Final

Programmatic Environmental Assessment

Addressing Renewable Energy Projects

Kirtland Air Force Base, New Mexico

September

2018

FINDING OF NO SIGNIFICANT IMPACT
PROGRAMMATIC ENVIRONMENTAL ASSESSMENT
ADDRESSING RENEWABLE ENERGY PROJECTS AT
KIRTLAND AIR FORCE BASE, NEW MEXICO

Pursuant to provisions of the National Environmental Policy Act (NEPA), 42 United States Code (USC) 4321 to 4347, as amended, implementing Council on Environmental Quality (CEQ) Regulations; 40 Code of Federal Regulations (CFR) 1500–1508; and 32 CFR § 989, Environmental Impact Analysis Process, the United States Air Force (USAF) prepared a Programmatic Environmental Assessment (PEA) to assess potential environmental consequences associated with renewable energy projects at Kirtland Air Force Base (AFB), Bernalillo County, New Mexico.

The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. Kirtland AFB currently purchases all of its electricity off-installation from the Western Area Power Authority.

The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693; Title II—Renewable Energy (42 USC § 15851 (2012)) of the Energy Policy Act of 2005 (109 Public Law [P.L.] 58, 119 Stat. 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

The PEA addressing renewable energy projects at Kirtland AFB, New Mexico, attached hereto and incorporated herein, analyzes the potential impacts of programmatic implementation of various renewable energy technologies at the installation such as solar photovoltaic (SPV) and geothermal energy. The PEA considers all potential impacts of the Proposed Action and the No Action Alternative. The PEA also considers cumulative environmental impacts with other projects within the Region of Influence.

PROPOSED ACTION (PEA § 2.1, pages 2-1 to 2-3)

The USAF is proposing to develop and implement renewable energy technology at Kirtland AFB. The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation. It includes renewable energy technology categories that meet general suitability criteria (Level 1 selection standards). The Proposed Action does not include specific projects. Future proposed specific projects for renewable energy technologies that meet the Level 1 selection standards would be evaluated against site selection criteria (Level 2 selection standards) and undergo separate NEPA analysis, as needed.

NO ACTION ALTERNATIVE (PEA § 2.2, page 2-3)

The No Action Alternative was analyzed to provide a baseline of the existing environmental, social, and economic conditions the Proposed Action was compared against. Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and it would not reduce the amount of electricity it receives

from off-installation suppliers. It would continue to satisfy its electrical power requirements through purchase of all of its electricity off-installation from the Western Area Power Authority.

SUMMARY OF FINDINGS

Based on the scope of the Proposed Action, the following environmental resource areas were eliminated from detailed analysis: airspace management and visual resources **(PEA § 3, page 3-1)**. Under the Proposed Action, none of the proposed activities would result in a change to current airspace types, flight activities, or training. The proposed facilities would be in keeping with the features of Kirtland AFB and would not adversely affect the existing visual landscape. As a result, USAF anticipates no short- or long-term impacts on airspace management or visual resources at Kirtland AFB. Environmental analyses within the PEA focused on the following resource areas:

Noise (PEA § 3.1, pages 3-2 to 3-6). Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short-term, minor, adverse noise impacts from construction; no impacts from operations; and long-term, negligible, adverse impacts from maintenance on the Kirtland AFB noise environment. Additionally, the off-installation noise environment might also experience short-term, minor, adverse impacts if a proposed renewable energy project was sited in proximity to the Kirtland AFB boundary where construction noise would propagate beyond the installation's boundary.

All construction-related noise impacts would be temporary and would last only for the duration of the construction period. Construction would occur during the daytime hours of 0700 to 1700. No impacts from noise would result from the operation of a proposed renewable energy project, which are largely silent during normal operation.

Land Use (PEA § 3.2, pages 3-6 to 3-13). Programmatic implementation of renewable energy technologies under the Proposed Action would be consistent with the renewable energy goals, strategies, and standards identified in the Air Force Energy Plan, Kirtland AFB Environmental Commitment Statement, and Kirtland AFB Installation Development Plan, as well as federal energy goals and strategies outlined in the Energy Policy Act of 2005, Energy Independence and Security Act, 10 USC § 2911(e), and EO 13693. Therefore, the Proposed Action would be consistent with existing land use plans and policies.

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in no impacts from an SPV project within the Manzano district or Southern Research and Development Area; long-term, minor, adverse impacts if unable to avoid land use compatibility issues; and beneficial impacts if sited on redevelopable land. Impacts to this area shall be reduced wherever possible by co-locating energy generation facilities with existing development and siting areas for unavoidable new development adjacent to areas that have already been developed and no longer serve as effective open space and wildlife habitat. Prior to siting an SPV project, a solar glare study would be performed to ensure the proposed SPV arrays would not create a glint/glare problem for aircraft pilots or Albuquerque International Sunport air traffic controllers. Implementation of a geothermal energy project would result in no adverse impacts if sited on developable or redevelopable land in the cantonment area or other locations on Kirtland AFB; long-term, minor, adverse impacts if unable to avoid land use compatibility issues; and beneficial impacts if sited on redevelopable land. No impacts on land use at Kirtland AFB or off-installation would result from infrastructure construction. Long-term, minor, beneficial impacts would result if utility lines are placed underground.

Air Quality (PEA § 3.3, pages 3-13 to 3-18). The Proposed Action is within Bernalillo County, New Mexico, which is in attainment status for all National Ambient Air Quality Standards. Construction of proposed renewable energy projects on Kirtland AFB would result in short-term, negligible to moderate, adverse impacts on air quality. Long-term, negligible, adverse impacts on air quality would occur from the operation and maintenance of the proposed renewable energy projects.

Per the New Mexico Air Quality Control Act and 20.11.20 New Mexico Administrative Code, a fugitive dust control construction permit would be required for projects disturbing 0.75 acre or more. The Federal General Conformity Rule does not apply to the Proposed Action and neither an applicability determination nor a conformity analysis is required. However, for analysis purposes, the estimated air emissions from the construction of the two different sized SPV arrays and a geothermal energy project can be compared to the 100 tons per year (tpy) *de minimis* level. Emissions of all criteria pollutants except particulate matter measured as equal to or less than 10 microns in diameter (PM_{10}) for the SPV arrays would be well below the 100 tpy *de minimis* threshold. Fugitive dust emissions would be reduced with best management practices (BMPs) and environmental control measures specified in a fugitive dust control plan. It is not expected that emissions from construction would contribute to or affect local or regional attainment status with the National Ambient Air Quality Standards. The Proposed Action might result in a slight decrease in the regional demand for energy supplied from nonrenewable sources, which could lead to beneficial impacts on regional air quality.

Geology and Soils (PEA § 3.4, pages 3-18 to 3-24). Programmatic implementation of renewable energy technologies would result in long-term, negligible, adverse impacts on topography. Short- and long-term, minor, adverse impacts on soil during proposed construction and maintenance activities would result from ground disturbance, erosion, and soil compaction. Construction or operation of geothermal energy projects would have short-term, minor to moderate, adverse impacts on regional geology and physiography.

If necessary, SPV site designs in topographically diverse areas would minimize grading by using variable elevation heights to support different blocks of arrays. Adherence to the Erosion and Sediment Control Plan would minimize potential adverse impacts during construction. Soil compaction and erosion would be controlled by using appropriate, required environmental protection measures that could include installing silt fencing and sediment traps, applying water to disturbed soil to prevent wind erosion, and re-vegetating disturbed areas as soon as possible.

Water Resources (PEA § 3.5, pages 3-25 to 3-35). Programmatic implementation of renewable energy technologies would result in short- and long-term, negligible to minor, adverse impacts on groundwater resources. Short-term, negligible, adverse impacts would be expected during construction from ground disturbance. Increased sediment loads in surface water runoff from erosion could be transported to groundwater resources via recharge points. Short-term, negligible to minor, adverse impacts on surface waters could occur during implementation of the Proposed Action. Surface water quality impacts would result from soil erosion and sedimentation of nearby surface water during construction of the proposed SPV and geothermal energy projects.

Through use of BMPs and adherence to the Kirtland AFB Environmental Management System program, potential impacts on groundwater from construction of the SPV and geothermal energy projects would be minimized. The number, type, and location of the proposed project components would determine the scope and intensity of the impact. Soil erosion from ground disturbance

would be controlled by using appropriate environmental protection measures and adhering to the Erosion and Sediment Control Plan. The proposed SPV and geothermal energy projects would not be constructed within any jurisdictional wetlands or floodplains on Kirtland AFB; therefore, no direct impacts on these areas would occur.

Biological Resources (PEA § 3.6, pages 3-35 to 3-44). Programmatic implementation of renewable energy technologies, including development of up to a 500-acre SPV array, would result in short- and long-term, moderate, adverse impacts from SPV array construction; and long-term, minor, adverse impacts on wildlife species from the loss or disturbance of habitat and from maintenance and operation of the SPV array. Impacts on wildlife species shall be reduced wherever possible by co-locating energy generation facilities with existing development and siting areas for unavoidable new development adjacent to portions of Kirtland AFB that have already been developed and no longer serve as effective open space and wildlife habitat. Construction of a proposed geothermal energy project would result in short-and long-term, minor, adverse impacts on biological resources. The proposed locations for the sites would occur in grassland habitat because of precluded land use constraints and topography requirements (i.e., less than 5 percent slope). Long-term, minor, beneficial impacts on wildlife species would be expected for wildlife that prefer disturbed habitat.

Proper site selection would minimize impacts on biological resources by avoiding sensitive or important biological areas, such as suitable habitat for threatened or endangered species, floodplains, and wetlands, and would be done in accordance with the Integrated Natural Resources Management Plan for Kirtland AFB. New transmission lines for SPV arrays would be placed along existing road rights-of-way and within existing utility easements to the greatest extent possible to minimize impacts on biological resources. BMPs would be implemented for the geothermal energy project to minimize soil disturbance; control erosion, sedimentation, and surface water runoff; minimize soil compaction; minimize air pollution; avoid accidental spills of hazardous material and transportation of nuisance species; and avoid inadvertent wildland fires sparked by construction. New Mexico Department of Game and Fish comments received during the public comment period will be taken into consideration when siting and constructing any renewable energy technologies on Kirtland AFB.

Cultural Resources (PEA § 3.7, pages 3-45 to 3-48). Construction, operation, and maintenance of renewable energy projects at Kirtland AFB would have the potential to affect cultural resources depending on the proposed project location and the type of cultural resources encountered. However, proposed Level 2 selection standards require that these projects must avoid cultural resources and historic properties including known archaeological sites, historic structures and buildings, and historic districts. Given this consideration, the Proposed Action would likely have short-term, negligible to minor impacts on cultural resources. Should an inadvertent discovery of human or cultural remains occur, all project activities shall stop and operational procedures outlined in the Installation Cultural Resources Management Plan shall be followed. Because of the programmatic nature of this PEA, no specific activities or locations have been identified. As specific projects are developed, Section 106 consultation would be conducted if necessary.

Infrastructure (PEA § 3.8, pages 3-48 to 3-52). Programmatic implementation of SPV and geothermal energy technologies under the Proposed Action would result in no short- or long-term impacts on natural gas and propane, liquid fuel, sanitary sewer/wastewater, and communications systems because these infrastructure components (e.g., natural gas pipes and communication wires) would be avoided during construction and neither technology would use these types of

infrastructure during operations. Programmatic implementation of SPV and geothermal energy technologies on the installation would result in short-term, negligible, adverse impacts on transportation; short- and long-term, negligible to minor, adverse impacts on the electrical system; short-term, negligible to minor, adverse impacts on the water supply system; and short-term, negligible, adverse impacts on solid waste management.

Hazardous Materials and Wastes (PEA § 3.9, pages 3-52 to 3-58). Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short-term, negligible to minor, adverse impacts on hazardous materials and wastes from construction; short-term, negligible, adverse impacts from special hazards during construction; long-term, negligible, adverse impacts from operations and maintenance; long-term, negligible, beneficial impacts from the removal of special hazards; and no impact on the status of existing environmental contamination sites or from radon.

Contractors would follow the procedures outlined in the Kirtland AFB Environmental Management System program. A siting analysis would be done to determine if any Environmental Restoration Program, Areas of Concern, Military Munitions Response Program sites, or Department of Energy Environmental Restoration sites are within the project's footprint of disturbance and to assess how such sites could constrain the proposed renewable energy project.

Safety (PEA § 3.10, pages 3-59 to 3-62). Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short- and long-term, minor, adverse impacts on human health and safety. The construction phase of the Proposed Action could expose workers to safety risks.

Under the Proposed Action, all contractors would be responsible for compliance with applicable federal and state safety regulations. This compliance would include a comprehensive health safety plan with site-specific guidance and direction for contractors to prevent or minimize potential safety risks.

Socioeconomics and Environmental Justice (PEA § 3.11, pages 3-62 to 3-66). Programmatic implementation of SPV and geothermal energy technologies on the installation would result in a short-term, negligible to minor, beneficial impacts on socioeconomics. Direct and indirect, beneficial impacts would result from increased payroll tax revenue and the purchase of construction materials and goods in the area resulting in a short-term, negligible, beneficial impact on the local economy of the Albuquerque Metropolitan Statistical Area. Long-term, negligible to minor, beneficial impacts on the socioeconomic environment at Kirtland AFB would result from providing predictable and potentially reduced electricity costs. Programmatic implementation of SPV and geothermal energy technologies on the installation would not result in an impact on environmental justice and protection of children due to the distance to off-installation populated areas.

Cumulative Impacts (PEA § 4, pages 4-1 to 4-10). The USAF has concluded that no significant adverse cumulative impacts would result from activities associated with implementation of the Proposed Action when considered with past, present, or reasonably foreseeable future projects at Kirtland AFB and the Region of Influence.

FINDING OF NO SIGNIFICANT IMPACT

Based on my review of the facts and analyses contained in the attached PEA, conducted under the provisions of NEPA, CEQ Regulations, and 32 CFR § 989, I conclude that the Proposed Action would not have a significant environmental impact, either by itself or cumulatively, with other known projects. Accordingly, an Environmental Impact Statement is not required. The signing of this Finding of No Significant Impact completes the environmental impact analysis process.

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander, 377th Air Wing Base

25 Sep 18
Date

Attachment: *Programmatic Environmental Assessment Addressing Renewable Energy Projects, Kirtland Air Force Base, New Mexico.*

ACRONYMS AND ABBREVIATIONS

377 SFG	377th Security Forces Group
377 MSG	377th Mission Support Group
377 ABW	377th Air Base Wing
ACAM	Air Conformity Applicability Model
ACM	asbestos-containing material
AEHD-AQD	Albuquerque Environmental Health Department Air Quality Division
AFB	Air Force Base
AFGSC	Air Force Global Strike Command
AFI	Air Force Instruction
AMAFCA	Albuquerque Metropolitan Arroyo Flood Control Authority
bgs	below ground surface
BIA	Bureau of Indian Affairs
BMP	best management practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CO	carbon monoxide
CWA	Clean Water Act
dB	decibels
dBA	A-weighted decibel
DNL	day/night sound level
DoD	Department of Defense
DOE	Department of Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EMS	Environmental Management System
EO	Executive Order
EPAct 2005	Energy Policy Act of 2005
ER	Environmental Restoration
ERP	Environmental Restoration Program
ESCP	Erosion and Sediment Control Plan
FAA	Federal Aviation Administration
FPPA	Farmland Protection Policy Act
FY	fiscal year
GHG	greenhouse gases
HWMP	Hazardous Waste Management Plan
I	Interstate
ICRMP	Integrated Cultural Resources Management Plan
IDP	Installation Development Plan
JD	Jurisdictional Determination
LBP	lead-based paint
LID	Low Impact Design
L_{max}	maximum sound level
mgd	million gallons per day
MMRP	Military Munitions Response Program
MS4	Municipal Separate Storm Sewer System
MSA	Metropolitan Statistical Area
MSG/CEIEC	Mission Support Group/Civil Engineering Installation Management – Environmental Management – Compliance
MSW	municipal solid waste
MW	megawatt(s)
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act

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NHPA	National Historic Preservation Act
NMAC	New Mexico Administrative Code
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
O_3	ozone
OSHA	Occupational Safety and Health Act
P.L.	Public Law
PEA	Programmatic Environmental Assessment
Pb	lead
PCB	polychlorinated biphenyl
$PM_{2.5}$	particulate matter measured as equal to or less than 2.5 microns in diameter
PM_{10}	particulate matter measured as equal to or less than 10 microns in diameter
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
SGHAT	Solar Glare Hazard Analysis Tool
SHPO	State Historic Preservation Officer
SNL	Sandia National Laboratories
SO_2	sulfur dioxide
SPV	solar photovoltaic
SDWA	Safe Drinking Water Act
TEAMS	Technical Evaluation Assessment Monitor Site
TNW	Traditional Navigable Water
tpy	tons per year
USACE	US Army Corps of Engineers
USAF	US Air Force
USC	United States Code
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
UTC	Urban Training Complex
VOC	volatile organic compound
WFMP	Wildland Fire Management Plan

Cover Sheet

Final Programmatic Environmental Assessment Addressing Renewable Energy Projects, Kirtland Air Force Base, New Mexico

Responsible Agencies: US Air Force, Air Force Global Strike Command, Kirtland Air Force Base (AFB)

Affected Location: Kirtland AFB, New Mexico

Report Designation: Programmatic Environmental Assessment (PEA)

Abstract: This PEA describes the US Air Force proposal to develop and implement renewable energy technologies at Kirtland AFB. The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation. It includes renewable energy technology categories that meet general selection standards for suitability. The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*; Title II—Renewable Energy (42 United States Code [USC] § 15851 (2012)) of the Energy Policy Act (109 Public Law 58, 119 Stat. 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 Public Law 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and therefore would not reduce the amount of electricity it receives from off-installation suppliers. It would continue to satisfy its electrical power requirements through purchase of all of its electricity off-installation from the Western Area Power Authority.

This PEA analyzes the potential for significant environmental and socioeconomic impacts associated with the Proposed Action and alternatives, including the No Action Alternative, and aids in determining whether a Finding of No Significant Impact can be prepared or an Environmental Impact Statement is required.

Written comments and inquiries regarding this document should be directed by mail to the Kirtland AFB National Environmental Policy Act Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB, New Mexico 87117-5270, or by email to *KirtlandNEPA@us.af.mil*.

Final

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

ADDRESSING RENEWABLE ENERGY PROJECTS AT KIRTLAND AIR FORCE BASE, NEW MEXICO

UNITED STATES AIR FORCE

Kirtland Air Force Base, New Mexico

SEPTEMBER 2018

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1. Purpose of and Need for the Proposed Action

1.1 Introduction

The US Air Force (USAF) proposes to develop and implement electricity-generating renewable energy projects at Kirtland Air Force Base (AFB). This Programmatic Environmental Assessment (PEA) evaluates the potential environmental impacts resulting from the Proposed Action and No Action Alternative.

Declining costs, coupled with policy support, have led to increased deployment of renewable energy technology, with renewable sources accounting for 14.9 percent (6.5 percent hydropower, 5.6 percent wind, 1.5 percent biomass, 0.9 percent solar, and 0.4 percent geothermal) of net generation in the United States in 2016 (USEIA 2017a). Of the 2016 total nationwide utility-scale capacity additions, more than 60 percent were wind (8.7 gigawatts) and solar (7.7 gigawatts), with 33 percent (9 gigawatts) from natural gas. The 7.7 gigawatts of utility-scale solar electricity generating capacity added in 2016 were greater than all utility-scale solar that had been added through 2013. A total of 3.4 gigawatts of distributed solar photovoltaic (SPV) capacity (i.e., rooftop systems that are not part of the utility-scale numbers) were also added in 2016. With the exception of 2014, annual utility-scale solar additions have increased each year since 2008 (USEIA 2017b). The trend in increased usage of renewable energy, including utility-scale solar technology, supports its availability for use by USAF.

This PEA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code [USC] § 4321 et seq.) and the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (40 Code of Federal Regulations [CFR] §§ 1500–1508). USAF is also required to adhere to the USAF NEPA-implementing regulations, 32 CFR § 989, as amended.

1.2 Project Location

Kirtland AFB is in Bernalillo County to the southeast of Albuquerque, New Mexico (see **Figure 1-1**). The land within the installation is owned by the entities listed in **Table 1-1**. The installation encompasses 51,585 acres with elevations that range from 5,200 to almost 8,000 feet above mean sea level. The Manzanita Mountains on its eastern boundary rise to over 10,000 feet (KAFB 2018a). The northwestern portion of Kirtland AFB is developed. The remaining portion of the installation is undeveloped and is used for training and testing missions.

Surrounding land adjacent to Kirtland AFB includes the US Forest Service (USFS) Cibola National Forest to the northeast and east, the Isleta Pueblo Reservation to the south, Bernalillo County developments to the southwest, residential and business areas of the city of Albuquerque to the west and north, and the Albuquerque International Sunport, hereafter referred to as the Sunport, directly to the northwest.

Kirtland AFB was established in the late 1930s as a training installation for the US Army Air Corps. In January 1941, construction of the Albuquerque Army Air Base began with permanent barracks, warehouses, and a chapel. On 1 April 1941, a single B-18 bomber arrived marking the official opening of Albuquerque Army Air Base. Troops soon followed, and the installation

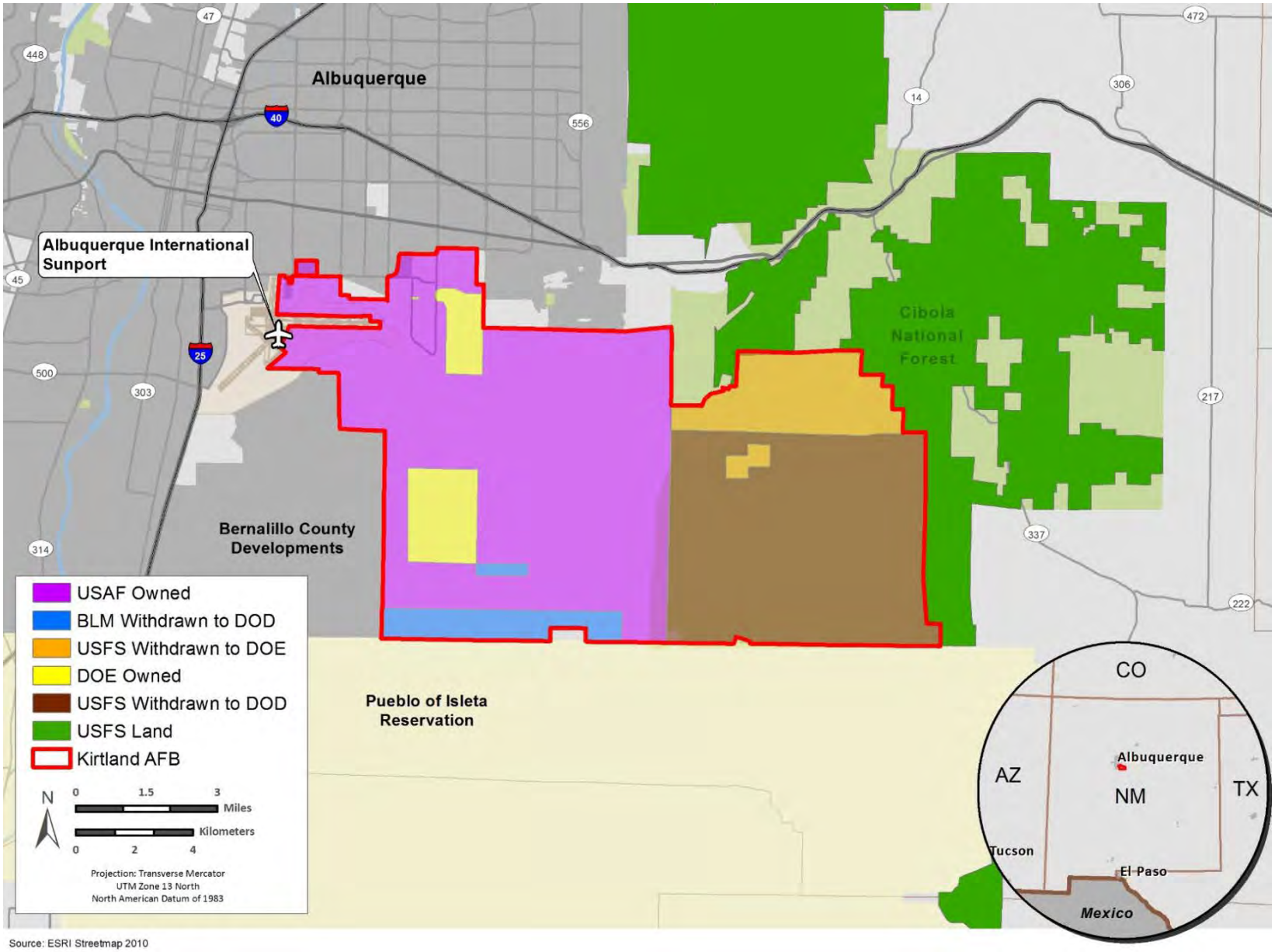


Figure 1-1. Kirtland AFB Vicinity Map with Land Ownership and Withdrawn Areas

Table 1-1. Kirtland AFB Land Ownership

Kirtland AFB Lands	Acres
USAF Fee Owned	25,612
USFS withdrawn to the Department of Defense (DoD)	15,891
Bureau of Land Management withdrawn to DoD	2,549
USAF Total	***44,052***
Department of Energy (DOE) Fee Owned	2,938
USFS withdrawn to DOE	4,595
DOE Total	***7,533***
GRAND TOTAL	**51,585**

Source: KAFB 2012

grew rapidly with the involvement of the United States in World War II. The installation served as a training site for aircrews for many of the country's bomber aircraft, including the B-17, B-18, B-24, and B-29.

In February 1942, Albuquerque Army Air Base was renamed Kirtland Army Air Field in honor of Colonel Roy C. Kirtland, one of the Army's earliest aviation pioneers. In 1942, the US Army Air Corps established a training depot for aircraft support and logistics to the east of Kirtland Army Air Field, near the original private airport, Oxnard Field. The depot became known as Sandia Base. With the completion of the ground crew training program in 1943, Sandia Base was used as a convalescent center for wounded aircrew members, and then as a storage and dismantling facility for war-weary and surplus aircraft as the war ended.

The war years at Kirtland Army Air Field continued to be filled with distinguished records of training entire flight crews for the B-17 and B-24 bombers, and the installation's three schools of advanced flying, bombardier training, and the multi-engine school operated at full capacity. In February 1945, Kirtland Army Air Field participated in training combat crews for the B-29 Super Fortress, which eventually brought an end to the hostilities with Japan by dropping the first atomic bombs on Hiroshima and Nagasaki.

In July 1945, the Los Alamos Laboratory Z-Division was formed to manage the engineering design, production, assembly, and field testing of non-nuclear components of nuclear bombs. In September 1945, the Z-Division transferred its field-testing group to Sandia Base along with staff from the US Army Air Corps' 509th Composite Group at Wendover Air Base in Utah to do weapon assembly. In 1948, under the US Atomic Energy Commission, the Z-Division was renamed Sandia Laboratory and became a separate branch from the Los Alamos Laboratory. The US Congress designated Sandia Laboratories as a National Laboratory in 1979.

In February 1946, Kirtland Army Air Field was placed under the Air Materiel Command and its flying and training activities terminated. Its new mission entailed flight test activities for Sandia Laboratory, development of aircraft modifications for weapons delivery, and characterizing nuclear weapon ballistics. In 1947, the US Army Air Corps became USAF, and Kirtland Army Air Field was renamed Kirtland AFB. In 1949, USAF established its own Special Weapons Center and testing laboratory at Kirtland Field near Sandia, which eventually became Phillips

Laboratory and subsequently the Air Force Weapons Laboratory. Most test and evaluation activities were conducted on a 46,000-acre tract in the Manzano Mountains, referred to as the New Mexico Proving Ground, on the southern part of Kirtland AFB, which included USFS lands withdrawn for DoD and US Atomic Energy Commission research, testing, and development activities. The establishment of these activities at Kirtland AFB was considered ideal because of its proximity to the Los Alamos Laboratory and Sandia Base.

The late 1940s and 1950s were expansion years as both Kirtland AFB and Sandia Base played increasing roles in the nation's defense efforts. New buildings, hangars, and the east-west runway, which is now owned by the city of Albuquerque, were constructed. During this period, air defense, weather, and atomic test squadrons operated from Kirtland AFB, and personnel from both installations took part in 12 nuclear test series conducted by the US Atomic Energy Commission in Nevada and the Pacific. In 1958, efforts were underway between the United States and the Soviet Union to agree on a moratorium for atmospheric nuclear testing. The anticipated limitations on determining weapons effects inspired efforts by the Special Weapons Center and Sandia Laboratory to develop methods of simulating nuclear effects with non-nuclear techniques. The Limited Nuclear Test Ban Treaty was signed with the Soviet Union in late 1962, prohibiting nuclear testing in the atmosphere and space, as well as under water.

In 1971, Kirtland AFB and its adjoining military neighbors to the east, Sandia and Manzano Army Bases, were merged to form what is known as Kirtland AFB. On 1 January 1993, Kirtland AFB changed hands to the newly formed Air Force Materiel Command where it remained until 1 October 2015, when it was transferred to the Air Force Global Strike Command (AFGSC).

Kirtland AFB is the sixth largest installation in USAF. It is operated by the 377th Air Base Wing (377 ABW), which is a unit of AFGSC's 20th Air Force and the host unit at Kirtland AFB. Missions at Kirtland AFB fall into four major categories: research, development, and testing; readiness and training; munitions maintenance; and support to installation operations for more than 100 mission partners. The primary mission of 377 ABW is to execute nuclear, readiness, and support operations for American airpower. Kirtland AFB is a center for research, development, and testing of nonconventional weapons, space and missile technology, laser warfare, and much more. Organizations involved in these activities include the Air Force Nuclear Weapons Center, Air Force Operational Test and Evaluation Center, Space and Missile Systems Center, Air Force Inspection Agency, Air Force Safety Center, Air Force Research Lab, Department of Energy, and Sandia National Laboratories. In addition, 377 ABW ensures readiness and training of airmen for worldwide duty and operates the airfield for present and future USAF operations, prepares personnel to deploy worldwide on a moment's notice, and keeps the installation secure. Mission partners involved in these activities include the 58th Special Operations Wing, 150th Special Operations Wing (New Mexico Air National Guard), and the USAF Pararescue School.

1.3 Renewable Energy Program

US Air Force

The USAF energy goals and strategy are aligned with renewable energy policies developed throughout the federal government and contained in the following documents:

- Title II—Renewable Energy (42 USC § 15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Stat. 594): The Energy Policy Act of 2005 (EPAct 2005) was developed in response to rising concerns about the security of domestic energy supplies. Title II of EPAct 2005 set requirements for renewable power use at federal facilities and defined the sources from which renewable energy is obtained. It requires the federal government to consume no less than 7.5 percent of its electricity from renewable sources in and after fiscal year (FY) 2013.
- Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140): Section 431 requires federal buildings to reduce total energy use 30 percent by 2015 (FY 2003 baseline). Section 526 prohibits federal agencies from purchasing fuels with higher lifecycle greenhouse gas emissions than conventional petroleum fuels.
- 10 USC § 2911(e)(2012): This statute requires DoD to submit an energy performance master plan and performance goals, including the goal to produce or procure 25 percent of the total quantity of energy consumed within its facilities from renewable sources by 2025 and each fiscal year thereafter.
- Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*: EO 13693 replaced EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, and the 2013 Presidential Memorandum "*Federal Leadership on Energy Management*" and set new goals and timelines for use of renewable electrical energy by federal agencies. Under EO 13693, federal agencies must maintain leadership in sustainability and greenhouse gas emission reductions. Specifically, federal agencies shall ensure that by FY 2025 at least 25 percent of the total amount of building electric energy and thermal energy they use shall be clean energy, accounted for by renewable electric energy and alternative energy. EO 13693 set the following goals and timelines for use of renewable electrical energy by federal agencies:
  - The percentage of building electrical energy and thermal energy that shall be clean energy, accounted for by renewable electrical energy and alternative energy:
    - not less than 10 percent in FYs 2016 and 2017
    - not less than 13 percent in FYs 2018 and 2019
    - not less than 16 percent in FYs 2020 and 2021
    - not less than 20 percent in FYs 2022 and 2023
    - not less than 25 percent by FY 2025 and each year thereafter.
  - The percentage of building electrical energy consumed by the agency that is renewable electrical energy shall be:
    - not less than 10 percent in FYs 2016 and 2017
    - not less than 15 percent in FYs 2018 and 2019
    - not less than 20 percent in FYs 2020 and 2021
    - not less than 25 percent in FYs 2022 and 2023
    - not less than 30 percent by FY 2025 and each year thereafter.

  - Actions that may be considered in order to meet the percentage goals for building electrical energy and thermal energy include the following:
    - Install agency-funded renewable energy at federal facilities to include installing fuel cell energy systems.
    - Contract for the purchase of energy that includes installation of renewable energy at a federal facility.
- USAF published its "Air Force Energy Plan" in May 2010 with the vision to "make energy a consideration in all we do" (USAF 2010). Goals of the plan include the following:
  - Reduce energy demand by installations, flight operations, and ground operations.
  - Increase energy supply by developing and utilizing renewable and alternative energy wherever possible.
  - Change the culture to increase energy awareness in daily operations.
  - Meet energy "End State Goals" by 2030:
    - Installations meet USAF energy security criteria, while optimizing the mix of on- and off-installation generation.
    - Aircraft fly on alternative fuel blends if cost competitive, domestically produced, and have a lifecycle greenhouse gas footprint equal to or less than petroleum.
    - Forward Operating Bases are capable of operating on renewable energy.
    - Optimize energy utilization as a tactical advantage across disciplines.

Kirtland AFB

The Kirtland AFB installation commander issued a memorandum that outlines the installation's commitment to conducting its mission in an environmentally responsible manner (KAFB 2017b). Specifically, it commits to the responsible use of energy throughout the installation with practices and procedures to conserve energy, improve energy efficiency, and promote sustainability.

The Kirtland AFB Installation Development Plan (IDP) contains a Strategic Vision Alignment Summary Matrix that depicts how the IDP aligns, supports, and contributes to realizing the goals and objectives of DoD, USAF, Air Force Civil Engineer Center, AFGSC, and 377 ABW (KAFB 2016a). The matrix creates the foundation upon which a prioritization strategy for future projects can be built at the installation. One of the goals of the Strategic Vision Alignment is the pursuit of energy surety. To achieve that goal, the IDP lists several objectives, including developing renewable energy, exploring net zero energy opportunities, and improving and expanding energy network metering.

EO 13693 established energy use intensity reduction goals and renewable energy development goals for 2016 through 2025. These goals are interconnected in that renewable energy generated on Kirtland AFB not only counts toward the renewable energy development goals, but it also reduces energy use intensity because it is not reported as energy consumed.

EO 13693 and the Kirtland AFB IDP address renewable energy standards and goals beyond the use of renewable electric energy. These goals include technologies that focus on reducing energy consumption through energy conservation and building performance such as solar hot water and solar ventilation preheat. While future renewable energy oriented actions may be taken by Kirtland AFB, including use of the previously mentioned technologies, the actions addressed under the PEA are limited to those that use renewable energy sources as a means to generate electricity.

1.4 Purpose and Need

The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. Kirtland AFB currently purchases of all of its electricity off-installation from the Western Area Power Authority.

The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including EO 13693; Title II—Renewable Energy (42 USC § 15851 (2012)) of the EPAct 2005 (109 P.L. 58, 119 Stat. 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB IDP.

1.5 Scope of the Programmatic Environmental Assessment

The scope of this PEA includes the actions proposed, alternatives considered, a description of the existing environment, and direct, indirect, and cumulative impacts. It includes analysis of the potential impacts of programmatic implementation of various renewable energy technologies at the installation, such as SPV and geothermal energy. Use of SPV technology could include the installation of an SPV array with battery storage capacity and small rooftop/carport SPV systems in the cantonment area of the installation. Analysis of renewable energy technologies under this PEA provides a format for comprehensive cumulative impacts analysis by examining renewable energy activities as a whole. This PEA also identifies appropriate mitigation measures that are not included in the Proposed Action in order to avoid, minimize, reduce, or compensate for adverse environmental impacts, if necessary.

This PEA will reduce duplication of effort by analyzing general aspects of use of renewable energy technologies and establishing a framework for environmental impact analysis of future site-specific actions. The impacts of future site-specific actions can be addressed in subsequent NEPA evaluations, per CEQ regulations (40 CFR § 1502.20). The use of tiering allows future documents to be specific in their analysis of individual renewable energy projects when they are more fully developed and designed while referencing previous environmental analyses.

1.5.1 NEPA Compliance Requirements

NEPA is a federal law requiring the analysis of potential environmental impacts associated with proposed federal actions before the actions are taken. The intent of NEPA is to make decisions informed by potential environmental consequences and take actions to protect, restore, or

enhance the environment. NEPA established the CEQ, which is responsible for ensuring federal agency compliance with NEPA. CEQ regulations mandate all federal agencies use a prescribed approach to environmental impact analysis. The approach includes an evaluation of the potential environmental consequences associated with a proposed action and considers alternative courses of action.

The process for implementing NEPA is outlined in 40 CFR §§ 1500–1508, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*. These CEQ regulations specify that an Environmental Assessment (EA) be prepared to determine whether a Finding of No Significant Impact is appropriate or preparation of an Environmental Impact Statement (EIS) is necessary. An EA considers the effects (direct, indirect, and cumulative) of a proposed action on the human environment. It uses a systematic, interdisciplinary approach to evaluate a proposed action and possible alternatives and must disclose all considerations to the public. An EA can aid in an agency's compliance with NEPA when an EIS is unnecessary and facilitate preparation of an EIS when one is required.

USAF regulations under 32 CFR § 989 provide procedures for environmental impact analysis for USAF to comply with NEPA and CEQ regulations. Air Force Policy Directive 32-70, *Environmental Quality*, states USAF will comply with applicable federal, state, and local environmental laws and regulations, including NEPA. If significant impacts are predicted under NEPA, USAF would decide whether to conduct mitigation to reduce impacts below the level of significance, prepare an EIS, or abandon the Proposed Action. The PEA would also be used to guide USAF in implementing the Proposed Action in a manner consistent with USAF standards for environmental stewardship should the Proposed Action be approved for implementation.

1.5.2 Affected Resources

The following resource areas are analyzed and discussed in detail for potential impacts from implementation of the Proposed Action and alternatives: Noise, Air Quality, Geological Resources, Water Resources, Biological Resources, Cultural Resources, Infrastructure and Transportation, Hazardous Materials and Wastes, Safety, and Socioeconomics and Environmental Justice.

