontal.

Direct current (DC): A steady current that flows in one direction only. The current from batteries is an example of direct current.

Direct effects: Effects on the environment which occur at the same time and place as the initial cause or action.

Direct impacts: Impacts occurring at the place of origin and at the time of the proposed activity. An effect that results solely from the construction or operation of a proposed action without intermediate steps or processes. Examples include habitat destruction, soil disturbance, and water use. *See also* Impact.

Direct Normal Insolation (DNI): Sunlight that directly strikes a surface. DNI does not include refracted sunlight that strikes clouds, dust, or the ground first.

Directional drilling: The practice of drilling non-vertical wells. Also called slant drilling.

Discharge: The volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Dish engine: The dish engine is a concentrating solar power (CSP) technology that produces electricity, typically in the range of 3 to 25 kilowatts, by using a parabolic array of mirrors to reflect sunlight to heat a working gas (typically hydrogen) in a closed container, causing it to expand and drive a reciprocating engine connected to an electric generator. The dish engine is unique among CSP systems because it uses mechanical energy rather than steam to produce electricity.

Dish engine system: *See* Dish engine.

Dish engine technologies: *See* Dish engine**.**

Dispatchable power (dispatchability): The ability of a power-producing facility to provide required amounts of power (at or below the facility's nameplate rating) on demand of the grid operator and consistent with the terms of the existing Power Purchase Agreement (PPA), regardless of the time of day or weather conditions.

Disposal: The act of placing unwanted materials in an area with the intent of not recovering them in the future.

Distance zones: A subdivision of the landscape as viewed from an observer position. The BLM defined zones include foreground, middleground, background, and seldom seen.

Distributed generation: The installation of small-scale solar energy facilities at individual locations that are at or near the point of consumption (e.g., use of solar PV panels on a business or home to generate electricity for on-site consumption). Distributed generation systems typically generate less than 10,000 kW. Other terms for distributed generation include on-site generation, dispersed generation, and distributed energy.

Disturbance (land): *See* Land disturbance.

Diversion: Water diverted from supply sources such as streams, lakes, reservoirs, springs, or wells for a variety of uses including cropland irrigation as well as residential, commercial, institutional, and industrial purposes. The terms *diversion* and *withdrawal* are often used interchangeably.

DNI: *See* Direct Normal Insolation.

Dolomite: A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral ($CaMgCO_3$).

Dome, volcanic: Rounded, steep-sided mounds built by very viscous magma, usually either dacite or rhyolite. Such magmas are typically too viscous (resistant to flow) to move far from the vent before cooling and crystallizing. Domes may consist of one or more individual lava flows. Volcanic domes are also referred to as lava domes. *See also* Rhyolite.

Domestic solid waste: Solid wastes of the type routinely generated by households.

Domestic water use: Water used for household purposes such as drinking; food preparation; bathing; washing clothes, dishes, and dogs; flushing toilets; and watering lawns and gardens. About 85% of domestic water is delivered to homes by public-supply facilities, such as county water departments. About 15% of the Nation's population supplies their own water, mainly from wells.

Down-dropped basin: *See* Graben.

Drawdown: Lowering of a reservoir's water level; process of depleting reservoir or groundwater storage.

Drill: An oblong tool made of flaked stone used in drilling holes in wood, leather or hides. Oftentimes, drills were made from well-used projectile points that were near the end of their lives; thus, many drills maintain the stem and hafting area of the original point type.

Drop structure: An in-stream structure of various materials designed to reduce the energy and force of stream flow.

Dry closed-loop cooling: *See* Dry cooling system.

Dry cooling: *See* Dry cooling system.

Dry cooling system: Also known as dry closed-loop cooling; a technology for rejecting heat from the steam condensate of a thermoelectric plant. Cooling water circulates in a closed loop between a steam condenser, where it accepts heat from steam condensate, and a dry condenser located in an outdoor location. Fans are used to establish a flow of ambient air across the surface of the dry condenser, allowing the heated cooling water inside the dry condenser to transfer heat to the ambient air before cycling back to the steam condenser.

Dry lake: An ephemeral lake of an arid or semiarid region, typically found at low elevation points in desert valleys. They are topographically flat areas, support sparse vegetation, and contain fine-grained, consolidated sediments that are deposited during precipitation runoff events where the water temporally ponds and then infiltrates to groundwater aquifers or evaporates. The surface sediments of dry lakes can often have high concentrations of dissolved minerals.

Dry wash: A natural drainage channel that is typically dry, but conveys water following significant rainfall events and is subject to rapid flow during flash flooding.

Dune: Mounds of unconsolidated sand grains shaped by wind. Often temporary and nonstationary.

Dunnage: Package waste. Loose packing material.

Duripan: A subsurface soil horizon cemented by silica (usually derived from a volcanic source such as ash). Duripans occur in arid and semi-arid environments and make cultivation of the land difficult.

Early Archaic: The period 7,500 to 5,000 years B.P.

Earthern cattle tank: A watering area or basin for cattle that is usually created in a natural drainage area by obstructing natural water flows with berms of soil.

Earthquake: Ground shaking caused by the sudden release of energy stored in rock beneath the Earth's surface.

Ecological resources: Biota (fish, wildlife, and plants) and their habitats, which may be land, air, or water.

Ecological segmentation: Development that fragments animal habitat and does not provide corridors for movement.

Ecoregion: A geographically distinct area of land that is characterized by a distinctive climate, ecological features, and plant and animal communities.

Ecosystem: A group of organisms and their physical environments, interacting as an ecological unit.

Ecotones: The borders between two different types of ecosystems or communities (e.g., a forest and a grassland) containing characteristic species of each.

Edge habitat: The transitional zone where one cover type ends and another begins.

Edge-on: A descriptor for the appearance of solar facility collector/reflector arrays when viewed at very low vertical angles, such that the viewing angle is at or very close to horizontal.

Effects: Environmental consequences (the scientific and analytical basis for comparison of alternatives) as a result of a proposed action. Effects may be either direct, which are caused by the action and occur at the same time and place, or indirect, which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable, or cumulative.

Efficiency: Ratio of "power out" divided by "power in." The definitions of power out and power in are specific to a given technology and depend on whether the efficiency value describes a total system efficiency or an individual component's efficiency.

Effigy: An object bearing the likeness of an animal or human.

Effluent: Wastewater discharges.

Electric and magnetic fields (EMFs): Electric and magnetic fields are generated when charged particles (e.g., electrons) are accelerated. Charged particles in motion produce magnetic fields. Electric and magnetic fields are typically generated by alternating current in electrical conductors. Also referred to as electromagnetic fields.

Electrolytes (battery): A nonmetallic (liquid or solid) conductor that carries current by the movement of ions (instead of electrons) with the liberation of matter at the electrodes of an electrochemical cell.

Electron: A subatomic particle with a negative electric charge. Electrons form part of an atom and move around its nucleus.

Eligible properties: *See* Historic properties.

Embryotoxicity: Adverse effects on the embryo due to a substance that enters the maternal system and crosses the placental barrier. The effects of the substance may be expressed as embryonic death or an abnormal development of one or more body systems and can be deleterious to maternal health.

Emergent: Aquatic plants having some or most of the leaf area extending out of the water.

Emergent wetlands: The Emergent wetland class is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season, in most years. These wetlands are usually dominated by perennial plants.

Emission factor: The relationship between the amount of pollution produced and the amount of raw material processed.

Emissions: Substances that are discharged into the air from industrial processes, vehicles, and living organisms. A release into the outdoor atmosphere of air contaminants.

Endangered species: Any species (plant or animal) that is in danger of extinction throughout all or a significant part of its range. Requirements for declaring a species endangered are found in the Endangered Species Act of 1973 (ESA). *See also* Special Status Species.

Endangered Species Act of 1973 (ESA): Requires consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service to determine whether endangered or threatened species or their habitats will be impacted by a proposed activity and what, if any, mitigation measures are needed to address the impacts.

Endemic: Native to and restricted to a particular geographic region.

Entrainment: The incorporation of fish, eggs, larvae, and other plankton with intake water flow entering and passing through a cooling water intake structure and into a cooling water system.

Entry: An application to acquire title to public lands.

Environmental Assessment (EA): A concise public document that a federal agency prepares under the National Environmental Policy Act to provide sufficient evidence and analysis to determine whether a proposed action requires preparation of an Environmental Impact Statement (EIS) or whether a Finding of No Significant Impact can be issued. An EA must include brief discussions on the need for the proposal, the alternatives, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted.

Environmental Impact Statement (EIS): A document required of federal agencies by the National Environmental Policy Act for major proposals or legislation that will or could significantly affect the environment.

Environmental justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Environmental media: Soil, water, air, biota, or any other parts of the environment that can contain contaminants.

Eolian: Refers to the processes of wind erosion, transport, and deposition. For example, sand dunes are landforms produced by eolian processes in arid environments.

EPA: *See* U.S. Environmental Protection Agency.

Ephemeral allotment: A BLM grazing allotment in areas of the Hot Desert Biome (Region) that do not consistently produce enough forage to sustain a livestock operation, but from time to time produce sufficient forage to accommodate livestock grazing.

Ephemeral stream: A stream that flows only after a storm or during snowmelt and whose channel is, at all times, above the water table; groundwater is not a source of water for the stream. Many desert streams are ephemeral.

Erosion: The wearing away of land surface by wind or water, intensified by land-clearing practices related to farming, residential or industrial development, road building, or logging.

Eruption: The process by which solid, liquid, and gaseous materials are ejected into the Earth's atmosphere and onto the Earth's surface by volcanic activity. Eruptions range from the quiet overflow of liquid rock to the tremendously violent expulsion of pyroclastics.

ESA: *See* Endangered Species Act of 1973.

Escarpment: A cliff or the steep slopes of a plateau edge.

Ethnobotany (ethnobotanical): The plant lore and agricultural customs of a people; the study of such lore and customs.

Eutectic: Of, relating to, or formed at the lowest possible temperature of solidification for any mixture of specified constituents.

Evaporation ponds: Shallow man-made ponds designed to contain liquid effluents and concentrate the residual waste through evaporation.

Evaporation ponds: Artificial ponds designed to efficiently evaporate water by sunlight and exposure to ambient temperatures.

Evaporation rate: In hydrologic terms, the quantity of water, expressed in terms of depth of liquid water, which is evaporated from a given surface per unit of time. It is usually expressed in inches depth, per day, month, or year. *See also* Pan evaporation.

Evapotranspiration: Plants absorb water through their roots and emit it through their leaves. This movement of water is called "transpiration." Evaporation, the conversion of water from a liquid to a gas, also occurs from the soil around vegetation and from trees and vegetation as they intercept rainfall on leaves and other surfaces. Together, these processes are referred to as *evapotranspiration*, which lowers temperatures by using heat from the air to evaporate water.

Exceedance: A measured level of an air pollutant that is higher than the national or state ambient air quality standards. *See also* NAAQS and CAAQS.

Excessive grades: Ground surface inclines relative to the horizon beyond which the ground may become unstable. The excessiveness of a slope is determined by its instability, which is influenced by the type of material on the slope.

Excessive slopes: *See* Excessive grades.

Executive Order: A president's or governor's declaration which has the force of law, usually based on existing statutory powers, and requiring no action by the Congress or state legislature.

Extensional (structural features or faults): Refers to tectonic forces that extend or stretch the Earth's crust.

Exposure: Contact of an organism with a chemical, radiological, or physical agent.

Extirpation: The elimination of a species or subspecies from a particular area, but not from its entire range.

Extremely low frequency (ELF): Refers to a band of frequencies from 30 to 300 Hz.

Facultative wetland vegetation species: A species that can occur both in wetlands and uplands.

Fall-line: Direction that water flows down a hill.

Fan: *See* Alluvial fan.

Fan apron: A sloping alluvial fan surface made of sediment deposited by streams at the mouth of a canyon between a mountain and the adjacent alluvial valley floor. *See also* Alluvian fan.

Fan piedmont: A sloping alluvial fan surface made of sediment deposited by streams at the mouth of a canyon between a mountain and the adjacent alluvial valley floor.

Fan remnant: An erosional remnant (or fossil) of a once active and more extensive alluvial fan.

Fan terrace: *See* Alluvial fan terrace.

Fast-track: Projects on public land for which the environmental review and public participation process is underway and the application could be approved by December 2010.

Fault: A fracture along which blocks of the Earth's crust on either side have moved relative to one another. *See also* strike-slip fault; potentially active fault; zoned fault.

Fault block: A rock mass that is bounded by normal faults. Fault blocks on either side of the fault are elevated or depressed, relative to each other.

Fault plane: The plane that best approximates the fracture surface of a fault.

Fault, left-lateral: A strike-slip fault on which displacement of the block opposite the observer is to the left. *See also* Strike-slip fault.

Fault, normal: A fault occurring usually as a result of extensional forces, such as when a hanging wall drops down relative to the footwall forming a graben or half graben.

Fault, potentially active: Generally denotes that a fault has shown evidence of surface displacement during Quaternary time.

Fault, right-lateral: A strike-slip fault on which displacement of the block opposite the observer is to the right. *See also* Strike-slip fault.

Fault trace: The expression of a fault on the ground surface.

Fault, transform: A strike-slip fault forming the boundary between tectonic plates (e.g., the San Andreas Fault system is a transform fault zone that marks the boundary between the Pacific and North American Plates). *See also* Strike-slip fault.

Fault, zoned: Under the Alquist-Priolo Act, zoned faults include those that are "sufficiently active," showing evidence of surface displacement within the past 11,000 years along one or more of their segments or branches, and "well-defined," having a clearly detectable trace at or just below the ground surface.

Fauna: The community of animals in a specific region or habitat.

Feature: A large, complex artifact, or part of a site, such as a hearth, cairn, housepit, rock alignment, or activity area.

Federal land: Land owned by the United States, without reference to how the land was acquired or which Federal agency administers the land, including mineral and coal estates underlying private surface.

Federal Land Policy and Management Act of 1976 (FLPMA): Act requiring the Secretary of the Interior to issue regulations to manage public lands and the property located on those lands for the long term.

***Federal Register*:** The official daily publication for rules, proposed rules, and notices of Federal agencies and organizations, as well as executive orders and other presidential documents.

Fill: Man-made deposits of soil and rock and/or waste material.

Fire emissions: Emissions caused by wildfires, prescribed fires, agricultural fires, and structural fires.

Fire-cracked rock: Burned rocks, typically fractured during intense heating in a fire hearth or remnants of rocks associated with cooking. Fairly common at prehistoric archaeological sites.

Fire-tolerant species: Species of plants that can withstand certain frequency and intensity of fire.

First in time, first in right: *See* Prior Appropriation Doctrine.

Fissure, earth or ground: Surface fractures resulting from subsidence, often due to the withdrawal of groundwater and compaction of an aquifer.

Flake: A thin, flattened piece or chip of stone, intentionally removed from the core rock by chipping with either a stone or bone hammer.

Flash flood: A sudden flood event through a valley, canyon, or wash, following a short duration, high-intensity rainfall.

Flat-plate PV: A type of photovoltaic solar energy technology that uses a flat plate onto which are installed solar cells. Sunlight strikes the solar cells directly without being reflected or concentrated. Flat plate systems can be either fixed (stationary) or designed to track the sun's movement over the course of the day.