1.5.3 Intergovernmental and Stakeholder Coordination

NEPA requirements help ensure environmental information is made available to the public during the decision-making process and prior to an action's implementation. A premise of NEPA is that the quality of federal decisions will be enhanced if the public is involved in the planning process. EO 12372, *Intergovernmental Review of Federal Programs*, as amended by EO 12416, requires federal agencies to provide opportunities for consultation by elected officials of state and local governments that would be directly affected by a federal proposal. In compliance with NEPA, Kirtland AFB notified relevant stakeholders about the Proposed Action and alternatives (see **Appendix A** for stakeholder coordination materials). The notification process provided these stakeholders the opportunity to cooperate with Kirtland AFB and provide comments on the Proposed Action and alternatives.

The National Historic Preservation Act (NHPA) requires federal agencies to consult with federally recognized Native American tribes on proposed undertakings that have the potential to affect properties of cultural, historical, or religious significance to the tribes. The tribal

consultation process is distinct from NEPA consultation or the intergovernmental coordination process, and it requires separate consultation with all relevant tribes. The timelines for tribal consultation are also distinct from those of other consultations. The Kirtland AFB point-of-contact for Native American tribes is the Installation Commander. The Native American tribal governments coordinated or consulted with regarding the Proposed Action are listed in **Appendix A** along with all USAF correspondence. Comments received from the various stakeholders and Native American tribes were considered during preparation of the PEA and included in **Appendix A**.

Scoping letters were provided to relevant federal, state, and local agencies and Native American tribes notifying them that USAF is preparing a PEA to evaluate the Proposed Action at Kirtland AFB. The agencies and tribes were requested to provide information regarding potential impacts of the Proposed Action on the natural environment or other environmental aspects that they feel should be included and considered in the preparation of the PEA. During the scoping period, USAF received responses from one federal agency (Bureau of Indian Affairs [BIA]) and two state agencies (New Mexico State Historic Preservation Officer [SHPO] and New Mexico Department of Game and Fish [NMDGF]); see **Appendix A**. BIA recommended DoD complete the Section 106 process and provide any cultural survey reports, as needed, if concurrence from the BIA Regional Archaeologist is required. BIA further stated the Proposed Action would not impact trust resources under the jurisdiction of the BIA. The New Mexico SHPO noted that the Section 106 process must be completed prior to completion of a Finding of No Significant Impact and requested that Kirtland AFB contact them when the project's area of potential effect is better defined. NMDGF provided recommendations to minimize impacts on wildlife. These recommendations were taken into consideration during the preparation of this PEA.

1.5.4 Public and Agency Review of Draft PEA

A Notice of Availability for the Draft PEA was published in the *Albuquerque Journal* on 1 and 2 July 2018 announcing the availability of the Draft PEA. The publication of the Notice of Availability initiated a 30-day public review period that ended on 31 July 2018. A copy of the Draft PEA was made available for review at the San Pedro Public Library at 5600 Trumbull SE, Albuquerque, NM 87108. A copy of the Draft PEA also was made available for review online at *http://www.kirtland.af.mil* under the environmental information tab. Additionally, Kirtland AFB notified relevant stakeholders of the availability of the Draft PEA for review via correspondence (see **Appendix A** for stakeholder coordination materials).

No comments were received from the general public during the public review period. USAF received comments from one federal agency (Federal Aviation Administration [FAA]), two state agencies (Mid-Region Council of Governments and NMDGF), one city agency (city of Albuquerque Planning Department), one Native American Tribe (Ysleta del Sur Pueblo), and PNM Resources Inc. FAA recommended that a solar glare study be performed to ensure proposed SPV arrays would not create a glint/glare problem for aircraft pilots or air traffic controllers working in the Sunport's air traffic control tower. This recommendation has been included in the environmental consequences discussion in **Section 3.2** of this PEA. The Mid-Region Council of Governments gave its support to Kirtland AFB in implementing its energy goals and does not anticipate major impacts. NMDGF reiterated comments made during scoping and provided recommendations for minimizing impacts. NMDGF also expressed

concern about development of an SPV array in the southwestern portion of the installation. These comments will be taken into consideration when siting and constructing renewable energy technologies on Kirtland AFB, and NMDGF recommendations have been included in the discussion in **Section 3.6** of this PEA. The city of Albuquerque stated they had no adverse comments regarding the PEA and commended Kirtland AFB for its efforts to incorporate renewable energy sources into its energy program. Ysleta del Sur Pueblo stated it has no comments and does not request consultation regarding the Proposed Action. PNM Resources Inc. indicated they have transmission facilities on the installation; however, they have no unique knowledge of environmental conditions on Kirtland AFB. All comment letters are included in **Appendix A**.

2. Proposed Action and Alternatives

This chapter describes the Proposed Action (**Section 2.1**), No Action Alternative (**Section 2.2**), selection standards for evaluating renewable energy technologies (**Section 2.3**), and a discussion of renewable energy technologies considered (**Section 2.4**). **Section 2.5** provides a summary of the renewable energy technologies considered and discusses which technologies will be carried forward for further analysis. The final section, **Section 2.6**, identifies the Preferred Alternative.

2.1 Proposed Action

USAF is proposing to develop and implement renewable energy technology at Kirtland AFB. The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation. It includes renewable energy technology categories that meet general suitability criteria (Level 1 selection standards).

The Proposed Action does not include specific projects. Future proposed specific projects for renewable energy technologies that meet the Level 1 selection standards would be evaluated against site selection criteria (Level 2 selection standards) and undergo separate NEPA analysis.

Sections 2.1.1 through **2.1.4** provide a general discussion regarding construction, connection, storage and distribution, and operation and maintenance of renewable energy projects. **Sections 2.3** through **2.5** present the categories of renewable energy technology that are commercially available and potentially suitable for implementation at Kirtland AFB.

2.1.1 Construction

The electrical equipment, such as utility lines, substations, and transformer equipment, installed as part of the Proposed Action would be installed among existing compatible equipment and existing utility rights-of-way as much as feasible and would be seamlessly integrated into the electrical distribution system. During construction, surface vegetation and trees within the project site would be cleared and the land graded in accordance with the specifics of the project design. Temporary construction laydown areas for materials, equipment, and parking also may be required within the project site. At a minimum, construction would include actions such as installing foundations and footers, assembly of the renewable energy system, and extending utility lines (aboveground or underground based on project site conditions). After construction, the project site would be seeded with native vegetation or vegetation detailed in the Kirtland AFB Architectural Compatibility Plan (KAFB 2007a). Temporary construction laydown areas would be restored to pre-construction conditions.

2.1.2 System Interconnection

To safely transmit electricity to the installation load demand and comply with the local utility's electric grid-connection requirements, the following areas must be addressed:

- *Power conditioning equipment.* A renewable energy project could be variable in its power generation output, which can contribute to electric grid instability. Power

conditioning equipment would be required to ensure that the power generated by a renewable energy source matches the voltage and frequency of the electricity provided by the local utility. An inverter could serve this purpose by converting the variable direct current output of a renewable energy system into a utility frequency alternating current that could be fed into the Kirtland AFB electrical grid or used by a local, off-grid electrical network.

- *Substation.* A project substation may be needed to provide the connection with the local utility electrical grid. The project substation would have a low side and a high side, as defined by the point of power transformation from the low side stepped up in voltage to match the specifications in the transmission system (high side). Each renewable energy project would include the necessary electrical line to connect the proposed substation, if required, to the Kirtland AFB electrical grid.
- *Safety equipment.* Safety equipment to ensure safe operation must include the means to limit access to authorized individuals as well as proper signage. Personal protective equipment needed when working with renewable energy systems varies. For example, a SPV system may require fall protection, fire-rated clothing, arc flash protection, hot gloves, protective eyewear, and safety footwear.
- *Metering and instrumentation.* If a Kirtland AFB grid-connected small renewable energy system produces excess power that cannot be used or stored, the Public Utility Regulatory Policy Act of 1978 requires power providers to purchase excess power at a rate equal to what it costs the power provider to produce the power itself. This requirement can be implemented, as needed, through various metering arrangements.

2.1.3 Storage and Distribution

Should Kirtland AFB choose to become energy independent, it might also consider energy storage options, which could include use of batteries, hydrogen storage, or fuel cells. For example, an energy storage system would allow the installation to collect solar energy during the day, store it, and then use the power at night when the solar systems are no longer generating power. In addition to allowing Kirtland AFB to become energy independent, an energy storage system would provide Kirtland AFB the ability to use all of the energy produced by the various proposed generation sources, and provide energy security for a subset of critical facilities, including as part of a microgrid. A microgrid is a localized grouping of energy generation, storage, and loads that would normally operate through connection to the central utility grid. Because generation, storage, and end uses are all connected to a microgrid, it would be able to function autonomously if it ever became disconnected from the central utility grid and therefore would provide Kirtland AFB with energy security.

2.1.4 Operation and Maintenance

An effective Operations and Maintenance program enhances the likelihood a system will perform at or above its projected production rate and cost over time. Renewable energy system operations would include the following five areas: Administration of Operations (ensures effective implementation and control of Operations and Maintenance services including curation of as-built drawings, equipment inventories, owners and operating manuals, and warranties);

Conducting Operations (ensures efficient, safe, and reliable process operations including making decisions about maintenance actions based on cost/benefit analysis); Directions for the Performance of Work (specifies the rules and provisions to ensure that maintenance is performed safely and efficiently); Monitoring (maintains monitoring system and analysis of resulting data to remain informed on system status); and Operator Knowledge, Protocols, Documentation (ensures that operator knowledge, training, and performance will support safe and reliable plant operation).

A typical renewable energy system maintenance program would include four types of maintenance procedures: Administration of Maintenance (ensures effective implementation, control, and documentation of maintenance activities and results); Preventative Maintenance (set by the operations function and is influenced by factors such as equipment type and environmental conditions); Corrective Maintenance (required to repair damaged or replace failed components); and Condition-based Maintenance (use of real-time information from data loggers to schedule preventative measures such as cleaning) (NREL 2016).

At least once a year, Operations and Maintenance personnel would conduct a general inspection of the renewable energy equipment. Routine maintenance would be required for all renewable energy systems. For example, SPV arrays would require panel washing and panel replacement.

Safety requirements during system servicing would include the use of lockout/tagout procedures and personal protective equipment, adherence to procedures for safely disconnecting live circuits, and observation of and compliance with all system signage and warnings.

2.2 No Action Alternative

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and it would not reduce the amount of electricity it receives from off-installation suppliers. It would continue to satisfy its electrical power requirements through purchase of all of its electricity off-installation from the Western Area Power Authority.

The No Action Alternative would not meet the purpose of and need for the Proposed Action as described in **Section 1.4**; however, USAF Environmental Impact Analysis Process (32 CFR § 989.8[d]) requires consideration of the No Action Alternative. In addition, CEQ guidance recommends inclusion of the No Action Alternative in an EA to assess any environmental consequences that may occur if the Proposed Action is not implemented. Therefore, this alternative will be carried forward for detailed analysis in the PEA. The No Action Alternative also serves as a baseline against which the Proposed Action can be compared.

2.3 Renewable Energy Technology Selection Standards

To warrant detailed evaluation in the PEA, an alternative must be reasonable. Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint and use common sense, rather than simply being desirable from the standpoint of the applicant. To be considered reasonable, an alternative must meet the purpose of and need

for the action, be feasible and able to be implemented, and be suitable for consideration by decision makers.

Guidance for complying with NEPA requires an assessment of potentially effective and reasonable alternatives for implementing the Proposed Action. An organized approach to evaluating alternatives can identify reasonable ways to achieve the Proposed Action's purpose and avoid unnecessary impacts. In accordance with 32 CFR § 989.8(c), the development of selection standards is an effective tool for identifying, comparing, and evaluating reasonable and feasible alternatives in NEPA documents. Two levels of selection standards have been developed to evaluate potential renewable energy technologies and specific projects within the acceptable technology categories.

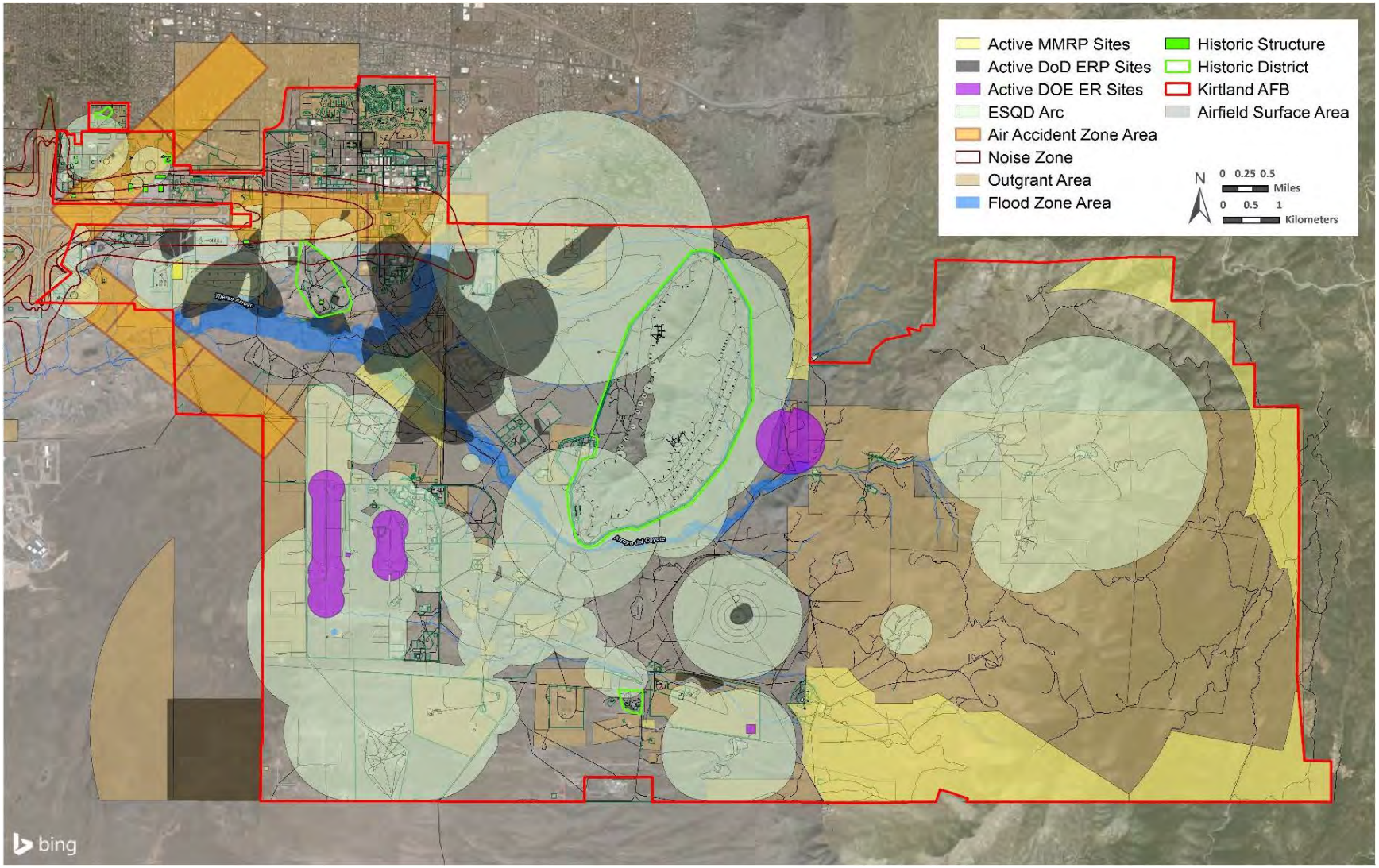
The first level of the evaluation process, which is applicable for the PEA, assesses the categories of renewable energy technology that are commercially available and potentially suitable for implementation at Kirtland AFB. This level of evaluation considers how a particular category of renewable energy generation would meet important general selection standards such as compatibility with the installation's mission, land use objectives, future development, and community relationship. Application of the first level selection standards will identify viable renewable energy technologies for use at the installation.

The second level of the evaluation process, which would occur in the future as individual projects are moved forward for development, assesses the suitability of locating a renewable energy project at a particular site on the installation. The second level selection standards focus on site-specific characteristics such as proximity to the installation electrical system, size and topography, compatibility with adjacent land uses, resource issues (e.g., wetlands, endangered species), and tribal considerations. Areas within Kirtland AFB constrained by operational and environmental limitations are shown in **Figure 2-1**. The amount of available space remaining after consideration of constraints would likely lead to the colocation of energy generating facilities with existing facilities, siting new energy generating facilities adjacent to existing development, and the use of smaller in-fill land parcels.

Level 1 Selection Standards

The first level of evaluation, which was developed to be consistent with the purpose of and need for the Proposed Action and address pertinent mission, land use, and technology factors, assesses the suitability of renewable energy technologies for implementation at Kirtland AFB. These selection standards are used in the evaluation of renewable energy technologies in **Section 2.4**. To be considered reasonable and suitable for implementation at Kirtland AFB, a renewable energy technology must meet the following first level selection standards:

- *Mission compatibility.* The technology would need to be compatible with the mission and training at the installation. For instance, a renewable energy technology must not adversely impact military training.
- *Compatible land use.* The technology must be compatible with the land use objectives of the Kirtland AFB IDP. Compatible land use objectives would consider all large-scale constraints applicable to withdrawn lands or outgrants and would avoid areas with environmental or operational constraints.



ER – Environmental Restoration
ERP – Environmental Restoration Program
ESQD – Explosive Safety Quantity Distance

Figure 2-1. Land Use Constraints at Kirtland AFB

- *Feasibility.* The factors supporting use of a particular renewable energy technology must be sufficient to ensure the implementation of that technology category is feasible and sustainable. Factors include cost (initial capital and operational) and energy source characteristics.
- *Mature technology.* The renewable energy technology must be supported by mature and proven technology.
- *Community relationship.* Use of a particular renewable energy technology must enhance or not harm Kirtland AFB's relationship with the surrounding community.

Level 2 Selection Standards

The second level of selection standards would be used in the future to evaluate potential sites for specific renewable energy projects within the renewable energy technology categories that have been determined to be reasonable against the first level selection standards. These second level selection standards would evaluate whether a project is suitable for a particular location and compatible with applicable constraints and adjacent land uses. The second level selection standards are as follows:

- Sites must be capable of accommodating the appropriate footprint of the proposed facility, and, if possible, should also have additional space available to accommodate future modification or expansion.
- If a renewable energy technology would be applied to an existing structure or facility, it must be incorporated into that facility such that it does not negatively affect the mission or operation of that structure or facility.
- Sites must meet anti-terrorism/force protection setbacks and other safety criteria (e.g., height restrictions around the airfield). Airfield Clear Zones and existing utility rights-of-way must also be avoided.
- Site topography must be suitable to the particular type of project; for instance, land areas for development of ground-mounted SPV systems would need to be relatively flat (i.e., less than 5 percent slope).
- Sites must not be encumbered by wetlands, protected plant or animal species habitat, or known cultural resources.
- Sites must not adversely impact the status of existing Environmental Restoration Program (ERP) and DOE Environmental Restoration (ER) sites.
- Sites must meet the requirements of Air Force Manual 32-1084, *Facility Requirements* (26 February 2016), the Kirtland AFB Architectural Compatibility Plan, the Kirtland AFB Integrated Natural Resources Management Plan, the Kirtland AFB Integrated Cultural Resources Management Plan (ICRMP), and other applicable guidance. These requirements ensure that informed decisions regarding standards for site, landscape, and buildings are made when considering project design, construction, and maintenance.

- Sites must support suitable access for connection to the installation electrical system. The installation electrical system must be capable of receiving, or upgradable to receive, the energy produced.
- Sites must have reasonable access to existing roadways to facilitate construction and support maintenance.
- Sites must require minimal grading/site preparation.
- Projects must consider, to the extent economically feasible and technically practical, use of land areas that, because of their former use, are not readily convertible to otherwise productive use (e.g., formerly contaminated sites and landfills), consistent with EO 13693, *Planning for Federal Sustainability in the Next Decade*. Such sites must reflect that remedial actions have been properly terminated, operations have achieved proper closure, and the site conditions are protective of human health and the environment.

2.4 Evaluation of Renewable Energy Technologies

Renewable energy comes from sources that are constantly replenished such as sunlight, wind, geothermal heat, and ocean waves, tides, and currents. However, selection of the most appropriate and cost-effective renewable energy technologies is dependent on the particular features and mission of a given location. The following renewable energy technologies have been considered for use at Kirtland AFB. The evaluation of each of these technologies considers their suitability relative to the first level selection standards presented in **Section 2.3**.

2.4.1 Solar Photovoltaic

SPV systems are based on the use of semiconductors, which are materials that can convert sunlight directly to electricity. To produce electricity at utility scale, many individual solar cells are connected as a module; modules are combined to make individual solar panels; and solar panels are grouped into arrays that produce direct current electricity.

The power-producing components of utility-scale SPV facilities are the solar field, or array, which contains the SPV panels, the power conditioning system that contains an inverter to convert the produced direct current to alternating current, and the transformer to boost voltage for feeding electricity into the power grid. The power conditioning system also contains devices that can sense grid destabilization and automatically disconnect the SPV facility from the grid, if needed.

The two types of SPV technologies are flat-plate and concentrating systems. The solar cell materials for both systems are typically a thin film in a weather-resistant enclosure. The two systems differ in the manner in which they capture sunlight and direct it to the solar cell materials. In flat-plate SPV systems, the modules are placed in the solar field, either in a fixed position optimal for capturing sunlight, or on a tracking system that follows the sun's path to optimize power production. A concentrating SPV system converts light energy into electrical energy in the same way that the conventional flat-plate SPV system does, but uses an

advanced optical system to focus a large area of sunlight onto each cell for maximum efficiency. It also usually incorporates tracking devices (CPV Consortium 2017).

Candidate sites at Kirtland AFB for an SPV array would be undeveloped and up to 500 acres in size, which would allow for a generating capacity of 10 to 20 megawatts (MW). The array would be connected to existing substations and transmission lines on the installation via extension of a connection line along existing roads or existing utility rights-of-way. The connection line between the array and the point at which it connects to the local grid could be up to 1 mile. Because the existing electrical infrastructure is subject to change due to Kirtland AFB's ongoing upgrades, the connection line route would be determined during the design phase of the array. It is possible that an array could require the construction of a new substation that would need to be connected to the existing electrical system. The decision to place electrical connections above or below ground would be contingent on the location of the SPV system. In developed areas of the installation, especially near the flight line, buried electrical lines could be required. However, most locations would allow for electrical lines to be placed overhead, which is generally less intrusive and more cost effective.

SPV systems could also be installed in smaller areas on existing facilities, including building rooftops and parking areas, such that the function of those facilities would not change or be impaired. SPV systems installed in parking areas would typically use a carport structure so that the system would not impede or reduce available parking.

Analysis

SPV systems have been a major component of the renewable energy generating capacity added nationwide in recent years. SPV is a mature technology that can be implemented in several locations and at varying scales at Kirtland AFB, and is compatible with the land use and mission at the installation. Future development of SPV at Kirtland AFB would require a site-specific evaluation to ensure each project meets the second level screening standards.

2.4.2 Wind Energy

Wind energy is the transformation of wind into mechanical power through a turbine, which is then converted into electricity through a generator. Turbines range in size from small, residential units with capacities less than 100 kilowatts to large-scale 2 to 3 MW turbines used in commercial wind farms. The United States has an installed wind energy capacity of 82,183 MW, with over 52,000 wind turbines operating in 40 states plus Guam and Puerto Rico (AWEA 2016).

Wind as a renewable resource generally requires large amounts of land. The average total area required of 172 wind farm projects analyzed nationwide is 86 acres per MW (NREL 2009). However, wind farms allow for multiple land uses. Wind facilities have variable power output that require different management strategies from other forms of power generation, and can result in higher costs for integration into the grid. Utility-scale wind farms use large wind turbines capable of high energy output. The widely used GE 1.5 MW wind turbine consists of 116-foot blades atop a 212-foot tower for a total height of 328 feet (National Wind Watch 2017). Some turbines reach total heights of over 400 feet.

Analysis

Large wind turbines could pose challenges to the installation mission because of the height of the towers and the effects they can produce on various types of radars, aircraft operations, and other critical systems. Given the large areas of land required for this technology and the amount of land at Kirtland AFB that is under constraint for a variety of reasons, insufficient area is available for development of a wind farm. Wind turbines can also generate low frequency vibrations that can be problematic for locations that are sensitive to seismic noise, such as seismic monitoring stations and other sensitive scientific instruments (Keele University 2005). The visual impact of wind turbines is also frequently a point of contention.

Wind energy is not compatible with the mission or overall land use plan at Kirtland AFB. Additionally, it is not compatible with the installation's constraints to land use including tribal, flight operations, and helicopter landing zones near the airport. Vibrations generated by wind turbines could also interfere with the operation of sensitive equipment at Kirtland AFB. Therefore, use of wind energy technology is not suitable for use at Kirtland AFB and is dismissed from further consideration.

2.4.3 Geothermal Energy

Geothermal energy is generated by natural heat stored in the Earth. The temperature difference between the Earth's core and its surface drives a continuous conductive process where molten rock (magma) inside the Earth heats rock and water to produce geothermal heat. The heat produced by a geothermal source is used to generate electric power via heat exchangers and turbines. Where available, geothermal sources produce full-time baseload power, unlike the intermittent energy provided by solar and wind. In 2015, the United States had 3.7 MW of installed geothermal electricity capacity, with over 1,250 MW of capacity in development (GEA 2016).

Geothermal energy can be harnessed through direct use, electrical generation, or heat pumps. Direct-use applications include heating buildings, growing plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes. There are three types of geothermal power plants: dry steam, flash steam, and binary cycle. Electrical generation occurs when steam from underground wells turns a turbine, which drives a generator to produce electricity. Geothermal heat pumps are able to heat, cool, and, if so equipped, supply buildings with hot water.

Analysis

Where natural heat sources exist, geothermal is an excellent source of energy for USAF installations; however, the exploration and production costs of geothermal wells are increased in the absence of proven resources. In April 2010, a team from the National Renewable Energy Laboratory conducted a reconnaissance assessment of the geothermal potential at Kirtland AFB. They concluded that there appears to be indications of potential geothermal activity within the installation; however, further investigation is likely necessary.

Geothermal as a source of renewable energy electricity is compatible with the mission and land use at Kirtland AFB. It is a mature technology that does not occupy a large footprint, so it is feasible to implement. The feasibility of generating electricity at Kirtland AFB through the use of

geothermal resources is uncertain at this time because it is unknown whether or not an adequate geothermal source exists at the installation. However, depending on the results of further investigation of geothermal activity, this technology may remain a potential renewable energy source in the future.

2.4.4 Biomass (Waste-to-Energy)

Biomass electricity is generated from the burning of waste materials, such as wood or agricultural residue, for the cogeneration of heat and electricity in stream-driven generators. Biomass burning is the primary and most proven waste-to-energy technology; other methods include high-temperature gasification and anaerobic digestion. Biomass applications utilizing waste products can help resolve waste disposal problems, a feature unique to this renewable energy category.

Biomass fuels provided approximately 5 percent of the energy used in the United States in 2015. Of that 5 percent, approximately 43 percent was from wood and wood-derived biomass, 46 percent was from biofuels (mainly ethanol), and 11 percent was from municipal waste (USEIA 2016). The total biomass energy consumed in the United States in 2016 was 373 trillion British thermal units in the residential sector and 136 trillion British thermal units in the commercial sector (USEIA 2017c).

Municipal solid waste (MSW) is burned at special waste-to-energy plants that use the heat to make steam to generate electricity or to heat buildings. In 2013, approximately 80 waste-to-energy plants in the United States generated electricity or produced steam. These plants burned approximately 30 million tons of MSW in 2013, and generated nearly 14 billion kilowatt hours of electricity, approximately the same amount used by 1.3 million households in the United States in 2013. The biogenic material in MSW contributed approximately 52 percent of the energy from MSW that was burned in electricity-generating waste-to-energy facilities (USEIA 2017d).

Analysis

Availability of feedstock, requirements for emissions control, and waste disposal represent the biggest challenges for biomass projects. To construct and operate a biomass system, a steady source of fuel would need to be identified. Kirtland AFB conducts many operations and activities that generate solid waste, including training, industrial, commercial, residential, administrative, and recreational operations. In 2016, Kirtland AFB generated 1,700 tons of MSW and 12,000 tons of construction and demolition debris (Wheelock 2017a). A small incinerator typically burns approximately 100 tons daily, and also has contract mechanisms in place to ensure a sufficient supply stream to operate efficiently. Failure to meet stated minimums typically results in financial penalties.

Biomass as a source for generating renewable energy electricity is compatible with the mission and land use at Kirtland AFB. It is a mature technology that generally does not occupy as large a footprint as other technologies being considered, so it is feasible to implement. While biomass meets most of the Level 1 selection standards, the volume of solid waste generated at Kirtland AFB is inadequate to make such a project feasible at this time. Therefore, use of biomass is not suitable for use at Kirtland AFB and is dismissed from further consideration.

2.5 Comparative Summary of Renewable Energy Technologies

Table 2-1 contains a summary of the analysis for the four renewable energy technologies considered and the resultant conclusions. Two renewable energy technologies (i.e., SPV and geothermal energy) will be carried forward for further analysis.

Table 2-1. Summary of Renewable Energy Technology Analysis

Category	Summary of Analysis	Conclusion
Solar Photovoltaic	SPV technology meets the purpose of and need for the Proposed Action. It is a mature technology, compatible with the mission of the installation, readily available, and cost effective.	Meets purpose and need and therefore is carried forward for further analysis.
Wind Energy	Kirtland AFB lacks sufficient unconstrained land for a wind turbine farm. Vibrations from turbines are incompatible with certain activities on Kirtland AFB. Wind energy is not compatible with the mission or overall land use plan at Kirtland AFB.	Not carried forward for further analysis.
Geothermal Energy	Kirtland AFB has shown potential signs of geothermal activity. Geothermal is compatible with the mission and land use at Kirtland AFB. It is also a mature technology that would not occupy a large footprint.	Meets purpose and need and therefore is carried forward for further analysis.
Biomass (Waste-to-Energy)	Biomass is compatible with the mission and land use at Kirtland AFB. It is also a mature technology that would not occupy a large footprint, relative to other technologies considered. Kirtland AFB meets most of the criteria necessary to support a biomass project, but the volume of solid waste generated by Kirtland AFB is inadequate to make such a project feasible at this time.	Not carried forward for further analysis.

2.6 Identification of the Preferred Alternative

The Preferred Alternative is the Proposed Action via programmatic implementation of SPV and geothermal energy technologies, as described in **Sections 2.1**, **2.4.1**, and **2.4.3** and **Table 2-1**. Although specific projects have not been selected or designed, it is likely that some of the proposed projects would be on undeveloped land. Implementation of SPV technology, either as an array or as a rooftop/carport system, is feasible at several locations at Kirtland AFB, both in undeveloped areas and in the cantonment area. Implementation of geothermal technology would depend on determining if an adequate geothermal source exists on the installation.

2.7 Summary of Environmental Impacts

Table 2-2 summarizes the impact characterizations from the Proposed Action and No Action Alternative.

Table 2-2. Summary of Potential Impacts from the Proposed Action and No Action Alternative

Resource Area	Proposed Action	No Action Alternative*
Noise	• Short-term, minor, adverse impacts from construction • No impacts from operations • Long-term, negligible, adverse impacts from maintenance	No impacts
Land Use	• No impacts from an SPV project within the Manzano district or Southern Research and Development Area o Long-term, minor, adverse impacts if unable to avoid land use compatibility issues o Long-term, minor, beneficial impacts if sited on redevlopable land • No adverse impacts from a geothermal energy project on developable or redevelopable land in the cantonment area or other locations on Kirtland AFB o Long-term, minor, adverse impacts if unable to avoid land use compatibility issues o Long-term, minor, beneficial impacts if sited on redevlopable land • No impacts from infrastructure construction or on off-installation land uses • Long-term, minor, beneficial impacts from undergrounding of utility lines • A solar glare study would be performed to ensure proposed SPV arrays would not create a glint/glare problem for aircraft pilots or Sunport air traffic controllers	No impacts
Air Quality	• Short-term, negligible to moderate, adverse impacts from construction • Long-term, negligible, adverse impacts from operation and maintenance • Potential long-term, negligible, beneficial impacts from operations • Long-term, negligible, beneficial impacts from reducing greenhouse gas (GHG) emissions	No impacts
Geology and Soils	• Short- and long-term, minor, adverse impacts on soil during proposed construction and maintenance activities • Long-term, negligible, adverse impacts on topography from construction	No impacts
Water Resources	• Short-term, negligible, adverse impacts on groundwater during construction • Long-term, minor, adverse impacts on groundwater from operation of a geothermal project • Short-term, negligible to minor, adverse impacts on surface waters could occur during construction	No impacts
Biological Resources	• Short- and long-term, moderate, adverse impacts from SPV array construction • Long-term, minor, adverse impacts on wildlife species from the loss or disturbance of habitat • Long-term, minor, adverse impacts on wildlife from maintenance and operation of the SPV array • Short-and long-term, minor, adverse impacts from geothermal energy project construction • Long-term, minor, beneficial impacts on wildlife species for wildlife that prefer disturbed habitat	No impacts
Cultural Resources	• Short-term, negligible to minor impacts on cultural resources	No impacts

Resource Area	Proposed Action	No Action Alternative*
Infrastructure	• No impacts on the natural gas and propane, liquid fuel, sanitary sewer/wastewater, and communications systems • Short-term, negligible, adverse impacts on transportation and solid waste management from construction • Short-term, negligible to minor, adverse impacts on the electrical and water supply systems from construction and maintenance • Long-term, negligible to minor, beneficial impacts on the electrical system from operations	No impacts
Hazardous Materials and Wastes	• Short-term, negligible to minor, adverse impacts from construction • Long-term, negligible, adverse impacts from operations and maintenance • Short-term, negligible, adverse impacts from special hazards during construction • Long-term, negligible, beneficial impacts from the removal of special hazards • No impact on the status of existing environmental contamination sites • No impacts from radon	No impacts
Safety	• Short-term, negligible, adverse impacts on safety during construction • Long-term, negligible, adverse impacts on safety from operation of a geothermal project	No impacts
Socioeconomics and Environmental Justice	• Short-term, negligible to minor, beneficial impacts from construction • Long-term, negligible to minor, beneficial impacts from operations • No impact on environmental justice and protection of children	No impacts

Note: * Implementation of the No Action Alternative would result in no impacts to Kirtland AFB, either beneficial or adverse.

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3. Affected Environment and Environmental Consequences

This section of the PEA describes the natural and human environments that exist within Kirtland AFB and the consequences of the Proposed Action and No Action Alternative on affected resources within that environment. Only those resources that have the potential to be affected by either of the alternatives considered are described, as per CEQ guidance (40 CFR § 1501.7[3]).

Based upon the scope of the Proposed Action, resource areas with no impacts were identified through a preliminary screening process. The following describes those resource areas not being carried forward for detailed analysis, along with the rationale for their elimination:

1. Airspace management is not addressed in this PEA because none of the proposed activities would result in a change to current airspace types, flight activities, or training. A solar glare study would be performed prior to siting the SPV array to ensure it does not impact airspace operations, to include air traffic controllers working in the Sunport's air traffic control tower. As a result, USAF anticipates no short- or long-term impacts on airspace management at Kirtland AFB. Therefore, airspace management will not be carried forward for detailed analysis.
2. Visual resources are not addressed in this PEA because military and civilian airfields, testing and training areas, and government and military facilities comprise much of the visual environment of Kirtland AFB and the Proposed Action would not result in a change to that environment. The prominent visual features of the installation include hangars, maintenance and support facilities, and aircraft. While a proposed SPV array could cover 500 acres, its appearance would be in keeping with these features. As a result, USAF anticipates no short- or long-term impacts on visual resources at Kirtland AFB. Therefore, visual resources will not be carried forward for detailed analysis.

Specific criteria for evaluating the potential environmental impacts of the Proposed Action and No Action Alternative are discussed in the following text by resource area. The significance of an action is measured in terms of its context and intensity. The context and intensity of potential environmental impacts are described in terms of duration, magnitude of the impact, and whether they are adverse or beneficial as summarized below:

1. ***Short-term or long-term*.** In general, short-term impacts are those that would occur only with respect to a particular activity, for a finite period, or only during the time required for construction or installation activities. Long-term impacts are those that are more likely to be persistent and chronic.
2. ***Significant, moderate, minor, negligible, or no impact*.** These relative terms are used to characterize the magnitude or intensity of an impact. Significant impacts are those effects that would result in substantial changes to the environment (as defined by 40 CFR § 1508.27) and should receive the greatest attention in the decision-making process. Less than significant impacts are those that would be slight but detectable.

3. ***Adverse or beneficial*.** An adverse impact is one having unfavorable or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. All impacts are considered adverse unless specifically stated otherwise.

3.1 Noise

Sound is defined as a particular auditory impact produced by a given source, for example the sound of rain on a rooftop. Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise annoying. Noise and sound share the same physical aspects, but noise is considered a disturbance while sound is defined as an auditory impact. Noise can be intermittent or continuous, steady or impulsive, and can involve any number of sources and frequencies. Noise can be readily identifiable or generally nondescript. Human response to increased sound levels varies according to the source type, characteristics of the sound source, distance between the source and receptor, receptor sensitivity, and time of day. Affected receptors are specific (e.g., residential areas, schools, places of worship, hospitals) or broad (e.g., nature preserves, designated districts) areas in which occasional or persistent sensitivity or noise above ambient levels exists. These are generally referred to as sensitive noise receptors.

Sound levels vary with time. For example, the sound increases as an aircraft approaches, then falls and blends into the ambient, or background, as the aircraft recedes into the distance. Because of this variation, it is often convenient to describe a particular noise "event" by its highest or maximum sound level (L_{max}). It should be noted that L_{max} describes only one dimension of an event; it provides no information on the cumulative noise exposure generated by a sound source. In fact, two events with identical L_{max} levels may produce different total noise exposures. One may be of short duration, while the other may last much longer.

Human response to noise varies, as do the metrics used to quantify it. Generally, sound can be calculated with instruments that record instantaneous sound levels in decibels (dB). A-weighted decibel (dBA) is the unit used to characterize sound levels that can be sensed by the human ear. “A-weighted” denotes the adjustment of the frequency range to what the average human ear can sense when experiencing an audible event. The lower boundary for the range of audibility is generally within the range of 10 to 25 dBA for normal hearing. The threshold of pain occurs at the upper boundary of audibility, which is normally in the region of 135 dBA (USEPA 1981a). **Table 3-1** compares common sounds and shows how they rank in terms of auditory impacts. As shown, a whisper is normally 30 dBA and considered to be quiet while an air conditioning unit 20 feet away is considered an intrusive noise at 60 dBA. Noise levels can become annoying at 80 dBA and very annoying at 90 dBA. To the human ear, each 10 dBA increase seems twice as loud (USEPA 1981b).

Under the Noise Control Act of 1972, the Occupational Safety and Health Administration established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 dBA over an 8-hour period. The highest allowable sound level to which workers can be constantly exposed to is 115 dBA, and exposure to this level must

Table 3-1. Sound Levels and Human Response

Noise Level (dBA)	Common Sounds	Effect
10	Just audible	Negligible
30	Soft whisper (15 feet)	Very quiet
50	Light auto traffic (100 feet)	Quiet
60	Air conditioning unit (20 feet)	Intrusive
70	Noisy restaurant or freeway traffic	Telephone use difficult
80	Alarm clock (2 feet)	Annoying
90	Heavy truck (50 feet) or city traffic	Very annoying Hearing damage (8 hours)
100	Garbage truck	Very annoying
110	Pile drivers	Strained vocal effort
120	Jet takeoff (200 feet) or auto horn (3 feet)	Maximum vocal effort
140	Carrier deck jet operation	Painfully loud

Source: USEPA 1981a

not exceed 15 minutes within an 8-hour period. These standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

The average day/night sound level (DNL) metric is a measure of the total community noise environment. DNL is the average A-weighted sound level over a 24-hour period, with a 10 dBA adjustment added to the nighttime levels (between 2200 and 0700 hours). This adjustment is an effort to account for increased human sensitivity to nighttime noise events. DNL was endorsed by the US Environmental Protection Agency (USEPA) for use by federal agencies and was adopted by the US Department of Housing and Urban Development. DNL is an accepted unit for quantifying annoyance to humans from general environmental noise, including construction noise. Land use compatibility and incompatibility are determined by comparing the predicted DNL at a site with the recommended land uses. Noise levels occurring at night generally produce a greater annoyance than those of the same levels occurring during the day. It is generally agreed that people perceive intrusive noise at night as being 10 dBA louder than those occurring during the day, at least in terms of its potential for causing community annoyance.

3.1.1 Affected Environment

The ambient sound environment of Kirtland AFB is affected mainly by USAF and civilian aircraft operations, automotive vehicles, and live-fire weapons. In the heavily developed northwestern portion of the installation, the commercial and military aircraft operations at the Sunport are the primary source of noise. **Figure 3-1** shows the existing DNL noise contours for the Sunport plotted in 5 dB increments, ranging from 65 to 75 dBA DNL. Secondary sources of noise, such as vehicle travel, industrial activities, and military training, also contribute to the louder ambient

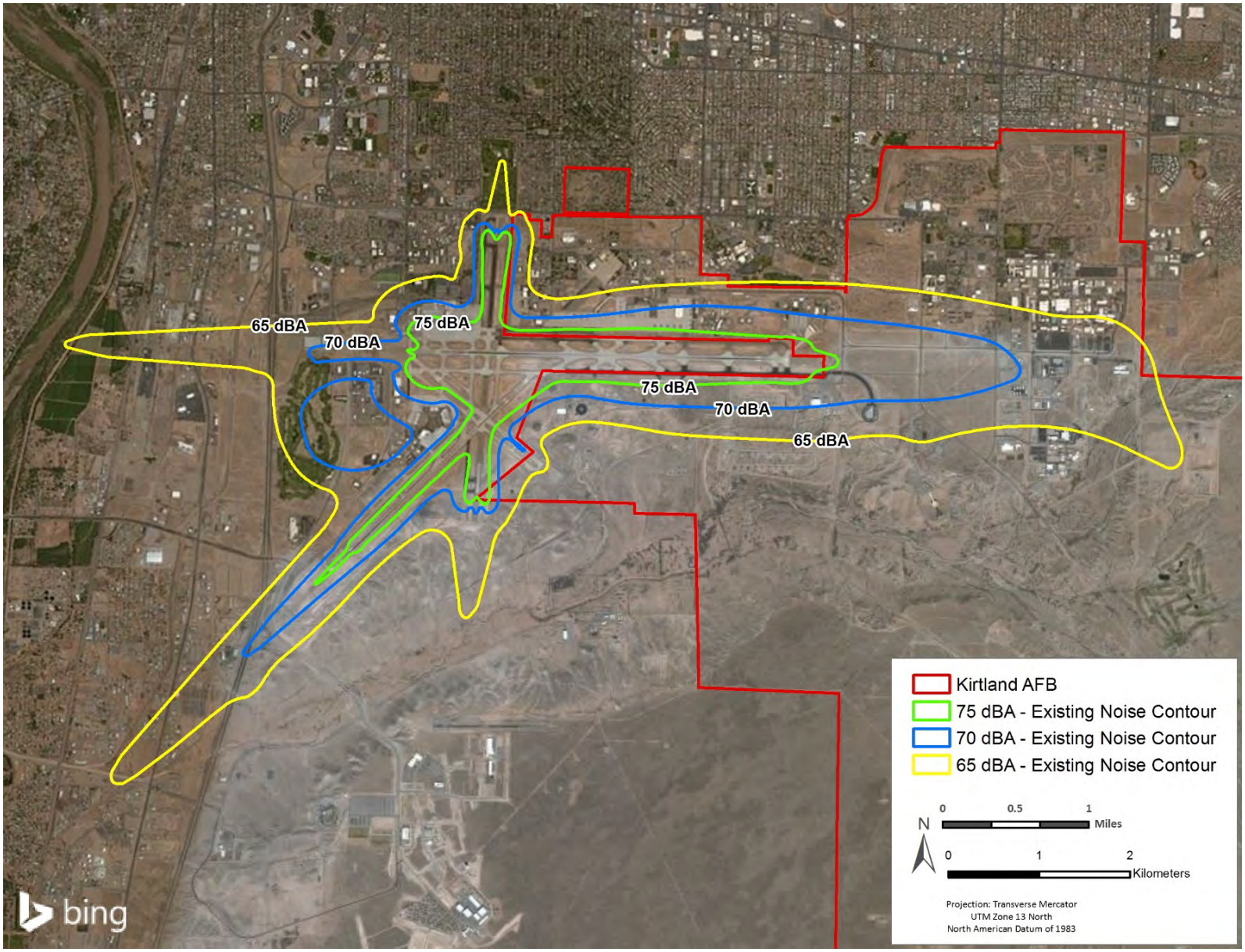

Figure 3-1. DNL Noise Contours for the Albuquerque International Sunport

sound environment of the northwestern portion of the installation compared to other portions of Kirtland AFB. The ambient sound environment of the remaining portions of Kirtland AFB is quieter because development is less concentrated. Intermittent noises from military training, mainly live-fire weapons and explosives training, dominate the ambient sound environment of these portions of Kirtland AFB.

3.1.2 Environmental Consequences

3.1.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short-term, minor, adverse noise impacts from construction, no impacts from operations, and long-term, negligible, adverse impacts from maintenance. Impacts resulting from noise generated by either an SPV or geothermal energy project are similar, therefore the two technologies are discussed collectively in this resource section.

The use of heavy construction equipment can cause an increase in sound that is well above the ambient level. As a result, construction associated with proposed renewable energy projects would result in short-term, minor, adverse impacts on the Kirtland AFB noise environment. Additionally, the off-installation noise environment might also experience short-term, minor, adverse impacts if a proposed renewable energy project was sited in proximity to the Kirtland AFB boundary where construction noise would propagate beyond the installation's boundary. **Table 3-2** presents noise levels associated with common types of construction equipment, which can exceed the ambient sound levels by 20 to 25 dBA in an urban environment and up to 30 to 35 dBA in a remote area. All construction-related noise impacts would be temporary and would last only for the duration of the construction period. Construction would occur during the daytime hours of 0700 to 1700.

Table 3-2. Predicted Noise Levels for Construction Equipment

Construction Equipment	L_{max} at 50 feet	L_{max} at 500 feet	L_{max} at 1,500 feet
Backhoe	78	58	48
Chain Saw	84	64	54
Compactor (Ground)	83	63	53
Concrete Mixer Truck	79	59	49
Concrete Pump Truck	81	61	51
Concrete Saw	90	70	60
Crane	81	61	51
Dozer	82	62	52
Excavator	81	61	51
Front End Loader	79	59	49
Grapple (Backhoe)	87	67	57
Impact Pile Drive	101	81	71
Jack Hammer	89	69	59
Pavement Scarifier	90	70	60
Pneumatic Tools	85	65	55
Vacuum Excavator	85	65	55

Source: FHWA 2006

During the process to site each proposed renewable energy project, Kirtland AFB personnel would identify receptors–such as schools, hospitals, housing, and places of worship–proximal to each site. Construction workers would implement best management practices (BMPs) to reduce adverse noise impacts on these receptors, as needed. Noise from construction equipment would be managed using mufflers and temporarily placing noise dampening barriers (e.g., sound screens) around construction sites. Noise levels from construction sites would vary depending on the types of equipment being used on a given day, the topography of the area where the project would occur, the distance between the receptor from the generating source, and the presence of trees or buildings. Because Kirtland AFB is an active military installation that supports aircraft and live-fire weapons training, the temporary increases in construction noise would be a fraction of the noise generated routinely on the installation. Additionally, construction noise occurring within the heavily developed northwestern portion of Kirtland AFB would be less noticeable than construction noise occurring elsewhere on the installation because of the louder ambient noise environment of this portion of the installation. While construction noise might be more noticeable on the portions of Kirtland AFB that are less developed, fewer receptors would be exposed to these increased levels of noise. Proposed renewable energy projects would be a permissible type of development within all of the Sunport's DNL noise contours.

No impacts from noise would result from the operation of a proposed renewable energy project. The SPV and geothermal energy systems are largely silent during normal operation, and the only appreciable noises would result from supporting infrastructure such as cooling fans and electrical distribution equipment. These noises would be similar to those from air conditioning systems and would be perceptible only in close proximity to the noise sources.

Long-term, negligible, adverse impacts on the ambient noise environment of Kirtland AFB would occur from the maintenance of proposed renewable energy projects. Activities such as washing and replacing SPV panels, performing preventative maintenance and corrective repairs, and conducting periodic inspections would occur annually. These actions would generate noise from the operation of trucks, equipment, and other tools. Such noises would be produced intermittently when maintenance activities are needed and would be similar to noises already produced on Kirtland AFB from similar maintenance activities on existing infrastructure. As such, noises from maintenance to a proposed renewable energy project would not be significant.

3.1.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and noise conditions would remain the same as described in **Section 3.1.1**. No new noises would be introduced to the Kirtland AFB and off-installation sound environments. No new impacts would occur.

3.2 Land Use

The term "land use" refers to real property classifications that indicate either natural conditions or the types of human activity occurring on a parcel. In many cases, land use descriptions are codified in local zoning laws. However, there is no nationally recognized convention or uniform

terminology for describing land use categories. As a result, the meanings of various land use descriptions, "labels," and definitions vary among jurisdictions. Natural conditions of property can be described or categorized as unimproved, undeveloped, conservation or preservation area, and natural or scenic area. There is a variety of land use categories resulting from human activity. Descriptive terms often used include residential, commercial, industrial, agricultural, institutional, and recreational.

Air Force Instruction (AFI) 32-7062, *Comprehensive Planning*, describes procedures for developing, implementing, and integrating an IDP with activity management plans. It establishes a systematic framework for informative decision making on the physical development of Air Force installations and the surrounding area. Comprehensive planning integrates the multiple Air Force processes that support and sustain current and future missions. It relies on active participation in the development of a sustainable plan and promotes compliance with applicable federal, state, and local laws, regulations, and policies. Through comprehensive planning, installations are divided into identifiable Planning Districts based upon geographical features, land use patterns, building types, and transportation networks. The concepts and principles of sustainable planning are incorporated into all installation development planning and infrastructure projects. The goal is to satisfy mission requirements while maintaining a safe, healthy, and high quality environment for current and future generations.

In appropriate cases, the location and extent of a proposed action needs to be evaluated for its potential effects on a project site and adjacent land uses. The foremost factor affecting a proposed action in terms of land use is its compliance with any applicable land use or zoning regulations. Other relevant factors include matters such as existing land use at the proposed project site, the types of land uses on adjacent properties and their proximity to a proposed action, the duration of a proposed activity, and its "permanence."

3.2.1 Affected Environment

Surrounding Land Use. Kirtland AFB is located in the southwestern portion of Bernalillo County, New Mexico (see **Figure 1-1**). It is bound on the west and north by the city of Albuquerque, on the northeast and east by the Cibola National Forest, and on the south by the Isleta Pueblo. The area east of the Withdrawn Area includes a low impact recreational area and open space in the Cibola National Forest. The Sunport, the city of Albuquerque's airport, abuts the installation's northwestern border and allows the installation use of its runways. Runway 17/35 is a decommissioned north-south runway that will eventually be home to the Aviation Center of Excellence, which will be the centerpiece of a new development known as Destination Sunport. This new development will include the decommissioned runway and a 10-acre strip along Gibson Boulevard that will feature aviation and aerospace businesses, high tech companies, and retail businesses (ABQ Sunport 2017).

Kirtland AFB works with the planning commissions and governing bodies within the city of Albuquerque and Bernalillo County to ensure compatible development occurs in areas near or adjacent to the installation. The neighborhoods in the city of Albuquerque north of the installation include a mix of residential (both single- and multi-family development) and commercial uses. The Juan Tabo Hills subdivision, which abuts the northern boundary of the installation, has been a concern because of their close proximity and potential to impact

installation and DOE activities. Commercial uses range from neighborhood retail to commercial/industrial uses. Institutional uses in the same area include the Veterans Affairs Medical Center facilities located south of Gibson Boulevard. The Sandia Science and Technology Park is an industrial park with many mission partners that benefit from the close proximity to Sandia National Laboratories (SNL).

Two large developments within the city of Albuquerque pose constraints to development on Kirtland AFB: Mesa del Sol and Valle del Sol. The Mesa del Sol community consists 13,000 acres and is located adjacent to the southwest boundary of the installation. The Mesa del Sol community will include residential and employment centers and commercial, civic, institutional, and recreational uses. Because of its proximity, a buffer zone called La Semilla, which is 1 mile wide and 5 miles long, has been established. La Semilla is leased to DOE by the State Land Office for a term of 100 years. It is controlled by DOE and USAF has no jurisdiction over the parcel or the activities conducted on the parcel. La Semilla is located along the installation's western boundary toward the southern end of the installation. It serves as a buffer between activities at the installation and residences at Mesa del Sol. La Semilla is a 2,549-acre environmental education and sustainable living research center divided into three interrelated parts: a Renewable Resource Research Park, an Environmental Education Campus, and the McCormick Ranch, a farming and ranching interpretive site. A visitor orientation center is the only planned permanent structure on the parcel (KAFB 2016a).

The planned Valle del Sol community, located southwest of Kirtland AFB, will consist of 540 acres and will include industrial/manufacturing uses. The proposed land use for this development is compatible with the flight activities at both Kirtland AFB and the Sunport (KAFB 2016a).

On-Installation Land Use. Kirtland AFB is 51,585 acres, and most of the land is owned by USAF. DOE occupies the largest amount of land area of any mission partner on the installation. DOE owns and operates facilities on 7,533 acres at Kirtland AFB, primarily in the eastern portion of the cantonment area and the northeastern and southwestern portions of the installation (see **Figure 1-1**).

Land use at Kirtland AFB consists of a total of 12 Planning Districts. Four planning districts are primarily dedicated to testing, storage, and training operations. These include the Manzano District, the Arroyo District, the Southern Research and Development Area, and the Withdrawn Area. The cantonment area of the installation consists of the Flightline, Science and Technology, Medical, Industrial, Community, Enterprise, Airfield, and DOE/SNL Districts.

The most heavily developed area of Kirtland AFB is the cantonment area in the northwestern portion of the installation. The cantonment area is commonly referred to in terms of its east or west sides; the west side is the site of the original Kirtland AFB, while the east side included the former Sandia and Manzano bases. Recent installation planning and infrastructure efforts have focused on unifying the formerly segregated western and eastern portions of the cantonment area into a more unified installation.

Airfield operations and aircraft support facilities are concentrated in the Flightline District, which is in the western portion of the cantonment area adjacent to the Sunport and its runways.

Several associate organizations, including the Air Force Research Laboratory; the New Mexico Air National Guard; the Space and Missiles Systems Center, Detachment 12; and the 58th Special Operations Wing are also in this area. The administrative area of the Air Force Nuclear Weapons Center and most of the installation support functions, to include the 377 ABW Headquarters and the 377th Mission Support Group (377 MSG), are located in the eastern portion of the cantonment area. Facilities of other mission partners to include DOE's Albuquerque Office, SNL, Air Force Operational Test and Evaluation Center, Defense Threat Reduction Agency, and Air Force Safety Center are also located in this area. Most housing areas and their associated community uses are at the northeastern border of the cantonment area in the Community District, adjacent to existing off-installation neighborhoods.

The Star Fire Optical Range, High Energy Research Test Facility, and the Lovelace Respiratory Research Institute are located in the southern portion of the installation, which is dominated by undeveloped open space. While most recreational facilities are in the cantonment area, the Tijeras Arroyo Golf Course is in the southwestern portion of the installation in the Manzano District.

In the Future Land Use Plan, presented in the installation's 2016 IDP, a major emphasis of the installation's long-range facility development plan is to consolidate land uses and collocate similar functions. Special attention is given to energy conservation, architectural compatibility, and low maintenance exteriors. The future land use patterns described in the IDP resemble the installation's existing land use pattern, although modifications have been made to the plan to enhance functional efficiency through consolidation of similar land uses. Changes to the overall land use pattern at Kirtland AFB will take place incrementally and will focus on consolidating existing land uses. The Future Land Use Plan establishes clear land use zones that indicate what development types should occur within the various areas of the installation. Future facility siting decisions should consider compatible land uses and seek to establish a logical order, or hierarchy of uses (KAFB 2016a).

3.2.2 Environmental Consequences

3.2.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in no impacts from an SPV project within the Manzano district or Southern Research and Development Area, long-term, minor, adverse impacts if unable to avoid land use compatibility issues, and beneficial impacts if sited on redevelopable land. No adverse impacts would result from a geothermal energy project on developable or redevelopable land in the cantonment area or other locations on Kirtland AFB, long-term, minor, adverse impacts if unable to avoid land use compatibility issues, beneficial impacts if sited on redevelopable land. No impacts to land use at Kirtland AFB or off-installation would result from infrastructure construction. Long-term, minor, beneficial impacts would result from undergrounding of utility lines.

The Level 1 selection standards identified in **Section 2.3** were considered prior to selection of the potential electricity-generating renewable energy technologies (i.e., SPV and geothermal energy) that would be implemented under the Proposed Action. As such, implementation of the proposed technologies would support the Kirtland AFB mission; be feasible; and be compatible with installation land use objectives, future development, and community relationships.

The Proposed Action would be consistent with the renewable energy goals, strategies, and standards identified in the Air Force Energy Plan, Kirtland AFB Environmental Commitment Statement, Kirtland AFB IDP (energy surety goal and objectives), as well as federal energy goals and strategies as outlined in EPAct 2005, Energy Independence and Security Act (EISA), 10 USC § 2911(e), and EO 13693. Therefore, the Proposed Action would be consistent with existing land uses plans and policies.

Implementation of the Proposed Action would preclude the use of the sites selected for renewable energy projects for other land uses. However, it is assumed that SPV and geothermal energy projects would be sited and designed in accordance with the Kirtland AFB IDP (Future Land Use Plan and form-based planning standards, respectively). Therefore, the programmatic implementation of SPV and geothermal technologies would likely be compatible with surrounding land uses, and would not preclude the continued use or occupation of any areas. Additionally, the Proposed Action would likely not preclude the viability of existing uses; however, prior to selecting sites for each renewable energy project, Kirtland AFB should consider certain technology-specific land uses issues that could result in adverse impacts associated with planning criteria established to ensure health and safety of life and property. In order to be consistent with these health and safety planning criteria, siting of proposed renewable energy projects would need to avoid active ERP and DOE ER sites, flood zones, and airfield surface areas. Potential technology-specific adverse land use impacts are discussed below in each proposed renewable energy technology section.

The infrastructure associated with each renewable energy technology, including electrical utility lines, substations, and transformer equipment, would be installed among existing compatible equipment and existing utility rights-of-way as much as feasible. This would be consistent with the Kirtland AFB IDP Future Land Use Plan that emphasizes collocating and consolidating similar land uses. Similarly, it is assumed that potential energy storage options, including a microgrid, would also be appropriately sited with other similar, industrial uses, and would be compatible with surrounding land uses. Therefore, no adverse impacts on land use or recreation would be expected. Additionally, underground electric distribution lines would be constructed where site conditions dictate, and would be required in the Flightline, Science and Technology, Medical, Industrial, Community, and Enterprise districts in the cantonment area. Undergrounding of utility lines would allow for more efficient use of land, and result in a long-term, beneficial land use effect.

Kirtland AFB has 42 parcels consisting of 870.1 acres that are available for development (326 acres) or redevelopment (544.1 acres) in the Flightline, Science and Technology, Medical, Industrial, Community, and Enterprise districts in the cantonment area (KAFB 2016a). Additional land is available for development outside of the cantonment area in the southwestern portion of the installation. The Proposed Action would not be sited within active ERP and DOE ER sites, air accident zones, outgrant areas, flood zones, historic district, or airfield surface area. If the proposed technologies are sited and constructed within redevelopable areas, the land would be repurposed for a more productive use to preserve undeveloped land. This would be consistent with DoD and USAF-prescribed development principles and best practices, and the Kirtland AFB IDP that prioritizes efficient land use and resource conservation through compact, infill development and redevelopment to maximize functional adjacencies. Siting of

the proposed renewable energy technologies on redevelopable land would be a long-term, minor beneficial land use impact.

AFI 32-7063, *Air Installations Compatible Use Zones Program*, states that all potential renewable energy developments should be analyzed on a case-by-case basis for land use compatibility issues. The AFI indicates that utilities, including large scale, commercial sized renewable energy development such as the Proposed Action, should not be sited within the clear zone, but can be sited in Accident Potential Zones I or II as long as associated distribution lines are underground. In the interest of safety and preserving flying mission viability, DoD clear zones and accident potential zones should be respected in siting future facilities at Kirtland AFB (KAFB 2016a). The height of overhead distribution lines associated with both proposed renewable energy technologies, regardless of location, should be considered to ensure compatibility with military training and testing missions, and aviation uses at the Sunport and installation locations. Additionally, AFI 32-7063 indicates that the location of land uses that produce radio frequency or electromagnetic interference can directly affect signal and electronic testing mission and, thus, interfere with aircraft computer/communication systems or navigational equipment, or weapons systems. SPV and geothermal energy projects could possibly create this interference; therefore, Kirtland AFB should ensure that design of renewable energy projects does not produce this interference, and that the selected sites are not on or near safe travel corridors for ordnance.

The Proposed Action would be compatible with off-installation land uses, and would not result in impacts on these uses.

Solar Photovoltaic Energy. A potential SPV project at Kirtland AFB would likely be a ground mounted system on one site consisting of up to 500 acres. None of the 42 parcels (or a combination of multiple contiguous parcels) of developable or redevelopable land in the cantonment area are large enough to accommodate an SPV project; therefore, it would likely be located in the southwestern portion of the installation within the Manzano district or Southern Research and Development Area. This area is dominated by undeveloped land designated as Open Space in the Future Land Use Plan. An SPV system would generally be compatible in this area, and would not result in impacts on land use or recreation. Impacts to this area shall be reduced wherever possible by co-locating energy generation facilities with existing development and siting areas for unavoidable new development adjacent to areas that have already been developed and no longer serve as effective open space and wildlife habitat.

However, prior to siting an SPV project, Kirtland AFB should consider the potential of the SPV arrays to produce glare/glint and other lighting emissions impacts, particularly with respect to the nearby Sunport and other on-installation aviation uses. AFI 32-7063 states that the potential for glint and glare from SPV panels is extremely rare; however, based on the materials or the siting of the panels, there is potential for glint and glare impacts on air traffic control facilities and pilots on approach to airfields. It is recommended that prior to siting an SPV project, the SNL Solar Glare Hazard Analysis Tool (SGHAT) or other analysis tool, in accordance with DoD Instruction 4165.57, *Air Installations Compatible Use Zones (AICUZ)*, be used to determine whether SPV arrays could create a glint/glare problem for sites within the airfield imaginary surface area from the Sunport or other aviation uses. The solar glare study would ensure that

glare from the proposed site would not impact pilots or air traffic controllers working at the Sunport. If any issues are identified, the USAF would consider measures to avoid impacts on pilots or air traffic controllers. If a proposed SPV project is unable to avoid land use compatibility issues because of site selection, then the Proposed Action would result in long-term, minor, adverse impacts on land use.

Any SPV systems sited on existing facilities, such as building rooftops and carport structures, would be compatible with surrounding land uses, and would not preclude the viability of existing uses or prevent the continued occupation of any areas. It is assumed that all SPV projects would be sited according to the Kirtland AFB IDP. However, structure or facility-mounted SPV projects should also be analyzed prior to choosing a specific site to determine if there would be an impact from glint/glare. If these issues are able to be avoided, a proposed SPV project would be compatible with surrounding land uses and not result in impacts on land use.

Geothermal Energy. A potential geothermal energy project at Kirtland AFB would likely be on a 5- to 20-acre site that is in close proximity to the geothermal energy source. While it is unknown if adequate geothermal sources exists at the installation, existing developable or redevelopable land in the cantonment area or in other locations within the installation could accommodate a proposed geothermal energy project. Geothermal energy technology is generally compatible with the mission and land use at Kirtland AFB, and would not result in impacts on land use or recreation.

However, prior to siting a geothermal energy project, Kirtland AFB must ensure that the proposed project does not conflict with planning criteria established to ensure health and safety of life and property. AFI 32-7062 states that geothermal projects should be evaluated to determine whether the height of the steam towers would create hazards to flight, and if the steam or lighting associated with the project could create visual interference for pilots. Tall objects can pose significant hazards to flight operations or interfere with navigational equipment. Prior to siting and design of the proposed geothermal plant, it should be determined if the steam tower and other system components meet the height restrictions, if any, associated with the Sunport or other aviation uses on the installation. Similarly, steam and lighting (as described under ***SPV Energy***) could interfere with flight activities, and may not be compatible with air operations. The type of geothermal energy plant technology would depend on the state of the fluid (steam or water) and temperature of the geothermal source (DOE EERE 2017). Binary and flash/binary power plants normally emit no visible steam or water vapor plumes; however, flash and steam plants produce steam (MIT 2006). Kirtland AFB should evaluate if steam or lighting emissions from the geothermal energy plant would obscure the vision of pilots or air traffic control. If, based on the selected site, a proposed geothermal energy project is unable to avoid these land use compatibility issues, then the Proposed Action would result in long-term, adverse impacts.

3.2.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation. Electricity would continue to be purchased from Western Area Power Administration, and the amount of electricity from off-installation suppliers would not be reduced. Kirtland AFB would continue to address its

commitment to the responsible use of energy throughout the installation through implementation of practices and procedures to conserve energy, improve energy efficiency, and promote sustainability. Kirtland AFB would focus on reducing energy consumption through energy conservation and building performance, but would not increase installation energy security or provide strategic flexibility in energy generating sources and, thus, would not meet the need of the Proposed Action. There would be no change to existing land uses, including recreation, as a result of the No Action Alternative; therefore, there would be no new impacts.

3.3 Air Quality

Air quality is defined by the concentration of various pollutants in the atmosphere at a given location. Under the Clean Air Act, the six pollutants defining air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide, ozone (O_3), suspended particulate matter (measured less than or equal to 10 microns in diameter [PM_{10}] and less than or equal to 2.5 microns in diameter [$PM_{2.5}$]), and lead (Pb). CO, SO_2, Pb, and some particulates are emitted directly into the atmosphere from emissions sources. O_3, nitrogen dioxide, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes. Volatile organic compounds (VOC) and nitrogen oxides (NO_x) emissions are used to represent O_3 generation because they are precursors of O_3.

USEPA has established National Ambient Air Quality Standards (NAAQS) (40 CFR § 50) for the criteria pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have short-term and long-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects. The state of New Mexico has established its own ambient air quality standards for the criteria pollutants, which in some cases are more stringent than the NAAQS.

Areas that are and have historically been in compliance with the NAAQS or have not been evaluated for NAAQS compliance are designated as attainment areas. Areas that violate a federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment. The maintenance designation can be removed from an area if the area demonstrates to USEPA it can consistently remain below NAAQS for more than 20 years.

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called *de minimis* levels. *De minimis* levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

The New Mexico Environment Department (NMED) Air Quality Bureau oversees programs for permitting the construction and operation of new or modified stationary source air emissions in

the state of New Mexico. The NMED Air Quality Bureau has delegated authority over air quality in Bernalillo County to the Albuquerque Environmental Health Department Air Quality Division (AEHD-AQD).

Fugitive Dust Control Regulation. The AEHD-AQD has fugitive dust control requirements in 20.11.20 New Mexico Administrative Code (NMAC), *Fugitive Dust Control*. A fugitive dust control construction permit is required for projects disturbing 0.75 acres or more and the demolition of buildings containing more than 75,000 cubic feet of space. As stated in 20.11.20.12 NMAC, *General Provisions*, each person shall use reasonably available control measures or any other effective control measure during active operations or on inactive disturbed surface areas, as necessary, to prevent the release of fugitive dust, whether or not the person is required by 20.11.20 NMAC to obtain a fugitive dust control permit.

Climate Change and Greenhouse Gases. Global climate change refers to long-term fluctuations in temperature, precipitation, wind, sea level, and other elements of Earth's climate system. Ways in which the Earth's climate system may be influenced by changes in the concentration of various gases in the atmosphere have been discussed worldwide. Of particular interest, GHGs are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century because of an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

3.3.1 Affected Environment

Kirtland AFB is located in Bernalillo County, New Mexico, which is located within the Albuquerque-Mid Rio Grande Intrastate Air Quality Control Region 152. The Albuquerque-Mid Rio Grande Intrastate Air Quality Control Region also includes portions of Sandoval and Valencia counties, New Mexico (NMED 2017). Bernalillo County is designated by USEPA as unclassified/attainment for all criteria pollutants. The county was designated as nonattainment for CO until 1996 when it was redesignated as maintenance because CO concentrations decreased and no longer exceeded NAAQS (USEPA 2017a). CO concentrations continued to steadily decrease in the region over the next 20 years, so the AEHD-AQD submitted a CO Limited Maintenance Plan to USEPA. The CO Limited Maintenance Plan is an option provided by USEPA for areas that demonstrated CO levels will remain below 85 percent of the CO NAAQS. This Limited Maintenance Plan expired on 13 June 2016, and made conformity analysis unnecessary for CO in Bernalillo County. As such, Bernalillo County is in attainment for CO and all other criteria pollutants.

Kirtland AFB manages multiple air quality permits including 20.11.41 NMAC, *Construction Permits*; 20.11.21 NMAC, *Open Burning*; 20.11.20 NMAC, *Fugitive Dust Control*; and 20.11.40 NMAC, *Source Registrations*, all of which include operating or emissions limits to ensure compliance with the Clean Air Act. Kirtland AFB must also comply with 20.11.42 NMAC Title V Operating Permit #527-RN1, which covers a majority of the permitted stationary emission sources on the installation. These sources include emergency generators, fire pump engines, boilers, water heaters, fuel storage tanks and fuel dispensing systems, gasoline service stations, surface coating operations, aircraft engine testing, fire training, remediation activities,

mulching activities, miscellaneous chemical usage, and open detonation of munitions for military training and research and development. **Table 3-3** presents the 2017 stationary air emissions inventory for Kirtland AFB.

Table 3-3. Calendar Year 2017 Stationary Air Emissions Inventory for Kirtland AFB

Actual Emissions	NO_x (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)
	6.03	41.15	5.60	0.34	0.68

Kirtland AFB also holds a Fugitive Dust Control Programmatic Permit, Permit No. 8091-P, with the AEHD-AQD that covers routine heavy equipment activities. The permit includes BMPs such as watering during ground-disturbing activities, using soil stabilization agents for dust suppression, and decreasing speed limits on unpaved roads.

Climate Change and Greenhouse Gases. Ongoing global climate change has the potential to increase average temperatures and cause more frequent, intense, and prolonged droughts in the southwest United States including New Mexico (Garfin et al. 2014). These changes to regional climate patterns could result in regional changes to flooding frequency, vegetation types, vegetation growth rates, wildfire potential, groundwater depth, and potable water availability.

3.3.2 Environmental Consequences

3.3.2.1 PROPOSED ACTION

Construction of proposed renewable energy projects on Kirtland AFB would result in short-term, negligible to moderate, adverse impacts on air quality. Emissions of criteria pollutants and GHGs would be directly produced from construction activities such as operation of heavy equipment, construction workers commuting daily to and from job sites in their personal vehicles, heavy duty diesel vehicles hauling construction materials and debris to and from the job sites, and ground disturbance. Construction emissions would be temporary and last only for the duration of construction. For the purposes of this air quality analysis, each renewable energy project is assumed to be constructed within 12 months and no more than one renewable energy project would be constructed in a given year.

Solar Photovoltaic Energy. The air pollutant of greatest concern from construction of SPV projects is particulate matter, such as fugitive dust. The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of activity. For a large-scale SPV project constructed on undeveloped land, site grading could extend across an area measuring up to 500 acres and would produce moderate fugitive dust emissions. Negligible fugitive dust emissions would be produced from the construction of small-scale SPV projects, such as those attached to existing buildings or above existing parking lots where site grading would not be required. Fugitive dust air emissions would be greatest during the initial site grading and excavation and would vary day to day depending on the work phase, level of activity, and prevailing weather conditions. Particulate matter emissions would also be produced from the combustion of fuels in vehicles and equipment needed to construct the array.

Construction would incorporate BMPs and environmental control measures (e.g., wetting the ground surface) to minimize fugitive particulate matter air emissions. Additionally, work vehicles are assumed to be well maintained and to use diesel particulate filters to reduce particulate matter air emissions. Each time a SPV project is proposed, USAF would obtain a fugitive dust control construction permit from AEHD-AQD in accordance with 20.11.20 NMAC. Application for the fugitive dust control construction permit would require USAF to develop a fugitive dust control plan, which would enumerate specific dust control measures that would be implemented during construction. These BMPs and environmental control measures could reduce uncontrolled particulate matter emissions from a construction site by 10 to 50 percent depending on the number of BMPs and environmental control measures required and the potential for particulate matter air emissions (City of Albuquerque 2016). Per 20.11.20.12 NMAC, USAF would also use reasonably available fugitive dust control measures during any construction activity associated with the Proposed Action, whether or not a fugitive dust control permit was required.

As stated above, the amount of air emissions from an SPV project is highly variable and depends on the size of the construction area, scope of construction, and location of the site. For example, the construction of a small-scale SPV project on an existing building or parking lot would produce negligible air emissions, while the construction of a large-scale SPV project on undeveloped land would produce moderate air emissions. USAF's Air Conformity Applicability Model (ACAM) was used to estimate the annual air emissions from the construction of two large-scale SPV projects: the construction of a 200-acre and 500-acre SPV array on undeveloped areas. These acreages represent reasonable size bounds for a candidate SPV array on Kirtland AFB. The ACAM analyzed 3 months of site grading over 200- and 500-acre areas, 6 months of trenching over a distance of 1 mile, and 9 months of small-scale building construction over 200- and 500-acre areas. **Table 3-4** summarizes the anticipated air emissions from the construction of SPV arrays of these sizes. **Appendix B** contains the detail ACAM reports for both size SPV arrays.

Geothermal Energy. Construction associated with the proposed geothermal energy projects on Kirtland AFB would have similar but less intense adverse impacts on air quality than the construction associated with the proposed SPV energy projects. Emissions of all criteria pollutants during construction would be less with the geothermal energy projects than the SPV energy projects because the area of ground disturbance for the geothermal energy projects would be much smaller than that of the SPV energy projects (e.g., approximately 5 to 20 acres). Additionally, the intensity of construction would be less with the geothermal energy projects because construction equipment would be largely limited to a drill rig. Similar BMPs and environmental control measures would be implemented during construction to control air emissions including fugitive dust. As with the SPV energy projects, in accordance with 20.11.20 NMAC, USAF would obtain a fugitive dust control construction permit from AEHD-AQD whenever a project is proposed.

USAF's ACAM was used to estimate the annual air emissions from the construction of a hypothetical geothermal energy project. The ACAM analyzed 3 months of site grading over a 10-acre area (10 acres was chosen for calculation purposes as the average project size), 6 months of trenching over a distance of 1 mile, and 9 months of small-scale building construction

over a 10-acre area. **Table 3-4** summarizes the anticipated air emissions from the construction of this geothermal energy project, and **Appendix B** contains the detail ACAM report.

Table 3-4. Range of Air Emissions from Construction of Large-Scale Renewable Energy Projects

Construction Year	NO_x (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	GHG (tpy)
200-Acre SPV Array	10.307	1.394	6.880	0.021	130.366	0.204	2,175.7
500-Acre SPV Array	14.590	1.821	8.297	0.030	325.433	0.266	3,226.5
Typical Geothermal Energy Project	3.947	0.620	3.683	0.009	6.749	0.091	834.2

Notes:

Pb emissions are not included because they are negligible for the types of emission sources under this Proposed Action.

All air emissions have been estimated using the USAF ACAM, which generally overestimates air emissions and produces conservative results. Actual construction equipment and operating periods are expected to produce lesser emissions than those estimated in this table. A 50 percent control factor to PM_{10} and $PM_{2.5}$ emissions has been applied because fugitive dust emissions would be reduced with BMP and environmental control measures specified in a project's fugitive dust control plan.

Summary of All Impacts. As noted in **Section 3.3.1**, Bernalillo County is designated by USEPA as unclassified/attainment for all criteria pollutants. Therefore, the Federal General Conformity Rule does not apply to the Proposed Action and neither an applicability determination nor a conformity analysis is required. However, for informational purposes, the estimated air emissions from the construction of the two SPV arrays and the geothermal energy project can be compared to the 100 tpy *de minimis* level. Emissions of all criteria pollutants except PM_{10} for the SPV arrays would be well below the 100 tpy threshold. PM_{10} emissions are estimated to exceed the 100 tpy threshold for both size SPV arrays; however, actual construction equipment and operating periods are expected to produce lesser emissions than those estimated in **Table 3-4** because the estimation methodology (i.e., USAF ACAM) generally overestimates air emissions and produces conservative results. Fugitive dust emissions would be reduced with BMPs and environmental control measures specified in a fugitive dust control plan. As such, a 50 percent control factor to PM_{10} and $PM_{2.5}$ emissions has been applied in **Table 3-4**. By obtaining a fugitive dust control construction permit from AEHD-AQD, USAF would demonstrate that through the implementation of BMPs, the Proposed Action would not result in significant impacts from PM_{10} emissions.