Flat-plate reflector (heliostat): One of many components of a CSP power tower facility consisting of a large nearly-flat mirror, mounted on a support structure that tracks the sun's movement and reflects sunlight onto a receiver located at the top of a centrally located tower. CSP power tower systems typically consist of hundreds of heliostats arrayed around the central tower.

Flats: Level or nearly level areas of land marked by little or no relief.

Flats wetland: A level landform composed of unconsolidated sediments, usually mud or sand. Flats are unvegetated or support sparse plant communities, often composed of annual species.

Flood irrigation: Water is pumped or brought to the fields and is allowed to flow along the ground among the crops.

Floodplain: A generally flat, low-lying area adjacent to a water body that is subjected to inundation during high flow or rainfall events. The relative elevation of floodplain areas determines their frequency of flooding, which ranges from rare, severe, storm events to flows experienced several times a year.

Flora: Plants, especially those of a specific region, considered as a group.

FLPMA: Federal Land Policy and Management Act of 1976.

Fluvial: Pertaining to a river. Fluvial sediments are deposited by rivers.

Flyway: A seasonal route followed by birds migrating to and from their breeding areas.

Footprint: The land or water area covered by a project. This includes direct physical coverage (i.e., the area on which the project physically stands) and direct effects (i.e., the disturbances that may directly emanate from the project, such as noise).

Forage: Forms of vegetation available for animal consumption. Food for animals, especially when taken by browsing or grazing. Vegetation used for food by wildlife, particularly big-game wildlife and domestic livestock.

Forbs: Herbaceous (nonwoody), broad-leaved flowering plants; non-graminoid (grasses, sedges, and rushes) herbaceous plants. *See also* Graminoid herbaceous.

Form: The mass or shape of an object or objects that appears unified, such as a vegetative opening in a forest, a cliff formation, or a water tank.

Fossil: Remains of ancient life forms, their imprints or behavioral traces (e.g., tracks, burrows, or residues) and the rocks in which they are preserved.

Fossil fuels: Natural gas, petroleum, coal, and any form of solid, liquid, or gaseous fuel derived from such materials for the purpose of creating useful heat.

Fragmentation: Process by which habitats are increasingly subdivided into smaller units, resulting in their increased insularity as well as losses of total habitat area.

Fragmentation of habitat: The breaking up of a single habitat area into two or more smaller habitat patches that are separated from each other.

Fresnel: Compact Linear Fresnel Reflector (CLFR): *See* Compact Linear Fresnel Reflector (CLFR).

Fresnel lens: As used in a solar energy facility, an optical device that focuses sunlight. The mirrors are arranged in concentric rings and are faced at slightly different angles so that light falling on any mirror is focused on the same point, resulting in a substantial concentration of the sunlight.

Friable: Said of a rock or mineral that crumbles naturally or is easily broken, pulverized, or reduced to powder, such as a soft and poorly cemented sandstone.

Fugitive dust: The dust released from any source other than a definable point source such as stack, chimney, or vent. Sources include construction activities, storage piles, roadways, etc.

Fujita scale: The official classification system for tornado damage. The scale ranges from F0 (gale tornado, minor damage, winds up to 72 mph) to F5 (devastating tornado, winds 261 to 318 mph). In the United States and in some other countries, on February 1, 2007, the Fujita scale was decommissioned in favor of what scientists believe is a more accurate Enhanced Fujita Scale, which replaces it.

Full-time equivalent (FTE): Equivalent to a full-time worker/employee. For example, two people, each working half time, constitute one FTE.

Furbearer: An animal that is hunted or farmed for its fur.

Gallium (Ga): A chemical element, metallic in nature, used in making certain kinds of solar cells and semiconductor devices.

Gap: In a visual impact analysis context, a break or interruption (as in a row of mountains) or similar topographic void through which the landscape may be viewed.

GDAs: *See* Renewable Resource Generation Development Areas.

Generalist (species): An organism that can survive under a wide variety of conditions, and does not specialize to live under any particular set of circumstances.

Geoglyphs: Ground markings of a figure or shape produced by the clearing or alignment of stones.

Geographic air basin: A land area with generally similar meteorological and geographic conditions throughout. To the extent possible, air basin boundaries are defined along political boundary lines and include both the source and receptor areas.

Geographic information system (GIS): A computer system for performing geographical analysis. GIS has four interactive components: an input subsystem for converting into digital form (digitizing) maps and other spatial data; a storage and retrieval subsystem; an analysis subsystem; and an output subsystem for producing maps, tables, and answers to geographic queries.

Geology: The science that deals with the study of the materials, processes, environments, and history of the Earth, including the rocks and their formation and structure.

Geometric spreading: As the sound moves away from the source, the area that the sound energy covers becomes larger and thus sound intensity decreases. This is referred to as "geometric spreading," which is independent of frequency and plays a major role in sound propagation situations. Due to geometric spreading, the sound level is reduced by 6 dB and 3 dB for each doubling of distance from the point (e.g., fixed equipment) and line (e.g., road traffic) sources, respectively.

Geotechnical: Refers to the use of scientific methods and engineering principles to acquire, interpret, and apply knowledge of earth materials for solving engineering problems.

Geotextile mats: Permeable fabrics that interact with soils in manners used to reinforce soil surfaces for erosion, as well as act as filters for water, solutes, and fine sediments.

Geothermal energy: Natural heat from within the Earth, captured for production of electric power.

Geothermal generating plant: A plant in which the prime mover is a steam turbine. The turbine is driven either by steam produced from hot water or by natural steam that derives its energy from heat found in rocks or fluids at various depths beneath the surface of the Earth.

Geothermal resources: Typically underground reservoirs of hot water or steam created by heat from the Earth, but also include subsurface areas of dry hot rock.

GHGs: *See* Greenhouse gases.

GIS: *See* Geographic information system.

Glacial till: An unsorted, unstratified mixture of fine and coarse rock debris deposited by a glacier.

Glare: The sensation produced by luminances within the visual field that are sufficiently greater than the luminance to which the eyes are adapted, which causes annoyance, discomfort, or loss in visual performance and visibility. *See als*o Glint

Glint: A momentary flash of light resulting from a spatially localized reflection of sunlight. *See also* Glare.

Global warming: An increase in the near-surface temperature of the Earth. Global warming has occurred in the distant past as the result of natural influences, but the term is today most often used to refer to the warming that many scientists predict will occur as a result of increased anthropogenic emissions of greenhouse gases.

Graben (fault-bounded basins): An elongated crustal block that is relatively depressed (down dropped) between two parallel normal faults or horsts. *See also* Half-graben.

Graminoid herbaceous: A grass or plant of similar growth form, such as sedges, rushes, and others.

Grandfathered rights: In Arizona, grandfathered water rights are based on historic use of groundwater for five years prior to the designation of an Active Management Area. Most grandfathered rights are appurtenant to the land, but some are not and may be purchased or leased from the owner.

Granite: A coarse-grained felsic intrusive (or plutonic) igneous rock with at least 65% silica. Quartz, plagioclase feldspar, and potassium feldspar make up most of the rock and give it a fairly light color; the plutonic equivalent of rhyolite.

Granodiorites: A plutonic igneous rock, formed by an intrusion of silica-rich magma, which cools in batholiths or stocks below the Earth's surface. It is usually only exposed at the surface after uplift and erosion have occurred. The volcanic equivalent of granodiorite is dacite.

Grasslands: Grasslands are characterized as lands dominated by grasses rather than large shrubs or trees.

Graver: A small tool with a sharp tip that was used to engrave bone, stone, wood, or other materials.

Grazing: Consumption of native forage from rangelands or pastures by livestock or wildlife.

Grazing allotment: An area where one or more livestock operators graze their livestock. An allotment generally consists of federal land but may include parcels of private or state-owned land.

Grazing lease: An authorization that permits the grazing of livestock on public lands outside the grazing districts during a specified period of time (Section 15 of the Taylor Grazing Act).

Great Basin: An area covering most of Nevada and much of western Utah, as well as portions of southern Oregon and southeastern California, consisting primarily of arid, high elevation, desert valleys, sinks (playas), dry lake beds, and salt flats. The Great Basin is characterized by the fact that all surface waters drain *inward* to terminal lakes or sinks. The Great Basin cultural area extends beyond the physiographic Great Basin to include traditional areas of tribes who speak languages related to those spoken in the Great Basin and who traditionally pursued a similar lifestyle. These include the Utes of the Colorado Plateau in eastern Utah and western Colorado.

Greenhouse gases (GHGs): Heat-trapping gases that cause global warming. Natural and human-made greenhouse gases include water vapor, carbon dioxide, methane, nitrogen oxides, ozone, and chlorofluorocarbons.

Grid: A term used to describe an electrical utility distribution network.

Ground: An edge or surface that was smoothed by abrasion.

Ground failure: Permanent ground displacement capable of damaging structures that may occur as a result of differential settlement, liquefaction, lateral spreading, or landslides.

Ground fault mats: Mats made of insulating materials that do not conduct electricity.

Ground motion (shaking): The movement of the Earth's surface from earthquakes. Ground motion is produced by seismic waves that are generated by a sudden slip on a fault and travel through the Earth and along its surface.

Groundwater: The supply of water found beneath the Earth's surface, usually in porous rock formations (aquifers), which may supply wells and springs. Generally, it refers to all water contained in the ground.

Groundwater basin: (1) A general term used to define a groundwater flow system that has defined boundaries and may include permeable materials that are capable of storing or furnishing a significant water supply. The basin includes both the surface area and the permeable materials beneath it. (2) The underground area from which groundwater drains. The basins could be separated by geologic or hydrologic boundaries.

Groundwater overdraft: The condition in which water extractions from an aquifer exceed recharge processes in such excess as to cause substantial and sustained decreases in groundwater flows and groundwater elevations.

Groundwater recharge: Inflow of water to a ground-water reservoir from the surface. Infiltration of precipitation and its movement to the water table is one form of natural recharge. Also, the volume of water added by this process.

Grubbing: *See* Clearing and grubbing.

Gypsum: A soft mineral composed of hydrated calcium sulfate ($CaSO_4 \cdot 2H_20$); occurs as an evaporite residue from ancient lakes in arid basins (e.g., Tularosa Basin in New Mexico).

Gypsum badlands: Badlands dominated by soils derived from the mineral gypsum (hydrated calcium sulfate).

Habitat: The place, including physical and biotic conditions, where a plant or animal lives. *See also* Aquatic habitat.

Habitat alteration: A change in the particular environment or place where an organism or species lives. Usually implies changes made to the environment that adversely affect the function of the ecosystem, although not completely or permanently.

Habitat degradation: Decline in habitat quality that accompanies non-natural forms of disturbance.

Habitat generalist (species): *See* Generalist.

Habitat type: An aggregation of all land areas potentially capable of producing similar plant communities at climax.

Half-graben: A geological term that describes a sedimentary basin where one side is bounded by a normal (extensional) fault.

Harassment: The intentional or unintentional disturbance of individual animals causing them to flee a site or avoid use of an area.

Hardpan: A dense, often impermeable soil horizon cemented with silica, iron oxides, calcium carbonate, or organic matter.

Hazardous air pollutants (HAPs): Substances that have adverse impacts on human health when present in ambient air.

Hazardous material: Any material that poses a threat to human health and/or the environment. Hazardous materials are typically toxic, corrosive, ignitable, explosive, or chemically reactive.

Hazardous waste: By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appears on special U.S. Environmental Protection Agency lists.

Headwater: (1) The source and upper reaches of a stream; also the upper reaches of a reservoir; (2) the water upstream from a structure or point on a stream; (3) the small streams that come together to form a river. Also may be thought of as any and all parts of a river basin other than the mainstream river and main tributaries.

Heat exchanger: Any device that transfers heat from one fluid (liquid or gas) to another or to the environment.

Heat transfer fluid (HTF): Fluids that transfer heat generated at the solar collectors to a heat exchanger where steam is produced to run a steam generator.

Heavy metals: Metallic elements with high atomic weights (e.g., mercury, chromium, cadmium, arsenic, and lead); can damage living things at low concentrations and tend to accumulate in the food chain.

Hedonic – (modeling approach): The hedonic method is a regression technique used to estimate the prices of qualities or models that are not available on the market in particular periods, but whose prices in those periods are needed in order to be able to construct price relatives.

Hedonic statistical framework: A method of assessing the impact of various structural (number of bedrooms, bathrooms, square footage, age, etc.) and locational attributes (local amenities, fiscal conditions, distance to workplace, etc.) on residential housing prices.

Heliostat: One of many components of a CSP Power Tower facility; a large, nearly flat mirror, usually on a tracker, pedestal, or other support structure, that allows it to continuously reflect the sun's rays onto a central receiver at the top of a centrally positioned tower over the course of the day. *See also* Flat-plate reflector.

Herbaceous: The plant strata that contain soft, not woody, stemmed plants that die to the ground in winter.

Herbicide: Chemicals used to kill undesirable vegetation.

Herd Area (HA): Following passage of the Wild Free-Roaming Horses and Burros Act (WFRHBA) in 1971, the Bureau of Land Management was directed to identify areas where wild horses and burros were located. These areas were designated as *Herd Areas* (areas where horses and burros were in 1971). Herd areas are not managed for wild horses and burros.

Herd Management Area (HMA): An area that has been designated for management of wild horses and/or burros.

Herpetofauna: Amphibian and reptile species including frogs, toads, salamanders, turtles, lizards, and snakes.

Hertz (Hz): The unit of measurement of frequency, equivalent to one cycle per second.

High liquefaction potential: Refers to the susceptibility of soils to liquefy when subjected to sudden loading, such as intense ground shaking from an earthquake. Liquefaction hazards are associated with saturated, sandy, and silty soils with low plasticity, such as those in the San Francisco Bay Area and along various inland water bodies in earthquake-prone areas. *See also* Liquefaction.

Highly discordant land use: Refers to development that is at variance with the existing condition of the land. It might also be described as incongruous.

Historic: The time period after the appearance of written records. In the New World, this generally refers to the time period after the beginning of European settlement at approximately 1600 A.D.

Historic properties: Any prehistoric or historic districts, sites, buildings, structures, or objects included in, or eligible for inclusion in, the *National Register of Historic Places* maintained by the Secretary of the Interior. They include artifacts, records, and remains that are related to and located within such properties.

Historic resources: Material remains and the landscape alterations that have occurred since the arrival of Euro-Americans.

Hogbacks: An eroded steep ridge of resistant rocks produced by erosion of the broken edges of highly tilted strata.

Holocene: The past 10,000 years of geologic time. The most recent epoch of the Quaternary period. Together the Holocene and Pleistocene make up the Quaternary Period.

Horizontal angle of view: The angle of landscape viewed in sharp focus, measured along the horizon, without turning the head. *See also* Vertical angle of view; Angle of view.

Horizontal field of view: *See* Horizontal angle of view.

Horizon line: The apparent line in the landscape formed by the meeting of the visible land surface and the sky.

Horst: An elongated crustal block that is relatively raised between two parallel normal faults or grabens. *See also* Half-graben.

Hunter gatherers: A term applied to people whose diet is based on hunting, fishing, and gathering, as opposed to domesticating animals or plants.

Hunting: Includes big- and small-game hunting, waterfowl hunting, and trapping.

Hybrid (wet-dry cooling) systems: A variation on a dry cooling system. In this hybrid system, small amounts of water are sprayed as a fine mist into the flow of ambient air being directed over the surface of a dry condenser. The water evaporates, cooling the air as it does so. Alternatively, water is deluged over the surface of the dry condenser where it evaporates after interacting with the overflowing ambient air stream, cooling that air. Wet/dry hybrid systems consume only minor amounts of water (compared to wet closed-loop cooling) but offer significantly better performance than dry cooling systems, especially in hot climates with low relative humidity.

Hydraulic gradient: In an aquifer, the rate of change of total head per unit of distance of flow at a given point and in a given direction. In a stream, the slope of the hydraulic grade line.

Hydro-compactable, collapsible soil (settlement): Low-density soils that undergo appreciable loss of volume when wetted or subjected to increased load (or both). Settlement of these types of soils can be rapid and have devastating effects on structures and facilities.

Hydrofluorocarbons (HFCs): Man-made chemicals, many of which have been developed as alternatives to ozone-depleting substances (ODSs) for industrial, commercial, and consumer products.

Hydrology: The study of water that covers the occurrence, properties, distribution, circulation, and transport of water, including groundwater, surface water, and rainfall.

Hydrostratigraphic: Grouping of rock and sedimentary units based on the capacity of the rock, sediment, or soil to transmit water.

Hz: *See* Hertz.

Igneous rock: A crystalline rock formed by the cooling and solidification of molten or partly molten material (magma). Igneous rock includes volcanic rock (rock solidified above the Earth's surface) and plutonic rock (rock solidified at considerable depth).

Impact: The effect, influence, alteration, or imprint caused by an action.

Impermeable: Refers to a rock matrix that water cannot infiltrate.

Impingement: The entrapment of aquatic organisms on the outer part of an intake structure or against a screening device during periods of intake water withdrawal.

IMPLAN: Input-output economic model based on economic accounts showing the flow of commodities to industries from producers and institutional consumers. The accounts also show consumption activities by workers, owners of capital, and imports from outside the region.

Impoundment (surface): A body of water or sludge confined by a dam, dike, floodgate, or other barrier.

Impulsive noise: Noise from impacts or explosions (e.g., from a pile driver, forging hammer, punch press, or gunshot), which is brief and abrupt, and its startling effects cause great annoyance.

In attainment: In compliance with air-quality standards. Areas that are in attainment have air quality that is as good as or better than specified in the National Ambient Air Quality Standards for a given pollutant. An area may be in attainment for one pollutant and nonattaining for others.

Incidental take permit: A permit issued under Section 10 of the Federal Endangered Species Act to private parties undertaking otherwise lawful projects that might result in the take of an endangered or threatened species. Application for an incidental take permit is subject to certain requirements, including preparation by the permit applicant of a conservation plan, generally known as a Habitat Conservation Plan or HCP.

Indian trust assets: Lands, natural resources, or other assets held in trust or restricted against alienation by the United States for Native American tribes or individual Native Americans.

Indian trust resources: Those natural resources, either on or off Indian lands, retained by or reserved by or for Indian tribes through treaties, statutes, judicial decisions, and E.O.s, which are protected by a fiduciary obligation on the part of the United States.

Indirect effects: Secondary effects that occur in locations other than that of the initial action or significantly later in time.

Indirect impacts: Impacts that occur away from the place of origin. Effects that are related to, but removed from, a proposed action by an intermediate step or process. An example would be changes in surface-water quality resulting from soil erosion at construction sites.

Induration: The hardening of a rock, usually sedimentary, by drying, pressure, or cementation.

Industrial waste: Materials discarded from industrial operations or derived from manufacturing processes.

Infiltration: The movement of water (usually precipitation) from the ground surface into the subsurface.

Infiltration pond: A shallow impoundment designed to infiltrate stormwater into the soil. Also referred to as an infiltration basin.

Inflow: Water that flows into a surface water or groundwater body. The amount of water entering a reservoir expressed as a volume per time.

In-migration: People moving into an area.

In-situ: In its natural position or place; unmoved, unexcavated, remaining at the site or subsurface.

Inset fans: An alluvial fan that occurs on top of an older alluvial fan.

Insolation: The solar power density incident on a surface of stated area and orientation, usually expressed as watts per square meter or btu per square foot per hour.

Intaglio: An impression, design, or figure created on the ground by man through the placement of rocks or mounding of earth.

Interbasin flow: Surface water or groundwater flow between two hydrologic basins.

Interbasin transfers: The transfer of water to another water management basin.

Interbasin transfer of water: A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one drainage or hydrographic basin to another.

Interdune flat: The area between dunes, generally flat and often erosion-resistant.

Intermittent stream: A stream that flows for a portion of the year but occasionally is dry or reduced to a pool stage when losses from evaporation or seepage exceed the available streamflow.

Intermontane basin: An alluvium-filled valley between mountain ranges, often formed over a graben.

Interpretive site: Information communicated via plaques, markers, and other methods, about the natural and/or cultural resources, their history and values, that are found at a specific site or along a trail. Tours, signs, brochures, informational kiosks, and other means can be used to interpret a particular resource.

Intrusive: An igneous rock that forms under the Earth's surface. Examples include granite, diorite, and gabbro.

Invasive species: Any species, including noxious and exotic species, that is an aggressive colonizer and can out-compete indigenous species.

Invertebrate: An animal, such as an insect or mollusk, that lacks a backbone or spinal column.

Inverter: An electrical device that converts direct current (DC) into alternating current (AC).

Irradiance: *See* Insolation.

Irrigation: The controlled application of water for agricultural purposes through manmade systems to supply water requirements that are not satisfied by rainfall.

Irrigation Non-Expansion Area (INA): A geographic area in Arizona that has been designated as having insufficient groundwater to provide a reasonably safe supply for the irrigation of the cultivated lands at the current rate of withdrawal.

Junior water rights: Water rights that are more recent than older or more senior rights. *See also* Senior water rights.

Just-in-time ordering: A strategy for managing materials used at a project that ensures materials become available as needed to support activities, but are not stockpiled at the project location in excess of what is needed at any point in time. The just-in-time approach controls costs by avoiding the accumulation of inflated inventories, reducing the potential for stockpiled materials to go out-of-date or otherwise become obsolete, and minimizing product storage and management requirements. When applied to hazardous chemicals, this approach reduces waste generation, the potential for mismanagement of materials and the overall risk of adverse impacts resulting from emergency or off-normal events involving those materials.

Key observation point(s) (KOPs): One or a series of points on a travel route or at a use area or a potential use area, where the view of a management activity would be most revealing. KOPs are typically used as viewpoints for assessing potential visual impacts resulting from a proposed management activity.

Kilowatt: A unit of electrical power equal to 1,000 watts (W).

Kiva: An underground (or partially underground) ceremonial room or chamber used in ancient and modern Pueblo villages.

Knob: A small hilltop that is round in shape.

Known Geothermal Area (KGA): A region identified by the U.S. Geological Survey as containing geothermal resources.

Laccolith: An igneous intrusion that has been forced between two layered rock units. The top of the intrusion is arched upwards and the bottom of the intrusion is nearly flat.

Lacustrine wetland: Wetlands that are generally larger than 20 acres and having less than 30% cover of vegetation such as trees, shrubs, or persistent emergent plants. Lacustrine sediments are generally made up of fine-grained particles deposited in lakes.

Lag gravel: Residual deposit of coarse material that has had the finer fraction removed by a transporting agent, usually wind or water.

Lahar: A mudflow composed of water and volcanic ash. Lahars can be triggered by the flash melting of the snow cap of a volcanic mountain or from heavy rain. Lahars are very dangerous because they can occur suddenly and they can travel at great speeds.

Land area: Includes dry land and land temporarily or partially covered by water, such as marshlands, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than 1/8 of a statute mile in width; and lakes, reservoirs, and ponds having less than 40 acres of water-surface area.

Land cover: The physical coverage of land, usually expressed in terms of vegetation cover or lack of it.

Land disturbance: Discrete event or process that alters soil and/or kills or damages vegetation. From an ecological and hierarchical perspective, disturbance is a change in the minimal structure of an ecosystem caused by a factor external to the reference structure. Examples of disturbance are habitat reduction, habitat fragmentation, and habitat alteration.

Land disturbance in natural drainage systems: Any movement (e.g., grading or excavation) of soil or sediment in a natural drainageway.

Landform: Any feature of the Earth's surface having a distinct shape and origin. Landforms include major features (such as continents, ocean basins, plains, plateaus, and mountain ranges) and minor features (such as hills, valleys, slopes, drumlins, and dunes).

Land subsidence: The sinking or settling of land to a lower level in response to various natural and man-caused factors. With respect to groundwater, subsidence most frequently results from overdrafts of the underlying water table or aquifer and its inability to fully recharge, a process called aquifer compaction. *See also* Subsidence.

Land use: A characterization of land surface in terms of its potential utility for various activities.

Land Use Plan: A set of decisions that establish management direction for land within an administrative area, as prescribed under the planning provisions of FLPMA; an assimilation of land-use-plan-level decisions developed through the planning process outlined in 43 CFR 1600, regardless of the scale at which the decisions were developed. *See also* Resource Management Plan.

Land withdrawal: Withdrawals are governed by regulations issued under FLPMA, contained in 43 CFR Part 2300. A withdrawal is defined as: "Withholding an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program; or transferring jurisdiction over an area of Federal land, other than property governed by the Federal Property and Administrative Services Act (40 U.S.C. 472), from one department, bureau or agency to another department, bureau or agency." (See 43 CFR 2300.0-5(h).)

Landform: Any recognizable physical form of the Earth's surface, having a characteristic shape, and produced by natural causes. Landforms include major forms such as plains, plateaus, and mountains, and minor forms such as hills, valleys, slopes, and moraines. Taken together, the landforms make up the surface configuration of the Earth.

Landmark: Type of reference point external to the observer. Usually a simply defined physical object. Some are distant, seen from many angles and distances over the tops of smaller elements and used as a radial reference.

Landscape: The traits, patterns, and structure of a specific geographic area including its biological composition, its physical environment, and its anthropogenic or social patterns.

Landscape character: The arrangement of a particular landscape as formed by the variety and intensity of the landscape features and the four basic elements of form, line, color, and texture. These factors give the area a distinctive quality which distinguishes it from its immediate surroundings.

Late Archaic: The period 3,000 to 1,500 years B.P.

Latite: An igneous, volcanic (extrusive) rock.

Lava: Magma that reaches the Earth's surface and issues from volcanoes.

Lava tubes: Natural conduits through which lava moves beneath the surface of a lava flow during a volcanic eruption. In solidified lava flows, lava tubes may be seen as collapsed features or open trenches at the surface.

Lava flow: An outpouring of lava onto the land surface from a vent or fissure. Also, a solidified tongue-like or sheetlike body formed by outpouring lava.

Law of the River: A complex body of laws, court decrees, contracts, agreements, regulations and an international treaty used to govern allocation and management of Colorado River water.

Laydown area: An area that has been cleared for the temporary storage of equipment and supplies. To ensure accessibility and safe maneuverability for transport and off-loading of vehicles, laydown areas are usually covered with rock and/or gravel.

L_{dn}: The day-night average sound level. It is the average A-weighted sound level over a 24-hour period that gives additional weight to noise that occurs during the night (10:00 p.m. to 7:00 a.m.) to account for the greater sensitivity of most people to nighttime noise.

Lead: A gray-white metal that is listed as a criteria air pollutant. Health effects from exposure to lead include brain and kidney damage and learning disabilities. Sources include leaded gasoline and metal refineries.

Leasable minerals: Federal minerals such as coal, oil shale, oil, gas, phosphate, potash, sodium, tar sands, geothermal resources, potassium, asphaltic materials, and all other minerals that are subject to lease under the Mineral Leasing Act of 1920, as amended and supplemented.

Lease: A contract in legal form that provides for the right to develop and produce resources within a specific area for a specific period of time under certain agreed-upon terms and conditions.

Left-lateral fault: *See* Fault, left-lateral.

Lentic environment: An aquatic ecosystem in which the water is still and not rapidly moving, such as is found in ponds and swamps.

Lek: A communal mating area within which males of certain species hold small territories, which they use solely for courtship and copulation.

L_{eq}: Equivalent/continuous sound level. L_{eq} is the steady sound level that would contain the same total sound energy as the time-varying sound over a given time.

License: An authority granted by the United States to do a particular act or series of acts upon public lands without the licensee possessing any estate or interest in the land itself.

Light fixture: An electrical device used to create artificial light and/or illumination.

Light pollution: Any adverse effect of human-made lighting, such as excessive illumination of night-skies by artificial light. Light pollution is an undesirable consequence of outdoor lighting that includes such effects as sky glow, light trespass, and glare.

Light spillage: An undesirable condition in which light is cast where it is not wanted. (Also referred to as light trespass.)

Light trespass: *See* Light spillage.

Limestone: A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes in a marine environment, but may also form by inorganic precipitation.

Line: The path, real or imagined, that the eye follows when perceiving abrupt differences in form, color, or texture. Within landscapes, lines may be found as ridges, skylines, structures, changes in vegetative types, or individual trees and branches.

Lineament: A straight topographic feature of regional extent that is thought to represent crustal structure. Other examples include faults, a linear series of depressions or sinkholes, a straight length of a river or stream, or a line of volcanoes.

Liner: A relatively impermeable barrier designed to keep leachate inside a landfill. Liner materials include plastic and dense clay.

Liquefaction: Refers to a sudden loss of strength and stiffness in loose, saturated soils. It causes a loss of soil stability and can result in large, permanent displacements of the ground.

Lithic: Relating to stone or rock.

Lithic debitage: Debris produced during stone (lithic) tool manufacture.

Lithic scatter: A distribution of cultural items that consists primarily of lithic (stone) material. The scatter may include formed tools such as points or knives, or it may contain only chipping debris from tool-making activities.

Livestock guzzler: A watering system for cattle and other livestock that maintains a set water level as water is used.

Livestock watering area: Water used for livestock watering, feed lots, dairy operations, fish farming, and other on-farm needs.

Loam: A soil consisting of an easily crumbled mixture of clay, silt, and sand.

Locatable Minerals: Minerals or materials subject to disposal and development through the Mining Law of 1872 (as amended). Generally include metallic minerals such as gold, copper, lead, and silver and other materials that are not subject to lease or sale (i.e., oil and natural gas).

Lode: A mineralized ledge, vein or mineral deposit in place.

Lode mining claim: A claim based on the presumption that the valuable mineral is a part of a bed-rock lode, vein, stockwork, stratum, or intrusion and is not dominantly a physical redistribution of values by surficial processes; the latter constitutes a placer deposit.

Loess: A group of windblown soils, largely comprising silt, weakly cemented by calcite.

Low-income population: Persons whose average family income is below the poverty line. The poverty line takes into account family size and age of individuals in the family. For any family below the poverty line, all family members are considered to be below the poverty line.

Low-level magnetic fields: Fields of force that are generated whenever electric current flows. The sun's average large-scale magnetic field, and the Earth's, exhibit a north and a south pole, linked by lines of magnetic force.

Luminaire: A complete lighting unit consisting of a lamp (or lamps) and the parts designed to distribute the light, to position and protect the lamp(s), and to connect the lamp(s) to the power supply. Also referred to as a light fixture.

Maar: A volcanic crater that is produced by an explosion in an area of low relief, is generally more or less circular, and often contains a lake, pond, or marsh.