Long-term, negligible, adverse impacts on air quality would occur from the operation and maintenance of the proposed renewable energy projects. Activities such as washing SPV panels, performing preventative maintenance and corrective repairs, and conducting periodic inspections would occur annually. These actions would produce negligible air emissions from the operation of trucks, equipment, and other tools. These emissions would be produced intermittently and occur only when such activities are needed. The installation's existing Fugitive Dust Control Programmatic Permit, Permit No. 8091-P, with the AEHD-AQD that covers routine heavy equipment activities, could be used to cover maintenance associated with the proposed renewable energy projects.

The use of renewable solar and geothermal energy to supply the everyday energy needs of Kirtland AFB could have a long-term, negligible, beneficial impact on regional air quality. The Proposed Action might result in a slight decrease in the regional demand for energy supplied from nonrenewable sources, which could lead to beneficial impacts on regional air quality. However, the sources for the energy currently supplied to Kirtland AFB depend on many different economic factors, and energy could be generated at locations far from the Albuquerque region. Therefore, it cannot be said definitely that implementing the proposed SPV projects on Kirtland AFB would have long-term, beneficial impacts on regional air emissions and regional air quality from energy generation. No changes to the Kirtland AFB air emission inventory would likely occur from the proposed renewable energy projects.

***Climate Change and Greenhouse Gases*.** Construction associated with the proposed SPV projects would emit between approximately 2,176 and 3,227 tons of carbon dioxide equivalent and construction associated with a proposed geothermal energy project would emit approximately 834 tons of carbon dioxide equivalent during a construction year. By comparison, these amounts of carbon dioxide equivalent are approximately the GHG footprints of 106, 157, and 41 single family houses with two cars per home (USEPA 2017b). As such, this single-year emission of GHG would not contribute meaningfully to the potential effects of global climate change. The use of renewable energy projects to supply the everyday energy needs of Kirtland AFB would have a long-term, negligible, beneficial impact on global climate change by reducing the amount of GHG emissions from Kirtland AFB.

Ongoing changes to climate patterns in the southwestern United States are described in **Section 3.3.1**. These climate changes are unlikely to affect USAF's ability to implement the proposed renewable energy projects and would not change the solar or geothermal energy potentials for the region.

3.3.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and the existing conditions discussed in **Section 3.3.1** would continue. No new additional air emissions would be produced beyond those levels currently experienced in the production of energy for Kirtland AFB. The No Action Alternative would not result in any new or additional impacts on air quality.

3.4 Geology and Soils

Geological resources consist of the Earth's surface and subsurface materials. Within a given physiographic province, these resources typically are described in terms of topography and physiography, geology, soils, and, where applicable, geologic hazards and paleontology. Topography and physiography pertain to the general shape and arrangement of the land surface, including its height and the position of its natural and human-made features. Geology is the study of the Earth's composition and provides information on the structure and configuration of surface and subsurface features. Such information is derived from field analyses based on observations of the surface and borings to identify subsurface composition.

Soils are the unconsolidated materials overlying bedrock or other parent material. Soils typically are described in terms of their complex type, slope, and physical characteristics. Differences among soil types, in terms of their structure, elasticity, strength, shrink-swell potential, and erosion potential, affect their abilities to support certain applications or uses. In appropriate cases, soil properties must be examined for their compatibility with particular construction activities or types of land use.

Farmland is protected under the Farmland Protection Policy Act (FPPA) of 1981. The intent of the FPPA is to minimize the extent that federal programs contribute to the unnecessary conversion of high-quality farmland to non-agricultural uses. The FPPA also ensures that federal programs are administered in a manner that, to the extent practicable, is compatible with private, state, and local government programs and policies to protect farmland. The implementing procedures of the FPPA (7 CFR § 658) require federal agencies to evaluate the adverse effects (direct and indirect) of their activities on farmland, which includes prime farmland, unique farmland, and farmland of statewide or local importance, and to consider alternative actions that could avoid adverse effects.

3.4.1 Affected Environment

Regional Geology and Physiography. The Rio Grande Rift is a zone of faults and sediment-filled basins extending from south-central Colorado across New Mexico and into northern Mexico. The rift is a defining physiographic feature of central New Mexico and the approximately 3,000-square-mile Albuquerque Basin (also referred to as the Middle Rio Grande Basin). This basin is comprised of three discrete sub-basins each containing more than 14,000 feet of rift-filled valley deposition accrued over millions of years. Along the margins of the basin, sediment deposits thin out to depths as low as 3,000 feet in areas where tectonic activity formed and uplifted mountains (USGS 2003).

Kirtland AFB is situated near the east-central edge of the Albuquerque Basin, along the margins of the Sandia and Manzanita Mountains. The geology of Kirtland AFB is defined by the vertical displacement between the rock units exposed at the top of these mountains and areas west and southwest towards the Rio Grande River (hereafter, the Rio Grande) and its tributaries. The subsurface environment underlying Kirtland AFB is complex because of the gradual filling of the basin with sediments deposited by river and stream (fluvial), slopes and mountain fronts (alluvial-colluvial), wind (eolian), and volcanic activity in the form of lava or ash. Sediment deposition was further complicated by the large-scale faulting of the Albuquerque Basin that occurred approximately 5 to 11 million years ago (SNL 2017a).

The portion of the Albuquerque Basin underlying Kirtland AFB is primarily composed of poorly consolidated alluvial-colluvial sediments. The exposed bedrock in the eastern part of the installation generally consists of igneous (i.e., granite) and metamorphic rock, overlain by non-corresponding deposits of marine carbonate rock (i.e., limestone, sandstone, and shale) (KAFB 2018a).

Topography. The east-central portion of the Albuquerque Basin (locally referred to as East Mesa) extends west and southwest from the steep foothills and slopes of the Sandia and Manzanita Mountains to the gently sloping areas near the Rio Grande. Similarly, the topography

of Kirtland AFB ranges from the mountainous terrain of the Cibola National Forest Withdrawn Area in the east to the relatively flat mesa in the west (KAFB 2018a). Elevations range from nearly 8,000 feet above mean sea level in the Manzanita Mountains to approximately 5,200 feet above mean sea level on the mesa. The greatest change in elevation occurs in the centrally located Coyote Canyon and along the far eastern boundary of Kirtland AFB. The ground surface slope across the installation generally occurs in a west to southwest direction.

Soils. Regionally, the soils of the Albuquerque Basin vary from fine-grained clays and silts near river channels to well-drained sands and sandy loams on plateaus and highlands. Soils associated with Kirtland AFB predominantly consist of sand and loam with varying amounts of gravel, cobble, or stone. Nearly all soils found on the installation are well drained, and some are susceptible to erosion, particularly in areas with topographic relief (KAFB 2016a, KAFB 2018a).

Table 3-5 describes the soil characteristics for areas of Kirtland AFB that directly support USAF training and operations. **Figure 3-2** displays the location of these soils on Kirtland AFB.

Table 3-5. Soil Characteristics of Air Force Controlled Lands at Kirtland AFB

Soil Series	Slope	Runoff
Bluepoint loamy fine sand	1 to 9%	low
Embudo gravelly fine sandy loam	0 to 5%	very low
Embudo-Tijeras complex	0 to 9%	very low to medium
Gila fine sandy loam	0 to 2%	low
Ildefonso gravelly sandy loam	1 to 9%	low
Laporte-Rock Outcrop-Escabosa complex	5 to 20%	medium
Latine sandy loam	1 to 5%	low
Madurez loamy fine sand	1 to 5%	low
Madurez-Wink Association	1 to 7%	very low to low
Nickel-Latene Association	1 to 30%	low to medium
Pino-Rock outcrop Association	3 to 15%	very high
Rock outcrop (various)	15 to 80%	high to very high
Salas complex	20 to 80%	high
Seis-Silver complex	10 to 40%	very high
Seis very cobbly loam	0 to 15%	medium
Silver and Witt soils	5 to 9%	high to very high
Tesajo-Millet stony sandy loam	3 to 20%	low to medium
Tijeras gravelly fine sandy loam	1 to 5%	low
Tome very fine sandy loam	0 to 2%	medium
Wink fine sandy loam	0 to 5%	very low

Source: USDA-NRCS 2017

None of the soils denoted in **Table 3-5** are classified as “prime farmland,” “unique farmland,” or “farmland of statewide or local importance” pursuant to the FPPA (USDA-NRCS 2018). Additionally, Kirtland AFB is not currently utilized for agriculture, nor is any agricultural use planned in the future.

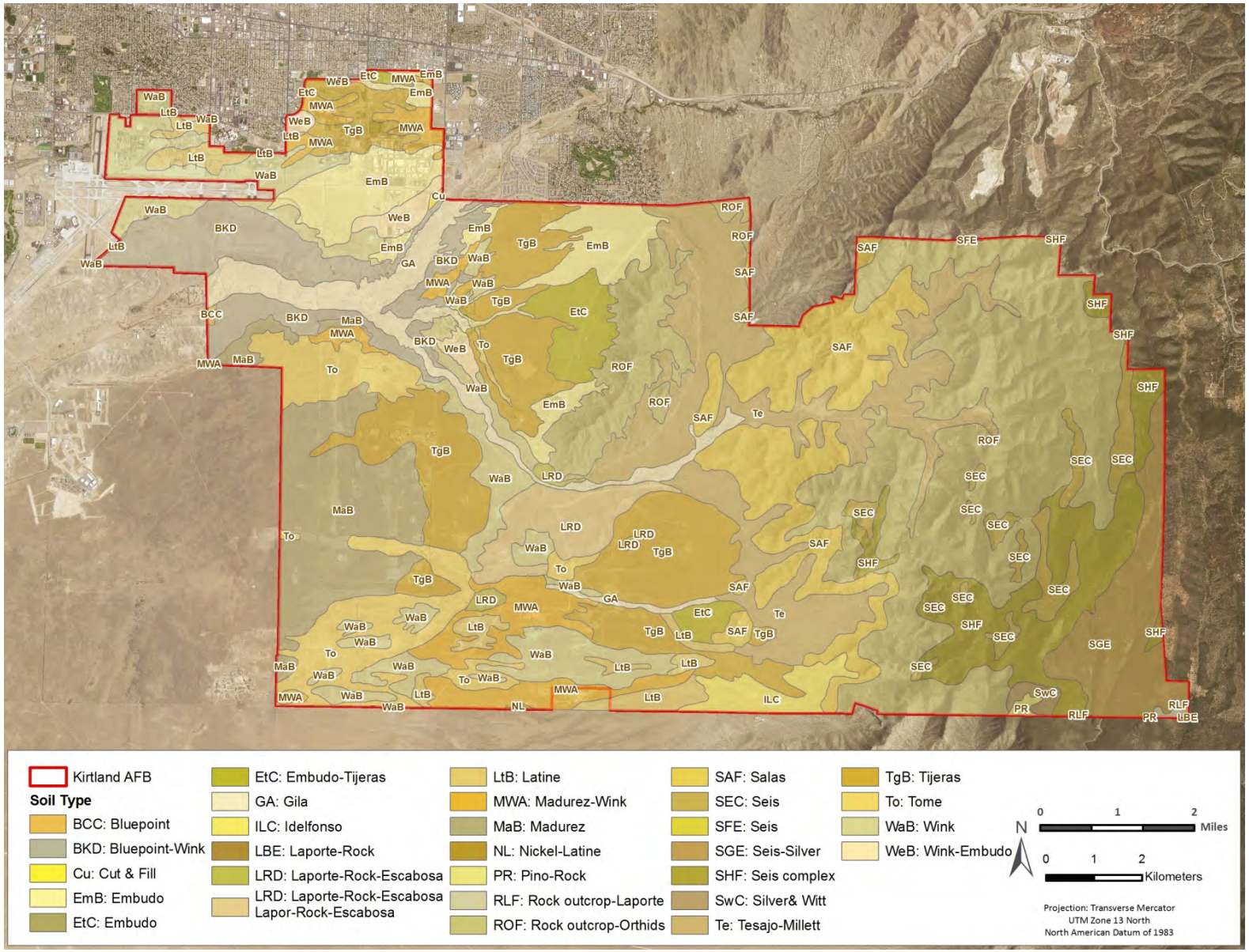

Figure 3-2. Soils on Kirtland AFB

Geological Hazards. Earthquake activity or seismicity is generally caused by displacement across active faults. Earthquakes are more prevalent in areas with a high-level of tectonic activity such as volcanic regions and fault zones. Landslides or mudslides are also commonly associated with tectonically active zones. Landslides include a wide range of ground movements and are typically caused by multiple, overlapping environmental factors (e.g., rockfalls, deep failure of slopes, land modifications, earthquakes, and storms).

More commonly known as the Tijeras fault zone, the Tijeras-Cañoncito fault system consists of several northeast-oriented, sub-vertical faults that form the eastern edge of the Albuquerque Basin. The Tijeras fault zone is part of this regionally extensive group of faults. The southern end of the Tijeras fault zone converges with the southern Sandia and Hubbell Spring fault zones beneath Kirtland AFB near Tijeras Arroyo (USGS 2002).

Frequent, low magnitude and intensity earthquakes are common occurrences for the Albuquerque region, including Kirtland AFB. Accordingly, the US Geological Survey rates the seismic hazard of this area as “moderate” based upon a measurement of expected building damage in an earthquake scenario (USGS 2014).

3.4.2 Environmental Consequences

3.4.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies would result in short-term, minor to moderate, impacts to geology, topography, and soil resources dependent on the proposed site design and the technology employed. Long-term, adverse impacts would be negligible. Impacts to geology and soils resulting from either an SPV or geothermal energy project would be similar; therefore, the two technologies are discussed collectively in this resource section.

Regional Geology and Physiography. Potential impacts on the subsurface environment from renewable energy project construction would vary with the site selected and technology employed. For SPV technologies, the mounting system proposed for the array field would determine the scope of excavation or ground penetration. In many cases, bedrock depth would be a factor in determining excavation requirements (MA DER 2015). Site specific projects would likely include a geotechnical survey to improve the site design for mounting systems and arrays. No impacts on regional geology or physiography would result from the operation of SPV projects or their placement on existing facilities (e.g., rooftops and carports).

Geothermal energy applications inherently intrude into the subsurface. Potential geologic impacts from such applications could occur during construction or operation. Subsidence, the gradual, downward sinking of the land surface, is the most common operational concern with respect to geothermal energy production. Subsidence can occur in the natural environment; however, the thermal extraction of subsurface fluids (e.g., groundwater, hydrocarbons, and geothermal fluids) coupled with natural recharge can also induce subsidence. The potential for such an occurrence would be more likely in geothermal reservoirs that occur in porous sedimentary formations (GEA 2007).

Drilling requirements for geothermal energy applications would be based upon an in-depth geotechnical survey. Standard injection techniques (i.e., re-injection of spent geothermal brines back into an underground reservoir) would maintain reservoir pressure and mitigate for subsidence. Additionally, subsurface excavation associated with geothermal applications could impact economically-viable minerals within an applicable area; however, these resources can now be extracted for sale and/or use in other commercial and industrial applications. Construction or operation of geothermal energy projects would have short-term, adversely minor to moderate impacts on regional geology or physiography.

Topography. The Proposed Action would result in long-term, negligible, adverse impacts on topography as the site design would minimize grading as a cost savings measure. If necessary, SPV site designs in topographically diverse areas would minimize grading by using variable elevation heights to support different blocks of arrays (MA DER 2015). By comparison, topographic impacts of geothermal applications would be reduced in that the land area required is small. In general, the site selection process for the Proposed Action would focus on areas with minimal topographic relief (i.e., less than 5 percent slope).

Soils. Potential impacts on soils from the implementation of the Proposed Action would depend on the number, type, and location of varying the renewable energy project ground stem components. For example, vegetation removal and grading to establish a level surface and requirements for secondary features (e.g., security fencing, equipment shelters, access roads, substations, or transmission lines) would vary between sites. Therefore, the site design would determine the extent of land disturbance associated with systems infrastructure and the connectivity between the varying components. For example, the proposed mounting system for an SPV array field would influence the extent of disturbance.

Short- and long-term, minor, adverse impacts on soil during proposed construction and maintenance activities would result from ground disturbance, erosion, and soil compaction. Under the Proposed Action, soil compaction and erosion would be controlled by using appropriate, required environmental protection measures that could include installing silt fencing and sediment traps, applying water to disturbed soil to prevent wind erosion, and re-vegetating disturbed areas as soon as possible. Many such measures would be explicitly required for projects equal to or greater than 1 acre in size in accordance with the 2017 Construction General Permit (CGP). Coverage under the CGP would also require the preparation and implementation of site-specific Erosion and Sediment Control Plans (ESCPs) to minimize potential adverse impacts during construction. In the long-term, vegetation and/or gravel cover would be maintained around system components to prevent and minimize impacts from runoff and soil loss.

Although the Proposed Action would generally site system components in relation to the existing built environment to minimize ground disturbance, fugitive dust would be generated during proposed construction and maintenance activities. However, all projects that disturb 0.75-acre or more under the Proposed Action would be required to obtain a fugitive dust control construction permit from Bernalillo County. Each of these permits would include site-specific measures for dust control and suppression such as watering, the use of soil stabilization agents, and vehicle speed limits on unpaved roads. Further, some maintenance activities under the

Proposed Action would be subject to a Programmatic Fugitive Dust Control Permit (Permit No. 6085-P) held by Kirtland AFB that includes similar requirements for dust control and suppression. Implementation of the Proposed Action could also result in the accidental release of contaminants into soil media. In such cases, contaminants could be transported in surface runoff, leach into groundwater, or remain in-situ. These impacts would primarily be associated with the construction phase of the Proposed Action. With respect to SPV projects, solar panel materials are contained in a solid, enclosed, and insoluble matrix (MA DER 2015). As such, any chemical release into the environment would likely be the result of a long-duration fire with sufficient heat.

By comparison, solid waste discharges from geothermal applications are minimal and classified as non-hazardous pursuant to the Resource Conservation and Recovery Act (RCRA). Overall, substances potentially released into the environment during geothermal operations are either too low in concentration or recycled through an enclosed system that is devoid of any contact with land or water (GEA 2007).

Geological Hazards. The Proposed Action would be sited in an area where earthquake activity is common. Most earthquakes are naturally occurring events; however, in some instances, human activity has induced earthquake activity or seismicity. Under the Proposed Action, geothermal production and injection operations have potential to cause induced seismicity. These events are commonly referred to as "micro-earthquakes" and sometimes result from geothermal fluid injections back into the subsurface system. However, induced seismicity from geothermal operations generally ranges in magnitude from 1 to 3 on the Richter scale, too low to be felt by humans. To date, "micro-earthquakes" associated with geothermal applications are not considered to be a hazard or operational concern (GEA 2007). SPV applications would not induce seismic activity; however, minor damage to arrays could occur in the event of an earthquake.

Landslides are another naturally occurring geologic hazard associated with volcanic and fault zones. Although geothermal field construction operations can prompt a landslide, certain geologic conditions must already exist. Because landslides are produced by a combination of events or circumstances (and not a singular action), the extent to which geothermal applications contribute to landslides is not well understood. These same factors provide a number of warning signs that can be leveraged to mitigate landslide risks (GEA 2007). Under the Proposed Action, site-specific hazard mapping, groundwater assessment, and deformation monitoring are examples of landslide risk mitigation techniques that could be employed. It is unlikely that SPV field development would trigger a landslide; however, minor damage to arrays could occur in the event of a landslide.

3.4.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and the existing conditions discussed in **Section 3.4.1** would remain unchanged. The No Action Alternative would not result in any new or additional impacts on geology and soils.

3.5 Water Resources

Water resources are natural and man-made sources of water that are available for use by, and for the benefit of, humans and the environment. Water resources relevant to Kirtland AFB's location in New Mexico include groundwater, surface water, floodplains, and wetlands. Evaluation of water resources examines the quantity and quality of the resource and its demand for various purposes and ensures compliance with the Clean Water Act (CWA).

Groundwater. Groundwater is water that exists in the saturated zone beneath the Earth's surface that collects and flows through aquifers. Groundwater is an essential resource that functions to recharge surface water and is used for drinking, irrigation, and industrial purposes. Groundwater typically can be described in terms of depth from the surface, aquifer or well capacity, water quality, recharge rate, and surrounding geologic formations.

Groundwater quality and quantity are regulated under several federal and state programs. The federal Underground Injection Control regulations, authorized under the Safe Drinking Water Act (SDWA), require a permit for the discharge or disposal of fluids into a well. The federal Sole Source Aquifer regulations, also authorized under the SDWA, protect aquifers that are critical to water supply. The state of New Mexico passed state drinking water rules, which incorporate the federal SDWA regulations, under 20.7.10 NMAC and regulates water rights under 72-1 New Mexico Statutes Annotated.

Surface Water. Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contribution to the economic, ecological, recreation, and human health of a community or locale. Wetlands perform several hydrologic functions including: water quality improvement, groundwater recharge and discharge, pollution mitigation, nutrient cycling, stormwater attenuation and storage, sediment detention, and erosion protection. Wetlands are protected as a subset of "waters of the United States" under Section 404 of the CWA. The term "waters of the United States" has a broad meaning under the CWA and incorporates deep water aquatic habitats and special aquatic habitats (including wetlands). US Army Corps of Engineers (USACE) defines wetlands as "those areas that are inundated or saturated with ground or surface water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR § 329). For regulatory purposes, wetlands are defined by three factors: hydrologic regime, soil characteristics, and vegetation. In addition, many states have local regulations governing wetlands and their buffer areas.

In 2006, the US Supreme Court addressed the jurisdictional scope of Section 404 of the CWA, specifically the term "waters of the United States," in Rapanos v. United States and in Carabell v. USACE; hereafter referred to as the Rapanos decision. As a consequence of the associated US Supreme Court decisions, USEPA and USACE, in coordination with the Office of Management and Budget and the CEQ, developed the Clean Water Act Jurisdiction Following the US Supreme Court's Decision in Rapanos v. United States and Carabell v. United States Army Corps of Engineers Memorandum (USEPA and USACE 2007a). This guidance requires a greater level of documentation to support an agency's Jurisdictional Determination (JD) for a

particular water body. As a result of these decisions, the agencies now assert jurisdiction over the following categories of water bodies: Traditional Navigable Waters (TNWs), all wetlands adjacent to TNWs, non-navigable tributaries of TNWs that are relatively permanent (i.e., tributaries that typically flow year-round or have continuous flow at least seasonally), and wetlands that directly abut such tributaries. In addition, the agencies assert jurisdiction over every water body that is not a Relatively Permanent Water if that water body is determined (on the basis of a fact-specific analysis) to have a significant nexus with a TNW.

An additional memorandum regarding USEPA and USACE coordination on JDs under Section 404 of the CWA, in light of recent Supreme Court Decisions, was developed and signed (USEPA and USACE 2007b). Headquarters originally required the districts to request concurrence for only those JDs where the district was considering asserting jurisdiction over a non-navigable, intrastate, isolated water or wetland. The agencies now require that all JDs for non-navigable, isolated waters be elevated for USACE and USEPA Headquarters review prior to the district making a final decision on the JD.

The guidance provided in the June 2007 memorandum was superseded in a December 2008 memorandum, which incorporated the regulations definition of "adjacent" and recognition that USEPA regions and the USACE districts need guidance to ensure that JDs, permitting actions, and other relevant actions are consistent with the decision. It noted that the agencies will continue to monitor implementation of the Rapanos decision in the field and recognizes that further consideration of jurisdictional issues, including clarification and definition of key terminology may be appropriate in the future, either through issuance or additional guidance or through rulemaking (USEPA and USACE 2008).[1]

The classes of water bodies that are subject to CWA jurisdiction only if such a significant nexus is demonstrated are: non-navigable tributaries that do not typically flow year-round or have continuous flow at least seasonally; wetlands adjacent to such tributaries; and wetlands adjacent to, but that do not directly abut, a relatively permanent, non-navigable tributary. A significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or an insubstantial impact on the chemical, physical, or biological integrity of a TNW. Principal considerations when evaluating significant nexus include the volume, duration, and frequency of the flow of water in the tributary and the proximity of the tributary to a TNW, plus the hydrologic, ecologic, and other functions performed by the tributary and all of its adjacent wetlands.

A water body can be deemed "impaired" if water quality analyses conclude that exceedances of the water quality standards, established under the CWA, occur. The CWA requires that states establish a Section 303(d) list to identify impaired waters and establish Total Maximum Daily Loads for the source(s) causing the impairment. A Total Maximum Daily Load is the maximum amount of a substance that can be assimilated by a water body without causing impairment. The CWA also mandated the National Pollutant Discharge Elimination System (NPDES)

[1] The Clean Water Rule is currently enjoined from implementation until the U.S. Court of Appeals for the Sixth Circuit issues a decision on this issue – 803 F.3d 804, *; 2015 U.S. App. LEXIS 17642, **; 2015 FED App. 0246P (6th Cir.), ***; 2015 AMC 2409.

program, which regulates the discharge of point (end of pipe) and non-point (stormwater) sources of water pollution and requires a permit for any discharge of pollutants into "waters of the United States."

Stormwater is an important component of surface water systems because of its potential to introduce sediments and other contaminants that could degrade surface waters. Proper management of stormwater flows, which can be intensified by high proportions of impervious surfaces associated with buildings, roads, and parking lots, is important to the management of surface water quality and natural flow characteristics. Prolonged increases in stormwater volume and velocity associated with development and increased impervious surfaces have the potential to impact adjacent streams as a result of stream bank erosion and channel widening or down cutting associated with the adjustment of the stream to the change in flow characteristics. Stormwater management systems are typically designed to contain runoff onsite during construction and to maintain pre-development stormwater flow characteristics following development through either the application of infiltration or retention practices. Failure to size stormwater systems appropriately to hold or delay conveyance of the largest predicted precipitation event often leads to downstream flooding and the environmental and economic damages associated with flooding.

USEPA published the technology-based Final Effluent Limitations Guidelines and New Source Performance Standards for the Construction and Development Point Source Category on 1 December 2009 to control the discharge of pollutants from construction sites. The Rule became effective on 1 February 2010. After this date, all USEPA- or state-issued CGPs were to be revised to incorporate the Effluent Limitations Guideline requirements except for the numeric limitation for turbidity, which has been suspended while USEPA further evaluates this limitation. USEPA currently regulates large (equal to or greater than 1 acre) construction activity through the 2017 CGP. The 2017 CGP provides coverage for a period of 5 years.

Construction activities, such as clearing, grading, trenching, and excavating, disturb soils and can create sediment. If not managed properly, disturbed soils can be easily washed into nearby surface water bodies during storm events, where water quality is reduced and sedimentation is increased. Section 438 of the EISA (42 USC § 17094) establishes into law new stormwater design requirements for federal development projects that disturb a footprint of greater than 5,000 square feet. EISA Section 438 requirements are independent of stormwater requirements under the CWA. The project footprint consists of all horizontal hard surface and disturbed areas associated with project development. Under these requirements, pre-development site hydrology must be maintained or restored to the maximum extent technically feasible with respect to temperature, rate, volume, and duration of flow. Pre-development hydrology shall be modeled or calculated using recognized tools and must include site-specific factors, such as soil type, ground cover, and ground slope.

Post-construction analyses shall be conducted to evaluate the effectiveness of the as-built stormwater reduction features (DoD 2010). These regulations were incorporated into an applicable DoD Unified Facilities Code in April 2010, which states that Low Impact Design (LID) features need to be incorporated into new construction activities to comply with the restrictions on stormwater management promulgated by EISA Section 438. LID is a stormwater

management strategy designed to maintain site hydrology and mitigate the adverse impacts of stormwater runoff and non-point source pollution. LIDs can manage the increase in runoff between pre- and post-development conditions on the project site through interception, infiltration, storage, and evapotranspiration processes before the runoff is conveyed to receiving waters. Examples of LID methods include bio-retention, permeable pavements, cisterns/recycling, and green roofs (DoD 2016). Additional guidance is provided in USEPA's Technical Guidance on Implementing the Storm Water Runoff Requirements for Federal Projects under Section 438 of the EISA (USEPA 2009). Site design shall incorporate LIDs to promote stormwater retention and re-use to the maximum extent technically feasible.

Floodplains. Floodplains are areas of low, level ground present along rivers, stream channels, or coastal waters that are subject to periodic or infrequent inundation due to rain or melting snow. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, nutrient cycling, water quality maintenance, and provision of habitat for a diversity of plants and animals. Flood potential is evaluated by the Federal Emergency Management Agency, which defines the 100-year floodplain as an area within which there is a 1 percent chance of inundation by a flood event in a given year, or a flood event in the area once every 100 years. The risk of flooding is influenced by local topography, the frequencies of precipitation events, the size of the watershed above the floodplain, and upstream development. Federal, state, and local regulations often limit floodplain development to passive uses, such as recreation and conservation activities, to reduce the risks to human health and safety. EO 11988, *Floodplain Management*, directs federal agencies to avoid siting development or projects within floodplains unless the agency determines that there is no practicable alternative.

3.5.1 Affected Environment

Groundwater. Kirtland AFB is located within the limits of the Rio Grande Underground Water Basin, which is defined as a natural resources area and designated as a "declared underground water basin" by the state of New Mexico. The average depth to groundwater beneath Kirtland AFB is 450 to 550 feet below ground surface (bgs). The Rio Grande Basin's source of groundwater is the Santa Fe Aquifer, which has an estimated 2.3 billion acre-feet of recoverable water. This aquifer is most likely recharged east of the installation in the Manzanita Mountains where the sediment soil materials favor rapid infiltration (KAFB 2018a).

The regional aquifer present under Kirtland AFB ranges in depth from near surface to 200 feet bgs east of the major fault zones in the eastern portion of the installation, and to depths of 350 to 500 feet bgs west of the fault zone. The regional aquifer is used for the installation's water supply. Kirtland AFB has a court-decreed[2] water right that allows it to divert approximately 6,400 acre-feet of water, or approximately 2 billion gallons, per year from the underground aquifer (KAFB 2016a). In 2017, Kirtland AFB pumped 2,641 acre-feet (861,000,000 gallons) of water from these wells (Baros 2018).

[2] On 27 November 1973, the U.S. District Court for the District of New Mexico issued a Judgment and Order granting Kirtland AFB a right to divert 6,398 acre-feet of groundwater from two wells within the Rio Grande Underground Water Basin (4,500 acre-feet and 1,898 acre-feet), as well as three minor decrees to divert 3 acre-feet per year of groundwater from three domestic wells.

The shallow aquifer generally straddles the Tijeras Arroyo northeast of its confluence with Arroyo del Coyote, occurring at depths of 200 to 400 feet bgs. This aquifer system is the result of natural and man-made surface infiltration and generally flows in a southeast direction. Shallow aquifer recharge on this portion of Kirtland AFB derives from numerous sources such as arroyos, irrigation and landscaping, and leaking water utility distribution lines. Kirtland AFB does not use the groundwater of this aquifer system for a specific purpose (KAFB 2016b).

Surface Water. Kirtland AFB is located within the Rio Grande watershed. The Rio Grande is the major surface hydrologic feature in central New Mexico, flowing north to south through Albuquerque, approximately 5 miles west of the installation. Surface water resources on Kirtland AFB reflect its dry climate. The average annual rainfall in Albuquerque is 9 inches, with half of the average annual rainfall occurring from July to October during heavy thunderstorms. Surface water generally occurs in the form of stormwater sheet flow that drains into small arroyos during heavy rainfall events (KAFB 2018a). Surface water generally flows across the installation in a westerly direction toward the Rio Grande.

The two main surface water drainage channels on Kirtland AFB are the Tijeras Arroyo and the smaller Arroyo del Coyote (see **Figure 3-3**).

The Tijeras Arroyo and Arroyo del Coyote are tributaries to the Rio Grande. The Tijeras Arroyo and Arroyo del Coyote flow intermittently during heavy thunderstorms and the spring snowmelt, but most of the water percolates into alluvial deposits or is lost to the atmosphere via evapotranspiration. The Tijeras Arroyo, which is dry for most of the year, is the primary surface channel that drains surface water from Kirtland AFB to the Rio Grande. Precipitation reaches the Tijeras Arroyo through a series of storm drains, flood canals, and small, mostly unnamed arroyos.

Nearly 95 percent of the precipitation that flows through the Tijeras Arroyo evaporates before it reaches the Rio Grande. The remaining 5 percent is equally divided between groundwater recharge and runoff (KAFB 2018a).

There are fifteen known naturally occurring springs on Kirtland AFB associated with the unique hydrogeologic characteristics of the Tijeras fault complex and the foothills and canyons to the west. Two such springs are perennial (i.e., continuous flow) while the others are ephemeral. In some cases, the springs create small wetland areas. There are no natural lakes or rivers on Kirtland AFB, only man-made ponds associated with the golf course.

The topography of Kirtland AFB causes stormwater runoff to either percolate into the ground or flow towards the Rio Grande. During heavy precipitation, stormwater on Kirtland AFB is collected via a series of storm drains, flood canals and small, mostly unnamed, arroyos that eventually drain to Tijeras Arroyo or Arroyo del Coyote. Such storms are most prevalent from June to August each year. The Tijeras Arroyo drains the more developed portions of Kirtland AFB. Overland flow in the undeveloped portions of the installation is limited by higher rates of soil infiltration and evapotranspiration.

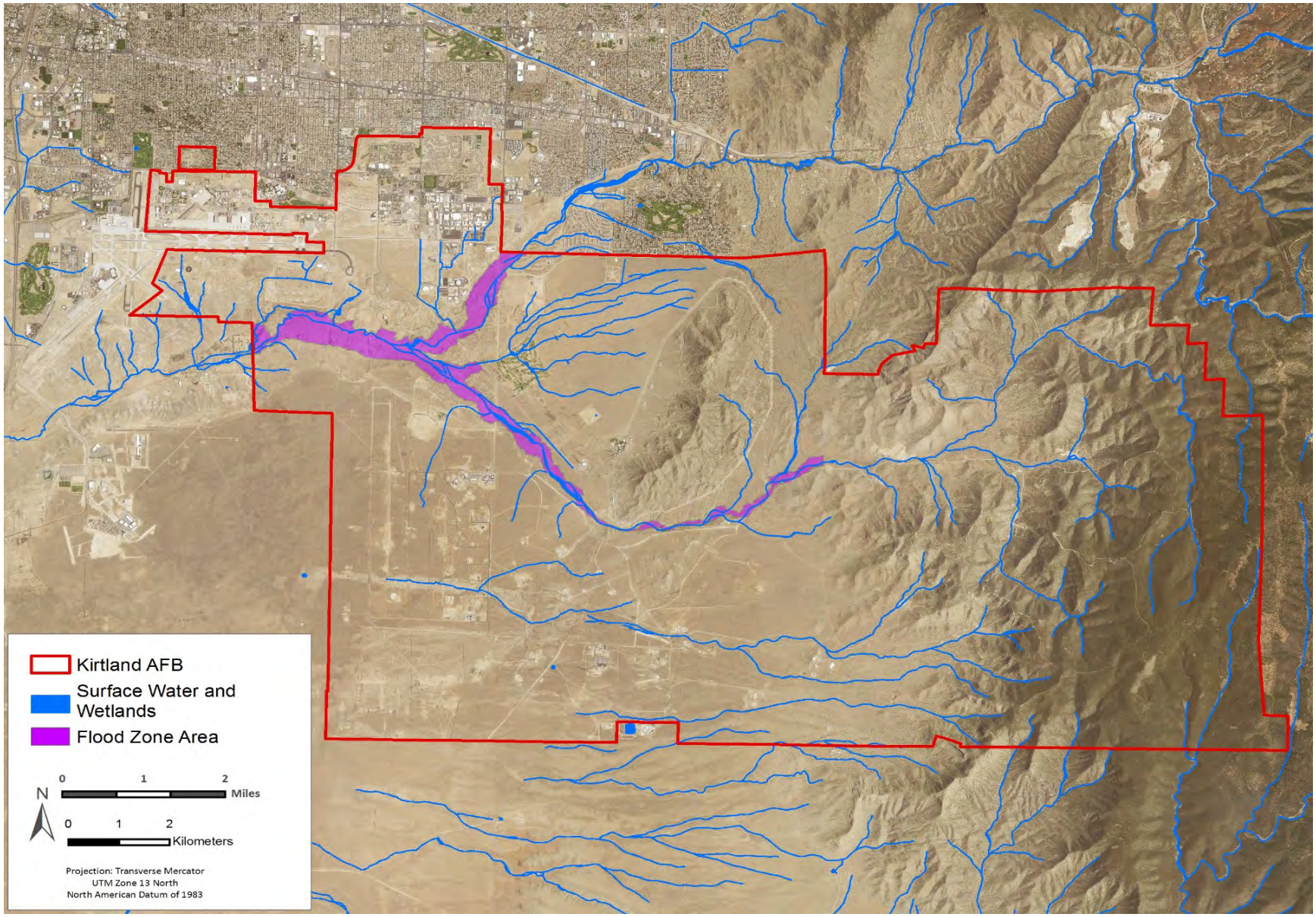

Figure 3-3. Surface Water Features and Flood Zone Areas on Kirtland AFB

Kirtland AFB operates under three NPDES permits: the Multi-Sector General Permit for industrial activities, the Municipal Separate Storm Sewer System (MS4) Permit for water conveyances from installation development, and the CGP for construction projects. Stormwater runoff on the installation predominantly flows through the drainage patterns created by natural terrain and paved surfaces. In some areas, runoff is directed through ditches and piping, with direct discharges into a receiving stream or surface water body.

Issued in December 2015, the Multi-Sector General Permit requires the installation to have a Stormwater Pollution Prevention Plan and includes specific requirements for implementing control measures (e.g., minimize exposure, good housekeeping, maintenance, spill prevention and response), conducting self-inspections and visual assessments of discharges, taking corrective action, and conducting training, as appropriate. The MS4 Permit, issued in September 2015, regulates stormwater sediment and pollutant discharges from the municipality sources of the installation. The MS4 collects and conveys stormwater from storm drains, pipes, and ditches and discharges into the Tijeras Arroyo and the city of Albuquerque's MS4. Kirtland AFB has developed a Stormwater Management Plan as required by the MS4 permit. When construction projects are not subject to NPDES CGP requirements (i.e., due to the size of the project or waivers), the contractor must implement appropriate BMPs to minimize stormwater pollutants.