Macrophyte (aquatic): An aquatic plant that is large enough to be observed with the naked eye. It grows in or near water.

Mafic (or maphic): A term used to describe an igneous rock that has a large percentage of dark-colored minerals such as amphibole, pyroxene, and olivine. Also used in reference to the magmas from which these rocks crystallize. Mafic rocks are generally rich in iron and magnesium. Basalt and gabbro are examples of mafic rocks.

Magma: Molten rock containing liquids, crystals, and dissolved gases that forms within the upper part of the Earth's mantle and crust. When erupted onto the Earth's surface, it is called lava.

Maintenance area: Any geographic region of the United States previously designated nonattainment pursuant to the CAA Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under Section 175A of the CAA, as amended.

Mammals: A group of air-breathing animals whose skin is more or less covered with hair or fur and who have mammary glands. Young are born alive (except for the platypus and echidna) and are nourished with milk. Mammals include man, dogs, cats, deer, mice, squirrels, raccoons, bats, opossums, whales, seals, and others.

Mano: A stone with a flat side that was primarily held in one's hand or hands and used to grind edible substances, typically corn, grains, and nut meats. *See also* Metate.

Mantle: The main bulk of the Earth, between the crust and core, ranging from depths of about 40 to 3,480 kilometers. It is composed of dense mafic silicates and divided into concentric layers by phase changes that are caused by the increase in pressure with depth.

Mantle hot spot: A region of continental or oceanic crust below which a mantle plume causes melting of the overlying crust, resulting in a broad regional topographic swell (e.g., Yellowstone plume) or hot spot volcanism (e.g., the Hawaiian chain of volcanoes which represent movement of ocean crust over a stationary hot spot).

Marsh: An area of low-lying wetlands dominated by grasslike plants.

Maximum contaminant level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk.

Maximum output: *See* Nameplate capacity.

MCL: *See* Maximum contaminant level.

Mean: Average.

Mean sea level (MSL): The arithmetic mean of hourly water elevations observed over a specific 19-year tidal epoch.

Median household income: Divides households into two equal segments, with one-half of households earning less than the median household income and the other half earning more. Median income is a better indicator of typical income levels in an area than average household income as median income is not dramatically affected by unusually high or low values.

Median housing value: Divides housing units into two equal segments, one-half of housing units less than median housing value and the other half valued more. Median housing value is a better indicator of typical housing values in an area than average housing values as median housing value is less likely to be affected by a small number of very highly priced homes.

Megafauna: A number of species of presently extinct mammals including mammoths and mastodons.

Megawatt: A unit of power equal to one million watts (equivalent to one joule per second). One megawatt serves about 300 homes in the western United States based on national data.

Megawatt electrical (MWe): One million watts of electrical energy; a measure of electrical power capacity, use in PEIS is synonymous with MW.

Mesa: A broad, flat-topped elevation with one or more steeply-sloping to vertical sides.

Mesic habitat: A habitat type characterized by the presence of a moderate amount of moisture or water. *Compare:* hydric; *opposite:* xeric.

Mesozoic: An era of geologic time between the Paleozoic and the Cenozoic, spanning the time between 251 and 65 million years ago. The word Mesozoic is from Greek and means "middle life."

Metamorphic rock: A sedimentary or igneous rock that has been changed by pressure, heat, or chemical action. For example, marble is the metamorphosed version of limestone, a sedimentary rock.

Metate: A portable stone slab upon which seeds and other grains are milled with a mano using a push-pull, back-and-forth motion. *See also* Mano.

Microbiotic soil crusts: *See* Biological soil crusts.

Microphytic soil crusts: *See* Biological soil crusts.

Microsite: A small area within an environment with unique features, conditions, or characteristics relative to the surrounding area. Differentiating features may be temperature, humidity, sunlight, nutrient availability, vegetation cover, or physical characteristics.

Migration corridor: A route followed by animals such as big game, birds, or fish when traveling between winter and summer habitats**.**

Migratory Bird Treaty Act (MBTA): The MBTA implements various treaties and conventions between the United States, and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. The MBTA made it illegal for people to "take" migratory birds, their eggs, feathers, or nests. *See also* Take.

Military Training Route (MTR): A designated corridor of airspace with defined vertical and lateral dimensions established for conducting military flight training at airspeeds in excess of 250 nautical miles per hour.

Milligauss (mG): A unit of measure for magnetic fields.

Millsite mining claim: Claim on nonmineral land for processing ore from a mining claim.

Mineral: A naturally occurring inorganic element or compound having an orderly internal structure and characteristic chemical composition, crystal morphology, and physical properties such as density and hardness. Minerals are the fundamental units from which most rocks are made.

Mineral Leasing Act of 1920 (MLA): Authorizes the agency to issue rights-of-way grants for oil and gas gathering and distribution pipelines and related facilities not already authorized through a lease, and oil and natural gas transmission pipelines and related facilities.

Mineral materials: Widespread deposits of common clay, sand, gravel, or stone which are not subject to disposal under the 1872 Mining Law, as amended.

Mining claim: That portion of the public mineral lands which a miner, for mining purposes, takes and holds in accordance with the mining laws. A mining claim may be validly located and held only after the discovery of a valuable mineral deposit.

Mining water use: Water use during quarrying rocks and extracting minerals from the land.

Minority population: Includes Hispanic, American Indian, or Alaskan Native; Asian; Native Hawaiian or Other Pacific Islander; Black (not of Hispanic origin) or African American. "Other" races and multi-racial individuals may be considered as separate minorities.

Miocene: An epoch of the upper Tertiary period, 23 to 5.3 million years ago.

Mirror: A reflecting surface of various physical shapes (parabolic, nearly flat, or flat) used to reflect and/or concentrate the sun's energy to specific locations within solar energy facilities.

Mitigation: A method or process by which impacts from actions can be made less injurious to the environment through appropriate protective measures.

Mitigation measures: Methods or actions that will reduce adverse impacts from solar facility development. Mitigation measures can include best management practices, stipulations in BLM ROW agreements, siting criteria, and technology controls.

Module: *See* Photovoltaic (PV) module.

Molten salts: Mixtures of sodium nitrate and potassium nitrate in various proportions that are used as a heat transfer or heat storage medium in CSP Solar Energy facilities. Mixtures are chosen because of their long-term thermal stability at temperatures as high as 1200°F (649°C).

Montane: The highland area located below the subalpine zone. Montane regions generally have cooler temperatures, and often have higher rainfall than the adjacent lowland regions, and they are frequently home to distinct communities of plants and animals.

Mosses: Low-growing, nonvascular plants that are common to moist habitats.

Mortar: A stone bowl or bowl-shaped depression (such as in a rock) in which seeds, berries, nuts, meats, and other items are ground or pulverized with a pestle, or other handstone or milling stone, using an up-and-down motion. Mortars occur in bedrock outcrops and as portable items. *See also* Pestle.

Multijunction solar cell: A photovoltaic device comprised of two or more semiconductor materials or cell junctions, each capable of producing electricity with the photovoltaic effect by absorbing solar energy from different wavelengths of the solar spectrum. Multijunction solar cells can convert sunlight to electricity at greater overall efficiencies than single-junction cells.

Multiple use: A combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife, and fish, along with natural scenic, scientific, and historical values.

Multiple Use Classes: Class C is for lands designated either as wilderness or for wilderness study areas. These lands are managed to protect their wilderness values. **Class L** (Limited Use) protects sensitive, natural, scenic, ecological, and cultural resource values. Public lands designated as Class L are managed to provide for generally lower intensity, carefully controlled multiple use of resources, while ensuring that sensitive values are not significantly diminished. **Class M** (Moderate Use) is based upon a controlled balance between higher intensity use and protection of public lands. This class provides for a wide variety of present and future uses such as mining, livestock grazing, recreation, energy, and utility development. Class M management is also designed to conserve desert resources and to mitigate damage to those resources which permitted uses may cause. **Class I** (Intensive Use) is to provide for the concentrated use of lands and resources to meet human needs. Reasonable protection will be provided for sensitive natural and cultural values. Mitigation of impacts on resources and rehabilitation of affected areas will occur insofar as possible.

Multiple use management: Coordinated management of the various surface and subsurface resources, without permanent impairment of the productivity of the land, that will best meet the present and future needs of the people.

NAAQS: *See* National Ambient Air Quality Standards.

Nameplate rating: The maximum power-generating capacity of a generator or power-generating facility.

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the Clean Air Act, as amended. The primary NAAQS are intended to protect the public health with an adequate margin of safety; and the secondary NAAQS are intended to protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Environmental Policy Act of 1969 (NEPA): Requires federal agencies to prepare a detailed statement on the environmental impacts of their proposed major actions that are significantly affecting the quality of the human environment.

National Historic Preservation Act (NHPA): A federal law providing that property resources with significant national historic value be placed on the *National Register of Historic Places*. It does not require permits; rather, it mandates consultation with the proper agencies whenever it is determined that a proposed action might impact an historic property.

National Historic Trails: These trails are designated by Congress under the National Trails System Act of 1968 and follow, as closely as possible, on federal land, the original trails or routes of travel that have national historical significance.

National Landscape Conservation System (NLCS): Created by the BLM in June 2000 to increase public awareness of BLM lands with scientific, cultural, educational, ecological, and other values. It consists of National Conservation Areas, National Monuments, Wilderness Areas, Wilderness Study Areas, Wild and Scenic Rivers, and National Historic and Scenic Trails.

National Pollutant Discharge Elimination System (NPDES): A federal permitting system controlling the discharge of effluents to surface water and regulated through the Clean Water Act, as Amended.

National Recreation Area: An area designated by Congress to assure the conservation and protection of natural, scenic, historic, pastoral, fish, and wildlife values, and to provide for the enhancement of recreational values.

***National Register of Historic Places* (NRHP):** A comprehensive list of districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. The NRHP is administered by the National Park Service, which is part of the Department of the Interior.

National Scenic Byway: *See* All-American Roads.

Native American: Of, or relating to, a tribe, people, or culture that is indigenous to the United States. (*See* Native American Graves Protection and Repatriation Act).

Native American Graves Protection and Repatriation Act (NAGPRA): This act established the priority for ownership or control of Native American cultural items excavated or discovered on federal or tribal land after 1990 and the procedures for repatriation of items in federal possession. The act allows for the intentional removal or excavation of Native American cultural items from federal or tribal lands only with a permit or upon consultation with the appropriate tribe.

Natural drainages: Natural systems that convey water (such as a stream channel) that may be perennial, intermittent, or ephemeral.

NatureServe: A nonprofit organization that provides the scientific information and tools needed to guide effective conservation action. NatureServe and its network of natural heritage programs are a leading source of information about the species and ecosystems of the United States, Canada, and Latin America.

NatureServe Explorer: A Web site from NatureServe that provides authoritative conservation information in a searchable database for more than 70,000 plants, animals, and ecological communities in the United States, Canada, and Latin America.

Neotropical migrants: Birds (especially songbirds) that summer in North America but migrate to the tropics for the winter.

NEPA: *See* National Environmental Policy Act of 1969.

Net emissions: Applied to greenhouse gas emissions inventory in this report. "Net emissions" means gross emissions (including all industrial activities, mostly fossil fuel combustion) minus carbon sinks from forestry activities and agricultural soils.

Night-sky impact: An interference with enjoyment of dark night skies resulting from light pollution.

Nighttime mean rural background level: Nighttime (10 p.m. to 7 a.m.) average sound level in the rural environment, from all sources, rather than a particular noise that is of interest.

Nitrogen dioxide: (NO_2): A toxic, reddish-brown gas that is a strong oxidizing agent, produced by combustion (as of fossil fuels). It is the most abundant of the oxides of nitrogen in the atmosphere and plays a major role in the formation of ozone. NO_2 is one of the six criteria air pollutants specified under Title I of the Clean Air Act.

Nitrogen oxides (NO_x): Nitrogen oxides include various nitrogen compounds, primarily nitrogen dioxide and nitric oxide. They form when fossil fuels are burned at high temperatures and react with volatile organic compounds to form ozone, the main component of urban smog. They are also a precursor pollutant that contributes to the formation of acid rain.

NO_2: *See* Nitrogen dioxide.

Noise: Any unwanted sound that interferes with speech and hearing, causes damage to hearing, or annoys a person.

Noise criteria: Quantitative noise limits, below which it is acceptable for people to hear. Typically, noise criteria are specified in ordinances, regulations, or guidances.

Nonattainment area: The EPA's designation for an air quality control region (or portion thereof) in which ambient air concentrations of one or more criteria pollutants exceed National Ambient Air Quality Standards.

Nongame species: Those species not commonly harvested either for sport or profit.

Nonmarket value: Most environmental goods and services, such as clean air and water, and healthy fish and wildlife populations, are not traded in markets, meaning that their economic value, or how much people would be willing to pay for them, is not revealed in market prices. To incorporate them into economic analyses, monetary values are assigned to them using nonmarket valuation methods.

Nonpoint light source: A light source that is sufficiently large in size and close enough to the viewer to appear as an illuminated surface rather than a star-like point of light.

Nonpoint sources: Diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

Non-point source pollution: Pollution whose source is not specific in location; the sources of the pollutant discharge are dispersed, not well defined or constant. Examples include sediments from logging activities and runoff from agricultural chemicals.

Nonroad mobile sources (emissions): Sources such as farm and construction equipment, gasoline-powered lawn and garden equipment, and power boats and outdoor motors that emit pollutants.

NO_x: *See* Nitrogen oxides.

Noxious weeds: Those plants regulated by law or those that are so difficult to control that early detection is important.

Nurse plants: Mature plants that create favorable conditions for seeds to germinate and for seedlings to survive and grow.

Oasis: An isolated, fertile tract or green locality in a desert region, made so by the presence of water. *See also* Palm oasis.

Obligate species: Restricted to a particular condition of life; for example, dependent on a particular habitat to be able to breed. *See also* riparian obligate; sand-dune obligate.

O_3: *See* ozone.

Obsidian: A black or dark-colored volcanic glass.

Occupational Safety and Health Administration (OSHA): Congress created the OSHA under the Occupational Safety and Health Act on December 29, 1970. Its mission is to prevent work-related injuries, illnesses, and deaths.

Off-highway vehicle (OHV) or off-road vehicle: Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain; except that such term excludes (1) any registered motorboat; (2) any military, fire, emergency, or law enforcement vehicle when used for emergency purposes; and (3) any vehicle whose use is expressly authorized by the respective agency head under a permit, lease, license, or contract. *See also* Off-road vehicle designations.

Off-road vehicle: *See also* Off-highway vehicle.

Off-road vehicle (OHV) designations: OPEN: Vehicles are allowed without restrictions. **LIMITED:** Vehicle travel off existing roads and trails would be allowed only for authorized or permitted uses. **CLOSED**: Vehicle travel is closed in the area including existing roads and trails, except for authorized uses.

Off-site facility: A hazardous waste treatment, storage, or disposal area that is located away from the generating site.

Oil and gas leasing (on BLM land): The BLM leases oil and gas rights to explore for and produce oil and gas resources from federal lands or mineral rights owned by the federal government. Federal oil and gas leases may be obtained and held by any adult citizen of the United States.

Onroad mobile source (emissions): Any mobile source of air pollution such as cars, trucks, motorcycles, and buses that travels on roads and highways.