Kirtland AFB operates under a 2017 CGP (#NMR100000), which expires 16 February 2022. It includes guidelines to implement erosion and sedimentation control, pollution prevention, and stabilization. Permittees must select, install, and maintain effective erosion- and sedimentation-control measures as identified and as necessary to comply with the 2017 CGP, including the following:

- sediment controls, such as sediment basins, sediment traps, silt fences, vegetative buffer strips
- off-site sediment tracking and dust control
- runoff management
- erosive velocity control
- post-construction stormwater management
- construction and waste materials management
- non-construction waste management
- erosion control and stabilization
- spill/release prevention.

If a project at Kirtland AFB is subject to the CGP requirements, surface disturbance equal to or greater than 1 acre, the contractor must develop a site-specific Stormwater Pollution Prevention Plan and provide the plan to 377th Mission Support Group/Civil Engineering Installation Management – Environmental Management – Compliance (MSG/CEIEC) for review and approval. Upon approval, both the contractor and Kirtland AFB must submit Notices of Intent and be granted approval from USEPA before work begins.

Wetlands are considered "waters of the United States" if they are determined to be jurisdictional by USACE and USEPA. Pursuant to the CWA, there are nine jurisdictional wetlands supplied by 15 active springs on Kirtland AFB. The largest, referred to as the Coyote Springs wetland complex, is located along Arroyo del Coyote. These wetlands include four semi-discrete areas associated with nine springs, covering several hundred square feet of area. The other spring-supplied wetlands on the installation are smaller in size. Nearly all springs and wetlands present on Kirtland AFB are in or immediately adjacent to an arroyo or other small ephemeral drainage where groundwater is at or near the surface. Most areas can be identified by the presence of shallow, standing water or surface drainages that flow over short distance.

Floodplains. The only surface water features on Kirtland AFB with a designated floodplain are Tijeras Arroyo and Arroyo del Coyote. These arroyos are encompassed by a 100-year floodplain. During storm events, vegetation can obstruct channel flow, increasing flood potential and extent. However, flooding is generally infrequent and characterized by high peak flow, small volume, and short duration events (KAFB 2018a).

Required Permits. This section briefly summarizes environmental compliance requirements associated with the water resources of Kirtland AFB.

- **Groundwater.** The Rio Grande Basin is a state-designated groundwater basin. In such areas, the state assumes jurisdiction over the appropriation and use of groundwater resources[3,4,5].
- **Surface Water.** In New Mexico, USEPA issues CWA permits directly to local governments (cities and counties) and the private sector. All projects within the state must comply with the NMED Surface Water Quality Board Procedures for Certification of Federal NPDES Permit (NMAC 20.6.2.2001), and New Mexico CGP requirements for construction and other land clearing activities. A site-specific ESCP would be developed, implemented, and updated for the projects in accordance with the permit. Additionally, Kirtland AFB is a co-permittee to the city of Albuquerque/Bernalillo County for compliance with the Middle Rio Grande Watershed Based MS4 General Permit No. NMR04A000. Kirtland AFB also maintains a multi-sector Storm Water General Permit for its industrial facility operations (No. NMR050000); however, stormwater runoff from airfield runway is managed by the city of Albuquerque. All construction activities occurring at Kirtland AFB are required to comply with the applicable provisions of Storm Water General Permit No. NMR100000.

[3] Completion of the San Juan-Chama Drinking Water Project in 2008 ended Albuquerque's sole reliance on the regional aquifer system as a drinking water supply. Surface water is now transported from the Colorado River basin, treated to safe drinking water standards, and delivered to customers in the Albuquerque region. This water supply source is available to Kirtland AFB during peak demand.

[4] In 2016, the State of New Mexico passed the Geothermal Resources Development Act, moving geothermal resource development and regulation (for high-temperature [more than 250 degrees Fahrenheit] geothermal wells) under the purview of the New Mexico Energy Conservation and Management Division. This transition became effective on 1 July 2016. The New Mexico Energy Conservation and Management Division is in the process of developing new regulations for high-temperature geothermal applications (19.14.110 through 19.14.131 NMAC).

[5] The regulatory authority for low temperature geothermal wells is the NMED Ground Water Quality Bureau.

- **Wetlands.** Pursuant to Section 404 of CWA, the USACE regulates the discharge of dredged and fill materials into waters of the United States, including wetlands. Any such activities in jurisdictional waters or wetlands (i.e., based upon hydrology, soils, and vegetation characteristics) requires a USACE-issued CWA 404 permit.

3.5.2 Environmental Consequences

3.5.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short-term minor, and long-term, negligible adverse impacts to water resources. Impacts to water resources resulting from either an SPV or geothermal energy project are similar; therefore, the two technologies are discussed collectively in this resource section.

Groundwater. Short- and long-term, negligible to minor, adverse impacts on groundwater resources could occur under the Proposed Action. Short-term, negligible, adverse impacts would be expected during construction from ground disturbance. Erosion and increased sediment loads in surface water runoff could be transported to groundwater resources via recharge points. To minimize or avoid impacts, surface water runoff would be controlled by drainage control measures with no direct pathways to groundwater recharge points. Additionally, vehicles and equipment associated with the proposed construction could increase the potential for petroleum or hazardous material spills. Fuels, hydraulic fluids, oils, and lubricants could also be stored on site to support construction vehicles and machinery. To minimize the potential for a release of fluids into groundwater, proper housekeeping, maintenance of equipment, and containment of fuels and other potentially hazardous materials would be conducted. Absorbent pads and containment booms shall be stored on-site, if appropriate, to facilitate the clean-up of accidental petroleum releases. Through use of BMPs and adherence to the Kirtland AFB Environmental Management System (EMS) program, potential impacts on groundwater from proposed construction of the SPV and geothermal energy projects would be minimized.

With respect to geothermal energy, most underground geothermal reservoirs are found at depths well below that of groundwater reservoirs. The withdrawal of natural geothermal fluids that contain varying concentrations of potentially toxic minerals or other elements could result in long-term, minor, adverse impacts on groundwater if released into the environment. These fluids are purposely injected back into source reservoirs to enhance recovery operations and reduce the potential for subsidence. This method of disposal (and re-use) is also preferred as a means of pollution prevention. In practice, geothermal injection systems are comprised of thick well casings to isolate the fluids from shallow groundwater. Further, all deep reservoir fluid extractions are regulated under USEPA's Underground Injection Control Program or state programs with delegated authority to ensure groundwater protection (GEA 2007, NM ECMD 2017). The Proposed Action would be implemented in compliance with all applicable regulations and standards for groundwater protection; therefore, potential impacts to groundwater from geothermal operations and maintenance would be unlikely. The operation and maintenance activities associated with a proposed SPV project would not impact groundwater; therefore, these activities would not impact groundwater resources.

Dependent on technology selection, the Proposed Action could require water as an operational input. For example, water-cooled geothermal systems use steam from hot reservoir fluids to turn turbines and generate electricity. In such applications, at least 50 percent of the extracted liquid is lost to the atmosphere. Conversely, binary geothermal systems utilize air as a coolant and do not consume any water (GEA 2007). Water use in an SPV project generally would be limited to solar panel or array maintenance in lieu of timely rainfall (MA DER 2015). Under the Proposed Action, Kirtland AFB would be allowed to withdraw up to 6,000 acre-feet (2 billion gallons) of water per year. Based on current usage, groundwater resources are sufficient to support renewable energy technologies at Kirtland AFB (ANL 2013, MA DER 2015).

Surface Water. Short-term, negligible to minor, adverse impacts on surface waters could occur during the implementation of the Proposed Action. Surface water quality impacts would result from soil erosion and sedimentation of nearby surface water during construction of the proposed SPV and geothermal energy projects. The number, type, and location of the proposed project components would determine the scope and intensity of the impact. To minimize potential impacts under the Proposed Action, a 100-foot buffer zone would be retained in relation to primary surface water features, including designated floodplains. Additionally, soil erosion from ground disturbance would be controlled by using appropriate environmental protection measures (e.g., minimizing onsite soil and vegetation removal) and adhering to the ESCP. The ESCP would include BMPs (e.g., silt fences, straw bales) that would be implemented to manage stormwater flow and minimize sedimentation, as applicable. Additionally, BMPs would be implemented as necessary to minimize potential impacts from incidental construction equipment spills (i.e., fuels, lubricants, coolants). Ensuring onsite stormwater infiltration during construction activities, as required by EISA Section 438, would sustain groundwater recharge and minimize stormwater runoff.

As previously discussed, the Proposed Action provides a limited number of plausible scenarios in which contaminants could be released into the environment during renewable energy operations. System maintenance activities would generally be limited to the washing of material components with non-hazardous cleaning chemicals or water. Additionally, the Proposed Action would not affect any special status surface water features (e.g., geysers, hot springs). Therefore, no long-term impacts on surface waters from operations and maintenance would be expected.

Wetlands. The proposed SPV and geothermal energy projects would not be constructed within any jurisdictional wetlands on Kirtland AFB; therefore, no direct impacts on wetlands would occur. The siting of the projects would be subject to a 100-foot buffer zone from regulated surface waters, including wetlands. If the projects are constructed proximate to a wetland, impacts similar to those described for ***Surface Water*** could occur. Adherence to the ESCP would minimize potential adverse impacts.

Floodplains. The proposed SPV and geothermal energy projects would not be constructed within any designated floodplains on Kirtland AFB; therefore, no direct impacts on floodplains would occur. The 100-year floodplain overlapping Tijeras Arroyo and Arroyo del Coyote would be avoided and subject to a 100-foot buffer zone from its outer extent. If the projects are

constructed proximate to a floodplain, impacts similar to those described for ***Surface Water*** could occur. Adherence to the ESCP would minimize potential adverse impacts.

3.5.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and the existing conditions discussed in **Section 3.5.1** would remain unchanged. The No Action Alternative would not result in any new or additional impacts on water resources.

3.6 Biological Resources

Biological resources include native or naturalized plants and animals and the habitats in which they occur, and native or introduced species found in landscaped or disturbed areas. Laws protecting wildlife include the, Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act of 1940. Protected species are defined as those listed as threatened, endangered, or proposed or candidate for listing by the US Fish and Wildlife Service (USFWS) or NMDGF. Federal candidate species and species of concern are not protected by law; however, these species could become listed, and therefore are given consideration when addressing biological resource impacts of an action.

Sensitive habitats include those areas designated by USFWS as critical habitat protected by the Endangered Species Act and sensitive ecological areas as designated by state or federal rulings or guidance. Sensitive habitats also include wetlands, plant communities that are unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., migration routes, breeding areas, crucial summer/winter habitats).

The New Mexico Wildlife Conservation Act (New Mexico Statutes Annotated 17-2-37) authorizes the NMDGF to create a list of endangered or threatened wildlife within the state, and to take steps to protect and restore populations of species on the list. Actions causing the death of a state endangered animal are in violation of the New Mexico Wildlife Conservation Act. In addition, NMDGF maintains a list of species considered to be particularly sensitive or at risk.

3.6.1 Affected Environment

Kirtland AFB lies at the intersection of four major North American biotic provinces: the Great Plains, Great Basin, Rocky Mountains, and Chihuahuan Desert (KAFB 2018a). Vegetation and wildlife found within the installation are influenced by each of these provinces, with the Great Basin being the most dominant influence. Elevations range from approximately 5,000 feet in the west to almost 8,000 feet in the Manzanita Mountains, providing a variety of ecosystems. Five canyons (i.e., Lurance, Sol se Mete, Bonito, Otero, and Madera) are located in the eastern portion of the installation; a few smaller canyons occur on Manzano Base.

Kirtland AFB is situated near three regional natural areas: the Sandia Mountain Wilderness Area, Sandia Foothills Open Space, and Rio Grande Valley State Park. The Sandia Mountain Wilderness Area, encompassing 37,877 acres, lies approximately 5 miles north of the eastern portion of the installation. This area is home to many species of plants and animals and supports an important raptor migration route (KAFB 2018a).

Vegetation. Four plant communities occur on Kirtland AFB: grassland (includes sagebrush steppe and juniper (*Juniperus monosperma*) woodlands, piñon-juniper (*Pinus edulis-Juniperus monosperma*) woodlands, ponderosa pine (*Pinus ponderosa*) woodlands, and riparian/wetland/arroyo. **Figure 3-4** presents the distribution of the vegetation communities on the installation overlaid with the constraints shown in **Figure 2-1**. Grassland and piñon-juniper woodlands are the dominant vegetative communities on the installation. The riparian/wetland/arroyo community is confined to drainages and isolated areas inundated by surface water during at least some part of the year. The ponderosa pine woodland community is found along the eastern boundary of the installation (KAFB 2018a). The proposed renewable energy projects would be cited solely in grassland habitat because of installation's environmental and operational constraints.

- ***Grassland Community.*** This community is found between elevations of 5,200 and 5,700 feet at Kirtland AFB. The grassland community on the installation is further delineated into two community types: sagebrush steppe in the western portion of the installation and juniper woodlands in the eastern portion. In a sagebrush steppe, the understory is less dense, with cryptogamic crust covering areas of exposed ground. The juniper woodlands are similar to the grasslands to the east, except for the greater abundance of one-seeded juniper. The presence of this shrubby tree creates a savanna-like habitat in an otherwise treeless area. Juniper woodlands are found at a slightly higher elevation than the surrounding grassland. This habitat type provides a transition into piñon-juniper woodlands. Common grass species include ring muhly (*Muhlenbergia torreyi*), Indian ricegrass (*Achnatherum hymenoides*), sixweeks grama (*Bouteloua barbata*), black grama (*Bouteloua eriopoda*), blue grama (*Bouteloua gracilis*), and spike dropseed (*Sporobolus contractus*). Shrubs commonly found in the grassland community include sand sagebrush (*Artemisia filifolia*), winterfat (*Krascheninnikovia lanata*), and broom snakeweed (*Gutierrezia sarothrae*). Other species include purple threeawn (*Aristida purpurea*), sixweeks threeawn (*Aristida adscensionis*), hairy grama (*Bouteloua hirsuta*), mesa dropseed (*Sporobolus flexuosus*), four-wing saltbush (*Atriplex canescens*), Apache plume (*Fallugia paradoxa*), plains prickly pear (*Opuntia polyacantha*), and soapweed yucca (*Yucca glauca*). Transitional shrublands are common between grassland and piñon-juniper woodland communities, with many species from both communities inhabiting these areas (KAFB 2018a).
- ***Piñon-Juniper Woodland Community*.** The piñon-juniper woodland community ranges in elevation from 6,300 to 7,500 feet. This plant community is primarily composed of piñon pine and juniper, with an understory of shrubs and grasses. At most elevations, this community consists of open woodland with blue grama dominating the understory along with sideoats grama. Other species associated with this plant community are broom snakeweed, rubber rabbitbrush (*Ericameria nauseosa*), threadleaf groundsel (*Packera* sp.), and alderleaf mountain mahogany (*Cercocarpus montanus*) (KAFB 2018a). The proposed renewable energy projects would not be sited within this community because of installation and topographical constraints.

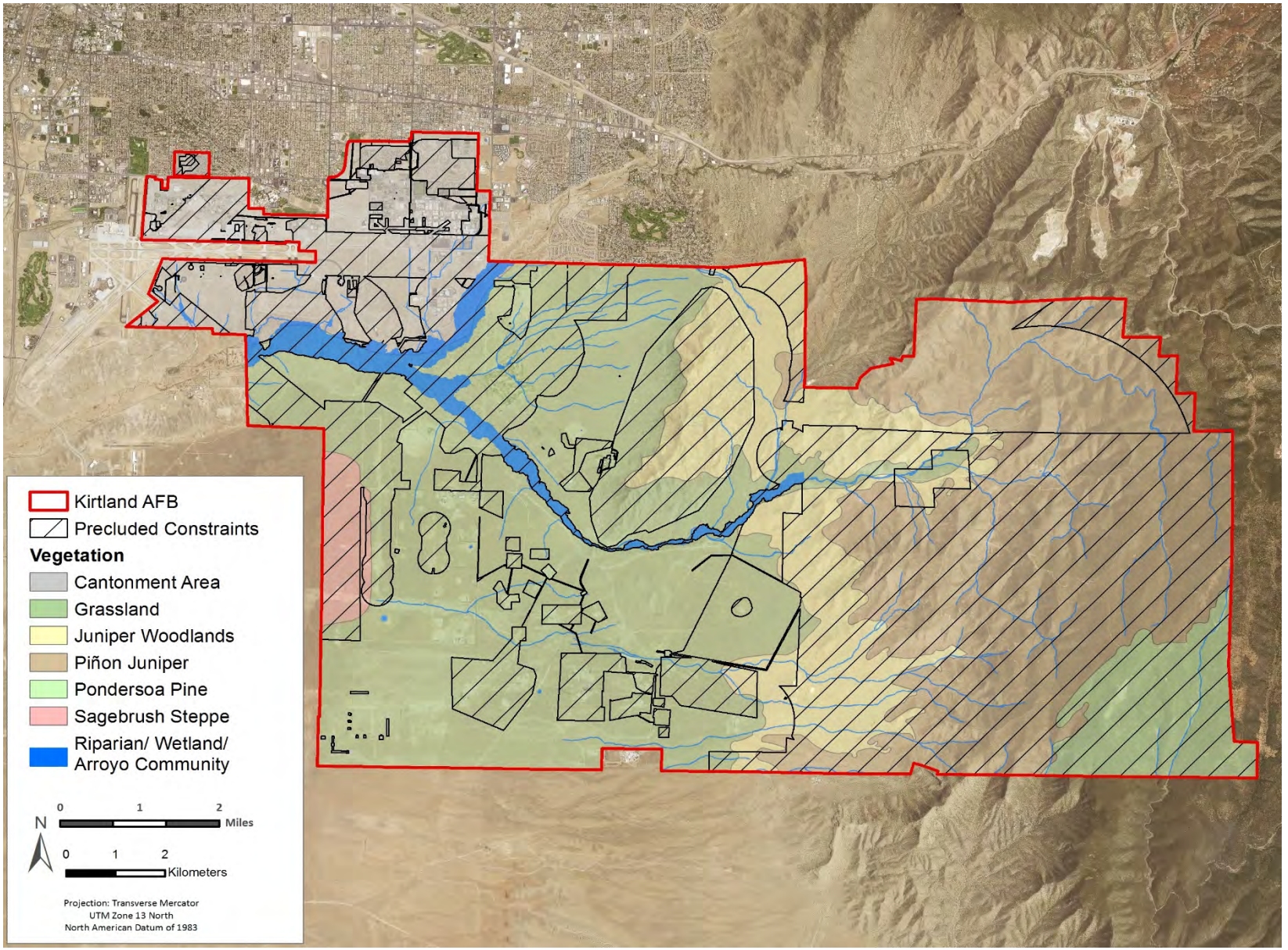

Figure 3-4. Vegetation Communities and Installation and Environmental Constraints

- ***Ponderosa Pine Woodland Community*.** The ponderosa pine woodland community is typically found in the highest elevations of the eastern portion of the installation. It is typically found between 7,600 and 7,988 feet. Common species include ponderosa pine, Colorado piñon pine, Rocky Mountain juniper (*Juniperus scopulorum*), and Gambel oak (*Quercus gambelii*). Intermingled with these species are creeping barberry (*Mahonia repens*), New Mexico locust (*Robinia neomexicana*), and snowberry (*Symphoricarpos* sp.). One-seeded juniper, hoptree (*Ptelea trifoliata*), and alderleaf mountain mahogany are also present in ponderosa pine woodland (KAFB 2018a). The proposed renewable energy projects would not be sited within this community because of installation constraints.
- ***Riparian/Wetland/Arroyo Community.*** The riparian/wetland/arroyo community is a minor component of the overall vegetation communities present on the installation and it consists of species that have a greater moisture requirement than species common to the other communities on the installation. These plant communities are found along the Tijeras Arroyo, Arroyo del Coyote, and at the various springs located throughout the installation. Common species include cottonwood (*Populus deltoides*), hoptree, Apache plume, yerba mansa (*Anemopsis californica*), three-square bulrush (*Scirpus americanus*), cattail (*Typha latifolia*), and saltcedar (*Tamarix* spp.). The proposed renewable energy projects would not be sited within this community because of environmental constraints.

Wildlife Species and Habitat. Wildlife species found on Kirtland AFB are representative of the species diversity common to the regional ecosystem and plant communities on the installation. The renewable energy projects would be within grassland or juniper woodland habitat. However, wildlife can be transient and travel between communities, inhabit several communities, or exist in transitional areas between vegetation communities.

Mammals commonly found on the military training areas of Kirtland AFB include the desert cottontail (*Sylvilagus audubonii*), black-tailed jack rabbit (*Lepus californicus*), spotted ground squirrel (*Xerospermophilus spilosoma*), rock squirrel (*Otospermophilus variegatus*), Gunnison's prairie dog (*Cynomys gunnisoni*), silky pocket mouse (*Perognathus flavus*), Ord's kangaroo rat (*Dipodomys ordii*), banner-tailed kangaroo rat (*Dipodomys spectabilis*), Merriam's kangaroo rat (*Dipodomys merriami*), western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), white-footed deer mouse (*Peromyscus leucopus*), and northern grasshopper mouse (*Onychomys leucogaster*), porcupine (*Erethizon dorsatum*), black bear (*Ursus americanus*), and mule deer (*Odocoileus hemionus*). Mammalian predators found in association with these species include the coyote (*Canis latrans*), badger (*Taxidea taxus*), kit fox (*Vulpes macrotis*), striped skunk (*Mephitis mephitis*), mountain lion (*Puma concolor*), and bobcat (*Lynx rufus*) (KAFB 2018a).

Reptiles and amphibians commonly found on the military training areas of Kirtland AFB include the New Mexico whiptail lizard (*Cnemidophorus neomexicanus*), short-horned lizard (*Phrynosoma hernandesi*), lesser earless lizard (*Phrynosoma hernandesi*), bull snake (*Pituophis catenifer sayi*), western diamondback rattlesnake (*Crotalus atrox*), prairie rattlesnake (*Crotalus viridis*), desert massasauga (*Sistrurus catenatus edwardsii*), glossy snake (*Arizona elegans*),

western box turtle (*Terrapene ornata*), Woodhouse's toad (*Anaxyrus woodhousii*), and red spotted toad (*Bufo punctatus*). Many of the amphibian species have extensive periods of dormancy during dry conditions and rapid breeding cycles when temporary ponds occur after rains (KAFB 2018a).

Birds that can commonly occur on the military training areas of Kirtland AFB include the horned lark (*Eremophila alpestris*), scaled quail (*Callipepla squamata*), mourning dove (*Zenaida macroura*), greater roadrunner (*Geococcyx californianus*), American crow (*Corvus brachyrhynchos*), northern mockingbird (*Mimus polyglottos*), western meadowlark (*Sturnella neglecta*), wild turkey (*Meleagris gallopavo*), brown-headed cowbird (*Molothrus ater*), and house finch (*Haemorhous mexicanus*). Raptor species known to occur or that may potentially occur include the northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), ferruginous hawk (*Buteo regalis*), American kestrel (*Falco sparverius*), and western burrowing owl (*Athene cunicularia* ssp. *Hypugaea*). Additionally, turkey vultures (*Cathartes aura*) are common scavengers in the area. The nesting season for most bird species that occur at Kirtland AFB runs from 1 March through 30 September (Peterson 1990).

Threatened and Endangered and State Listed Species. USFWS and NMDGF maintain lists of plant and animal species that have been classified as federally threatened or endangered or state listed by NMDGF (a full list is available in **Appendix C**). Of those species known to occur in the county, no federal threatened or endangered species and two state threatened species occur on Kirtland AFB (KAFB 2018a).

The five federally listed species that could occur on the installation, New Mexico meadow jumping mouse (*Zapus hudsonius luteus*), Mexican spotted owl (*Strix occidentalis lucida*), southwestern willow flycatcher (*Empidonax traillii extimus*), yellow-billed cuckoo (*Coccyzus americanus*), and Rio Grande silvery minnow (*Hybognathus amarus*) do not have suitable habitat and have not been identified on the installation (USFWS 2017, KAFB 2018a). New Mexico meadow jumping mouse prefers large wet meadows within floodplains. A 2016 survey conducted at Kirtland AFB did not detect the mouse or find desirable habitat for the species (KAFB 2018a). Mexican spotted owl, southwestern willow flycatcher, and yellow-billed cuckoo prefer riparian and forested habitat not found on Kirtland AFB. Rio Grande silvery minnow is a riverine fish that prefers low-gradient creeks and small to large rivers with slow to moderate flow. It is only found in one reach of the Rio Grande in New Mexico that is off the installation (NatureServe 2017). Therefore, no impacts on these species would occur and they are not discussed further.

Biological surveys are conducted annually in order to monitor species presence on Kirtland AFB. **Table 3-6** lists the status of species that occur on Kirtland AFB.

- ***Gray Vireo.*** The gray vireo, a state threatened species, is a small migratory songbird. They occur in colonies in several locations on Kirtland AFB throughout the withdrawn area. The highest density of colonies is located within lower elevation piñon-juniper habitat from Coyote Canyon south to the Isleta boundary at elevations ranging from 5,900 to 6,600 feet. Gray vireo populations have increased on Kirtland AFB because of fire suppression activities and subsequent increase of piñon-juniper stands.

Table 3-6. Kirtland AFB Species with Special Status

Species	Federal Status	State Status
Gray Vireo	-	Threatened
Peregrine Falcon	Species of Concern	Threatened
Loggerhead Shrike	-	New Mexico Species of Greatest Conservation Need
Mountain Plover	-	Sensitive taxa
Western Burrowing Owl	Species of Concern	-
Long-legged Myotis*	-	Sensitive taxa
Western Small-footed Myotis*	-	Sensitive taxa
Gunnison's Prairie Dog	-	Sensitive taxa
Golden Eagle	Bald/Golden Eagle Protection Act	-

Note: * Myotis = bat.

- ***Peregrine Falcon.*** The peregrine falcon, a state threatened species and federal species of concern, is a medium to large raptor. On Kirtland AFB, suitable nesting cliffs are located in the canyons of the withdrawn area. The species is observed hunting throughout the entire installation. Threats to peregrine falcons include use of pesticides, predation, electrical line electrocution, and noise impacts from installation activities.
- ***Loggerhead Shrike.*** The loggerhead shrike, a state species of greatest conservation need, is a small migratory songbird that occurs in grasslands west of the withdrawn area. The species is a year-round resident of Kirtland AFB; however, nesting shrikes no longer are found on the installation. The species breeds in grazed areas that have exposed ground and sparse vegetation and are not in close proximity to developed areas. The species is commonly encountered adjacent to Manzano Base and along the southern portion of the installation near the Starfire Optical Range, Giant Reusable Air Blast Simulator, and Chestnut sites.
- ***Mountain Plover.*** The mountain plover, a state sensitive taxa, is a small migratory songbird. It occurs in grasslands, typically within prairie dog towns. Potential nesting and brood-rearing habitat for the mountain plover at Kirtland AFB is limited to the southern grasslands directly north of Pueblo of Isleta. Impacts to the mountain plover population on Kirtland AFB are a result of decreased Gunnison's prairie dog towns/colonies within the southern portion of the installation.
- ***Western Burrowing Owl.*** The Western burrowing owl, a federal species of concern, is a small ground owl. Burrowing owls are migratory; however, some owls may occur on the installation during mild winters. The species is found on Kirtland AFB within developed areas where grasses are less dense and afford a greater line of sight for protection from predators and prey detection. Populations of burrowing owls have greatly decreased on the installation. Threats to the population include a decrease of the Gunnison's prairie dog population and incompatible land use.
- ***Long-legged Myotis and Western Small-footed Myotis.*** Two bat species identified on Kirtland AFB, the long-legged myotis and Western small-footed myotis, are state

sensitive taxa. Habitat on Kirtland AFB includes cliffs and abandoned mines throughout the withdrawn area. The species are nocturnal and feed on insects located near water or rocky cliffs. Threats to the two species include a decrease of surface water and the white-nose syndrome.

- ***Gunnison's Prairie Dog.*** The Gunnison's prairie dog, a state sensitive taxon, is a rodent within the squirrel family that occurs in colonies or towns. They are located primarily within grasslands in the northern half of Kirtland AFB and in the cantonment area. Threats to the population include periodic plague epidemics and loss of habitat.
- ***Golden Eagle.*** The golden eagle is a raptor, federally protected under the Bald/Golden Eagle Protection Act, which occurs on Kirtland AFB. Because of the size of the golden eagle, they are ranked at the top of the food chain as apex predators of avian species. Golden eagles have been observed during avian surveys conducted on Kirtland AFB and nests have been identified on cliffs within the withdrawn area. Threats to the species include use of pesticides, predation, electrical line electrocution, and noise impacts from installation activities.

Critical Habitat. Critical habitats are those areas of land, air, or water that are essential for maintaining or restoring threatened or endangered plant or animal populations. Surveys and literature indicate that sensitive habitats on the installation include wetlands, which are rare in this region, providing water in an otherwise arid environment. Other sensitive habitats on the installation include prairie dog towns, which provide nesting habitat for the burrowing owl, and areas between 5,900 and 6,600 feet containing open juniper woodlands, which are used as nesting habitat by the gray vireo (KAFB 2018a).

Neither NMDGF nor USFWS has designated or identified any critical habitat on Kirtland AFB (USFWS 2017).

3.6.2 Environmental Consequences

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short- and long-term, moderate, adverse impacts from SPV array construction; short-and long-term, minor adverse impacts from geothermal energy project construction; and long-term, minor, adverse impacts on wildlife species from the loss or disturbance of habitat and from maintenance and operation of the SPV array. Impacts on wildlife species shall be reduced wherever possible by co-locating energy generation facilities with existing development and siting areas for unavoidable new development adjacent to portions of Kirtland AFB that have already been developed and no longer serve as effective open space and wildlife habitat.

Potential impacts on biological resources are evaluated based on the importance (e.g., legal, commercial, recreational, ecological, and scientific) of the resource, the proportion of the resource that would be affected relative to its occurrence in the region, the sensitivity of the resource to proposed activities, and the duration of ecological impacts. A habitat perspective is used to provide a framework for analysis of general classes of impacts (e.g., removal of critical habitat, noise, and human disturbance).

Ground disturbance and noise associated with construction activities could potentially directly or indirectly result in adverse effects on biological resources. Effects from ground disturbance were evaluated by identifying the types and locations of ground-disturbing activities in correlation to important biological resources. Mortality of individuals, habitat removal, and damage or degradation of habitats might be effects associated with ground-disturbing activities. To evaluate the effects of noise, considerations were given to the potential number of individuals or critical species present, and type of stressors involved.

Potential impacts on threatened and endangered species are evaluated based on the potential for the Proposed Action to directly or indirectly adversely affect listed species or designated critical habitat; jeopardize the continued existence of species that are proposed for listing; or adversely modify proposed critical habitat. Consideration is given to context and intensity of the effects, and the measures proposed to avoid effects on listed species.

In response to the Scoping Notification Letter, and after reviewing the Draft PEA, NMDGF provided recommendations to avoid impacts on wildlife when siting and constructing renewable energy technologies (see **Appendix A**). NMDGF recommendations will be taken into consideration when siting and constructing renewable energy technologies on Kirtland AFB.

3.6.2.1 PROPOSED ACTION

SPV Energy. The development of up to a 500-acre SPV array would result in short- and long-term, moderate, adverse and long-term, minor, beneficial impacts on biological resources. The proposed locations for the sites would occur in grassland habitat because of precluded constraints (see **Figure 3-4**) and topography requirements (i.e., less than 5 percent slope). Construction of the proposed SPV array and its associated infrastructure (such as security fencing, equipment sheds, access roads and potentially ancillary power control systems, transmission and distribution lines, and sub or switching stations) would require ground-disturbing activities including vegetation removal, grubbing, and grading. Compaction of soils from ground disturbance could cause erosion or sedimentation that would further degrade vegetation. Additionally, ground disturbance and transport of construction equipment could increase the potential for establishment of noxious or invasive plant species. Construction vehicles would minimize the potential spread of these nuisance species by ensuring the spread of their seeds and spores. Revegetation of disturbed sites with native vegetation could support a native plant community that would further reduce the establishment of nuisance species. Tree removal likely would not be necessary; however, any tree removal, thinning, and revegetation would require coordination between the Kirtland AFB Natural Resources Program Manager, the Air Force Civil Engineer Center Forester, and USFS to develop a plan for survey and removal activities thus reducing any impact on biological resources.

BMPs to minimize soil disturbance; control erosion, sedimentation, and surface water runoff; minimize soil compaction issues; minimize air pollution; avoid accidental spills of hazardous material (e.g., fuel spills from vehicles and equipment); avoid transportation of noxious, invasive and pest species; and avoid inadvertent wildland fires sparked by construction activities would be implemented. The construction contractor would be responsible for properly maintaining construction vehicles and equipment and implementing all legally-required BMPs and standard operating procedures (e.g., as a result of regulation, contract, legally-binding agreement, etc.)

so as to help minimize or avoid impacts on biological resources. Additionally, SPV projects sited on existing facilities, such as building rooftops and carport structures, would reduce impacts to biological resources by minimizing the loss of undisturbed vegetation and potential erosion.

Long-term, minor, adverse impacts on wildlife species would be expected from the loss or disturbance of grassland habitat, which could lead to displacement, and because of noise events that could cause wildlife to engage in escape or avoidance behaviors. Species displaced because of the construction of the SPV array would vary depending on the amount of pre-development habitat that would be permanently lost and the size of the array. Any habitat that would be temporarily disturbed by construction vehicles would be expected to return to a natural state. Long-term, minor, beneficial impacts on wildlife species would be expected for wildlife that prefer disturbed habitat.

Although infrequent, wildfires are a natural component to habitats on Kirtland AFB and the potential for wildfire during construction exists if site conditions are vegetated and dry. The installation's *Wildland Fire Management Plan* (WFMP) outlines actions to be taken by Kirtland AFB to manage wildfire risk and would outline measures for construction operators to take to minimize the potential for wildfire. These measures would include fire suppression, controlled burns, and manual fuel reduction when necessary.

Proper site selection would minimize impacts on biological resources by avoiding sensitive or important biological areas (such as suitable habitat for threatened or endangered species, floodplains, or wetlands), and would be done in accordance with the Kirtland AFB Integrated Natural Resources Management Plan. Construction of the SPV should occur outside of nesting season for migratory birds, typically 1 March to 30 September, to avoid conflicts with migratory birds, including birds of conservation concern. However, biological surveys could be conducted to determine the presence of protected species and whether set-back requirements should be implemented. For active nests detected buffer distances should be appropriate distance to avian nests. Pre-construction surveys would occur within 30 days of construction and would be conducted by a qualified biologist to identify nests, burrows, and other wildlife shelters of concern and sensitive habitat and determine the most appropriate action to comply with species protection requirements.

New transmission lines for SPV would be placed along existing road rights-of-way and within existing utility easements to the greatest extent possible to minimize impacts on biological resources. Aboveground transmission lines would be constructed in accordance with avian protection guidelines, as described in *Suggested Practices for Avian Protection On Power Lines: The State of the Art in 2006* to reduce bird electrocution risks, and in *Reducing Avian Collisions with Power Lines: The State of the Art in 2012* to reduce bird collision risks. SPV arrays have the potential to have a lake-like appearance to birds and could cause them to accidentally strike the array leading to injury or death. Lake effect related mortalities are not known to be significant; however, using arrays with low reflectivity and providing structural elements or markings to break up the reflection could reduce birds approaching the array as if it was a lake. This would reduce impacts on migratory birds. Designing the array to avoid structures that promote nesting or perching and minimizing lighting and water that can attract

insects would further reduce attraction to the site by birds and bats. All light posts and permanent nighttime lighting installed to support operations would be selected to provide the lowest illumination possible while still allowing for safe operations. Lights would also be placed at the lowest height possible and only directed toward areas needing illumination.

Operation of the SPV array would be monitored for soil erosion and remedied as appropriate. Maintenance of vegetation would reduce erosion and stormwater runoff, which would minimize long-term adverse impacts on vegetation and habitat. Vegetation under and surrounding the array would be maintained and would provide cover for various small mammals and birds. However, maintenance related to periodic mowing could result in the mortality of smaller less mobile species. These impacts would be avoided to the maximum extent possible by reducing mowing activities at sites determined to have ground nesting migratory bird species during nesting season. Maintenance activities to control nuisance species could require the use of pesticides and herbicides that would be used in accordance to the installation's management plans. Impacts from these activities would be expected to be negligible.

Geothermal Energy. Impacts on biological resources from the construction of a proposed 5- to 20-acre geothermal energy project would be similar, but less intense than those for the SPV array because the area of disturbance would be much smaller. As a result, short-and long-term, minor adverse impacts on biological resources would be expected. The proposed site for a geothermal energy project would be more flexible because of the smaller construction requirements; however, the site would most likely be in grassland communities to meet topography requirements (i.e., less than 5 percent slope). The entire site would be cleared of vegetation and wildlife would be expected to relocate to surrounding grassland habitat. BMPs described for the SPV array to minimize soil disturbance; control erosion, sedimentation, and surface water runoff; minimize soil compaction issues; minimize air pollution; avoid accidental spills of hazardous material and transportation of nuisance species; and avoid inadvertent wildland fires sparked by construction would be implemented for a geothermal energy project.

Construction of a proposed geothermal energy project should occur outside of nesting season for migratory birds, typically 1 March to 30 September, to avoid conflicts with migratory birds, including birds of conservation concern. However, biological surveys could be conducted to determine the presence of protected species and whether set-back requirements should be implemented. Pre-construction biological surveys would occur within 30 days of construction and would be conducted by a qualified biologist to identify nests, burrows, and other wildlife shelters of concern and determine the most appropriate action to comply with species protection requirements. Maintenance and operation would also be similar to the SPV array; however, there would be no impacts on wildlife from the lake effect associated with the array. Additionally, mowing would not occur on the same scale as the array and would be limited to typical landscaping for buildings on the installation.

3.6.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation, and the existing conditions discussed in **Section 3.6.1** would remain unchanged.

3.7 Cultural Resources

Cultural resources are historic districts, sites, buildings, structures, or objects considered important to a culture, subculture, or community for scientific, traditional, religious, or other purposes. They include archaeological resources, historic architectural or engineering resources, and traditional resources. Depending on the condition and historic use, such resources might provide insight into the cultural practices of previous civilizations, or they might retain cultural and religious significance to modern groups.