OSHA: *See* Occupational Safety and Health Administration.

Ostracods: Group of small crustaceans with a bivalved carapace which can be closed to completely cover the body; important planktonic fish food.

Outflow: The amount of surface water or groundwater passing a given point downstream, expressed as a volume per time. Water flowing out of a body of water.

Overbank deposits: Fine-grained sediment (silt and clay) deposited from suspension on a floodplain by floodwaters from a stream channel.

Overdraft: The pumping of water from a groundwater basin or aquifer in excess of the supply flowing into the basin; resulting in a depletion or mining of the groundwater in the basin.

Ozone (O_3): A strong-smelling, reactive, toxic, chemical gas consisting of three oxygen atoms chemically attached to each other. Ozone is formed in the atmosphere by chemical reactions involving NO_x and volatile organic compounds in the presence of sunlight. Ozone is a criteria air pollutant under the Clean Air Act and is a major constituent of smog.

Paleontological resources: Fossilized remains, imprints, and traces of plants and animals preserved in rocks and sediments since some past geologic time.

Paleozoic: An era of geologic time, from the end of the Precambrian to the beginning of the Mesozoic, spanning the time between 542 and 251 million years ago. The word Paleozoic is from Greek and means “old life.”

Palm oasis: (1) A desert habitat with permanent water or a water table near the surface that supports a canopy of palm trees. Oasis habitats generally occupy sites with moist alkaline soils near seeps, springs, and streams. (2) An isolated palm-dominated area of vegetation in a desert, typically surrounding a spring or a similar water source. Palm oasis habitats are found adjacent to a number of other desert habitats including desert riparian, desert cactus shrub, and desert wash. In many cases, characteristic plant species from these habitats comprise the understory of palm oases.

Palustrine wetlands: Shallow freshwater wetlands that often support plant communities of trees, shrubs, emergent plants, mosses, or lichens. Palustrine wetlands without such plant communities are small (less than 20 acres [0.08 km^2]) and lack an active wave-formed or bedrock shoreline.

Pan evaporation: A measurement that combines or integrates the effects of several climate elements: temperature, humidity, solar radiation, and wind. Evaporation is greatest on hot, windy, dry days; and is greatly reduced when air is cool, calm, and humid. *See also* Evaporation rate.

Parabolic solar collector trough: *See* Parabolic trough**.**

Parabolic trough: A type of CSP solar energy technology that uses parabolic-shaped mirrors to concentrate sunlight on a receiver filled with a heat transfer fluid that subsequently transfers the heat it absorbs to water to produce steam to drive a steam turbine-generator (STG) to produce electricity. Parabolic trough systems typically mount the mirrors on a support that can track the sun's movement across the sky over the course of the day, ensuring maximum solar energy capture.

Parabolic trough system: *See* Parabolic trough.

Particulate matter: Fine solid or liquid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions. The size of the particulates is measured in micrometers (μm). One micrometer is 1 millionth of a meter or 0.000039 inch. Particle size is important because the EPA has set standards for $PM_{2.5}$ and PM_{10} particulates.

Passerine: Birds of the order Passeriformes, which includes perching birds and songbirds such as the jays, blackbirds, finches, warblers, and sparrows.

Patterned-body anthropomorphs: Object or drawing having a human shape with a pattern or design. *See also* Anthropomorphic; Anthropomorphism.

Peak horizontal acceleration: *See* Acceleration.

Peanut-body anthropomorphs: Object or drawing having a human-like shape resembling that of a peanut. *See also*: Anthropomorphic; Anthropomorphism.

Pediment: A broad, gently-sloping erosion surface developed at the base of a mountain range in a dry region. It is usually covered with a thin layer of gravel.

Per capita income: The average income per person in a given group.

Perennial allotment: A BLM grazing allotment that consistently produces enough perennial forage to support a year round livestock operation.

Perennial streams: Streams that flow continuously because they lie at or below the groundwater table, which constantly replenishes them.

Perennial surface water features: Surface water features that contain water at all times throughout the year.

Perennial yield (groundwater): The amount of groundwater that can be withdrawn from a groundwater basin over a period of time without exceeding the long-term recharge of the basin or unreasonably affecting the basin's physical and chemical integrity.

Perennial/safe/sustainable yield: A specified rate of groundwater pumping that can be sustained for an indefinite period of time without impairing hydrogeologic and ecologic processes, characteristics, or functions existing within a groundwater basin. Examples of impacts to hydrogeologic and ecologic processes, characteristics, and functions include (but are not limited to) alterations to basin-scale flow paths (direction and magnitude); significant drawdown of groundwater surface elevations; decreases in hydrostatic pressures; and decreased connectivity with surface features such as springs, wetlands, and phreatic vegetation. Quantifying perennial/safe/sustainable yields is a non-trivial task that is often done by examining basin-scale information on groundwater recharge, discharge, and storage processes that is obtained through the combination of extensive field-data collection and numerical modeling.

Perfluorocarbons (PFCs): Compounds consisting of carbon and fluorine. They do not deplete the stratospheric ozone but are very strong greenhouse gases with long lifetimes in the atmosphere.

Permeability: The rate at which liquids pass through soil or other materials in a specified direction.

Permissible Exposure Limit (PPL): The maximum amount or concentration of a chemical that a worker may be exposed to under OSHA regulations.

Permit: An authorization, license, or equivalent control document issued by the EPA or an approved state agency to implement the requirements of an environmental regulation. Permit includes information on which pollutants are being released, how much the source is allowed to release, and the program that will be used to meet pollutant release requirements. Permits are required both for the operation of plants (operating permits) and for the construction of new plants. The 1990 Clean Air Act introduced a nationwide permit system for air pollution control.

Permittee: An individual who holds either a BLM grazing permit or grazing lease that authorizes grazing use of the public lands issued under authority of Section 3 or 15 of the Taylor Grazing Act of June 28, 1934, as amended (TGA). Although an individual holding an authorization under Section 3 of the TGA is technically a permittee, an individual holding an authorization under Section 15 of the TGA holds a lease and is a lessee. For the purpose of the Solar PEIS, both permittees and lessees are referred to as permittees.

Permitted use: The forage allocated by, or under the guidance of, an applicable land use plan for livestock grazing in an allotment under a permit or lease; expressed in Animal Unit Months (AUMs) (43 CFR 4100.0-5).

Personal protective equipment (PPE): Clothing and equipment that are worn to reduce exposure to potentially hazardous chemicals and other pollutants.

Pesticide: Substances or mixtures thereof, intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

Pestle: An elongated, often cylindrical stone used to pulverize food products and other cultural products in a mortar. *See also* Mortar.

Petrocalcic: Soil horizon formed when secondary calcium carbonate accumulates in the subsoil and hardens into a hardpan.

Petroglyph: A figure or design carved, abraded, or pecked on rock.

PFYC: *See* Potential Fossil Yield Classification.

Phosphorous: A chemical element used as a dopant in making n-type semiconductor layers. An essential chemical food element that can contribute to the eutrophication of lakes and other water bodies. Increased phosphorus levels result from discharge of phosphorus-containing materials into surface waters.

Photon: A particle of light that acts as an individual unit of energy.

Photosynthesis: The process in green plants and certain other organisms by which carbohydrates are synthesized from carbon dioxide and water using sunlight as an energy source. Most forms of photosynthesis release oxygen as a byproduct. Chlorophyll typically acts as the catalyst in this process.

Photovoltaic (PV) array: An interconnected system of PV modules that function as a single electricity-producing unit. The modules are assembled as a discrete structure, with common support or mounting. In smaller capacity systems, an array can consist of a single module.

Photovoltaic (PV) cell: The smallest semiconductor element within a PV module that converts incident sunlight into electrical energy (direct current voltage and current). Also called a solar cell.

Photovoltaic (PV) facility: A solar energy facility that uses photovoltaic cells to produce electricity and that includes all components, such as the PV system, power conditioning equipment, monitoring and control capabilities, and other features required for safe connection of the facility to the bulk electricity transmission grid, as well as buildings, access roads, perimeter fence, and other equipment needed for operation and maintenance of the facility.

Photovoltaic (PV) module: An assembly of solar cells (flat-plate type) or receiver(s) and optics (concentrator type) and ancillary parts, such as interconnects and terminals, enclosed in a weatherproof container, intended to generate DC power under unconcentrated sunlight. (Note: A CPV module is a concentrator type PV module.) The structural (load carrying) member of a module can either be the top layer (superstrate) or the back layer (substrate).

Photovoltaic (PV) panel: A collection of modules, either flat-plate or concentrator type, mechanically fastened, electrically interconnected, and designed to provide a field-installable unit. (Note: Not all PV systems will use panelized units during installation. Sometimes the modules are individually attached to a support structure.)

Photovoltaic (PV) power plant: *See* Photovoltaic (PV) facility.

Photovoltaic (PV) receiver: An assembly of one or more PV cells that accepts concentrated sunlight and incorporates means for thermal and electric energy removal.

Photovoltaic (PV) system: *See* Photovoltaic (PV) facility.

Photovoltaics (PV): Technologies that utilize semiconducting materials that convert sunlight directly into electricity.

Phreatic vegetation: Vegetation supported by groundwater below the land surface.

Phreatophytes: Any plant, typically living in the desert, that obtains its water from long taproots that reach the water table.

Physiography: The physical geography of an area or the description of its physical features.

Phytoplankton: Small, often single-celled plants that live suspended in bodies of water.

Pictograph: A design drawn in pigment upon an unprepared or ground rock surface.

Piezometer: A nonpumping well, generally of small diameter, for measuring the elevation of a water table.

Pithouse: A semi-subterranean dwelling with an excavated floor and earthen superstructure supported by posts and beams.

Placer: An alluvial deposit of sand and gravel containing valuable minerals. (nps geo)

Placer mining: That form of mining in which the surficial detritus is washed for gold or other valuable minerals. When water under pressure is employed to break down the gravel, the term hydraulic mining is generally employed.

Placer mining claim: Minerals are loose on the ground or in a streambed.

Plains: An extensive area that ranges from level to gently sloping or undulating.

Planetary boundary layer turbulence structure: In the Earth's atmosphere, the planetary boundary layer is the air layer near the ground that is affected by diurnal heat, moisture, or momentum transfer, to or from the surface.

Plankton (planktonic): The aggregate of small plant and animal organisms that float or drift in fresh or salt water.

Playa: Flat areas that contain seasonal or year-to-year shallow lakes that often evaporate, leaving minerals behind. Playas form in arid basins where rivers merge, but do not drain.

Playa lake: Ephemeral lakes formed in the lowest part of a closed (internally drained) basin in an arid region. High rates of evaporation in these areas often leave behind mineral deposits. Also referred to as dry lakes or alkali flats.

Pleistocene: The oldest epoch of the Quaternary period, ranging from 2.6 million to 10,000 years ago. Together the Pleistocene and the Holocene make up the Quaternary period.

Plume: A visible or measurable discharge of a contaminant from a given point of origin. Can be visible or thermal in water, or visible in the air as, for example, a plume of smoke.

Plume downwash: Downward movement of plumes immediately to the lee of flow obstacles such as buildings, bluffs, or smokestacks, caused by wake turbulence or lee cavity circulations generated by the obstacles. It brings higher-concentration pollutants down toward the ground.

Plume model: A computer model used to calculate air pollutant concentrations at receptor locations. The model assumes that a pollutant plume is carried downwind from its emission source by a mean wind and dispersed horizontally and vertically by atmospheric stability characteristics.

Pluton: A body of igneous rock that solidified below the Earth's surface.

Plutonic: Pertaining to a class of igneous rocks that have solidified far below the Earth's surface.

Pluvial lake: A lake formed during episodes of heavy precipitation or glacial melting, such as during the Pleistocene, and may either be extinct or remain as a remnant or dry lake with periodic water.

$PM_{2.5}$: Particulate matter with a mean aerodynamic diameter of 2.5 micrometers (0.0001 inch) or less. Particles less than this diameter can lodge deeply in the lungs. $PM_{2.5}$ is one of the six criteria pollutants specified under Title I of the Clean Air Act.

PM_{10}: Particulate matter with a mean aerodynamic diameter of 10 micrometers (0.0004 inch) or less. Particles less than this diameter can be inhaled and accumulate in the respiratory system. PM_{10} is one of the six criteria pollutants specified under Title I of the Clean Air Act.

Point light source: A light source that has no visible surface area, and appears as a point, such as a star.

Point of diversion: A specifically named place where water is removed from a body of water. The location of a surface water or groundwater extraction associated with a water right.

Point source (emissions): A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g., a pipe, ditch, ship, ore pit, or a factory smokestack.

Potable water: Water of a sufficient quality that it can be consumed by humans without the risk of immediate or long-term effects. Also referred to as drinking water.

Potential Fossil Yield Classification (PFYC): Initially developed by the U.S. Forest Service and the Region 2 Paleo Initiative in May 1996, the PFYC system provides baseline guidance for assessing the relative occurrence of important paleontological resources and the need for mitigation. Specifically, it is used to classify geologic units, at the formation or member level, according to the probability that they could yield paleontological resources of concern to land managers.

Potentially Active Fault: *See* Fault, potentially active.

Power block: Portion of the facility at which electrical power is generated.

Power conditioning system (PCS): In solar energy facilities, the collection of electrical equipment that converts direct current (DC) from a photovoltaic array to alternating current (AC) or that conditions AC current produced at CSP facilities to match the voltage and phase conditions of the bulk electricity grid to which the solar energy facility is connected; power conditioning systems also include system monitoring devices and isolation switches that can isolate the solar energy facility from the bulk electricity grid during off-normal conditions that could jeopardize or damage either the facility or the grid.

Power, electrical: A unit of electrical energy, usually expressed in watts (W), kilowatts (kW), or megawatts (MW). One watt equals 3.14 Btu per hour.

Power production capacity: The amount of power that a facility can produce under ideal operating conditions. *See also* Battery capacity.

Power tower: A type of CSP technology composed of many large, sun-tracking mirrors (heliostats) that focus sunlight on a receiver at the top of a centrally located tower. The sunlight heats up a heat transfer fluid in the receiver, which then is used to generate steam (or directly heats water to produce steam) that powers a steam turbine-generator (STG) to produce electricity. Power tower systems can also be equipped with molten salt in which the heat generated at the receiver can be stored for delayed production of electricity.

Power tower system: *See* Power tower.

Precambrian: The oldest and largest division of geologic time, between the consolidation of the Earth's crust and the beginning of the Cambrian period. It includes all time from the origins of the Earth to about 542 million years ago; about 3.3 billion years in duration.

Prehistoric: The time period before the appearance of written records. In the New World this generally refers to indigenous, precontact societies.

Prehistoric resources: Refers to any material remains, structures, and items used or modified by people before Euro-Americans established a presence in the region.

Prescribed fires: Application of fire (by planned or unplanned ignitions) to fuels in either their natural or modified states, under specified conditions, to allow the fire to burn in a predetermined area while producing the fire behavior required to achieve certain management objectives.

Prevention of Significant Deterioration (PSD) Program: A Federal air pollution permitting program intended to ensure that air quality does not diminish in attainment areas which meet national ambient air quality standards.

Prey base: The assemblage of prey (food) animals available in a given area or habitat to support a predator such as a hawk or cougar.

Prior Appropriation Doctrine: A system for allocating water rights used in the western United States under which the first person (or entity) to divert water from a source has a priority to that water right, and so on. Under the system of prior appropriation, water rights that are junior are not allowed to prevent senior water rights holders from obtaining their allocation of water. Thus, in times of drought, a junior water rights holder may not be entitled to its share of the resource. However, even senior water rights holders are not allowed to change the time of use, place of use, purpose of use, or point of diversion of the right, if it would injure other water rights holders within a basin.

Projectile point: Any sharp tip of an arrow, spear, or dart.

PSD increments: The maximum increases in ambient pollution concentrations allowed over baseline concentrations for a pollutant while ensuring that an area continues to meet national ambient air quality standards. See 40 CFR §51.166 (c) for increments for specific pollutants.

Public land: Any land and interest in land (outside of Alaska) owned by the United States and administered by the Secretary of the Interior through the Bureau of Land Management.

Public Land Order (PLO): An order affecting, modifying, or cancelling a withdrawal or reservation that has been issued by the Secretary of the Interior pursuant to powers of the President delegated to the Secretary by Executive Order 9146 of April 24, 1942, or 9337 of April 24, 1943.

Public Land Survey System (PLSS): The survey carried out by the BLM and its predecessors for establishing boundaries and subdivisions of public lands of the United States, using the rules embodied in the U.S. Public Land System. The system is frequently used for designating the locations of a parcel of land based on township, range, section, and quarter delineations.

Pueblo: The Spanish word for town. A community dwelling with numerous households within, up to five stories high, built of stone or adobe by Indian tribes in the southwestern United States.

Pueblo rights: A water right possessed by a municipality which, as a successor of a Spanish or Mexican pueblo, entitled to the beneficial use of all needed, naturally-occurring surface and groundwater of the original pueblo watershed. Pueblo rights are paramount to all other claims.

Pyroclastic flow: High-speed avalanches of hot ash, rock fragments, and gas that move down the sides of a volcano during explosive eruptions or when the steep edge of a dome breaks apart and collapses. These pyroclastic flows, which can reach 1500ºF (815.55°C) and move at 100 to 150 miles per hour, are capable of knocking down and burning everything in their paths.

Pyroclastic surge: Similar to a pyroclastic flow, but contains a higher proportion of gas to rock and is more turbulent and faster moving.

Quad-level occurrence: The recorded occurrence of a species in the area represented by a specific, named U.S. Geological Survey 7.5-minute topographic quadrangle map (quad map). Some State Natural Heritage Programs record the locations of rare species as the name of the quad map on which a species location occurred.

Quaternary: The most recent period of the Cenozoic era, spanning the time between 2.6 million years ago and the present. It contains two epochs: the Pleistocene and the Holocene.

Quartzite: A hard, metamorphic rock that was originally sandstone.

Rain shadow effect: The region on the lee (sheltered) side of a mountain or mountain range where the precipitation is noticeably less than on the windward side, because the moisture-bearing air mass loses most of its moisture on the windward side before reaching the lee side.

Rangeland: Land on which the native vegetation, climax, or natural potential consists predominately of grasses, grasslike plants, forbs, or shrubs. Rangeland includes lands that are revegetated naturally or artificially to provide a plant cover that is managed similar to native vegetation. Rangelands may consist of natural grasslands, savannas, shrub lands, most deserts, tundra, alpine communities, coastal marshes, and wet meadows.

Rankine steam cycle: The thermodynamic cycle of temperature and pressure changes of water as it is converted from a liquid to a gaseous state by heating, and returns back to liquid as it performs work, typically by driving a steam turbine. Modern steam turbines operating in a Rankine cycle have a maximum steam temperature of about 1,963°F (1,073°C) with thermal efficiencies of about 40%.

Raptor: A bird of prey such as a falcon, hawk, or eagle.

Rare species: *See* Special status species.

Rated battery capacity: The term used by battery manufacturers to indicate the maximum amount of energy that can be withdrawn from a battery under specified discharge rate and temperature. *See* Battery capacity.

Rebound (of water levels): The recovery/rise of the water level in a groundwater aquifer after groundwater pumping has ceased.

Receiver: A component of a solar energy facility that receives solar energy and converts it to useful energy forms, typically heat.

Receptor: A location where environmental resources such as air concentration or noise level are evaluated (e.g., property boundaries, residences, schools, hospitals, libraries).

Recharge: The addition of water to an aquifer by natural infiltration (e.g., rainfall that seeps into the ground) or by artificial injection through wells.

Reclamation: The process of restoring surface environment to acceptable pre-existing conditions.

Reclamation withdrawal: Withholding an area of public land from the operation of the public land laws for the purpose of reserving the land for the use of the Bureau of Reclamation (BOR). In general, this means that the BOR has first priority for use of the land for BOR projects. Other uses of the land may sometimes be approved with the concurrence of the BOR.

Record of Decision (ROD): A document separate from but associated with an environmental impact statement (EIS) that publicly and officially discloses the responsible agency's decision on the EIS alternative to be implemented.

Reflector: A component of a solar energy facility that reflects incident sunlight to a desired location or component within the facility, allowing it to be converted to other useful forms of energy, typically heat.

Region of Influence (ROI): Area occupied by affected resources and the distances at which impacts associated with license renewal may occur.

Regular-track proposals: Proposals on public land with pending applications considered as potential future projects, but not necessarily foreseeable projects, since not all applications would be expected to be carried to completion.

Relict: A land surface that was once a basin (valley) floor.

Renewable Resource Generation Development Areas (GDAs): Regions within Colorado with a concentration of renewable resources that provide a minimum of 1,000 MW of developable electric generating capacity.

Reptile: Cold-blooded vertebrate of the class Reptilia whose skin is usually covered in scales or scutes. Reptiles include snakes, lizards, turtles, crocodiles, and alligators.

Reserved Water Right: A special water right accompanying federal lands (military reservations, national parks, forests, or monuments) or Indian reservations. Federal reserved water rights have a priority date originating with the creation of the federal land or reservation and may be used in the future in the amount necessary to fulfill the purpose of the federal land or reservation.

Reservoir: A natural or artificial place to store water. Water storage created by building a dam. A pond, lake, or basin used for the storage, regulation, and control of water.

Residuum: Unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place.

Resource Conservation and Recovery Act (RCRA): An amendment to the Solid Waste Disposal Act, RCRA (42 U.S.C. 6901 et seq.) authorized the development of federal regulations for the definition, storage, treatment, and disposal of solid wastes and hazardous wastes, as well as the process by which states may obtain primacy for implementation of the federal program.

Resource Management Plan (RMP): A land use plan that establishes land use allocations, multiple use guidelines, and management objectives for a given planning area. The RMP planning system has been used by the Bureau of Land Management since about 1980.

Retinal damage: Damage to photoreceptor cells of the retina. One mechanism for such damage is exposure to bright light that triggers chemical reactions in the tissues (this may also be called retinal burn).

Reuse: The reclamation of water diverted from a municipal or industrial wastewater conveyance system. To use again; to intercept for subsequent beneficial use, either directly or by exchange. Water that would otherwise return to the steam system.

Rhyolite: Volcanic rock (or lava), characteristically light in color and containing 69% silica or more and generally rich in potassium and sodium (felsic composition).

Rhyolitic domes: *See also* Dome, volcanic; Rhyolite.

Richter Magnitude Scale: Developed in 1935 by Charles Richter to measure and compare the size of earthquakes. The magnitude is determined from the logarithm of the amplitude of waves recorded by seismographs.

Rift: An area where the Earth's crust and lithosphere is being pulled apart by extensional tectonic forces.

Rift zone: A tectonic feature characterized by a central linear downfaulted segment (graben) with parallel normal faulting and flanking uplifts (horsts). The rift axis commonly contains volcanic rocks and volcanic and/or hydrothermal activity.

Right-of-way (ROW): The legal right to cross the lands of another. Also used to indicate the strip of land for a road, railroad, or power line. In BLM, a permit or an easement which authorizes the use of public lands for certain specified purposes. Also, the lands covered by such an easement or permit. The authorization to use a particular parcel of public land for specific facilities for a definite time period. Authorizes the use of a ROW over, upon, under, or through public lands for construction, operation, maintenance, and termination of a project.

Right-lateral fault: *See* Fault, right-lateral.

Rill: A small and shallow incision into topsoil layers resulting from erosion by overland flow or surface runoff that is common on slopes of unvegetated ground and agricultural land.

Rinsate: Water that is used to rinse or clean equipment or reaction vessels and that may, as a result, become contaminated and require special handling and disposal.

Riparian: Relating to, living in, or located on the bank of a river, lake, or tidewater.

Riparian obligate species: Plants or animal species found only in riparian habitats.

Risk: The likelihood of suffering a detrimental effect as a result of exposure to a hazard.

River basin: The land area surrounding one river from its headwaters to its mouth. The area drained by a river and its tributaries.

Riverine wetland: Wetlands within river and stream channels, generally characterized by flowing water. Ocean-derived salinity is less than 0.5 part per thousand.

Rock art: Images on rock surfaces. There are two types of rock art: pictographs, which are drawn or painted *onto* the surface, and petroglyphs, which are pecked, incised, or abraded *into* the surface.

Rock outcrop: The part of a rock formation that appears above the surface of the surrounding land.

Roost: An area where birds or bats rest or sleep. Birds often use branches or tree cavities for roosts while bats use tree bark, tree hollows, caves, mines, buildings, bridges, or rock crevices.

Sacred landscapes: Natural places recognized by a cultural group as having spiritual or religious significance.

Sacred site: Any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriate authoritative representative of an Indian religion has informed the agency of the existence of such a site.

Safe Drinking Water Act (SWDA): Act authorizing development of maximum contaminant levels for drinking water applicable to public water systems (i.e., systems that serve at least 25 people or have at least 15 connections).

Safe yield: The amount of groundwater that can be withdrawn from a groundwater basin over a period of time without exceeding the long-term recharge of the basin or unreasonably affecting the basin's physical and chemical integrity. *See also* Perennial/safe/sustainable yield.

Salinity: A measure of the amount of salt and other mineral substances dissolved in water.

Salt flat: Low-lying ground where salts collect in the soil because of the evaporation of standing water.

Sand: A rock or mineral fragment of any composition that has a diameter ranging from 0.5 to 2.0 mm. Sand has a gritty feel.

Sand boil: A sand boil is sand and water that come out onto the ground surface during an earthquake as a result of liquefaction at shallow depth.

Sand dune: An elongated mound (hill or ridge) of sand accumulated and sorted by the action of wind or water.

Sand dune obligate species: Plant or animal species found only in sand dune habitats.

Sanitary waste: Nonhazardous, nonradioactive liquid and solid waste generated by normal housekeeping activities.

Sanitary wastewater: Wastewater (includes toilet, sink, shower, and kitchen flows) generated by normal housekeeping activities.

Savanna: A flat grassland of tropical and subtropical regions usually having distinct periods of dry and wet weather.

Scarify: Loosening topsoil or breaking up the forest floor to improve conditions for seed germination or tree planting. Also refers to nicking or abrading the hard seed coat of some species to aid germination.

Scarp: *See* Escarpment.

Scenic integrity: The degree of "intactness" of a landscape, which is related to the existing amount of visual disturbance present. Landscapes with higher scenic integrity are generally regarded as more sensitive to visual disturbances.

Scenic quality: A measure of the intrinsic beauty of landform, water form, or vegetation in the landscape, as well as any visible human additions or alterations to the landscape.

Scenic resources: The visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features). Also referred to as visual resources.

Scenic value: The importance of a landscape based on human perception of the intrinsic beauty of landform, water form, and vegetation in the landscape, as well as any visible human additions or alterations to the landscape.

Schist: A metamorphic rock formed from many types of rocks. Minerals in the rocks include micas, chlorite, talc, hornblende, and garnets. The minerals are characteristically platey and foliated (layered), indicating they were subjected to intense compression.

Scoping: The process of inviting public comment on what should be considered prior to preparation of an environmental impact statement (EIS). Scoping assists the preparers of an EIS in defining the proposed action, identifying alternatives, and developing preliminary issues to be addressed in an EIS.

Scraper: A stone tool that is modified for the specific task of scraping; for example, to scrape the meat from hides, to remove fat from the underside of a skin, to smooth wood, to scrape leather, and so forth. Different types are described in terms of the shape and/or position of the cutting edge: side scraper, end scraper, snub-nosed scraper, thumbnail scraper, and scoop scraper.

Scoria: Congealed lava, usually of mafic composition and red or black in color, with a large number of vesicles formed by gases coming out of solution.

Scree: Small, loose, rock debris covering a slope; a slope of loose rock debris at the base of a steep incline or cliff.

Scrubland: An area of land that is uncultivated and covered with sparse stunted vegetation.

Secondary containment: A safeguarding method for the prevention of unauthorized releases of toxic or hazardous gases into uncontrolled work areas. Secondary containment is a method in addition to the primary containment system**.**

Sedge: A grasslike plant with a triangular stem often growing in wet areas.

Sedimentary rock: Rock formed at or near the Earth's surface from the consolidation of loose sediment that has accumulated in layers through deposition by water, wind, or ice, or living organisms. Examples are sandstone and limestone.

Sedimentation: The removal, transport, and deposition of sediment particles by wind or water.

Sedentism: A term used to describe the process of settling down to live in groups for periods of time.

Seepage: The act or process involving the slow movement of water or other fluid through a porous material such as soil or rock.

Seeps: Wet areas, normally not flowing, arising from an underground water source. Any place where liquid has oozed from the ground to the surface.

Seismic: Pertaining to any earth vibration, especially that of an earthquake.

Seismic swarm: *See* Swarm.

Seismicity: Refers to the geographic and historical distribution of earthquakes.

Semi-arid: Moderately dry region or climate where moisture is normally greater than under arid conditions but still definitely limits the production of vegetation.

Semiconductor: Any material that has a limited capacity for conducting an electric current. Certain semiconductors, including silicon, gallium arsenide, copper indium diselenide, and cadmium telluride, are uniquely suited to the photovoltaic conversion process.

Senior water rights: Water rights that have been established first (measured by the date of appropriation) to the limit of their respective right, frequently to the exclusion of other more junior (in time) water right holders. *See also* Junior water rights.

Sensitive species: A plant or animal species listed by the state or federal government as threatened, endangered, or as a species of special concern. The list of BLM sensitive species varies from state to state, and the same species can be considered sensitive in one state but not in another. Also, a species that is adversely affected by disturbance or altered environmental conditions, such as sedimentation. *See also* Special status species.

Sensitivity level (analysis): Measures (e.g., high, medium, and low) of public concern for the maintenance of scenic quality.

Shadow zone: The region where direct sound does not penetrate because of upward diffraction due to vertical temperature and/or wind gradients.

Shale (outcrop): A fine-grained sedimentary rock characterized by parallel layering.

Shear strength: Internal resistance to stress (or movement) that comes from friction and cohesion of the sediment.

Sherds: Broken pieces of earthenware/pottery.

Shrink-swell potential: The extent to which soil shrinks or swells with changes in soil moisture content. The shrink-swell potential is influenced by the amount and type of clay in the soil. Shrinking and swelling of soils cause damage to building foundations, roads, and other structures.

Shrub: A plant with persistent woody stems and relatively low growth form; usually produces several basal shoots as opposed to a single bole; differs from a tree by its low stature and nonarborescent form.