Several federal laws and regulations govern protection of cultural resources, including the NHPA of 1966, the Archeological and Historic Preservation Act (1974), the American Indian Religious Freedom Act (1978), the Archaeological Resources Protection Act (1979), and the Native American Graves Protection and Repatriation Act (1990). Kirtland AFB is required to comply with USAF regulations and instructions regarding cultural resources, including AFI 32-7065, *Cultural Resources Management*, and Kirtland AFB's ICRMP (KAFB 2018b). Consultation with federally recognized tribes is required under the laws listed previously, as well as EO 13175, *Consultation and Coordination with Indian Tribal Governments*; Department of Defense Instruction 4710.02, *DoD Interactions with Federally-Recognized Tribes*; and AFI 90-2002, *Air Force Interactions with Federally Recognized Tribes*.

The NHPA establishes criteria for assessing the significance of cultural resources. Resources that are listed in or eligible for listing in the National Register of Historic Places (NRHP) are termed "historic properties." Section 106 of the NHPA requires federal agencies to assess the potential impact of their undertakings on historic properties in the area of potential effect. Kirtland AFB will consult under Section 106 of the NHPA with the New Mexico SHPO and appropriate federally recognized tribes.

Typically, cultural resources are subdivided into archaeological resources, architectural resources, or resources of traditional or religious significance. Archaeological resources comprise areas where human activity has measurably altered the earth or deposits of physical remains are found (e.g., projectile points and bottles), but standing structures do not remain. Architectural resources include standing buildings, bridges, dams, other structures, and designed landscapes of historic or aesthetic significance. Generally, architectural resources must be more than 50 years old to warrant consideration for the NRHP. More recent structures might warrant eligibility if they are of exceptional importance or if they have the potential to gain significance in the future. Resources of traditional, religious, or cultural significance can include archaeological resources, sacred sites, structures, districts, prominent topographic features, landscapes, habitat, plants, animals, or minerals considered essential for the preservation of traditional culture.

3.7.1 Affected Environment

In compliance with Section 110 of the NHPA, Kirtland AFB has conducted an installation-wide survey of archaeological and cultural resources. Installation-wide surveys were completed in the early 2000s and are updated as required by the NHPA. A total of 740 archaeological sites were recorded within the boundaries of the installation and 251 have been determined to be eligible for the NRHP. Archaeological sites on the installation contain artifacts such as ceramics,

ground stone, lithics, and tools. In general, the archaeological sites are concentrated along the floodplains and stream terraces of natural waterways, particularly along Arroyo del Coyote. Many of these sites occur within the undeveloped portion of the installation. It is possible to encounter surface artifacts in these areas, which are protected under various federal regulations. The locations of these sites are protected and not disclosed to the general population. In addition to archaeological sites, a total of 583 facilities were evaluated for NRHP eligible and 271 were found to be eligible (Reynolds 2018).

The Kirtland AFB ICRMP is an integral part of the installation's comprehensive plan and addresses the cultural resources on the installation. It integrates the Cultural Resources Management Program with ongoing mission activities and the property managed by Kirtland AFB, allows for the identification of conflicts between mission activities and cultural resources management, and provides guidelines for mitigating any such conflicts. The ICRMP provides guidelines and standard operating procedures to non-technical managers and planners in order to comply with the installation's legal responsibilities for the preservation of significant archaeological and historic resources (KAFB 2018b). In addition, Kirtland AFB has an *Architectural Compatibility Plan* that requires buildings, landscapes, and sites to meet the requirements set forth in the document when considering project design, construction, and maintenance of facilities (KAFB 2007a).

3.7.2 Environmental Consequences

3.7.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would likely have short-term, negligible to minor impacts to cultural resources. Potential impacts to cultural resources resulting from either an SPV or geothermal energy project are similar, therefore the two technologies are discussed collectively in this resource section.

The area of potential effects for any proposed SPV or geothermal energy project site would encompass the project site itself as well as staging areas, access roads, and distribution lines. All historic properties within the area of potential effect as defined by the NHPA constitute the affected environment for cultural resources for the purposes of all applicable cultural resource regulations and NEPA.

Effects to cultural resources can be direct, indirect, and/or cumulative. For historic properties listed or eligible for listing in the NRHP, analysis of potential effects must consider whether there may be adverse effects to the historic property or those characteristics which make a property NRHP eligible. Direct effects are those that are predictable and occur at the project location during construction and implementation. They can include physical modifications as well as visual effects to the physical setting of historic buildings, structures, archaeological sites, and historic districts. Indirect effects are those that are further removed in time but are still reasonably foreseeable. These might include change in accessibility to a historic building or sacred site, or increased growth around a historic property. Cumulative impacts are the impact on the historic property from the proposed action when added to past, present, and reasonably foreseeable future action to the project area.

Under the NHPA, the first step in determining the significance of potential effects from the proposed action starts with whether or not there are historic properties in the project area. If there are historic properties, then it must be determined if there will be adverse effects to eligible historic properties. If an NRHP-eligible property would not be affected by a proposed action, it is determined to have no effect. Effects to historic properties that do not affect those aspects of historic integrity that cause a property to be listed or eligible for listing in the NRHP are said to have no adverse effects. Adverse effects occur when a proposed action has a negative effect on those characteristics that make a property eligible for listing in the NRHP. They can include physical change to all or a portion of the property; removal from its historic location; and introduction of visual, atmospheric, or noise elements that diminish integrity. If the proposed action causes a change in the setting of a historic property, adverse visual effects could potentially occur. Physical environmental features that might contribute to a historic setting can include topographic features, vegetation, paths and fences, and spatial relationships between buildings, structures, or open space.

The Proposed Action does not include specific projects or project areas; however, general guidelines for potential future projects assume that SPV would need up to approximately 500 acres for development of an array with distribution using the existing utility right-of-way, and geothermal projects would need 5 to 20 acres of land and need to be located near existing power distribution centers. Potential future projects must meet standards that relate to cultural resources, such as Mission Compatibility and Compatible Land Use. Any specific projects that meet these standards could be subject to separate NEPA analysis at a later date.

Mission Compatibility would require the technology to be compatible with the mission and training at the installation. For instance, a renewable energy technology must not adversely impact military training. Compatible Land Use requires that the technology must be compatible with the land use objectives of the Kirtland AFB IDP (KAFB 2016a). Compatible land uses would consider all large-scale constraints applicable to withdrawn lands or outgrants and would avoid areas with environmental or operational constraints. Both cultural resources and historic properties are considered environmental constraints which would make them unavailable for development of SPV and/or geothermal energy projects.

Construction, operation, and maintenance of SPV or geothermal energy projects have the potential to affect cultural resources depending on the proposed project location and the type of cultural resources encountered. These impacts, have the potential to be both direct and indirect in nature. However, proposed Level 2 selection standards require that a proposed site must avoid cultural resources and historic properties including known archaeological sites, historic structures and buildings, and historic districts. Given this consideration, the Proposed Action would likely have short-term, negligible to minor impacts to cultural resources. An increase in vibration, noise, and dust would be expected during ground disturbance and construction. With careful consideration, site selection would likely result in negligible visual impacts to NRHP-eligible properties. In the event of an inadvertent discovery during construction or implementation of the Proposed Action, Kirtland AFB would stop work immediately and follow the standard operating procedures outlined in their ICRMP (KAFB 2018b).

In response to the Scoping Notification Letter, New Mexico SHPO indicated that the Section 106 process must be completed prior to completion of a Finding of No Significant Impact and requested Kirtland AFB contact them when the project's area of potential effect are better defined. BIA recommended DoD complete the Section 106 process and provide any cultural survey reports, as needed, if concurrence from the BIA Regional Archaeologist is required. BIA further stated the Proposed Action would not impact trust resources under the jurisdiction of the BIA (see **Appendix A**). Because of the programmatic nature of this PEA, no specific activities or locations have been identified. As specific projects are developed, Section 106 consultation would be conducted with the New Mexico SHPO, tribes, and other interested parties during site-specific NEPA analysis and NHPA Section 106 reviews.

3.7.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop or implement electricity-generating renewable energy technologies on the installation. The No Action Alternative would have no impacts on cultural resources at Kirtland AFB.

3.8 Infrastructure

Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure is wholly manmade, with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as "urban" or developed. The availability of infrastructure and its capacity to support growth are generally regarded as essential to the economic growth of an area. The infrastructure information in this section was primarily obtained from the 2016 IDP and provides a brief overview of each infrastructure component and comments on its existing general condition.

The infrastructure components discussed in this section include transportation, utilities, and solid waste management. Transportation is defined as the system of roadways, highways, and transit services that are near the installation and could be reasonably expected to be potentially affected by the Proposed Action. Utilities include electrical, natural gas, liquid fuel, water supply, sanitary sewage/wastewater, stormwater handling, and communications systems. Solid waste management primarily relates to the availability of landfills to support a population's residential, commercial, and industrial needs.

3.8.1 Affected Environment

Transportation. Numerous modes of transportation are available at Kirtland AFB, including air, mass transit, and federal and state highway access. The Sunport, located along the northwestern boundary of the installation, provides commercial and public aviation and military support, particularly for USAF and Air Force Reserve units. The airfield at the Sunport consists of two commercial carrier runways and one runway dedicated to general aviation (ABQ Sunport 2018). The Albuquerque Transit Department, ABQ RIDE, provides and operates public bus services throughout the city. Several bus routes regularly service Kirtland AFB (ABQ RIDE 2017).

Kirtland AFB is situated approximately 4 miles east of Interstate (I)-25 and approximately 1.5 miles south of I-40. The installation is served from interstate highways and many state and

local roads. The city of Albuquerque street grid includes several major arterials that tie directly into the installation, including Eubank Boulevard, Wyoming Boulevard, Carlisle Boulevard, and Truman Street. These roadways serve north-south traffic flows. The east-west trending major arterial directly to the north of the installation is Gibson Boulevard. Other east-west arterials north of the installation include Zuni Boulevard and Central Avenue, the historic Route 66.

There are currently eight gated entrances from the city of Albuquerque to Kirtland AFB: Carlisle Gate, Truman Gate, Maxwell Gate, Gibson Gate, Wyoming Gate, Eubank Gate, and Hickam Gate. The eighth gate is the South Valley Gate, which is located at Ira Sprecker Road south of the Sunport (KAFB 2016a). The Gibson, Wyoming, Carlisle, Hickam, and South Valley gates currently have restricted hours.

Electrical System. Kirtland AFB purchases electrical power from the Western Area Power Administration. Electric lines are placed above and below ground, feeding the 20 substations on the installation. The installation's average yearly consumption is approximately 407,010 kilowatt hours (KAFB 2016a).

Natural Gas and Propane. Natural gas is supplied by Coral Energy and delivered in New Mexico Gas Company pipelines supplying the industrial complex, family housing, and heating plants on the installation. There are approximately 496,000 linear feet of natural gas mains on the installation (KAFB 2016a). Rural portions of the installation do not receive natural gas service and rely on propane, which is delivered to and stored in local propane storage tanks.

Liquid Fuel. Liquid fuels are supplied to Kirtland AFB by contractors. The primary liquid fuels supplied include JP-8 (jet propellant [fuel] – type 8), diesel, and unleaded gasoline. Fuels are purchased in bulk, delivered to the installation by tanker truck, and stored in various-sized storage tanks across the installation. Liquid fuels at Kirtland AFB are primarily used to power military aircraft and ground-based vehicles (KAFB 2016a).

Water Supply System. Drinking water is supplied to Kirtland AFB by six groundwater wells and two distribution systems that have a collective water-pumping maximum capacity of 8.1 million gallons per day (mgd). The installation pumps an average of 5.5 mgd of treated, potable water through 160 miles of distribution mains (KAFB 2016a). There are also approximately 50 miles of non-potable water pipeline serving the Tijeras Golf Course and providing water for fire protection.

In 1973, the US District Court for the District of New Mexico decreed[6] that Kirtland AFB has the right to divert approximately 6,400 acre-feet per year from the underground aquifer, which is equal to approximately 2 billion gallons of water (KAFB 2016a). In 2015, Kirtland AFB pumped a total of 813 million gallons (2,495 acre-feet) of water from these wells. The installation can also purchase water from the Albuquerque-Bernalillo County Water Utility Authority to meet demand during peak periods; however, the amount of water purchased from the city has been

[6] On 27 November 1973, the US District Court for the District of New Mexico issued a Judgment and Order granting Kirtland AFB a right to divert 6,398 acre-feet of groundwater from two wells within the Rio Grande Underground Water Basin (4,500 acre-feet and 1,898 acre-feet), as well as three minor decrees to divert 3 acre-feet per year of groundwater from three domestic wells.

negligible since 1998, and Kirtland AFB did not purchase any water from the city in 2015 (KAFB 2016b).

Sanitary Sewer/Wastewater System. Kirtland AFB does not have its own sewage treatment facility. Instead, the sanitary sewer system on the installation, which consists of approximately 491,000 linear feet of collection mains, transports wastewater to the city of Albuquerque treatment facility. The permissible discharge rate for Kirtland AFB is fixed at 70,805,000 gallons per month. The installation discharges an average of approximately 1.4 mgd (KAFB 2016a), or approximately 42 million gallons per month. Some facilities in remote areas and other portions of the installation are not serviced by the sanitary sewer system; these facilities use isolated, onsite septic systems to dispose of wastewater.

Communications System. The communication network on Kirtland AFB was originally constructed as two separate systems that were later connected to provide redundancy. The main information transfer node is on the west side of the installation. This facility is in need of additional capacity and expansion if Kirtland AFB expands mission requirements. The Communication Main Switch Facility is on the east side of the installation. There are future projects to upgrade the copper cable. The network fiber in the installation communication system is currently in the process of being upgraded (KAFB 2016a).

Solid Waste Management. Solid waste generated at Kirtland AFB is collected by a contractor and disposed of at the city of Albuquerque's Cerro Colorado Landfill. The Cerro Colorado Landfill receives approximately 1,700 tpy of MSW from Kirtland AFB (Wheelock 2017b).

Kirtland AFB operates a construction and demolition waste-only landfill on the installation. This landfill accepts only construction and demolition waste from permitted contractors working on the installation, has a total gross capacity of 10.2 million cubic yards, and has a net waste capacity of 7.2 million cubic yards. As of December 31, 2016, the remaining capacity of this landfill was 2.55 million cubic yards. In 2015 and 2016, an average of 14,375 tons of construction and demolition waste per year was deposited in this landfill (Wheelock 2017b). As of June 2012, the recycling of construction and demolition waste at Kirtland AFB has been codified into the Construction Waste Management specification (Section 01 74 19) for all USAF construction and demolition projects on the installation.

Green waste generated from land clearing or ground maintenance on the installation is brought to the Kirtland AFB landfill for chipping. A Memorandum of Agreement with the Albuquerque-Bernalillo County Water Utility Authority has been established to exchange this chipped green waste for finished compost, which is used across the installation for landscaping purposes.

Kirtland AFB manages a recycling program to reduce the amount of solid waste sent to landfills. The installation recycles scrap metal under the Qualified Recycling Program and collects corrugated cardboard from over 70 drop-off points across the installation. Per the DoD Strategic Sustainability Performance Plan, the diversion rate goal is 60 percent by FY 2015 and thereafter through FY 2020.

3.8.2 Environmental Consequences

3.8.2.1 PROPOSED ACTION

No short- or long-term impacts are expected to occur on the natural gas and propane, liquid fuel, sanitary sewer/wastewater, and communications systems from programmatic implementation of SPV and geothermal energy technologies on the installation because these infrastructure components (e.g., natural gas pipes and communication wires) would be avoided during construction and neither would use these types of infrastructure during operations. Therefore, the Proposed Action will have no impact on these utility systems. Impacts to infrastructure resulting from either an SPV or geothermal energy project are similar; therefore, the two technologies are discussed collectively in this resource section.

Transportation. Programmatic implementation of SPV and geothermal energy technologies on the installation would result in a short-term, negligible, adverse impact on transportation. During construction activities, installation roadways would be used to transport heavy equipment and materials; however, transportation would not occur during peak travel times. Therefore, no disruption in the flow of traffic on the installation is expected.

Electrical System. Programmatic implementation of SPV and geothermal energy technologies on the installation would result in short- and long-term impacts. Construction and maintenance activities associated with the Proposed Action would result in a short-term, negligible to minor, adverse impact on the electrical system. Although equipment associated with the Proposed Action would be installed among existing compatible equipment and within existing rights-of-way, service interruptions may be experienced when extending or rerouting existing electrical lines, integrating the proposed renewable energy system into the installation's electrical distribution system or facility infrastructure, and during maintenance and repair activities.

Long-term, negligible to minor, beneficial impacts would result on the electrical system. Programmatic implementation of SPV and geothermal energy technologies on the installation would result in increased installation energy security, strategic flexibility in energy-generating sources, and predictable and potentially reduced electricity costs.

Water Supply System. The Proposed Action would result in a short-term, negligible to minor, adverse impact on the water supply system. The proposed construction and maintenance activities would require minimal amounts of water, primarily for dust suppression and cleaning of the SPV panels. Although water demand would increase slightly from construction and periodic maintenance activities, this increase would be temporary and would not be expected to exceed the existing capacity. Kirtland AFB is allowed to withdraw up to 6,000 acre-feet (2 billion gallons) of water per year and in 2015 pumped only 2,495 acre-feet (813 million gallons) of water, which is less than half of what is permitted; therefore, sufficient water resources are available on the installation.

Solid Waste Management. The Proposed Action would result in short-term, negligible, adverse impacts on solid waste management. Construction activities associated with the Proposed Action would generate minimal amounts of solid waste. Construction debris generated would

consist primarily of recyclable and reusable building materials, such as concrete, metals (e.g., conduit, piping, and wiring), and removed vegetation and trees.

3.8.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and the existing conditions discussed in **Section 3.8.1** would remain unchanged. Additionally, implementation of the No Action Alternative would not result in increased installation energy security, strategic flexibility in energy-generating sources, and predictable and potentially reduced operational costs.

3.9 Hazardous Materials and Wastes

Hazardous materials are defined by 49 CFR §171.8 as "hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (49 CFR §172.101), and materials that meet the defining criteria for hazard classes and divisions" in 49 CFR § 173. Transportation of hazardous materials is regulated by the US Department of Transportation regulations within 49 CFR §§ 105–180.

Hazardous wastes are defined by RCRA at 42 USC § 6903(5), as amended by the Hazardous and Solid Waste Amendments, as: "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to an increase in, mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." Certain types of hazardous wastes are subject to special management provisions intended to ease the management burden and facilitate the recycling of such materials. These are called universal wastes and their associated regulatory requirements are specified in 40 CFR § 273. Four types of waste are currently covered under the universal waste regulations: hazardous waste batteries, hazardous waste pesticides that are either recalled or collected as part of waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps.

Special hazards are those substances that might pose a risk to human health and are addressed separately from other hazardous substances. Special hazards include asbestos-containing materials (ACMs), polychlorinated biphenyls (PCBs), and lead-based paint (LBP). USEPA is given authority to regulate these special hazard substances by the Toxic Substances Control Act (15 USC § 53). USEPA has established regulations regarding asbestos abatement and worker safety under 40 CFR § 763, with additional regulations concerning emissions at 40 CFR § 61. Whether from LBP abatement or other activities, depending on the quantity or concentration, the disposal of the LBP waste is regulated by the RCRA at 40 CFR § 260. The disposal of PCBs is addressed in 40 CFR §§ 750 and 761. The presence of special hazards, including describing their locations, quantities, and condition, assists in determining the significance of a proposed action.

DoD developed the ERP to facilitate thorough investigation and cleanup of contaminated sites on military installations (i.e., active installations, installations subject to Base Realignment and Closure, and Formerly Used Defense Sites). The Installation Restoration Program and Military Munitions Response Program (MMRP) are components of the ERP. The Installation Restoration Program required each DoD installation to identify, investigate, and clean up hazardous waste disposal or release sites. The MMRP addressed non-operational rangelands that are suspected or known to contain unexploded ordnance, discarded military munitions, or munitions constituent contamination. A description of ERP activities provides a useful gauge of the condition of soils, water resources, and other resources that might be affected by contaminants. It also aids in the identification of properties and their usefulness for given purposes (e.g., activities dependent on groundwater usage might be restricted until remediation of a groundwater contamination plume has been completed).

DOE developed the Office of Environmental Restoration and Waste Management in 1989. The goal of this office is to implement DOE's policy of ensuring that past, present, and future operations do not threaten human health or environmental health and safety. The Environmental Management Office was reorganized in 1999 to implement procedures to meet these goals through five underlying offices. The Office of Site Closure is responsible for achieving closure of ER sites in a manner that is safe, cost-effective, and coordinated with stakeholders. As a facility operated for DOE under the Albuquerque Operations Office, SNL is part of this program. The current investigation being conducted at SNL under the ER program is intended to determine the nature and extent of hazardous and radioactive contamination and to restore any sites where such materials pose a threat to human health or the environment.

Radon is a naturally occurring odorless and colorless radioactive gas found in soils and rocks that can lead to the development of lung cancer. Radon tends to accumulate in enclosed spaces, usually those that are below ground and poorly ventilated (e.g., basements). USEPA established a guidance radon level of 4 picocuries per liter in indoor air for residences, and radon levels above this amount are considered a health risk to occupants.

For USAF, Air Force Policy Directive 32-70, *Environmental Quality*, and Air Force Regulation 32-7000 series incorporate the requirements of all federal regulations and other AFIs and DoD Directives for the management of hazardous materials, hazardous wastes, and special hazards.

3.9.1 Affected Environment

Environmental Management System. Kirtland AFB has implemented an EMS program in accordance with International Organization for Standardization 14001 Standards; EO 13693, *Planning for Federal Sustainability in the Next Decade*; and AFI 32-7001, *Environmental Management*. The EMS program prescribes to protect human health, natural resources, and the environment by implementing operational controls, pollution prevention environmental action plans, and training.

All personnel, including contractors, are made aware of the Kirtland AFB EMS program. All project-related activities should be conducted in a manner that is consistent with relevant policy and objectives identified in the installation's EMS program. Project Managers shall ensure that

all personnel are aware of environmental impacts associated with their activities and reduce those impacts by practicing pollution prevention techniques.

Hazardous Materials and Petroleum Products. AFI 32-7086, *Hazardous Materials Management*, establishes procedures and standards that govern management of hazardous materials throughout the USAF to be in compliance with the Emergency Planning and Community Right to Know Act. AFI 32-7086 applies to all USAF personnel who authorize, procure, issue, use, or dispose of hazardous materials, and to those who manage, monitor, or track any of those activities.

Kirtland AFB has identified the 377 MSG/CEIEC as the responsible entity to oversee hazardous material tracking on the installation. Part of their responsibilities is to control the procurement and use of hazardous materials to support USAF missions, ensure the safety and health of personnel and surrounding communities, and minimize USAF dependence on hazardous materials. 377 MSG/CEIEC is charged with managing hazardous materials to reduce the amount of hazardous waste generated on the installation in accordance with the Kirtland Hazardous Waste Management Plan (HWMP) (KAFB 2015a).

Contractors bringing hazardous materials onto the installation must notify the 377 MSG/CEIEC Hazardous Material Program Team by submitting a completed Hazardous Material Worksheet and a list of all materials along with their associated Safety Data Sheets.

Hazardous and Petroleum Wastes. USAF maintains a HWMP as directed by AFI 32-7042, *Waste Management*. This plan describes the roles and responsibilities of all entities at Kirtland AFB with respect to the waste stream inventory, waste analysis plan, hazardous waste management procedures, training, emergency response, and pollution prevention. The HWMP establishes the procedures to comply with applicable federal, state, and local standards for solid waste and hazardous waste management.

Kirtland AFB is a large-quantity generator of hazardous waste (Handler Identification #NM9570024423). RCRA Large Quantity Generators generate 1,000 kilograms per month or more of hazardous waste or more than 1 kilogram per month of acutely hazardous waste. Kirtland AFB and DOE/SNL maintain separate RCRA permits for all current operations that generate hazardous waste (NMED 2010).

Special Hazards. Facilities constructed prior to 1990 are likely to contain ACMs, and those constructed prior to 1978 are likely to contain LBP and PCBs. Given that Kirtland AFB was established in the late 1930s, many older buildings are present on the installation, and there is the potential for special hazards to be encountered when working in such buildings.

Environmental Restoration Program. There are 287 ERP sites and 6 area of concern sites that together cover 484 acres of Kirtland AFB. These sites include known and suspected soil and groundwater contamination associated with landfills, oil/water separators, drainage areas, septic systems, fire-training areas, and spill areas. Kirtland AFB is working to clean up most sites to residential standards and to obtain no further action required approval from NMED. Once sites achieve the no further action required approval, they are closed because they no longer represent constraints for land use. Active ERP sites are in various stages of remediation

and some sites, such as the former landfills, may require more than 30 years of monitoring before closure can be obtained (KAFB 2013a, KAFB 2013b, KAFB 2016a).

Kirtland AFB has 24 MMRP sites (7 active) that occupy approximately 17 percent or 8,429 acres. These sites are former impact areas that are mainly located along the outer perimeter and center of the installation. The sizes, types of munitions debris, and potential for unexploded ordnance vary by location. A total of 16 MMRP sites and part of a 17th, with a total acreage of 4,073 acres, have been found acceptable for unlimited use and unrestricted exposure (KAFB 2013a, KAFB 2013b, KAFB 2016a). **Figure 3-5** shows the location of the active ERP, DOE ER, and MMRP sites on Kirtland AFB.

DOE actively manages 11 open ER sites on Kirtland AFB that require or may require corrective action. These sites are on DOE-leased lands and include three groundwater areas of concern and eight solid waste management units. When such sites are no longer active, DOE personnel determine if a site meets NMED criteria for acceptable levels of risk to human health and the environment. If the criteria are met, DOE submits a Corrective Action Complete proposal to NMED to modify its RCRA permit accordingly. As necessary, remediation is performed to meet NMED criteria for Corrective Action Complete status (SNL 2017b).

Radon. USEPA rates Bernalillo County, New Mexico, as radon zone 1. Counties in zone 1 have a predicted average indoor radon screening level greater than 4 picocuries per liter (USEPA 2017c).

3.9.2 Environmental Consequences

3.9.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short-term, negligible to minor, adverse impacts on hazardous materials and wastes from construction, and negligible, adverse impacts from special hazards during construction; long-term, negligible, adverse impacts from operations and maintenance and negligible, beneficial impact from the removal of special hazards; and no impact on the status of existing environmental contamination sites or from radon. The hazardous materials and wastes impacts occurring from the proposed SPV or geothermal energy projects would be similar to one another; therefore, these two technologies are discussed collectively in this resource section.

Environmental Management System, Hazardous Materials, Petroleum Products, and Hazardous Wastes. Short-term, negligible to minor, adverse impacts on hazardous materials and wastes would occur from construction of proposed renewable energy projects. Construction would require the use of hazardous materials and petroleum products and the generation of hazardous wastes and used petroleum products. Hazardous materials that could be used include paints, welding gases, solvents, preservatives, and sealants. Additionally, hydraulic fluids and petroleum products, such as diesel and gasoline, would be used in the vehicles and equipment supporting construction. Construction would generate negligible quantities of hazardous wastes. Contractors would be responsible for the disposal of hazardous wastes in accordance with federal and state laws. All hazardous materials, petroleum products, and hazardous wastes used or generated during construction would be contained, stored, and managed appropriately (e.g., secondary containment, inspections, spill kits) in accordance with

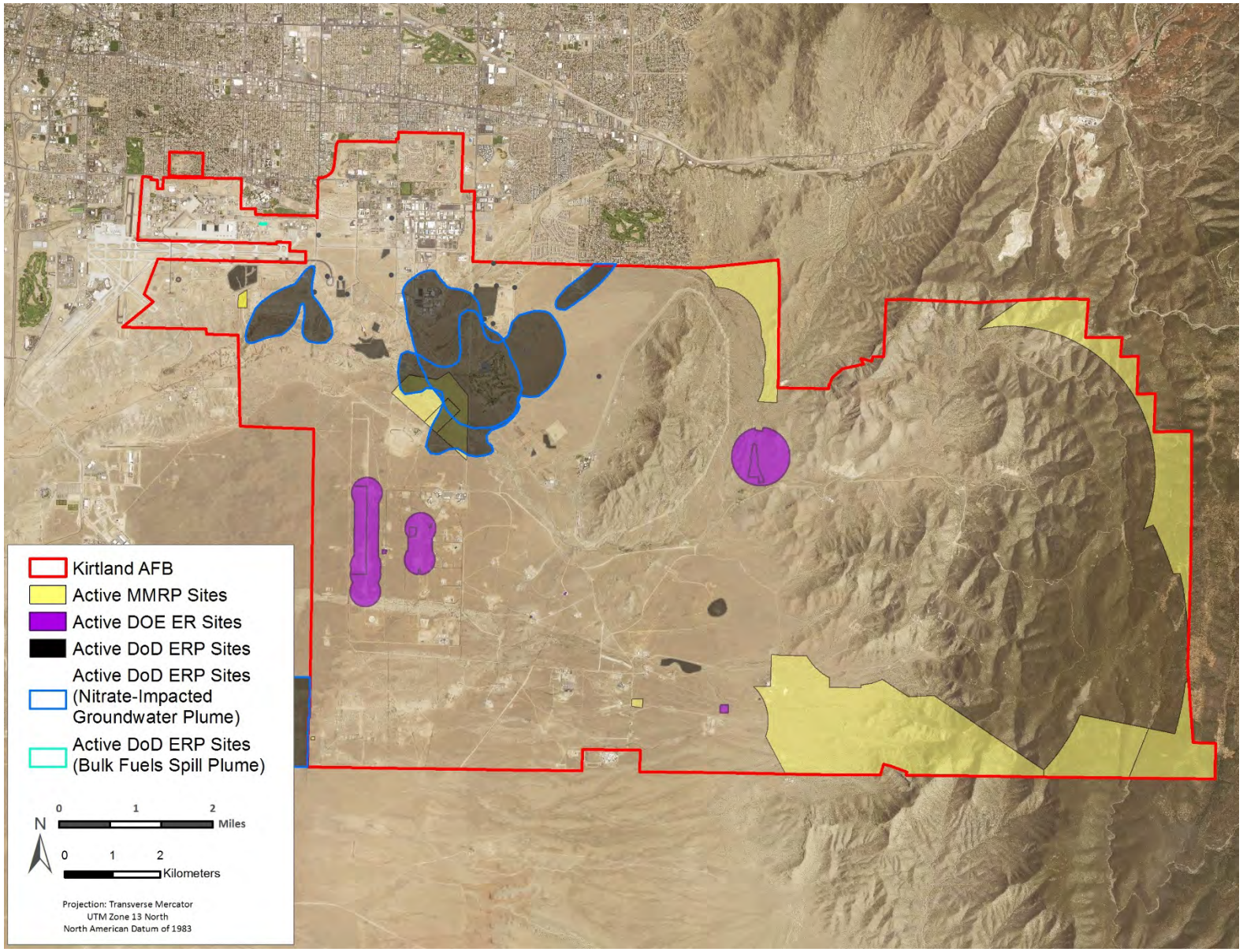

Figure 3-5. Active ERP, DOE ER, and MMRP Sites on Kirtland AFB

applicable regulations to minimize the potential for releases. Contractors would follow the procedures outlined in the Kirtland AFB EMS program. All construction equipment would be maintained according to the manufacturer's specifications and drip mats would be placed under parked equipment as needed. If any hazardous materials, hazardous wastes, or petroleum products are currently within the footprints of construction, they would be permanently relocated to other locations before construction begins.

Long-term, negligible, adverse impacts would occur from a slight increase in hazardous materials and petroleum product use and hazardous waste generation associated with operation and maintenance of the proposed renewable energy projects. Activities such as washing SPV panels, performing preventative maintenance and corrective repairs, and conducting periodic inspections would occur annually. These actions would use negligible quantities of hazardous materials and petroleum products and would generate negligible quantities of hazardous wastes and used petroleum products from the operation of trucks, equipment, and other tools. Such hazardous materials and wastes impacts would occur intermittently when such activities are needed and would be within the hazardous materials and wastes management capabilities of the installation. All Kirtland AFB hazardous materials and wastes management policies, including the EMS program, would be followed during operation and maintenance activities.

Special Hazards. Short-term, negligible, adverse impacts from special hazards might occur from construction of proposed renewable energy projects. While most renewable energy projects would be sited on undeveloped land and would not require demolition of existing buildings or disturbance of large quantities of special hazards, there is the potential for small quantities of special hazards to be disturbed when renewable energy projects are connected to the existing facilities of Kirtland AFB. For example, each proposed renewable energy project would require interconnection with existing energy infrastructure on Kirtland AFB, and some of the installation's existing energy infrastructure is old enough to potentially contain special hazards. Additionally, an SPV array constructed on the roof of an existing, older building could potentially result in the disturbance of special hazards from the necessary exterior and interior modifications to the building.

Surveys for special hazards would be completed, as necessary, by a certified contractor prior to the construction of each proposed renewable energy project. These surveys would be used to identify areas where appropriate measures would need to be taken to reduce potential exposure to, and release of, these special hazards. Contractors would wear appropriate personal protective equipment and would be required to adhere to all federal, state, and local regulations for these special hazards. All ACM- and LBP-contaminated debris would be disposed of at a USEPA-approved landfill. It is unlikely new construction would include the use of these special hazards because federal policies and laws limit their use in most construction applications. The removal of any special hazards from Kirtland AFB would represent a long-term, negligible, beneficial impact from reducing the potential for future human exposure and reducing the quantity of ACMs, LBP, and PCBs to manage.

Environmental Restoration Program. The Proposed Action would not adversely impact the status of existing environmental contamination sites. Whenever a renewable energy project is

proposed, USAF would perform a siting analysis to determine if any ERP, MMRP, and DOE ER sites are within the project's footprint of disturbance and to assess how such sites could constrain the proposed renewable energy project. Closed ERP, MMRP, and DOE ER sites that require no further action do not represent constraints to the proposed renewable energy projects. However, active ERP, MMRP, and DOE ER sites represent constraints, and the extent of contamination at these sites could preclude the viability of the proposed renewable energy project for that site. For example, should an SPV array be proposed on an active ERP site that consists of soil contamination, the siting analysis could require that the soil contamination be remediated to no further action required status before construction begins or it could reject the proposed siting because placing an SPV array on top of soil contamination would impair USAF's ability to remediate the ERP site and present a health risk to construction workers. The siting analysis could also determine that a similar SPV array could be constructed on an active ERP or DOE ER site that consists of groundwater contamination if the proposed SPV array would be constructed so that it does not reach the depth of groundwater and interfere with future groundwater monitoring and planned groundwater remedial activities. Siting renewable energy projects on ERP or DOE ER sites would undergo similar siting analysis to determine how contamination at the sites would constrain the proposed renewable energy project or impact the ERP or DOE ER site. Because geothermal energy projects require drilling deep into the earth, it is unlikely these projects could be sited on any active environmental contamination site. Should a project associated with the Proposed Action be conducted within or adjacent to an MMRP site, all project personnel shall attend a 30-minute Unexploded Ordnance Awareness Training.

While it is unlikely the proposed renewable energy projects would encounter environmental contamination during construction, if soil or groundwater that is believed to be contaminated was unexpectedly discovered, the construction contractor would be required to immediately stop work, report the discovery to USAF, and implement appropriate safety measures. Commencement of field activities would not continue in this area until the issue was investigated and resolved.

Radon. Although the USEPA rating for Bernalillo County, New Mexico, is radon zone 1, it is unlikely proposed renewable energy projects would experience any impacts from radon. Radon is a concern only in certain indoor environments such as basements and poorly ventilated areas. The proposed renewable energy projects would not entail the construction of new, habitable indoor spaces other than possibly the construction of small utility rooms to house infrastructure. These new indoor spaces would be occupied only for brief periods of time by maintenance staff and are unlikely to present a health risk from radon. As such, no impacts from radon would be encountered.

3.9.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed renewable energy projects would not be implemented and hazardous materials and wastes conditions would remain the same as described in **Section 3.9.1**. No additional quantities of hazardous materials and petroleum products would be delivered to the installation, and no additional quantities of hazardous wastes would be generated. Special hazards would remain in place and would not be disturbed. No impacts would occur.

3.10 Safety

A safe environment is one in which there is no, or an optimally reduced, potential for death, serious bodily injury or illness, or property damage. Human health and safety address workers' and public health and safety during a specific activity or event such as construction or military training and operations.

Site safety requires adherence to regulatory requirements imposed for the benefit of employees and the public. Site safety includes implementation of engineering and administrative practices that aim to reduce risks of illness, injury, death, and property damage. The health and safety of onsite military and civilian workers are safeguarded by numerous DoD and military branch-specific requirements designed to comply with standards issued by federal and state occupational safety and health agencies. These standards specify health and safety requirements, the amount and type of training required for workers, the use of personal protective equipment (PPE), administrative controls, engineering controls, and permissible exposure limits for workplace stressors.

Health and safety hazards can often be identified and reduced or eliminated before an activity begins. Necessary elements for an accident-prone situation or environment include the presence of the hazard itself, together with the exposed (and possibly susceptible) population or public. The degree of exposure depends primarily on the proximity of the hazard to the population. Hazards include transportation, maintenance, and repair activities, and the creation of a noisy environment or a potential fire hazard.

3.10.1 Affected Environment

Contractor Safety. New Mexico is one of several states that administer their own occupational safety and health program in accordance with the federal Occupational Safety and Health Act (OSHA). Within the NMED, the Occupational Health and Safety Bureau enforces state health and safety regulations; however, federal employees are excluded as they are covered by federal OSHA regulations.

Occupational safety and health programs address the health and safety of people at work. Occupational safety and health regulations cover potential exposure to a wide range of chemical, physical, and biological hazards, and ergonomic stressors. The regulations are designed to control these hazards by eliminating exposure via administrative or engineering controls, substitution, or use of PPE. Occupational health and safety is the responsibility of each employer, as applicable. Employer responsibilities include the following:

- Review potentially hazardous workplace conditions.
- Monitor exposure to workplace chemical (e.g., asbestos, lead, hazardous substances), physical (e.g., noise propagation, falls), and biological (e.g., infectious waste, wildlife, poisonous plants) agents, and ergonomic stressors.
- Recommend and evaluate controls (e.g., prevention, administrative, engineering, PPE).

- Ensure a medical surveillance program is in place to perform occupational health physicals for those workers subject to the use of respiratory protection, engaged in hazardous waste work, asbestos, lead, or other work requiring medical monitoring.

Installation Personnel Safety. AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Program* implements USAF policy with respect to personnel occupational safety and health. It does so by governing the recognition, evaluation, control, and protection of Air Force personnel from occupational health and safety hazards. The purpose of the Air Force Occupational and Environmental Safety, Fire Protection, and Health Program is to minimize the loss of USAF resources and to protect its personnel from occupational deaths, injuries, or illnesses by risks. For example, DoD issued a memorandum on 11 June 2014 regarding potential glint/glare issues from solar renewable energy projects sited in proximity to aviation operations. The memorandum defines the concern and establishes interim policy and procedures to mitigate such risks to the military pilots and aviation personnel (DoD 2014).

Public Safety and Emergency Services. The Kirtland AFB emergency services department provides fire suppression; crash response and rescue; emergency medical response; hazardous substance protection; emergency response planning and education; and community health and safety education through the dissemination of informational materials on the installation. Medical facilities at Kirtland AFB include a Department of Veterans Affairs hospital and the 377th Medical Group's Outpatient Clinic (KAFB 2007b, KAFB 2015b). The nearby city of Albuquerque is home to numerous public healthcare facilities, including the Heart Hospital of New Mexico, University of New Mexico Hospital, and Presbyterian Kaseman Hospital (City of Albuquerque 2018).

The Fire and Rescue Emergency Services Division for the city of Albuquerque provides fire suppression; crash response and rescue; emergency medical response; and hazardous substance response to the nearby municipality. This Division includes 23 fire engine companies, 7 fire ladder companies, 3 hazardous material response units, and 18 medical response ambulances. The city of Albuquerque also has an approximately 500-person police force available to provide law enforcement services. A mutual service agreement is in place between the city of Albuquerque and Kirtland AFB (City of Albuquerque 2017).

3.10.2 Environmental Consequences

3.10.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short- and long-term, minor adverse impacts to human health and safety. Impacts to safety resulting from either an SPV or geothermal energy project are similar; therefore, the two technologies are discussed collectively in this resource section.

Contractor Safety. The construction phase of the Proposed Action could expose workers to safety risks. Examples of such safety hazards include slips/trips/falls; exposure to the heat and wet conditions; and fire, mechanical, electrical, vision, noise, chemical, and respiratory hazards. Under the Proposed Action, all contractors would be responsible for compliance with applicable federal and state safety regulations. This would include a comprehensive health safety plan with

site-specific guidance and direction for contractors to prevent or minimize potential safety risks (e.g., PPE requirements, emergency response procedures, and evacuation procedures).

Potential contractor safety risks may also be associated with the operation and maintenance of the proposed SPV and geothermal energy systems. For example, electric shocks, burns, exposures to geothermal fluids or steam, and trips and falls could result from these day-to-day activities onsite. Accordingly, implementation of the Proposed Action would comply with all related and applicable safety requirements and standards (e.g., the proper maintenance of operational tools and equipment, and adherence to the National Electric Code, use of PPE, and use of lockout/tagout procedures).

Installation Personnel Safety. Potential safety risks to installation personnel associated with the proposed SPV arrays could include the generation of electric and magnetic fields or the glare associated with their reflective surfaces. Potential safety risks associated with geothermal energy projects include system failures, well blowouts (i.e., uncontrolled well flow), or leaks of geothermal fluids (TEEIC Undated). System failures could result in power outages and loss of visibility in otherwise safe work environments; blowouts could result in fires; and leaks of geothermal fluids could result in the contamination of soils, groundwater, or surface waters. While these risks could result in long-term, minor, adverse impacts, potential safety risks to installation personnel associated with the Proposed Action are not anticipated to result in any meaningful change to the risk profile of the installation.

Under the Proposed Action, SPV project operations would generate low electric and magnetic frequencies. In most cases, SPV and geothermal energy substations excluded, generated frequencies are comparable to a home electrical appliance. Additionally, studies have demonstrated a substantial drop in frequency strength with distance from source. Most importantly, SPV projects would not be sited within any of the installation's surface danger zones or explosives ordnance quantity distance arcs without an approved safety waiver of regulations. Additionally, solar panel reflectivity has the potential for glint or glare, which could detract from aircraft safety. *Glint* is defined as a momentary flash of bright light, while *glare* refers to a continuous source of bright light (DoD 2014). Military aviation operations involve multiple types of aircraft and diverse training maneuvers. As such, there is more potential for glint/glare to impact military aviation compared to commercial aviation. By extension, there is potential for these impacts to be more intense.

To prevent or mitigate for potential glint/glare risks, the siting and orientation of selected SPV applications would fully consider current and planned military aircraft operations over or proximate (i.e., with visual connectivity) to Kirtland AFB. Glass-enclosed SPV projects that would potentially be located within 2 nautical miles of military airfield control towers, air traffic areas, or helicopter landing zones would need to be evaluated. The Proposed Action would also carefully consider potential glint/glare impacts on flight operations from concentrating SPV projects. The Proposed Action would use the SGHAT or other analysis tool for solar renewable energy projects, as applicable. Further, in the absence of more specific DoD procedural guidance, implementation of the Proposed Action would follow the FAA's interim procedures for review of solar energy projects (DoD 2014). Incorporation of these project review procedures, including either the SGHAT or an equivalent pre-construction modeling and analytical tool, would ensure the proper placement of solar panels to minimize potential glint/glare impacts.

Additionally, as solar panel glass is designed to reflect only approximately 2 percent of incoming light (i.e., less reflectivity than water or window glass), glint/glare associated with the Proposed Action would not be anticipated to affect aircraft operations or the safety of the involved installation or DoD personnel (MA DER 2015).

Regular maintenance of the geothermal energy project would prevent the likelihood of system failures, blowouts, or accidental leaks of geothermal fluids. Maintenance personnel would quickly response to any potential or known system failure or blow out to minimize potential impacts and would follow all safety requirements for these procedures. Additionally, fire risk would be mitigated by compliance with applicable fire safety, electrical, and building codes, and readily available emergency response services near the site. In the event of a geothermal fluid spill, personnel would follow the procedures outlined in the Kirtland AFB EMS program.

Public Safety and Emergency Services. Implementation of the Proposed Action would not impact public safety or emergency services at or near Kirtland AFB. Under the Proposed Action, the sites would be fully enclosed by a perimeter fence. The site locations would be on an active military installation, and Kirtland AFB would provide additional security relative to required anti-terrorism/force protection criteria (e.g., setback distances). These security features would serve to prevent and minimize access to the site by unauthorized personnel, including children and the general public. Overall, the Proposed Action would reduce the amount of fossil fuels used for energy consumption, thereby resulting in an air quality improvement, a minor, long-term, beneficial impact to human health and safety.

3.10.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and the existing conditions discussed in **Section 3.10.1** would remain unchanged.

3.11 Socioeconomics and Environmental Justice

Socioeconomics is the relationship between economics and social elements, such as population levels and economic activity. Factors that describe the socioeconomic environment represent a composite of several inter-related and non-related attributes. There are several factors that can be used as indicators of economic conditions for a geographic area, such as demographics, median household income, unemployment rates, percentage of families living below the poverty level, employment, and housing data. Data on employment identify gross numbers of employees, employment by industry or trade, and unemployment trends. Data on industrial, commercial, and other sectors of the economy provide baseline information about the economic health of a region.

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, pertains to environmental justice issues and relates to various socioeconomic groups and disproportionate impacts that could be imposed on them. The EO requires that federal agencies' actions substantially affecting human health or the environment do not exclude persons, deny persons benefits, or subject persons to discrimination because of their race, color, or national origin. The EO was enacted to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with

respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Consideration of environmental justice concerns includes race, ethnicity, and the poverty status of populations near a proposed action.

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, states that each federal agency "(a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."

3.11.1 Affected Environment

Socioeconomics. The Albuquerque Metropolitan Statistical Area (MSA) is considered the region of influence for socioeconomic effects of the Proposed Action. The population of the Albuquerque MSA, defined by the US Census Bureau for the 2010 US Census as Bernalillo, Sandoval, Torrance, and Valencia counties, was 887,077 people. The state of New Mexico's population totaled 2,059,179 in 2010 (USCB 2010a).

The population of Bernalillo County was 662,564 in 2010, representing 32 percent of the total population for the state of New Mexico. The population of Bernalillo County grew 19 percent from 2000 to 2010, while during this same time period Sandoval County experienced a 46.3 percent increase in population, Torrance County experienced a 3.1 percent decrease, and Valencia County grew by 15.7 percent. The growth rate in the Albuquerque MSA from 2000 to 2010 (24.5 percent) was much greater than the growth rate of the state of New Mexico (13.2 percent) and of the United States (9.7 percent) over the same time period. However, Torrance County was not included in the Albuquerque MSA for the 2000 US Census; therefore, when added to the 2000 US Census data for the Albuquerque MSA, this represents a 21.6 percent increase in population. **Table 3-7** presents the 2000 and 2010 population data (USCB 2000, USCB 2010a).

Table 3-7. Population in the Region of Influence as Compared to New Mexico and the United States (2000 and 2010)

Location	2000	2010	Percent Change
United States	281,421,906	308,745,538	9.7%
New Mexico	1,819,046	2,059,179	13.2%
Albuquerque MSA	712,738	887,077	24.5%*
Bernalillo County	556,678	662,564	19.0%
Sandoval County	89,908	131,561	46.3%
Torrance County	16,911	16,383	-3.1%
Valencia County	66,152	76,569	15.7%

Source: USCB 2000, USCB 2010a

Note: *Torrance County was not included in the Albuquerque MSA in the 2000 US Census. When the 2000 population of Torrance County is added to the 2000 population of the Albuquerque MSA, this represents a 21.6 percent increase in population.

Employment Characteristics. The three largest industries in the Albuquerque MSA in terms of percentage of the workforce employed within the industry are: the educational services, and

health care and social assistance industry (25 percent); the professional, scientific, and management, and administrative and waste management services industry (13 percent); and the retail trade industry (11 percent). The construction industry represents 7 percent of the workforce (USCB 2011-2015). In September 2017, the Bureau of Labor Statistics reported a 5.8 percent unemployment rate in the Albuquerque MSA while the United States had a lower unemployment rate of 4.2 percent (BLS 2017).

Kirtland AFB. During FY 2016, 22,010 individuals were employed by Kirtland AFB, of which 4,173 were active-duty personnel. Direct payroll expenditures from the installation totaled over $2.4 billion. When non-payroll expenditures associated with Kirtland AFB are included, total expenditures exceeded $6.7 billion, with DoD expenditures representing approximately $3.3 billion of that total (KAFB 2017a).

Environmental Justice and Protection of Children. To provide a baseline measurement for environmental justice, an area around the installation must be established to examine the impacts on minority, low-income, and youth populations. For the purpose of this analysis, a 50-mile radius around Kirtland AFB was evaluated to identify minority, low-income, and youth populations. This 50-mile radius includes numerous towns, villages, census-designated places, and cities. The largest of these is the city of Albuquerque with a population of 545,852. In the city of Albuquerque, 46.7 percent of the population is Hispanic and 4.6 percent is Native American (see **Table 3-7**) (USCB 2010b).

The city of Rio Rancho is on the northwestern side of Albuquerque, has a population of 87,521, and is the second largest city within 50 miles of Kirtland AFB. The Hispanic or Latino population represents 36.7 percent of the total population in Rio Rancho and the Native American population represents 3.2 percent. The third largest population center within 50 miles of the installation is the South Valley, situated to the west of Kirtland AFB, containing 40,976 persons. In the South Valley, the Hispanic or Latino population is 80.2 percent of the total population and the Native American population is 2.2 percent (USCB 2010a).

The percentage of individuals under the age of 5 is similar in the city of Albuquerque, city of Rio Rancho, and South Valley when compared to the state of New Mexico and the United States (USCB 2010a). The percentage of families living below the poverty level varies greatly throughout the metropolitan areas of Albuquerque, with the city of Albuquerque having poverty levels similar to the state of New Mexico and the United States (see **Table 3-8**). The South Valley has a higher poverty rate compared to the state of New Mexico and the United States. Rio Rancho has a significantly lower poverty rate than the state of New Mexico and the United States. The median household income for the city of Albuquerque is $46,662, which is slightly less than the United States median of $51,914 (USCB 2010b).

3.11.2 Environmental Consequences

3.11.2.1 PROPOSED ACTION

Programmatic implementation of renewable energy technologies at Kirtland AFB would result in short-term, negligible to minor, beneficial impacts on socioeconomics from construction; long-term, negligible to minor, beneficial impacts from operations; and no impact on environmental justice and protection of children. Impacts to socioeconomics and environmental justice

resulting from either an SPV or geothermal energy project are similar, therefore the two technologies are discussed collectively in this resource section.

Table 3-8. Minority and Low-Income Characteristics (2010)

Race and Origin	City of Albuquerque	Rio Rancho	South Valley	New Mexico	United States
Total Population	545,852	87,521	40,976	2,059,179	308,745,538
Percent Under 5 Years of Age	7.0	7.2	7.3	7.0	6.5
Percent Over 65 Years of Age	12.1	10.8	12.3	13.2	13.0
Percent White	69.7	76.0	59.5	68.4	72.4
Percent Black or African American	3.3	2.9	1.2	2.1	12.6
Percent American Indian and Alaska Native	4.6	3.2	2.2	9.4	0.9
Percent Asian	2.6	1.9	0.4	1.4	4.8
Percent Native Hawaiian and Other Pacific Islander	0.1	0.2	0.0	0.1	0.2
Percent Other Race	15.0	11.1	32.7	15.0	6.2
Percent Two or More Races	4.6	4.7	4.0	3.7	2.9
Percent Hispanic or Latino	46.7	36.7	80.2	46.3	16.3
Estimated Median Household Income	$46,662	$59,063	$37,203	$43,820	$51,914
Estimated Percent of Families Living Below Poverty	11.8	6.1	18.2	13.9	10.1

Sources: USCB 2010a, b
Note: Hispanic and Latino denote a place of origin.

Socioeconomics. Programmatic implementation of SPV and geothermal energy technologies on the installation would result in a short-term, negligible to minor, beneficial impact on socioeconomics. Direct and indirect, beneficial impacts would result from increased payroll tax revenue and the purchase of construction materials and goods and materials in the area resulting in a short-term, negligible, beneficial impact on the local economy of the Albuquerque MSA. The proposed construction would occur intermittently over several years and only require a small number of construction workers for each activity; therefore, the existing construction industry within the Albuquerque MSA should adequately provide enough workers to support construction activities associated with the Proposed Action. The number of construction workers necessary to complete the Proposed Action is not large enough to outstrip the supply of the industry. The temporary increase of constructions workers at Kirtland AFB would represent a small increase in the total number of persons working on the installation, but no additional facilities (e.g., housing, schools) would be necessary to accommodate the workforce.

Long-term, negligible to minor, beneficial impacts on the socioeconomic environment at Kirtland AFB would result from the programmatic implementation of SPV and geothermal energy technologies by providing predictable and potentially reduced electricity costs. No long-term changes in employment would result under the Proposed Action. Therefore, implementation of the Proposed Action would not be expected to result in a significant impact on the socioeconomic environment.

***Environmental Justice and Protection of Children*.** Programmatic implementation of SPV and geothermal energy technologies on the installation would not result in an impact on environmental justice and protection of children. As presented in **Table 3-7**, cities within a 50-mile radius around Kirtland AFB contain elevated minority and low-income populations in comparison to the United States but similar to the state of New Mexico. Because of the distance from off-installation populated areas, no off-installation minority, low-income, or youth populations would be adversely impacted by the Proposed Action. Therefore, there would be no disproportionately high and adverse health or environmental effects on minority or low-income populations. There are no environmental health and safety risks associated with the Proposed Action that would disproportionately affect children. Therefore, implementation of the Proposed Action would not be expected to result in a significant impact on associated environmental justice and protection of children populations.

3.11.2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, Kirtland AFB would not develop and implement electricity-generating renewable energy technologies on the installation and the existing conditions discussed in **Section 3.11.1** would remain unchanged. The No Action Alternative would have no impacts on socioeconomics or environmental justice at Kirtland AFB or the surrounding area.

4. Cumulative Impacts

4.1 Impact Analysis

CEQ defines cumulative impacts as "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). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time by various agencies (i.e., federal, state, and local) or individuals. Informed decision-making is served by consideration of cumulative impacts resulting from projects that are proposed, under construction, recently completed, or anticipated to be implemented in the reasonably foreseeable future. Reasonably foreseeable future actions consist of activities that have been approved and can be evaluated with regard to their impacts.

This section briefly summarizes past, present, and reasonably foreseeable future projects within the same general geographic and time scope as the Proposed Action. The geographic scope of the analysis varies by resource area. For example, the geographic scope of the cumulative impacts on noise, geology and soils, and safety is narrow and focused on the location of the resource. The geographic scope of land use, air quality, infrastructure, and socioeconomics is much broader and considers more county- or region-wide activities.

The past, present, and reasonably foreseeable projects, identified below, make up the cumulative impact scenario for the Proposed Action. The cumulative impact scenario is then added to the Proposed Action's impacts on the individual resource areas analyzed in **Sections 3.1** through **3.11** to determine the cumulative impacts of the Proposed Action. In accordance with CEQ guidance, the current impacts of past actions are considered in aggregate as appropriate for each resource area without delving into the historical details of individual past actions.

4.1.1 Past Actions

Kirtland AFB has been used for military missions since the 1930s and has continuously been developed as DoD missions, organizations, needs, and strategies have evolved. Development and operation of training ranges have impacted thousands of acres with synergistic and cumulative impacts on soil, wildlife habitats, water quality, and noise. Beneficial impacts also have resulted from the operation and management of the installation including increased employment and income for Bernalillo County, the city of Albuquerque, and its surrounding communities; restoration and enhancement of sensitive resources such as Coyote Springs wetland areas; consumptive and nonconsumptive recreation opportunities; and increased knowledge of the history and pre-history of the region through numerous cultural resources surveys and studies.

4.1.2 Present and Reasonably Foreseeable Actions

Kirtland AFB is a large military installation that is continually evolving. Present, and reasonably foreseeable projects that were examined for potential cumulative impacts are included in **Table 4-1**.

Table 4-1. Present and Reasonably Foreseeable Actions at Kirtland AFB

Project Name	Description
Military Projects	
New Military Training Activities	The 210 RED HORSE Squadron would construct a permanent laydown yard on the Base Exercise Evaluation and Skills Training Area to store equipment to be used during monthly training activities. Monthly training activities involve the disturbance of up to 40 acres of ground and include the use of the abandoned dirt airstrip to practice demolishing, denying access to, and reconstructing airstrips; construction of forward operating bases to allow other units to train, with the 210 RED HORSE Squadron tearing them down; and dirt movement for heavy-equipment training. This recurring training could last up to 5 days and involve approximately 120 personnel. The Pararescue/Combat Rescue Officer school is proposing to construct an Urban Training Complex (UTC) on 25 acres within the Coyote Canyon Training Area. The UTC would consist of the placement of connexes on a gravel base to simulate a mock village similar to those found in the Middle East. Training would include the following helicopter operations: pararescue and insertion/extraction. Other training would include small team tactics, climbing, and emergency medical. During training at the UTC, personnel would use smokes, ground burst simulators, trip flares, flash-bang pyrotechnics, booby trap simulators, and blanks/simunitions. When the UTC is not scheduled for use by the Pararescue/Combat Rescue Officer, it would be open for use by other groups. Therefore, it is anticipated that the UTC could be used on a monthly basis. USAF is proposing to begin firing .50-caliber M107 Barrett sniper rifles and M2 machine guns at Small Arms Range East. An existing building located south of Forest Road 44 would be demolished in order to provide line of sight from the firing point to the target array. Approximately 240 acres would be cleared by tree removal and thinning to create firebreaks along Forest Roads 40, 40B, 530B, and 53. Small Arms Range East would continue to be available for training operations and deployment qualification 24 hours a day, 7 days a week. The 377th Security Forces Group (377 SFG) would begin using the M583A1 parachute illumination round at the M203 Range. This round has a burst height of 500 to 700 feet above ground surface when fired vertically, a candle burn rate of approximately 40 seconds, and an average candlepower of 90,000. The average class using the illumination round would consist of 15 to 30 students, once per month. It is anticipated that an average of 250 to 500 rounds would be dispensed per year. Training would occur during early morning hours, approximately 0300 to 0500, dependent upon coordination with the FAA and air traffic scheduling. Prior to initial use of this round, firebreaks consisting of cleared paths totaling approximately 8 acres would need to be created. The cleared paths also would be used for emergency vehicle access in case of an accidental fire.

Project Name	Description
Demolition and Construction of Military Support Facilities	USAF proposes to demolish and construct, operate, and maintain several military personnel support facilities in the northwestern portion of the installation. The areas include the Visiting Officer Quarters, the Main Enlisted Dormitory Campus, the Noncommissioned Officer Academy, and Dormitory Campus 2. This project would include the demolition of facilities totaling approximately 498,000 square feet and construction of facilities totaling approximately 389,000 square feet, resulting in a net decrease of approximately 109,000 square feet of building space on the installation. Approximately 36 acres would be impacted by construction and demolition.
Construction, Operation, and Maintenance of a New Fire Station	USAF proposes to construct, operate, and maintain a new Fire Station south of the intersection of Pennsylvania Street and Powerline Road. The proposed structure would be approximately 7,300 square feet; one story, with three high-bay drive-through apparatus stalls.
Additional Development, Testing, Use, and Associated Training at the Technical Evaluation Assessment Monitor Site (TEAMS)	The Defense Threat Reduction Agency and USAF propose to enhance the testing and training capabilities and use, as well as the functionality of the TEAMS. Specifically, the proposed facilities and activities include: a new radiological source storage facility, a mock train station, in-kind replacement of current TEAMS temporary buildings with permanent buildings, potential increase in testing and training event personnel levels by up to 50 percent. Approximately 2.7 acres would be affected during construction.
Building Demolition at Kirtland AFB	USAF is in the process of demolishing 23 buildings totaling approximately 105,000 square feet to make space available for future construction and to fulfill its mission as installation host through better site utilization. None of the buildings proposed for demolition are occupied or used by installation personnel.
Security Forces Complex	USAF proposes to construct, operate, and maintain a 42,500 square feet security forces complex to provide adequate space and modern facilities to house all 377 SFG administrative and support functions in a consolidated location. The 377 SFG functions that would be transferred to the new security forces complex include a base operations center with command and control facility, administration and office space, training rooms, auditorium or assembly room, guard mount, hardened armory for weapons and ammunition storage, confinement facilities, law enforcement, logistics warehouse, general storage, vehicle garage with maintenance area, and associated communications functions. One existing building (879 square feet) within the footprint of the security forces complex would be demolished. This project would result in an increase of 41,621 square feet of building space on the installation.
Construct New Military Working Dog Facility	USAF proposes to construct, operate, and maintain a new Military Working Dog Facility that consists of 14 indoor/outdoor kennels, four isolation kennels, storage and staff space, restrooms, food storage room, a covered walkway, and a veterinarian examining room, totaling 8,000 square feet. A parking area with 25 spaces and new access roads also would be constructed as part of the project. Demolition of facilities totaling 2,520 square feet would also be included in this project, resulting in a net increase of 5,480 square feet of building space on the installation.

Project Name	Description
21st Explosive Ordnance Division Expansion	The 21st Explosive Ordnance Division proposes facility expansion and site improvements for the Weapons of Mass Destruction Company Complex. This unit currently operates from a 90-acre property leased by the US Army within Kirtland AFB. The current site has seven structures, six of which are substandard and do not have adequate fire protection. The 21st Explosive Ordnance Division proposes to expand this site to a total of 280 acres, add three permanent structures totaling 40,000 square feet, demolish five of the six substandard structures (75,000 square feet), add two temporary storage containers, tie in to nearby utilities, construct water tanks for fire suppression, and construct several concrete pads for training activities. This project would result in a decrease of 35,000 square feet of building space on the installation.
New Deployable Structures Laboratory	Air Force Research Laboratory is proposing to construct a new 4,125-square foot high-bay addition to the southeast corner of Building 472. Proposed new construction would include structural pads on columns and trusses for anchoring active gravity off-load support frame; high precision environmental controls (temperature and humidity with low air currents); Gantry crane; and optically diffuse wall coatings for high precision optical motion metrology system (videogrammetry).
High Power Joint Electromagnetic Non-Kinetic Strike Laboratory	Air Force Research Laboratory is proposing to construct a 5,000-square foot addition to Building 332 to include a heavy lab with shielding, a light lab, and office space to support new electromagnetics research.
Navigation Technology Satellite Integration Laboratory	Air Force Research Laboratory is proposing to construct a 10,000-square-foot-high bay laboratory south of Building 590. The facility would contain office space; Near Field Antenna Range and control room; vault; security vestibule; restrooms; loading dock; and conference, break, storage, communication, and mechanical rooms.
Kirtland Exhaust Helium Gas Recovery Facility	Air Force Research Laboratory is proposing to construct a 3,700-square foot facility between Buildings 580 and 581 to recover helium gas exhaust from experiments occurring within these buildings. The recovered gas would be reliquefied for reuse in the labs.
Enhanced Use Lease	Kirtland AFB is in the process of leasing 107 acres of USAF property along Gibson Boulevard to Thunderbird Kirtland Development Ltd. To develop a research park with office, industrial, laboratory, retail, and hospital facilities.
WFMP	USAF proposes to implement the Tier 1 WFMP for Kirtland AFB. The plan includes development of a wildland fire training and certification program, funding for a wildland fire vehicle and equipment replacement program, and implementation of a fuels management program. Fuels management would reduce wildland fire hazard via prescribed fire, mechanical vegetation management, wildland fire infrastructure maintenance and development, and timber inventory monitoring.
Upgrade, Develop, and Maintain the Storm Drainage System	USAF proposes to develop, upgrade, and maintain storm drainage systems and conduct arroyo erosion repair and damage avoiding measures across the installation. Storm drainage system activities could include constructing stormwater system upgrades and components including cleaning, regrading, ditching, trenching, trench lining, backfilling, bedding, reinforced concrete pipe, culverts, vegetation, rip-rap, drop inlets, and retention and outlet structures. Arroyo repair could include excavating, filling, and lining arroyo banks and constructing and repairing box culverts, bank protection, and grade control structures to assist in stabilizing the arroyo bed towards a stable slope.

Project Name	Description
Military Projects (continued)	
Realign Gibson Boulevard	Kirtland AFB is proposing to realign access to the installation from the intersection of Louisiana and Gibson Boulevards in order to minimize unauthorized entrance through the Gibson Gate. The proposed project would impact approximately 5 acres of land and require adjustments to Louisiana Boulevard, which is located outside the installation's boundary within the city of Albuquerque.
Non-Military Projects	
Sunport South Business Park *(formerly Valle del Sol)*	A proposed 330-acre business park is expected to attract manufacturing, fabrication, warehousing, and distribution centers. It would be multi-modal to include access to the Sunport and an active rail spur. An additional 200 acres would be reserved for bike trails and walking paths. The site is located south of the Sunport.
Juan Tabo Hills West	Juan Tabo Hills West is Phase 4 of the Voltera Village community and sits on approximately 25 acres near Juan Tabo Boulevard and the Tijeras Arroyo. Phase 4 would consist of 250 single-family lots.
Albuquerque International Sunport Projects	The Sunport began the Terminal Improvement Project in February 2017. This project will refurbish and upgrade the ticketing, baggage claim, and exterior areas of the terminal. It is anticipated to take approximately 15 months to complete. Development began on Destination Sunport project in March 2017. The project will transform decommissioned Runway 17/35, approximately 80 acres, into space for aviation and aerospace businesses, high tech companies, and retail. The Aviation Center of Excellence is the centerpiece of the development, which also features "The Landing" a 10-acre strip along Gibson Boulevard that will contain retail businesses. Future projects planned for the Sunport over the next 20 years include rehabilitation of various runways, taxiways, and aprons; installation/expansion of aprons and taxiways; removal/closure of taxiways; construction of an Aircraft Rescue Firefighting Facility; removal of the Belly Freight Building; construction of an addition to Concourse B; and construction of a Federal Inspection Services/International Terminal.
I-25 and Rio Bravo Interchange	The New Mexico Department of Transportation is reconstructing the I-25 and Rio Bravo Interchange and the Rio Bravo roadway corridor from University to the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) channel. Improvements include a new intersection layout at I-25/Rio Bravo and new roadway pavement and features within the right-of-way infrastructure including multi-modal improvements.
Sunport Boulevard Extension	The New Mexico Department of Transportation has proposed an expansion project for Sunport Boulevard from Broadway Boulevard to I-25, consisting of constructing a 4-lane median divided urban arterial roadway. The roadway is approximately 0.5 mile in length and would contain twin bridges over the existing AMAFCA South Diversion Channel and twin bridges over Edmunds Street.
Valle de Oro Phase II	USFWS is proposing to conduct restoration, development, and management activities on Valle de Oro National Wildlife Refuge in Bernalillo County. The refuge is 570 acres primarily located between 2nd Street SW and the Rio Grande in the South Valley, approximately 3.5 miles southwest of the Sunport and Kirtland AFB. Proposed activities include habitat restoration; construction of a visitor's center, a parking lot, trails, and roads; vegetation and wildlife management; construction and management of AMAFCA stormwater drainage facilities, including a swale and water quality structures; and in partnership with Mid-Rio Grande Conservancy District align the Barr Interior Drain.

Project Name	Description
Non-Military Projects (continued)	
Mesa Del Sol Master Plan	Mesa del Sol is a 12,900-acre, mixed-use master planned community. It is bound by the Sunport along the northwestern edge, Kirtland AFB on the north and east, the Isleta reservation to the south, and I-25 to the west. The community would be built over 40 years and would cover 9,000 of the 12,900 acres. It is proposed to include 3,200 acres for park and open space; 4,400 acres for residential and supporting retail; 413 acres of office space; and 800 acres for schools, including university branches.
AMAFCA Flood Control Facility on Kirtland AFB	AMAFCA proposes to construct a 30 acre-foot drainage facility on Kirtland AFB at the southeast quadrant of the Louisiana/Gibson intersection in order to collect and limit stormwater runoff. Currently, stormwater flow off Kirtland AFB is not controlled and causing damage downstream of the installation, contributing to the floodplain in the San Pedro/Gibson area.

4.2 Cumulative Impact Analysis by Resource Area

The following analysis examines the cumulative impacts on the environment that would result from the incremental impacts of the Proposed Action in addition to other past, present, and reasonably foreseeable future actions. This analysis assesses the potential for an overlap of impacts with respect to project schedules or affected areas. This section presents a qualitative analysis of the cumulative impacts.

4.2.1 Noise

Construction associated with the Proposed Action would result in short-term, minor, adverse impacts on the Kirtland AFB noise environment. The off-installation noise environment might also experience short-term, minor, adverse impacts if a proposed renewable energy project was sited in proximity to the Kirtland AFB boundary. Long-term, negligible, adverse impacts on the ambient noise environment of Kirtland AFB would occur from the maintenance of proposed renewable energy projects. Noise impacts generated by present and reasonably foreseeable projects would result in only temporary increases in ambient noise levels during construction and maintenance activities. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on the ambient noise environment.

4.2.2 Land Use

Land use development for the Proposed Action and present and reasonably foreseeable actions would be implemented in accordance with the Kirtland AFB IDP. SPV and geothermal technologies would be compatible with surrounding and off-installation land uses, and would not impact or preclude the continued use or occupation of any areas. The Proposed Action would not be sited within active ERP, MMRP, or DOE ER sites; air accident zones; outgrant areas; flood zones; historic districts; or airfield surface areas. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on land use.

4.2.3 Air Quality

Construction for the proposed renewable energy projects on Kirtland AFB would result in short-term, negligible to moderate, adverse impacts on air quality. Long-term, negligible, adverse impacts on air quality would occur from the operation and maintenance of proposed renewable energy projects. The single-year emission of GHG from construction associated with proposed SPV and geothermal energy projects would not meaningfully contribute to the potential effects of global climate change. The use of renewable energy projects to supply the everyday energy needs of Kirtland AFB would have a long-term, negligible, beneficial impact on global climate change by reducing the amount of GHG emissions attributable to Kirtland AFB. Air quality impacts generated by present and reasonably foreseeable projects would not be regionally significant and would be intermittent, short-term, and temporary in nature. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on air quality.

4.2.4 Geology and Soils

Programmatic implementation of renewable energy technologies would result in short-term, minor to moderate, impacts on geology, topography, and soil resources dependent on the proposed site design and the technology employed. Any impacts on geology and soils would not exceed individual construction site boundaries and appropriate BMPs would minimize potential impacts. Long-term, adverse impacts would be negligible. Additionally, adherence to the ESCP would minimize potential adverse impacts during construction. Impacts on geology and soils generated by present and reasonably foreseeable projects would be localized, short-term, and temporary in nature. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on geology and soils.

4.2.5 Water Resources

Short-term, negligible to minor, adverse impacts would be expected from the Proposed Action during construction and demolition because of ground disturbance. Through use of BMPs and adherence to the Kirtland AFB EMS program, potential cumulative impacts on water resources from the Proposed Action would be minimized. Present and reasonably foreseeable projects would be conducted in accordance with environmental considerations, including implementation of stormwater and erosion control and water conservation measures to minimize impacts. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on water resources.

4.2.6 Biological Resources

Long-term, minor, adverse impacts would occur on vegetation, wildlife, protected species, migratory birds, and the associated habitats from construction and demolition associated with the Proposed Action. BMPs to minimize soil disturbance; control erosion, sedimentation, and surface water runoff; minimize soil compaction issues; minimize air pollution; avoid accidental spills of hazardous material (e.g., fuel spills from vehicles and equipment); avoid transportation

of noxious, invasive and pest species; and avoid inadvertent wildland fires sparked by construction activities would be implemented. Impacts on biological resources generated by present and reasonably foreseeable projects would be localized, short-term, and temporary in nature. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on biological resources.

4.2.7 Cultural Resources

Construction, operation, and maintenance of SPV or geothermal energy projects have the potential to affect cultural resources depending on the proposed project location and the type of cultural resources encountered. With careful consideration, site selection would likely result in negligible visual impacts to NRHP-eligible properties. In the event of an inadvertent discovery during construction or implementation of the Proposed Action, Kirtland AFB would stop work immediately and follow the standard operating procedures outlined in their ICRMP. Present and reasonably foreseeable projects would be conducted in accordance with the Kirtland AFB ICRMP to ensure inadvertent discoveries of cultural resources are properly addressed and minimize impacts. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on cultural resources.

4.2.8 Infrastructure

The Proposed Action has the potential to impact the following infrastructure resources: transportation, electrical systems, water resources, communications systems, and solid waste management. These impacts are anticipated to be short-term and temporary in nature. Impacts on infrastructure generated by present and reasonably foreseeable projects would be localized, short-term, and temporary in nature. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on infrastructure.

4.2.9 Hazardous Materials and Wastes

Short-term, negligible to minor, adverse impacts on hazardous materials and wastes would occur from construction of proposed renewable energy projects. Potential adverse impacts from hazardous materials and wastes and special hazards would be minimized or eliminated by following all Kirtland AFB hazardous materials and wastes management policies; by contractors wearing appropriate personal protective equipment and adhering to all federal, state, and local regulations for hazardous materials, hazardous wastes, and special hazards; and by disposing of all ACM- and LBP-contaminated debris at a USEPA-approved landfill. Present and reasonably foreseeable projects would incorporate measures to limit or control hazardous materials and wastes in their construction and operation plans. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on hazardous materials and wastes.

4.2.10 Safety

Long-term, minor, adverse impacts on safety would occur because of increases in construction and demolition associated with the Proposed Action. All appropriate safety requirements, restrictions, and guidelines, including use of PPE, would be adhered to during these activities to minimize the potential for safety impacts. Safety concerns for glint/glare would be localized to the SPV array. Implementation of appropriate safety methods and adherence to safety standards required by OSHA, DoD, and USAF during these activities would minimize the potential for such impacts. Applicable safety standards would be applied to present and foreseeable projects to minimize impacts. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on safety.

4.2.11 Socioeconomics and Environmental Justice

Programmatic implementation of SPV and geothermal energy technologies would result in short-term, negligible to minor, beneficial impacts on socioeconomics. There would be no disproportionately high and adverse health or environmental effects on minority or low-income populations. There are no environmental health and safety risks associated with the Proposed Action that would disproportionately affect children. No cumulative adverse impacts upon children would be anticipated; therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable projects on the installation (see **Table 4-1**), would not result in significant cumulative impacts on socioeconomics or environmental justice.

4.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts would result from implementation of the Proposed Action. None of these impacts would be significant.

The use of non-renewable resources is an unavoidable occurrence, although not considered significant. The Proposed Action would require the use of fossil fuels, a non-renewable natural resource, during construction and maintenance associated with the Proposed Action. Construction associated with the Proposed Action would also require consumption of materials typically associated with exterior and interior construction (e.g., concrete, wiring, piping, insulation, and windows). The amount of these materials used would not significantly decrease the availability of the resources. Small amounts of nonrenewable resources would be used; however, these amounts would not be appreciable and would not affect the availability of these resources. No irretrievable resources commitments would occur.

4.4 Compatibility of the Proposed Action with the Objectives of Federal, Regional, and Local Land Use Plans, Policies, and Controls

The Proposed Action would occur entirely within Kirtland AFB. Construction and maintenance would not be incompatible with any current land uses on the installation. The Proposed Action would not conflict with any applicable off-installation land use ordinances. The Proposed Action would follow all applicable permitting, building, and safety requirements.

4.5 Relationship between Short-Term Uses and Long-Term Productivity

The relationship between short-term uses and enhancement of long-term productivity from implementation of the Proposed Action is evaluated from the standpoint of short-term effects and long-term effects. Short-term effects would be those associated with the construction of the renewable energy technologies. The long-term enhancement of productivity would be those effects associated with operation of renewable energy technologies after implementation of the Proposed Action.

The Proposed Action represents an enhancement of long-term productivity for energy resources at Kirtland AFB. The negative effects of short-term operational changes during construction activities would be minor compared to the positive benefits from independent renewable energy. Immediate and long-term benefits would be realized for operation and maintenance after completion of the Proposed Action.

4.6 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the impacts that the use of these resources will have on future generations. Irreversible impacts primarily result from use or destruction of a specific resource that cannot be replaced within a reasonable timeframe (e.g., energy and minerals). The irreversible and irretrievable commitments of resources that would result from implementation of the Proposed Action involve the consumption of material resources used for construction, energy resources, biological resources, and human labor resources. The use of these resources is considered to be permanent.

Material Resources. Material resources used for the Proposed Action would potentially include building materials, concrete and asphalt, and various construction materials and supplies. The materials that would be consumed are not in short supply, would not limit other unrelated construction activities, and would not be considered significant.

Energy Resources. Energy resources used for the Proposed Action would be irretrievably lost. This includes petroleum-based products (e.g., gasoline and diesel). During construction and maintenance, gasoline and diesel would be used for the operation of vehicles and construction equipment. Consumption of these energy resources would not place a significant demand on their availability in the region; therefore, less than significant impacts would be expected.