Shrub-steppe: Habitat primarily composed of various shrubs and grasses.

Shrubsteppe obligate: A species that is dependent on shrubsteppe habitats to provide food and/or habitat necessary for its survival. Examples include the sage grouse, sage sparrow, and pygmy rabbit.

Silencer: A device used for reducing noise within air and gas flow systems.

Silicic volcanism: Volcanism characterized by the eruption of magma that is rich in lighter elements such as silicon, oxygen, aluminum, sodium, and potassium. Silicic volcanoes are associated with the melting of continental crust and often have explosive eruptions.

Silicon: A semi-metallic chemical element that makes an excellent semiconductor material for photovoltaic devices. It crystallizes in face-centered cubic lattice similar to a diamond. It is commonly found in sand and quartz (as the oxide).

Silt: A rock or mineral fragment of any composition that has a diameter ranging from 0.002 to 0.05 millimeter. Moist silt has a floury feel and is gritty when placed between the teeth.

Siltation: The process by which a river, lake, or other water body becomes clogged with sediment. The process of covering or obstructing with silt.

Siltstone: A sedimentary rock made mostly of silt-sized grains.

Sink: Any process, activity, or mechanism which removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere.

Skirt (fan, dune): A sloping alluvial fan surface made of sediment deposited by a stream at the mouth of a canyon between a mountain and the adjacent alluvial valley floor. *See* fan apron.

Sky glow: Brightening of the sky caused by outdoor lighting and natural atmospheric and celestial factors.

Skylining: Siting of a structure on or near a ridge line so that it is silhouetted against the sky.

Slash: Any tree-tops, limbs, bark, abandoned forest products, windfalls, or other debris left on the land after timber or other forest products have been cut.

Slip: Motion occurring along a fault plane.

Slip rate: The rate of motion obtained when the amount of offset is divided by a time interval. The common units of measure are millimeters per year or meters per thousand years (mm/yr or m/k.y.; equivalent units). The average slip rate at a point along a fault is commonly determined from geodetic measurements, displacement of manmade features, or from offset geologic features whose age can be estimated or measured. Offset is measured parallel to the predominant slip direction or estimated from the vertical or horizontal separation of geologic features. In special cases, interval slip rates may be calculated if the times and amounts of slip of prehistoric earthquake events have been determined. This type of high-quality data is rather sparse.

Slope failure: The downward and outward movement of a mass of rock or unconsolidated materials as a unit. Landslides and slumps are examples.

Slope stability: The resistance of an inclined surface to failure by sliding or collapsing.

Snag: Dead, drying, or defective trees that remain standing or leaning against other trees. Snags provide habitats for a variety of wildlife species.

SO_2: *See* Sulfur dioxide.

Social disruption: Social and psychological dislocation associated with the alteration or breakdown of social life in small rural communities that may occur as a result of rapid economic and demographic change with rapid industrial and natural resource development.

Socioeconomics: The social and economic conditions in the study area.

Soil compaction: Compression of the soil which results in reduced soil pore space (the spaces between soil particles), decreased movement of water and air into and within the soil, decreased soil water storage, and increased surface runoff and erosion.

Soil deposition: A general term for the accumulation of sediments by either physical or chemical sedimentation.

Soil horizon: A layer of soil developed in response to localized chemical and physical processes resulting from the activities of soil organisms, the addition of organic matter, precipitation, and water percolation through the layer.

Soil horizon mixing: Soil horizon mixing occurs when soil is disturbed by activities such as excavation.

Solar array: *See* Photovoltaic (PV) array.

Solar cell: *See* Photovoltaic (PV) cell.

Solar collector: A component of a solar energy facility that receives solar energy and converts it to useful energy forms, typically heat. Major components include the mirrors or reflectors, additional features designed to further concentrate the incident sunlight (in some facilities), and a receiver containing a heat transfer fluid.

Solar collector array: That portion of the solar energy facility containing components that track and capture sunlight and convert it to other useful forms of energy, typically heat. All such solar collector arrays are typically composed of mirrors, receivers containing some form of heat transfer fluid, and support structures and controls that allow the mirrors to track the sun over the course of the day to maximize solar energy capture. Together, all components of the solar array make up what is known as the solar field of a solar energy facility.

Solar energy: Electromagnetic energy emitted from the sun (solar radiation). The amount that reaches the Earth is equal to one billionth of total solar energy generated, or the equivalent of about 420 trillion kilowatt-hours.

Solar energy technology: Any engineered method for harnessing, storing, and using the Sun's energy.

Solar Energy Zone (SEZ): Lands identified by the BLM as best-suited for large-scale production of solar energy.

Solar module: *See* Photovoltaic (PV) module.

Solar panel: *See* Photovoltaic (PV) panel.

Solar power tower: *See* Power tower.

Solar tracking: The solar panels can be swiveled using the electric motors to follow the path of the sun exactly in the course of the day to maximize the yields.

Sole source aquifer: An aquifer that supplies 50 percent or more of the drinking water of an area.

Solid waste: All unwanted, abandoned, or discarded solid or semisolid material whether or not subject to decomposition, originating from any source.

Source: Any place or object from which air pollutants are released. Sources that are fixed in space are stationary sources and sources that move are mobile sources.

Southwest Regional Gap Analysis Project (SWReGAP): The Southwest Regional Gap Analysis Project is an update of the Gap Analysis Program's mapping and assessment of biodiversity for the five-state region encompassing Arizona, Colorado, Nevada, New Mexico, and Utah. It is a multi-institutional cooperative effort coordinated by the U.S. Geological Survey Gap Analysis Program. The primary objective is to use a coordinated mapping approach to create detailed, seamless GIS maps of land cover, all native terrestrial vertebrate species, land stewardship, and management status, and to analyze this information to identify those biotic elements that are underrepresented on lands managed for their long term conservation or are gaps.

Special areas: Areas of high public interest and containing outstanding natural features or values. Bureau of Land Management special areas include National Wild and Scenic Rivers, National Wildernesses, National Conservation Areas, National Scenic Areas, National Recreation Areas, National Monuments, National Outstanding Natural Areas, National Historic Landmarks, places on the *National Register of Historic Places*, National Natural Landmarks, National Recreational Trails, National Scenic Trails, National Historic Trails, National Backcountry Byways, Areas of Critical Environmental Concern, Research Natural Areas, Important Bird Areas, United Nations Biosphere Reserves, and World Heritage Sites. *See also* Specially Designated Areas.

Special status species (threatened, endangered, sensitive, rare): Includes both plant and animal species 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 Endangered Species Act; those listed by a state in a category such as threatened or endangered, implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

Special Use Airspace (SUA): Airspace of defined dimensions identified by an area on the surface of the Earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.

Specially Designated Areas: Includes a variety of areas that have received recognition or designation because they possess unique or important resource values. While these areas would not be available for development of solar energy resources, they could be located near solar development areas and could be affected by solar development. Examples of BLM-administered specially designated areas include components of the BLM National Landscape Conservation System (NLCS), areas of critical environmental concern (ACECs), special recreation management areas, and areas with wilderness values. These areas may have been designated by Congress or by the BLM. The majority of specially designated areas discussed in this PEIS are located on BLM-administered public lands; however, some specially designated areas managed by the U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), National Park Service, and states also are included in the analysis when they could be affected by solar development on public lands.

Species of Special Concern: A species that may have a declining population, limited occurrence, or low numbers for any of a variety of reasons.

Specular reflection: Also known as direct reflection, regular reflection, or mirror reflection. The reflection of electromagnetic rays without scattering or diffusion. In specular reflection, the angle at which the wave is incident on the reflecting surface is equal to the angle at which it is reflected from that surface. *See also* Glint; Glare.

Spill light: Light that falls outside of the area intended to be lighted.

Spring: The point at which the water table meets Earth's surface, causing water to flow from the ground.

Sprinkler system: Consists of pipelines which carry water under pressure from a pump or elevated source to lateral lines along which sprinkler heads are spaced at appropriate intervals.

Staging area: A designated area where construction equipment is temporarily stored (usually only during the construction phase).

State Historic Preservation Officer (SHPO): The State officer charged with the identification and protection of prehistoric and historic resources in accordance with the National Historic Preservation Act.

Steam amendment chemicals: Chemicals used to treat raw water to remove certain chemical species, thus amending its hardness or pH, making it suitable for use in a steam cycle.

Steam turbine-generator (STG): A device that uses high-pressure steam, produced in a boiler, to drive the blades of a turbine to produce mechanical energy that can then be used to produce electricity by causing rotation of the central shaft of a mechanically connected generator.

Steep slopes: Ground surface that rises precipitously above the horizon.

STG: *See* Steam turbine generator.

Steppe: Habitat dominated by shrubs and grasses.

Stirling engine: Named after its inventor, a reciprocating engine that converts heat into useable mechanical energy (shaftwork) by the heating (expanding) and cooling (contracting) of a captive gas (a working fluid) such as helium or hydrogen. As a solar energy technology, the Stirling engine uses sunlight reflected off a parabolic surface to heat hydrogen to drive the engine that in turn drives a mechanically connected generator to produce electricity.

Stolon: An elongated stem growing along the ground surface and giving rise to leaves and adventitious roots at the nodes. (Nodes are bud containing areas along a stem.)

Strain: A change in the volume or shape of a rock mass, in response to stress.

Strata: Single, distinct layers of sediment or sedimentary rock.

Stratigraphy (stratigraphic): Layers of sediments and rocks that reflect the geologic history of an area. With respect to cultural resources and archaeological sites, the relative stratigraphic locations of human artifacts help determine the sequence in which past human activities took place.

Stream terrace: A remnant of a floodplain surface formed by streams as they carve downward into their floodplains.

Stressors: Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.

Strike-slip fault: Vertical (or nearly vertical) fractures where the blocks have mostly moved horizontally. If the block opposite an observer looking across the fault moves to the right, the slip style is termed right lateral; if the block moves to the left, the motion is termed left lateral.

Structure: Any apparatus constructed to divert or impound water, such as a berm, head gate, pipe, or well.

Structural fires: Fire originating in and burning any part or all of any building, shelter, or other structure.

Subalpine: The upper mountain vegetation immediately below the cold limits of tree and tall shrub growth.

Sub-canopies: Woody vegetation that grows beneath the canopy or tree tops of a forest or woodland.

Subsidence: Sinking or settlement of the land surface, due to any of several processes. As commonly used, the term relates to the vertical downward movement of natural surfaces although small-scale horizontal components may be present. The term does not include landslides, which have large-scale horizontal displacements, or settlements of artificial fills.

Subsistence: The practices by which a group or individual acquires food, such as through hunting and gathering, fishing, and agriculture.

Substation: A substation consists of one or more transformers and their associated switchgear. It is used to switch generators, equipment, and circuits or lines in and out of a system. It is also used to change AC voltages from one level to another.

Substrate: The composition of a streambed, including either mineral or organic material. Materials that form an attachment medium for organisms.

Sulfur dioxide (SO_2): A gas formed from burning fossil fuels, notably from coal-fired power plants. Sulfur dioxide is one of the six criteria air pollutants specified under Title I of the Clean Air Act.

Sulfur oxides (SO_x): Compounds containing sulfur and oxygen, such as sulfur dioxide (SO_2) and sulfur trioxide (SO_3). Pungent, colorless gases that are formed primarily by fossil fuel combustion, notably from coal-fired power plants. Sulfur oxides may damage the respiratory tract, as well as plants and trees.

Surface expression: Refers to the physical expression of seismic activity at the ground exterior in the form of a fault rupture or fissure.

Surface rupture: The breakage of ground along the surface trace of a fault caused by the intersection of the fault surface area ruptured in an earthquake with the Earth's surface.

Surface texture: The visual manifestations of the interplay of light and shadow created by the variations in the top of an object or landscape.

Surface water: Water on the Earth's surface that is directly exposed to the atmosphere, as distinguished from water in the ground (groundwater).

Sustainable yield: *See* Perennial/Safe/Sustainable yield.

Swale: A low place in a tract of land, usually moister, and often having denser vegetation than the adjacent higher land.

Swarm (seismic swarm): A localized surge of earthquakes, with no one shock being conspicuously larger than all other shocks of the swarm. Seismic swarms typically last longer than more typical earthquake sequences that consist of a main shock followed by significantly smaller aftershocks. Seismic swarms occur in a variety of geologic environments. They are not known to be indicative of any change in the long-term seismic risk of the region in which they occur.

Take: Under the Bald and Golden Eagle Protection Act, it means to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb. Disturb means to agitate or bother a bald eagle or a golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior.

Talus: Rock debris accumulated at the base of the cliff or slope from which they have broken off.

Taxonomy: The field of science that classifies life.

Tectonic: Refers to the rock-deforming processes and resulting structures that occur over large sections of the lithosphere.

Tephra: A general term for fragments of volcanic rock and lava, regardless of size, that are blasted into the air by explosions or carried upward by hot gases in eruption columns or lava fountains. Tephra includes large dense blocks and bombs, and small light rock debris such as scoria, pumice, reticulite, and ash.

Tertiary volcanics (Tv): Volcanic rocks deposited during the Tertiary period (between 2.8 and 65 million years ago). The Tertiary period was a time of extensive volcanism in the western United States.

Terrace: A step-like surface, bordering a valley floor or shoreline, that represents the former position of a floodplain, lake, or sea shore.

Terrain: Topographic layout and features of a tract of land or ground.

Terrestrial: Pertaining to plants or animals living on land rather than in the water.

Tertiary period: The earliest period of the Cenozoic era, beginning about 65 million years ago and ending 2.6 million years ago. Together the Tertiary and Quaternary periods make up the Cenozoic era.

Texture: The visual manifestations of light and shadow created by the variations in the surface of an object or landscape.

Texture contrasts: Visual contrasts between different objects or landscapes resulting from different visual manifestations of the interplay of light and shadow created by the variations in the surfaces of the objects or landscapes.

Thermal energy: The use of heat as a source of energy. Thermal energy can be used directly or can be transformed into mechanical energy (using a steam engine), which can then be transformed into electrical energy. Thermal energy is usually measured in British thermal units (Btu).

Thermal inertia: The amount of heat energy that must be present in, preserved, or added to a system (in this case, a CSP facility) before it can function as designed.

Thermal water: A water body (usually a spring or its outflow) that is produced by geothermally heated groundwater.

Thermoelectric (power) water use: Water used in generating electricity with steam-driven turbine generators. Power plants that burn coal and oil are examples of thermoelectric-power facilities. Production of electrical power results in one of the largest uses of water in the United States and worldwide.

Thin film: A layer of semiconductor material, such as copper indium diselenide or gallium arsenide, a few microns or less in thickness, used to make photovoltaic cells.

Thorn forest: A type of forest formation, mostly tropical and subtropical, intermediate between desert and steppe, dominated by small trees and shrubs. Many are armed with thorns and spines; leaves are absent, succulent, or deciduous during long dry periods.

Threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Requirements for declaring a species threatened are contained in the Endangered Species Act. *See also* Special Status Species.

Topography: The shape of the Earth's surface; the relative position and elevations of natural and human-made features of an area.

Total dissolved solids (TDS): The dry weight of dissolved material, organic and inorganic, contained in water. The term is used to reflect salinity.

Toxic air pollutants (TAPs): *See* Hazardous air pollutants.

Toxic Substances Control Act (TSCA): An act, 7 U.S.C. Section 136 et seq., authorizing the U.S. Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances that are determined to cause an unreasonable risk to public health or the environment.

Toxicity: Harmful effects to an organism through exposure to a hazardous substance. Environmental exposures are primarily through inhalation, ingestion, or the skin.

Tracking array: A PV panel array that follows the path of the sun to maximize the solar radiation incident on the PV surface. The two most common orientations are (1) single-axis tracking where the array tracks the sun east to west and (2) dual-axis tracking where the array changes position seasonally as well as diurnally to allow the panels to directly face the sun at all times of the year. Tracking arrays use both the direct and diffuse sunlight. Dual-axis tracking arrays capture the maximum possible energy.

Traditional cultural property: A property that is eligible for inclusion in the *National Register of Historic Places* 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. An example would be a location associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world.

Transform fault: *See* Fault, transform.

Translocation: The intentional capture, movement, and release of individuals of a species into a different area, usually to prevent harm to the individuals or to establish populations elsewhere.

Transmission corridor: An electric or pipeline transmission corridor is a route approved on public lands, in a BLM or other federal agency land use plan, as a location that may be suitable for the siting of electric or pipeline transmission systems.

Transmission line: A set of electrical current conductors, insulators, supporting structures, and associated equipment used to move large quantities of power at high voltage, usually over long distances (e.g., between a power plant and the communities that it serves).

Transmissivity: The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is equal to an integration of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths.

Travertine: A sedimentary rock formed by the precipitation of carbonate minerals from solution in ground and surface waters, and/or geothermal hot-springs.

Tribal land: In NAGPRA, tribal land is defined as: (a) all lands within the exterior boundaries of any Indian reservation; (b) all dependent Indian communities; (c) any lands administered for the benefit of Native Hawaiians pursuant to the Hawaiian Homes Commission Act, 1920, and section 4 of Public Law 86-3. In NHPA, tribal land is defined as: (a) all lands within the exterior boundaries of any Indian reservation; and (b) all dependent Indian communities.

Tribe: Term used to designate a federally recognized group of American Indians and their governing body. Tribes may be composed of more than one band.

Tributary: A stream that flows into another stream, river, or lake.

Troposphere: The layer of the atmosphere closest to the Earth's surface.

Tsunami: Ocean wave produced by earthquakes or underwater landslides.

Tuff: Volcanic rock made up of rock and mineral fragments in volcanic ash matrix. Tuffs commonly are composed of much shattered volcanic rock glass—chilled magma blown into the air and then deposited. If volcanic particles fall to the ground at a very high temperature, they may fuse together, forming a welded tuff.

Tundra: *See* Arctic or Alpine tundra.

Turbidity: A measure of the cloudiness or opaqueness of water. Typically, the higher the concentration of suspended material, the greater the turbidity.

Unconfined aquifer: *See* Aquifer–unconfined.

Unconsolidated (basin fill deposits): Loose sediment; lacking cohesion or cement.

Unconsolidated shore wetlands: Includes all wetland habitats having three characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded.

Underflow: The movement of groundwater through the soil or a subsurface stratum, or under a structure; specifically, the water flowing beneath the bed of a stream, in the same direction, but much more slowly, especially in a dry stream channel in an arid region.

Understory: The vegetation layer immediately beneath the canopy.

Unfaulted: An area without faults.

***United States Code* (U.S.C.):** A compilation of the general and permanent federal laws of the United States. It is divided into 51 titles that represent broad areas subject to federal regulation. The U.S.C. is updated once every 6 years, and supplements are published on an annual basis.

Unrest (episode): Usually non-eruptive volcanic activity (e.g., ground deformation, steam plumes, degassing) that may be interpreted as a precursor to an eruption.

Unstable slopes: Slopes considered unstable due to their incline (or critical angle of repose), applied to slopes made of unconsolidated material. Unstable slopes are prone to failure in the form of rockfalls, rock flows, plane shears, or rotational shears.

Upland: The portion of the landscape above the valley floor or stream.

Upper-air sounding: An upper-air observation of the vertical profile of an atmospheric variable such as temperature or wind.

Uplighting: Light directed upward at greater than 90° above nadir, generally upward into the sky. Uplighting can result from direct illumination of the sky and/or light reflected upward from illuminated objects below a light source.

Upwarp: A broad anticline with gently sloping limbs formed as a result of differential uplift.

U.S. Environmental Protection Agency: The independent federal agency, established in 1970, that regulates federal environmental matters and oversees the implementation of federal environmental laws.

USGS: United States Geological Survey.

Utility scale facilities: Facilities that generate large amounts of electricity that is delivered to many users through transmission and distribution systems.

Valley floor: The gently sloping to nearly level bottom surface of a valley.

Vent: *See* Volcanic vent.

Vernal pool: Seasonally-flooded depressions found on soils with an impermeable layer such as a hardpan, claypan, or volcanic basalt. California's vernal pools occur on a variety of landscape formations, but most often on alluvial formations deposited by ancient waterways and seas. The impermeable layer allows the pools to retain water much longer than the surrounding uplands; nonetheless, the pools are shallow enough to dry up each season.

Vertebrate: Any species having a backbone or spinal column including fish, amphibians, reptiles, birds, and mammals.

Vertical angle of view: Elevation of viewer relative to the elevation of the proposed action, and the resulting angle of difference. *See also* Horizontal angle of view; Angle of view.

View duration: Length of time a proposed action is in view. Impacts that are viewed for a long period of time are generally judged to be more severe than those viewed briefly.

Viewer distance: The distance from a viewpoint to a seen object or landscape element.

Viewpoint: A point from which a landscape view is analyzed and/or evaluated.

Viewshed: The total landscape seen or potentially seen from all or a logical part of a travel route, use area, or water body.

Visibility factors: Conditions or other phenomena that affect the visibility or appearance of an object or a landscape. Examples of visibility factors include distance, lighting conditions, air quality, atmospheric conditions, and viewing angle.

Visual absorption capability: The physical capacity of a landscape to accept human alterations without loss of its inherent visual character or scenic quality.

Visual attention: Noticing and focusing of vision on a particular object or landscape element.

Visual clutter: The complex visual interplay of numerous disharmonious landscape characteristics and features resulting in a displeasing view.

Visual contrast: Opposition or unlikeness of different forms, lines, colors, or textures in a landscape.

Visual disharmony: A state of disagreement, incongruity, or disproportionate arrangement of forms, lines, colors, and textures in the visual elements of a seen landscape.

Visual feature: An element, such as a land or water form, vegetation, or structure in the seen landscape.

Visual harmony: A pleasing array of visual elements in a landscape, usually as a result of a sense of visual order, compatibility, and completeness between and among the land forms, water forms, vegetation, or structures visible in the landscape.

Visual impact: Any modification in land forms, water bodies, or vegetation, or any introduction of structures, which negatively or positively affect the visual character or quality of a landscape through the introduction of visual contrasts in the basic elements of form, line, color, and texture.

Visual intrusion: Any human-caused change in the land form, water form, vegetation, or the addition of a structure which creates a visual contrast in the basic elements (form, line, color, texture) of the naturalistic character of a landscape.

Visual mitigation: Actions taken to avoid, eliminate, or reduce potential adverse impacts on scenic resources.

Visual quality: *See* Scenic quality.

Visual resources: Refers to all objects (man-made and natural, moving and stationary) and features such as landforms and water bodies that are visible on a landscape.

Visual Resource Inventory (VRI): Consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones. Based on these three factors, BLM-administered lands are placed into one of four visual resource inventory classes.

Visual Resource Inventory (VRI) Classes: VRI Classes are assigned to public lands based upon the results from the Visual Resource Inventory. They do not establish management direction and should not be used as a basis for constraining or limiting surface disturbing activities. Inventory classes are informational in nature and provide the basis for considering visual values in the RMP process. There are four classes (I, II, III, and IV).

Visual Resource Management (VRM) Classes: Categories assigned to BLM lands, utilizing the Visual Resource Inventory Classes in the RMP process, with an objective which prescribes the amount of change allowed in the characteristic landscape. All actions proposed during the RMP process that would result in surface disturbances must consider the importance of the visual values and the impacts the project may have on these values. Management decisions in the RMP must reflect the value of visual resources. The value of the visual resource may be the driving force for some management decisions. There are four VRM classes: I, II, III and IV.

Visual Resource Management (VRM) Class Designations: Class I objective is 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** objective is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but must not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural landscape features. **Class III** objective 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 of form, line, color, and texture found in the predominant natural landscape features. **Class IV** objective is 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.

Visual Resource Management (VRM) System: BLM's system for minimizing the visual impacts of surface-disturbing activities and maintaining scenic values for the future. The inventory and planning actions taken to identify visual values and to establish objectives for managing those values; and the management actions taken to achieve the visual management objectives.

Visual sensitivity: Public concern for the maintenance of scenic quality in a particular landscape setting.

Visual unity: The quality or state of appearing to be united in principles and relationships or to be logically and aesthetically connected because of the visual elements and properties of a seen object or landscape.

Visual value: *See* Scenic value.

Volatile organic compound (VOC): Any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA as having negligible photochemical reactivity. Sources include certain solvents, degreasers (benzene), and fuels. Volatile organic compounds react with other substances (primarily nitrogen oxides) to form ozone, which contributes significantly to photochemical smog production and certain health problems.

Volcanic ash: Consists of rock, mineral, and volcanic glass fragments smaller than 2 millimeters (mm) (0.1 inch) in diameter, which is slightly larger than the size of a pinhead. Volcanic ash is not the same as the soft fluffy ash that results from burning wood, leaves, or paper. It is hard, does not dissolve in water, and can be extremely small; ash particles less than 0.025 mm (1/1,000th of an inch) in diameter are common. Volcanic ash is created during explosive eruptions by the shattering of solid rocks and violent separation of magma (molten rock) into tiny pieces.

Volcanic chain: A linear sequence of volcanoes that occurs within a tectonic plate. As the plate moves over a stationary hot spot, new volcanoes are created.

Volcanic cone: A landform built by the material ejected from a volcanic vent and piled up around the vent in the shape of a cone with a central crater. The cone type is defined by the nature of the fragments ejected from the vent (e.g., cinder cones or ash cones).

Volcanic-rock aquifer: *See* Aquifer–volcanic rock.

Volcanic vent: The opening at the Earth's surface through which volcanic materials issue forth.

Volcanism: The process by which magma and associated gases rise to the Earth's crust and are extruded, or expelled, onto the surface and into the atmosphere.

Volcano: A vent (opening) in the surface of the Earth through which magma erupts. It is also the landform that is constructed by the erupted material.

Volcanoclastic rock: Sedimentary rocks such as sandstones formed by the aggregation of rock fragments (clasts) of volcanic origin.

Voluntary relinquishment: To voluntarily relinquish possession with the intent of terminating ownership, but without vesting it in any other person. In determining whether one has abandoned his property or rights, intent is the paramount object of inquiry, for to abandon, one must intend to abandon. The intent must be clear and the act must be complete. To abandon a homestead one must leave with the intention of never returning. To abandon a mining claim held by location without patent, the holder must leave voluntarily, without any intention to retake or resume the claim and regardless of what may become of it in the future. Even in prescriptive rights, non-use is not abandonment.

Wake effect: Enhanced plume dispersion due to mechanical turbulence and zones of turbulent eddies, primarily downwind of a building, which results in increased ground-level concentrations of pollutants.

Wash: A normally dry stream bed that occasionally fills with water.

Waste management: Procedures, physical attributes, and support services that collectively provide for the identification, containerization, storage, transport, treatment (as necessary), and disposal of wastes generated in association with an activity.

Waste minimization: Actions, policies, or procedures that collectively serve to reduce the amount of wastes generated as a result of operation of an activity or facility. Efforts can extend to identifying recycling options for wastes and for discarded materials and equipment, or by selecting the least hazardous chemicals to input into the process.

Wastewater: Water that typically contains less than 1% concentration of organic hazardous waste materials. Water originating from human sanitary water use (domestic wastewater) and from a variety of industrial processes (industrial wastewater).

Water code: A type of legislation that is specific to the management of water resources.

Water quality: A term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Water right: A legal entitlement of an individual or entity to extract water from a water source (surface water or groundwater) and to use it for a beneficial use (e.g., potable water supply, irrigation, mining, livestock). *See also* Senior water rights.

Watershed: A region or area bounded peripherally by a water parting and draining ultimately to a particular water-course.

Water table: The upper level of ground water; the level below which soil and rock are saturated with water.

Watt (W): A basic unit of power; one joule of energy consumed per second. When used to describe electrical power, one watt is the product of voltage times current.

Weed: A plant considered undesirable, unattractive, or troublesome, usually introduced and growing without intentional cultivation.

Wet closed-cycle cooling system: *See* Closed-loop cooling system.

Wet cooling system: *See* Closed-cycle cooling system.

Wetlands: Areas that are soaked or flooded by surface or groundwater frequently enough or long enough to support plants, birds, animals, and aquatic life. Wetlands generally include swamps, marshes, bogs, estuaries, and other inland and coastal areas and are federally protected.

Wickiup: Temporary dwelling framed of arched poles covered by brush, bark, rushes, or mats.

Wild and Scenic Rivers (WSR) Act: Primary river conservation law enacted in 1968. The Act was specifically intended by Congress to balance the existing policy of building dams on rivers for water supply, power, and other benefits, with a new policy of protecting the free-flowing character and outstanding values of other rivers.

Wild Free-Roaming Horses and Burros Act of 1971: Act passed by Congress in 1971 giving BLM the responsibility to protect, manage, and control wild horses.

Wild horses and burros: Unbranded and unclaimed horses or burros roaming free on public lands in the western United States and protected by the Wild Free-Roaming Horse and Burro Act of 1971. They are descendants of animals turned loose by, or escaped from, ranchers, prospectors, Indian tribes, and the U.S. cavalry from the late 1800s through the 1930s.

Wilderness: All lands included in the National Wilderness Preservation System by public law, generally defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation.

Wilderness characteristics: Wilderness characteristics include (1) Naturalness: the area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) Outstanding Opportunities: the area has either outstanding opportunities for solitude, or outstanding opportunities for primitive and unconfined types of recreation; (3) Size: the area is at least 5,000 acres (20 km^2) of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) Values: the area may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Wildfire: Any nonstructural fire that occurs in the wildland.

Wildlife corridor: Linear spaces that connect various areas of an animal's habitat (i.e., links between feeding, watering, resting, breeding, or seasonal habitats).

Wind rose: A circular diagram, for a given locality or area, showing the frequency and strength of the wind from various directions over a specified period of record.

Winnowing: Selective sorting or removal of fine particles by wind or water.

Withdrawal: The removal of surface water or groundwater from the natural hydrologic system for use, including: public-water supply, industry, commercial, domestic, irrigation, livestock, or thermoelectric power generation.

Xeric (habitat): Low in moisture. Dry environmental conditions. Habitats or sites characterized by their limited water availability.

Yardang: A wind-carved rock ridge feature found in desert environments.

Zoned fault: *See* Fault, zoned.

Zoomorphic: Having or representing animal forms.

Zooplankton: A generic term referring to consumers that have limited ability to move against the current. Zooplankton can be permanent (i.e., rotifers or cladocerans) or temporary, as with the early life stages (i.e., eggs, larvae, juveniles, and adults) of many fish and invertebrate species.