Biological Resources. The Proposed Action would result in a loss of vegetation and wildlife habitat particularly under the SPV array. The SPV project area would cover up to 500 acres of vegetation; however, the loss would not be considered significant because of the abundance of available habitat in the surrounding area. Only minimal, if any, loss of insect life may occur because of the Proposed Action; this would not constitute a significant adverse impact on biological resources.

Human Resources. The use of human resources for construction and maintenance is considered an irretrievable loss only in that it would preclude such personnel from engaging in other work activities. However, the use of human resources for the Proposed Action represents employment opportunities and is considered beneficial.

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Albuquerque, NM 87108

Example Agency Scoping Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

Colonel Richard W. Gibbs, USAF
Installation Commander
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

07 December 2017

Mr. Samuel Coleman, P.E.
Acting Regional Administrator
U.S. Environmental Protection Agency
Region 6
Fountain Place 12th Floor, Suite 1200
1445 Ross Avenue
Dallas TX 75202-2733

Dear Mr. Coleman

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF is preparing a Programmatic Environmental Assessment (PEA) to evaluate the programmatic execution of various electricity-generating renewable energy technologies at Kirtland Air Force Base (AFB). The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] § 15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

Kirtland AFB has begun the NEPA process by developing a Description of the Proposed Action and Alternatives (DOPAA). The DOPAA provides background information, describes the Proposed Action, identifies reasonable alternatives, and defines the scope of the analysis. The DOPAA will become Sections 1 and 2 of the PEA, which will provide the existing conditions of the project area and identify potential impacts from implementation of the Proposed Action and alternatives.

The PEA will reduce duplication of effort by analyzing general aspects of use of renewable energy technologies and establishing a framework for environmental impact analysis of future site-specific actions. The impacts of future site-specific actions can be addressed in subsequent NEPA evaluations, per CEQ regulations (40 Code of Federal Regulations § 1502.20).

If you have additional information regarding impacts of the Proposed Action on the natural environment or other environmental aspects of which we are unaware, we would appreciate receiving such information for inclusion and consideration during the NEPA compliance process. The Final DOPAA for the PEA is available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. We look forward to and welcome your participation in this process. Please respond within 30 days of receipt of this letter to ensure your concerns are considered during development of the PEA.

Please send your written responses to the NEPA Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB NM 87117, or via email to KirtlandNEPA@us.af.mil.

Sincerely

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander

Example Joint Land Use Study Scoping Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

Colonel Richard W. Gibbs, USAF
377 ABW/CC
2000 Wyoming Blvd, SE
Kirtland AFB NM 87117

07 December 2017

Mr. Clyde Ward
Assistant Commissioner for Commercial Resources
New Mexico State Land Office
PO Box 1148
Santa Fe NM 87504

Dear Mr. Ward

As set forth in the Kirtland Air Force Base (AFB) – New Mexico State Land Office Joint Land Use Study Memorandum of Understanding and as required by the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF is preparing a Programmatic Environmental Assessment (PEA) to evaluate the programmatic execution of various electricity-generating renewable energy technologies at Kirtland Air Force Base (AFB). The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] § 15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

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Sincerely

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander

SHPO Scoping Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

DEC 0 4 2017

Colonel Richard W. Gibbs, USAF
Installation Commander
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

Jeff Pappas, Ph.D.
State Historic Preservation Officer and Director
New Mexico Historic Preservation Division
Department of Cultural Affairs
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe NM 87501

Dear Dr. Pappas

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF is preparing a Programmatic Environmental Assessment (PEA) to evaluate the programmatic execution of various electricity-generating renewable energy technologies at Kirtland Air Force Base (AFB). The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] § 15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

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Pursuant to Section 106 of the National Historic Preservation Act (36 CFR Part 800), the USAF would like to initiate consultation concerning the proposed project to allow you the opportunity to identify any comments, concerns, or suggestions that you might have. The Final DOPAA for the PEA is

available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. As we move forward through this process, we welcome your participation and input.

Please send your written responses to the NEPA Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB NM 87117, or via email to *KirtlandNEPA@us.af.mil*. We look forward to hearing from you in the near future.

Sincerely

RICHARD W. GIBBS, Colonel, USAF
Commander

Example Tribal Scoping Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

Colonel Richard W. Gibbs, USAF
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

07 December 2017

Chairman Jeff Hazous
Fort Sill Apache Tribe of Oklahoma
Rt 2, Box 121
Apache OK 73006

Dear Chairman Hazous

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF is preparing a Programmatic Environmental Assessment (PEA) to evaluate the programmatic execution of various electricity-generating renewable energy technologies at Kirtland Air Force Base (AFB). The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] § 15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

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The PEA will reduce duplication of effort by analyzing general aspects of use of renewable energy technologies and establishing a framework for environmental impact analysis of future site-specific actions. The impacts of future site-specific actions can be addressed in subsequent NEPA evaluations, per CEQ regulations (40 Code of Federal Regulations § 1502.20).

Pursuant to Section 106 of the National Historic Preservation Act (36 CFR Part 800) and EO 13175, the USAF would like to initiate government to government consultation concerning the proposed project to allow you the opportunity to identify any comments, concerns, or suggestions that you might have. The Final DOPAA for the PEA is available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. As we move forward through this process, we welcome your participation and input.

Please contact my office at (505) 846-7377 if you would like to meet to discuss the proposed project and/or proceed with Section 106 consultation.

Sincerely

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander

SHPO Scoping Response Letter

From: Estes, Bob, DCA
To: 377 MSG/CEIE NEPA Environmental
Cc: REYNOLDS, DAVID H GS-12 USAF AFGSC 377 MSG/CEIEC
Subject: [Non-DoD Source] Renewable Energies Technology
Date: Friday, January 05, 2018 3:35:28 PM

OFFICIAL RESPONSE OF THE NEW MEXICO STATE HISTORIC PRESERVATION OFFICER (SHPO)

To whom it may concern,

On behalf of the SHPO, I have want to thank Kirtland Air Force Base (KAFB) for providing our office the opportunity to review and comment on the Description of the Proposed Action and Alternatives (DOPAA) for the Programmatic Environmental Assessment (PEA) for proposed renewable energies generation development on the base.

I have completed a review of the DOPAA and would like to note that Section 106 consultation is a compliance process separate from NEPA, and needs to be completed before a Finding of No Significant Impact (FONSI). This can be accomplished through the standard consultation process defined in 36 CFR 800, the implementing regulations for Section 106, or through the development of a Memorandum of Agreement (MOA) pursuant to 36 CFR 800.6 or a Programmatic Agreement (PA) pursuant to 36 CFR 800. 14(b).

Please contact the SHPO when he project's area of potential effects is better defined, and we can provide better informed comments.

SHPO is looking forward to working with KAFB to advance the Section 106 consultation for this important undertaking. If you have any questions or comments, please feel free to call me directly at 505-827-4225 or email me.

Sincerely,

Bob Estes Ph.D.
HPD Staff Archaeologist
New Mexico State Historic Preservation Division
407 Galisteo St., Suite 236
Santa Fe, New Mexico 87501

State of New Mexico Department of Game and Fish Scoping Response Letter

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STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

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ELIZABETH A. RYAN
Roswell
THOMAS "DICK" SALOPEK
Las Cruces

5 January 2018

NEPA Program Manager
377 MSG/CEIEC
2050 Wyoming Blvd. SE
Kirtland AFB, New Mexico 87117

RE: Description of the Proposed Action and Alternatives (DOPAA) For the Programmatic Environmental Assessment Addressing Renewable Energy Projects at Kirtland Air Force Base, New Mexico; NMDGF No. 18196

Dear NEPA Program Manager,

The New Mexico Department of Game and Fish (Department) has reviewed the project referenced above. The U.S. Air Force proposes to develop and implement electricity-generating renewable energy projects at Kirtland Air Force Base (KAFB). The proposed action is needed to meet federally directed renewable energy standards. KAFB considered four types of renewable energy technologies to meet their requirements; solar photovoltaic (SPV), wind, geothermal, and biomass (waste to energy). Of those, the preferred alternatives selected for implementation were solar and geothermal. However, the DOPAA does not provide evidence of geothermal energy as a proven resource that is currently available to KAFB. Its selection was based on a 2010 reconnaissance assessment by the National Renewable Energy Laboratory that concluded there "appears to be indications of potential geothermal activity within the installation, and that further investigation is necessary".

Given the uncertainty of the geothermal resource, the Department strongly supports the use of proven SPV technology to meet KAFB's renewable energy requirements and provides the following recommendations:

- Construct and operate SPV facilities on existing infrastructure such as roof tops, covered parking areas, and disturbed areas that are not utilized by prairie dogs or Burrowing Owls, to the maximum extent possible. These actions should eliminate or minimize the need to site solar arrays in undisturbed wildlife habitat.
- Above-ground electrical transmission lines, substations, and transformer equipment should be constructed in conformance with the Avian Power Line Interaction Committee's guidance documents entitled "Suggested Practices for Avian Protection on Power Lines" (2006), and "Reducing Avian Collisions with Power Lines" (2012) (www.aplic.org/mission.php).
- To avoid potential destruction of occupied migratory bird nests, eggs or nestlings and to comply with applicable state and federal mandates regarding migratory birds, ground disturbance and vegetation removal activities should be conducted outside of the breeding season for songbirds and raptors (1 March – 15 September). If ground disturbing and

clearing activities during the breeding season cannot be avoided, the area should be surveyed for active nest sites prior to disturbance. For any active nests detected, an adequate buffer zone should be established to minimize disturbance to nesting birds. Buffer distances should be at least 100 feet from songbird and raven nests, and 0.25 mile from raptor nests. Active nest sites in trees or shrubs that must be removed should be mitigated by qualified biologists or wildlife rehabilitators. Department biologists are available for consultation regarding nest site mitigation, and can facilitate contact with qualified personnel.

From 2002 through 2016, KAFB has conducted numerous biological studies as part of their Integrated Natural Resource Management Plan. These study reports provide useful information regarding the biology, ecology, status, and conservation needs for wildlife species of concern, and important habitats that occur on KAFB. These reports serve as a valuable resource that should be consulted to help avoid impacts to wildlife when evaluating potential sites for solar energy development. In addition, Department biologists are available for assistance in siting and establishing appropriate buffer zones if necessary.

Thank you for the opportunity to review and comment on your proposed project. If you have any additional questions, please contact: Ron Kellermueller, Mining and Energy Habitat Specialist, Ecological and Environmental Planning Division, at (505) 476-8159 or ronald.kellermueller@state.nm.us.

Sincerely,

Matt Wunder, Ph.D.
Chief, Ecological and Environmental Planning Division

cc: USFWS NMES Field Office

Bureau of Indian Affairs Scoping Response Letter

United States Department of the Interior
Bureau of Indian Affairs
Southwest Region
1001 Indian School Road N.W.
Albuquerque, New Mexico 87104-2303

TAKE PRIDE IN AMERICA

In Reply Refer To:
620-Division of Environmental, Safety, and Cultural Resources Management

JAN 26 2018

National Environmental Policy Act (NEPA) Program Manager
377 MSG/CEIEC
2050 Wyoming Boulevard SE, Suite 116
Kirtland Air Force Base (AFB), New Mexico 87117

Dear NEPA Program Manager:

The Bureau of Indian Affairs (BIA), Division of Environmental, Safety, and Cultural Resources Management have received your request for information for the development of the Programmatic Environmental Assessment for the proposed execution of various electricity-generating renewal energy technologies at Kirtland AFB, New Mexico. We recommend that the Department of Defense acknowledges its trust responsibility in contacting tribes and pueblos on a government-to-government basis regarding environmental issues, specifically cultural resources. Please complete the Section 106 compliance for the National Historic Preservation Act and provide any cultural survey reports as needed, if concurrence from the BIA Regional Archaeologist is required.

As is, the proposed action does not impact any trust resources under the jurisdiction of the BIA.

Thank you for the opportunity to participate on the proposed action. If you have any questions or concerns, please contact Mrs. Priscilla J. Avila, Regional Environmental Protection Specialist at (505) 563-3417.

Sincerely,

Acting Regional Director

Example Agency Draft PEA Review Notification Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

20 June 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland Air Force Base NM 87117

Ms. Danita T. Burns, District Manager
Bureau of Land Management
New Mexico State Office
Albuquerque District Office
Pan American Building
100 Sun Avenue NE, Suite 330
Albuquerque NM 87109-4676

Dear Ms. Burns

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF has prepared a Programmatic Environmental Assessment (PEA) to evaluate the implementation of Kirtland Air Force Base (AFB) energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] §15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC §17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC §2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation that meet general selection standards for suitability. The PEA provides the existing conditions of the project area and identifies potential impacts from implementation of the Proposed Action and alternatives. The PEA will reduce duplication of effort by analyzing general aspects of use of renewable energy technologies and establishing a framework for environmental impact analysis of future site-specific actions. The impacts of future site-specific actions can be addressed in subsequent NEPA evaluations, per CEQ regulations (40 Code of Federal Regulations §1502.20).

In accordance with EO 12372, Intergovernmental Review of Federal Programs, as amended by EO 12416, Intergovernmental Review of Federal Programs, I am requesting your participation in the NEPA document review and comment process. Copies of the Draft PEA and

the proposed Finding of No Significant Impact (FONSI) are available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. If, after review of the Draft PEA and FONSI, you have additional information regarding impacts of the Proposed Action on the natural environment or other environmental aspects of which we are unaware, we would appreciate receiving such information for inclusion and consideration during the NEPA process. Please respond within 30 days of receipt of this letter to ensure your concerns are adequately addressed in the PEA.

Please send written responses to the NEPA Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB NM 87117, or via email to *KirtlandNEPA@us.af.mil*.

Sincerely

RICHARD W. GIBBS, Colonel, USAF
Commander

AGENCY DISTRIBUTION LIST
Federal, State, and Local Agencies

Mrs. Priscilla J. Avila, Acting Regional
Director Bureau of Indian Affairs
Southwest Regional Office
1001 Indian School Road NW
Albuquerque NM 87104

Ms. Danita Burns, District Manager Bureau
of Land Management
New Mexico State Office
Albuquerque District Office
Pan American Building
100 Sun Avenue NE, Suite 330
Albuquerque NM 87109-4676

Ms. Jennifer L. Faler, Area Manager
Bureau of Reclamation
Albuquerque Area Office
555 Broadway NE, Suite 100
Albuquerque NM 87102-2352

Mr. Stephen Spencer, Regional
Environmental Officer
US Department of Interior
Office of Environmental Policy &
Compliance - Albuquerque Region
1001 Indian School Road NW, Suite 348
Albuquerque NM 87104

Mr. Kelvin L. Solco, Regional Administrator
Federal Aviation Administration
Southwest Region
10101 Hillwood Parkway
Fort Worth TX 76177-1524

Ms. Pearl Armijo, District Conservationist
Natural Resources Conservation Service
Albuquerque Service Center
6200 Jefferson Street NE
Albuquerque NM 87109-3434

Mr. George Macdonnell, Chief
Environmental Resources Section
US Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque NM 87109

Ms. Anne L. Isdal
Regional Administrator
US Environmental Protection Agency,
Region 6
1445 Ross Avenue, Suite 1200
Dallas TX 75202-2733

Ms. Cheryl Prewitt, Regional Environmental
Coordinator US Forest Service
Southwestern Region
333 Broadway Boulevard SE
Albuquerque NM 87102-3407

Ms. Susan Lacy
DOE/NNSA Sandia Field Office
PO Box 5400
Albuquerque NM 87187

Mr. John Weckerle
DOE/NNSA Office of General Counsel
PO Box 5400
Albuquerque NM 87187

The Honorable Martin Heinrich
US Senate
400 Gold Avenue SW, Suite 1080
Albuquerque NM 87102

The Honorable Tom Udall
US Senate
400 Gold Avenue SW, Suite 300
Albuquerque NM 87102

The Honorable Steve Pearce
US House of Representatives
3445 Lambros Loop NE
Los Lunas NM 87031

The Honorable Michelle Lujan Grisham
US House of Representatives
400 Gold Avenue SW, Suite 680
Albuquerque NM 87102

The Honorable Ben R. Luján
US House of Representatives
1611 Calle Lorca, Suite A
Santa Fe NM 87505

Mr. Aubrey Dunn
Commissioner of Public Lands
New Mexico State Land Office
310 Old Santa Fe Trail
Santa Fe NM 87501

Mr. Matt Wunder, Chief
Conservation Services
New Mexico Department of Game and Fish
PO Box 25112
Santa Fe NM 87504

Ms. Jennifer L. Hower
Office of General Counsel & Environmental Policy
New Mexico Environment Department
1190 St. Francis Drive, Suite N4050
Santa Fe NM 87505

Mr. Jeff M. Witte, Director/Secretary
New Mexico Department of Agriculture
3190 S. Espina
Las Cruces NM 88003

Mr. Ken McQueen, Cabinet Secretary-Designate
New Mexico Energy, Minerals and Natural Resources Department
1220 South St. Francis Drive
Santa Fe NM 87505

Board of Directors
Mid-Region Council of Governments
809 Copper Avenue NW
Albuquerque NM 87102

Ms. Julie Morgas Baca, Bernalillo County Manager
Bernalillo County Manager's Office
One Civic Plaza NW, 10th Floor
Albuquerque NM 87102

Ms. Alicia Manzano
Interim Director of Communications
City of Albuquerque Office of the Mayor
PO Box 1293
Albuquerque NM 87103

Bernalillo County Board of Commissioners
One Civic Plaza NW, 10th Floor
Albuquerque NM 87102

Albuquerque City Councilmembers
One Civic Plaza NW, 9th Floor, Suite 9087
Albuquerque NM 87102

Mr. Ronald Moulton
Senior VP and Desert Southwest Regional Manager
Western Area Power Administration
PO Box 6457
Phoenix AZ 85005-6457

Ms. Cheryl A. LaFleur, Commissioner
Federal Energy Regulatory Commission
888 First Street NE
Washington DC 20426

Board of Directors
PNM Resources, Inc.
Corporate Headquarters – MS 1245
Albuquerque NM 87158

Example Joint Land Use Study Draft PEA Review Notification Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

20 June 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland Air Force Base NM 87117

Mr. Clyde Ward
Assistant Commissioner for Commercial Resources
New Mexico State Land Office
PO Box 1148
Santa Fe NM 87504

Dear Mr. Ward

As set forth in the Kirtland Air Force Base (AFB) – New Mexico State Land Office Joint Land Use Study Memorandum of Understanding and as required by the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF has prepared a Programmatic Environmental Assessment (PEA) to evaluate the implementation of Kirtland AFB energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] §15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC §17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC §2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation that meet general selection standards for suitability. The PEA provides the existing conditions of the project area and identifies potential impacts from implementation of the Proposed Action and alternatives. The PEA will reduce duplication of effort by analyzing general aspects of use of renewable energy technologies and establishing a framework for environmental impact analysis of future site-specific actions. The impacts of future site-specific actions would be addressed in subsequent NEPA evaluations, per CEQ regulations (40 Code of Federal Regulations §1502.20).

In accordance with EO 12372, Intergovernmental Review of Federal Programs, as amended by EO 12416, Intergovernmental Review of Federal Programs, I am requesting your participation in the NEPA document review and comment process. Copies of the Draft PEA and

the proposed Finding of No Significant Impact (FONSI) are available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. If, after review for the Draft PEA and FONSI, you have additional information regarding impacts of the Proposed Action on the natural environment or other environmental aspects of which we are unaware, we would appreciate receiving such information for inclusion and consideration during the NEPA process. Please respond within 30 days of receipt of this letter to ensure your concerns are adequately addressed in the PEA.

Please send your written responses to the NEPA Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB NM 87117, or via email to *KirtlandNEPA@us.af.mil*.

Sincerely

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander

AGENCY DISTRIBUTION LIST
JLUS MOU

Mr. Clyde Ward, Assistant Commissioner for Commercial Resources
New Mexico State Land Office
PO Box 1148
Santa Fe NM 87504

Development Management/Department Director
Bernalillo County Planning Section
111 Union Square SE, Suite 100
Albuquerque NM 87102

Department Director
City of Albuquerque Planning Department
PO Box 1293
Albuquerque NM 87103

SHPO Draft PEA Review Notification Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

20 June 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland Air Force Base NM 87117

Jeff Pappas, Ph.D.
State Historic Preservation Officer and Director
New Mexico Historic Preservation Division
Department of Cultural Affairs
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe NM 87501

Dear Dr. Pappas

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF has prepared a Programmatic Environmental Assessment (PEA) to evaluate the implementation of Kirtland Air Force Base (AFB) energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] §15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC §17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC §2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

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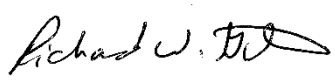
Pursuant to Section 106 of the National Historic Preservation Act (36 CFR Part 800), the USAF is requesting your participation in the NEPA document review and comment process.

Copies of the Draft PEA and the proposed Finding of No Significant Impact (FONSI) are available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. If, after review for the Draft PEA and FONSI, you have additional information regarding impacts of the Proposed Action on the natural environment or other environmental aspects of which we are unaware, we would appreciate receiving such information for inclusion and consideration during the NEPA process. Please respond within 30 days of receipt of this letter to ensure your concerns are adequately addressed in the PEA.

Please send your written responses to the NEPA Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB NM 87117, or via email to *KirtlandNEPA@us.af.mil*.

Sincerely



RICHARD W. GIBBS, Colonel, USAF
Commander

Example Tribal Draft PEA Review Notification Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

20 June 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland Air Force Base NM 87117

Governor Carlos Hisa
Ysleta del Sur Pueblo
117 S Old Pueblo Road
PO Box 17579-Ysleta Station
El Paso TX 79907

Dear Governor Hisa

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF has prepared a Programmatic Environmental Assessment (PEA) to evaluate the implementation of Kirtland Air Force Base (AFB) energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] §15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC §17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC §2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation that meet general selection standards for suitability. The PEA provides the existing conditions of the project area and identifies potential impacts from implementation of the Proposed Action and alternatives. The PEA will reduce duplication of effort by analyzing general aspects of use of renewable energy technologies and establishing a framework for environmental impact analysis of future site-specific actions. The impacts of future site-specific actions would be addressed in subsequent NEPA evaluations, per CEQ regulations (40 Code of Federal Regulations [CFR] §1502.20).

Pursuant to Section 106 of the National Historic Preservation Act (36 CFR Part 800) and EO 13175, *Consultation and Coordination With Indian Tribal Governments*, the USAF would like to initiate government-to-government consultation to allow you or your designee the opportunity to identify any comments, concerns, and suggestions relevant to the Proposed Action. Copies of the Draft PEA and proposed Finding of No Significant Impact (FONSI) are available at

http://www.kirtland.af.mil under the "Environment" button at the bottom of the webpage. For technical information, please contact my NEPA Program Manager, Ms. Martha E. Garciá, directly at martha.garcia.3@us.af.mil or (505) 846-6446.

Please contact my office at (505) 846-7377 if you would like to meet to discuss the proposed project or proceed with the Section 106 consultation.

Sincerely

RICHARD W. GIBBS, Colonel, USAF
Commander

DISTRIBUTION LIST
Native American Tribes

Governor Kurt Riley
Pueblo of Acoma
PO Box 309
Acoma Pueblo NM 87034

Governor Dwayne Herrera
Pueblo of Cochiti
PO Box 70
Cochiti Pueblo NM 87072

Chairman Timothy L. Nuvangyaoma
Hopi Tribal Council
PO Box 123
Kykotsmovi AZ 86039

Governor J. Robert Benavides
Pueblo of Isleta
PO Box 1270
Isleta NM 87022

Governor Paul S. Chinana
Pueblo of Jemez
PO Box 100
Jemez Pueblo NM 87024

President Levi Pesata
Jicarilla Apache Nation
PO Box 507
Dulce NM 87528

Governor Virgil A. Siow
Pueblo of Laguna
PO Box 194
Laguna NM 87026

President Arthur "Butch" Blazer
Mescalero Apache Tribe
PO Box 227
Mescalero NM 88340

Governor Phillip A. Perez
Pueblo of Nambe
Route 1 Box 117-BB
Santa Fe NM 87506
President Russell Begaye
Navajo Nation
PO Box 7440
Window Rock AZ 86515

Governor Peter Garcia, Jr.
Ohkay Owingeh Pueblo
PO Box 1099
San Juan Pueblo NM 87566

Governor Craig Quanchello
Pueblo of Picuris
PO Box 127
Peñasco NM 87553

Governor Joseph M. Talachy
Pueblo of Pojoaque
78 Cities of Gold
Santa Fe NM 87506

Governor Richard Bernal
Pueblo of Sandia
481 Sandia Loop
Bernalillo NM 87004

Governor Anthony Ortiz
Pueblo of San Felipe
PO Box 4339
San Felipe Pueblo NM 87001

Governor Perry Martinez
Pueblo of San Ildefonso
02 Tunyo Po
Santa Fe NM 87506

Governor Glenn Tenorio
Pueblo of Santa Ana
2 Dove Road
Santa Ana Pueblo NM 87004

Governor J. Michael Chavarria
Pueblo of Santa Clara
PO Box 580
Española NM 87532

Governor Thomas Moquino, Jr.
Pueblo of Santo Domingo
PO Box 99
Santo Domingo Pueblo NM 87052

Governor Gilbert Suazo, Sr.
Pueblo of Taos
PO Box 1846
Taos NM 87571

Governor Frederick Vigil
Pueblo of Tesuque
Route 42 Box 360-T
Santa Fe NM 87506

Chairman Ronnie Lupe
White Mountain Apache Tribe
PO Box 700
Whiteriver AZ 85941

Governor Carlos Hisa
Ysleta del Sur Pueblo
117 S Old Pueblo Road
PO Box 17579-Ysleta Station
El Paso TX 79907

Governor Anthony Delgarito
Pueblo of Zia
135 Capitol Square Drive
Zia Pueblo NM 87053-6013

Governor Val R. Panteah, Sr.
Pueblo of Zuni
PO Box 339 Zuni NM 87327

Chairman Jeff Haozous
Fort Sill Apache Tribe of Oklahoma
Route 2, Box 121
Apache OK 73006

Chairman Harold Cuthair
Ute Mountain Ute Tribe
PO Box JJ
Towaoc CO 81334-0248

USFWS Draft PEA Review Notification Letter

DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

20 June 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland Air Force Base NM 87117

Ms. Amy Leuders, Regional Director
US Fish & Wildlife Service
Southwest Regional Office
PO Box 1306
Albuquerque NM 87103-1306

Dear Ms. Leuders

In accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations, and the U.S. Air Force (USAF) NEPA regulations, the USAF has prepared a Programmatic Environmental Assessment (PEA) to evaluate the implementation of Kirtland Air Force Base (AFB) energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB. The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including Executive Order (EO) 13693, Planning for Federal Sustainability in the Next Decade; Title II—Renewable Energy (42 United States Code [USC] §15851 (2012)) of the Energy Policy Act (109 Public Law [P.L.] 58, 119 Statute 594); Energy Independence and Security Act of 2007 (42 USC §17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC §2911(e)(2012)); and the Kirtland AFB Installation Development Plan.

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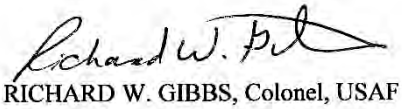
In accordance with EO 12372, Intergovernmental Review of Federal Programs, as amended by EO 12416, Intergovernmental Review of Federal Programs, I am requesting your participation in the NEPA document review and comment process. Copies of the Draft PEA and the proposed Finding of No Significant Impact (FONSI) are available at *http://www.kirtland.af.mil* under the "Environment" button at the bottom of the webpage. If,

after review of the Draft PEA and FONSI, you have additional information regarding impacts of the Proposed Action on the natural environment or other environmental aspects of which we are unaware, we would appreciate receiving such information for inclusion and consideration during the NEPA process. Please respond within 30 days of receipt of this letter to ensure your concerns are adequately addressed in the PEA.

Pursuant to Section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 USC §1531 et seq.), the USAF is requesting concurrence from the USFWS that the Proposed Action is not likely to adversely affect any species or critical habitat. We carefully reviewed your agency's Section 7 Consultation website for a list of species and critical habitat that "may be present" within the project area and have found none. For these reasons, we conclude that the Proposed Action is not likely to adversely affect any species or critical habitat and we request your concurrence with our determination.

Please send written responses to the NEPA Program Manager, 377 MSG/CEIEC, 2050 Wyoming Boulevard SE, Suite 116, Kirtland AFB NM 87117, or via email to *KirtlandNEPA@us.af.mil*.

Sincerely



RICHARD W. GIBBS, Colonel, USAF
Commander

City of Albuquerque Draft PEA Review Response Letter

From: GARCIA, MARTHA E CIV USAF AFGSC 377 MSG/CEIE
To: Sloger, William
Cc: Bare, Michelle
Subject: FW: Renewable Energy Projects at KAFB - PEA and FONSI
Date: Tuesday, July 17, 2018 2:40:34 PM
Attachments: image001.gif

From: Brito, Russell D. <RBrito@cabq.gov>
Sent: Tuesday, July 17, 2018 12:14 PM
To: 377 MSG/CEIE NEPA Environmental <KirtlandNEPA@us.af.mil>
Cc: Campbell, David S. <dscampbell@cabq.gov>
Subject: [Non-DoD Source] Renewable Energy Projects at KAFB - PEA and FONSI

To Whom it May Concern,

Thank you for the opportunity to comment on the Programmatic Environmental Assessment (PEA) for Renewable Energy Projects at KAFB. After reviewing the PEA and the draft FONSI, the City of Albuquerque Planning Department has no adverse comments regarding this PEA. We commend KAFB for this work to meet renewable energy standards put forth by federal directives, to make the base more sustainable, and for continuing to be a good neighbor with Albuquerque and other jurisdictions.

All the Best,

Russell D. Brito, Planning Manager
Urban Design & Development Division
City of Albuquerque Planning Department
rbrito@cabq.gov
505.924.3337 w
abc-zone.com

"Always in motion is the future."
- Yoda

FAA Draft PEA Review Response Letter

From: Kimberly.Eckhart@faa.gov<Kimberly.Eckhart@faa.gov>
Sent: Thursday, July 26, 2018 6:46 AM
To: 377 MSG/CEIE NEPA Environmental <KirtlandNEPA@us.af.mil>
Subject: [Non-DoD Source] Draft PEA and FONSI Comments

Good morning,

The Kirtland PEA and FONSI do not identify any specific proposed projects. The documents state that as specific projects are identified in the future, the projects will undergo a NEPA analysis. The FAA recommends, as part of the feasibility or site selection study of a solar energy project, or as part of the NEPA alternatives analysis for such a project, that a solar glare study be performed to determine whether the proposed site will impact a pilot's vision and ability to operate an aircraft in a safe manner. The solar glare study should also determine whether glare from the proposed site would impact air traffic controllers working in the Albuquerque Sunport Air Traffic Control Tower. If any issues are identified, the Air Force should look at another site to avoid impacts to pilots and air traffic controllers.

Thank you,
Kimberly Eckhart
Administrative Specialist
Office of the Regional Administrator
10101 Hillwood Parkway
Fort Worth, Texas 76177
(817) 222-5003

Mid-Region Council of Governments Draft PEA Review Response Letter

Mid-Region Council of Governments

July 9, 2018

NEPA Program Manager
377 MSG/CEIEC
2050 Wyoming Boulevard SE, Suite 116
Kirtland AFB NM 87117

Re: Programmatic Environmental Assessment to evaluate implementation of Kirtland Air Force Base energy goals

Dear NEPA Program Manager:

On behalf of the Mid-Region Council of Governments (MRCOG), I would like to give my support for your efforts to implement energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland Air Force Base (AFB).

It is my understanding that the proposed action is needed to meet renewable energy standards put forth by federal directives and the Kirtland AFB Installation Development Plan. At this time MRCOG does not anticipate major impacts. However, as part of the Joint Land Use Study (JLUS) implementation plan and subsequent memorandums of understanding (MOUs), the KAFB should consider notifying the City of Albuquerque Planning Department, the Bernalillo County Planning Department, and the Isleta Pueblo as to any potential impacts of this effort.

The mission of the Kirtland Air Force is very important in this region and to MRCOG communities. This proposal in no way conflicts with local or regional plans.

Please let me know if my staff or I can support you further.

Sincerely,

Dewey V. Cave
Executive Director

DC/MR

809 Copper Ave. NW, Albuquerque, NM 87102
Phone: (505) 247-1750 Fax (505) 247-1753 Web: www.mrcog-nm.gov

New Mexico Department of Game and Fish Draft PEA Review Response Letter

GOVERNOR
Susana Martinez

DIRECTOR AND SECRETARY
TO THE COMMISSION
Alexandra Sandoval

DEPUTY DIRECTOR
Donald L. Jaramillo

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

One Wildlife Way, Santa Fe, NM 87507

Post Office Box 25112, Santa Fe, NM 87504

Tel: (505) 476-8000 | Fax: (505) 476-8123

For information call: (888) 248-6866

www.wildlife.state.nm.us

STATE GAME COMMISSION

PAUL M. KIENZLE III
Chairman
Albuquerque

BILL MONTOYA
Vice-Chairman
Alto

CRAIG PETERSON
Farmington

RALPH RAMOS
Las Cruces

BOB RICKLEFS
Cimarron

ELIZABETH A. RYAN
Roswell

THOMAS "DICK" SALOPEK
Las Cruces

31 July 2018

NEPA Program Manager
377 MSG/CEIEC
2050 Wyoming Blvd. SE, Suite 116
Kirtland AFB, NM 87117

RE: Programmatic Environmental Assessment For Renewable Energy Projects at Kirtland Air Force Base; NMDGF No. 18558

Dear NEPA Program Manager,

The New Mexico Department of Game and Fish (Department) has reviewed the Programmatic Environmental Assessment for Renewable Energy Projects at Kirtland Air Force Base (PEA). The Department submitted scoping comments for this project on 5 January 2018.

Kirtland Air Force Base (KAFB) proposes to develop and implement electricity-generating renewable energy projects at KAFB. The proposed action is needed to meet renewable energy standards required by federal directives.

In our 5 January 2018 comments, the Department provided the following comments.

KAFB considered four types of renewable energy technologies to meet their requirements; solar photovoltaic (SPV), wind, geothermal, and biomass (waste to energy). Of those, the preferred alternatives selected for implementation were solar and geothermal. However, the Description of the Proposed Action and Alternatives does not provide evidence of geothermal energy as a proven resource that is currently available to KAFB. Its selection was based on a 2010 reconnaissance assessment by the National Renewable Energy Laboratory that concluded that there "appears to be indications of potential geothermal activity within the installation, and that further investigation is necessary". Given the uncertainty of the geothermal resource, the Department strongly supports focusing on SPV technology to meet KAFB's renewable energy requirements and provides the following recommendations:

- Utilize roof tops, covered parking areas, and disturbed areas that are not occupied by prairie dog towns or burrowing owls, to the maximum extent possible in order to eliminate or minimize the need to site solar arrays in undisturbed wildlife habitat.
- Above ground electrical transmission lines, substations, and transformer equipment should be constructed in conformance with the Avian Power Line Interaction Committee's (APLIC), "Suggested Practices for Avian Protection on Power Lines", 2006 and "Reducing Avian Collisions with Power Lines", 2012 (www.aplic.org/mission.php).
- To avoid potential destruction of occupied migratory bird nests, eggs or nestlings, ground disturbance and vegetation removal activities should be conducted outside of the breeding

season for songbirds and raptors (1 March – 15 September). If ground disturbing and clearing activities during the breeding season cannot be avoided, the area should be surveyed for active nest sites prior to any disturbance. For any active nests detected, an adequate buffer zone should be established to minimize disturbance to nesting birds. Buffer distances should be at least 100 feet from songbird and raven nests, and 0.25 mile from raptor nests. Active nest sites in trees or shrubs that must be removed should be mitigated by qualified biologists or wildlife rehabilitators. Department biologists are available for consultation regarding nest site mitigation, and can facilitate contact with qualified personnel.

The Department appreciates the commitment within the PEA to follow the second and third bullet recommendations above. In addition to the recommendations below, we request that the three bulleted management practices recommendations from our 5 January 2018 comments be carried forward and weighted heavily in future NEPA analyses and decisions for implementing specific renewable energy projects.

Page 2-6 of the PEA, "*Level 2 Selection Standards*", 7th bullet, requires specific plans "...and other applicable guidance..." be consulted and adhered to when considering sites for implementing renewable energy projects. However, this section does not reference the KAFB Integrated Natural Resource Management Plan (INRMP), and we could find no reference to the INRMP within the PEA. INRMPs for major military installations are required to be developed, implemented and revised every five years by the Sikes Act Amendment, which states that Department of Defense will: "carry out a program of planning for, and the development, maintenance, and coordination of, wildlife, fish, and game conservation and rehabilitation in each military reservation in accordance with a cooperative plan mutually agreed upon by the Secretary of Defense, the Secretary of the Interior, and the appropriate State agency".

The Commander of KAFB, the Department's Director, and the U.S. Fish and Wildlife Service's Region 2 Director signed the revised KAFB INRMP in February 2018. The INRMP contains much useful information on wildlife species and habitats on KAFB that are sensitive to disturbance and that could be impacted by implementation of renewable energy projects that modify or further fragment habitat. We therefore request that the KAFB INRMP be specifically referenced within the 7th bullet of the *Level 2 Selection Standards* PEA discussion.

Page 2-7 of the PEA states: "Candidate sites at Kirtland AFB for an SPV array would be undeveloped and up to 500 acres in size, which would allow for a generating capacity of 10 to 20 megawatts". Page 3-11 of the PEA states: "A potential SPV project at Kirtland AFB would likely be a ground mounted system on one site consisting of up to 500 acres. None of the 42 parcels (or a combination of multiple contiguous parcels) of developable or re-developable land in the cantonment area are large enough to accommodate an SPV project; therefore, it would likely be located in the southwestern portion of the installation within the Manzano district or Southern Research and Development Area. This area is dominated by undeveloped land designated as Open Space in the Future Land Use Plan. An SPV system would generally be compatible in this area, and would not result in impacts on land use or recreation".

The Department does not concur with the compatibility of a large SPV development in the southwest portion of KAFB, and believes that this proposal does not align with the KAFB INRMP. Construction of a SPV facility of up to 500 acres at this location would significantly fragment relatively intact desert grassland habitats and adversely affect Species of Greatest Conservation Need (SGCN), as identified in the 2016 State Wildlife Action Plan for New Mexico. SGCN that may be adversely affected include the desert massasauga (*Sistrurus catenatus*) (currently under review for listing under the federal Endangered Species Act), Sprague's pipit (*Anthus spragueii*), chestnut-collared longspur (*Calcarius ornatus*), burrowing owl (*Athene cunicularia*), mountain plover (*Charadrius montanus*), loggerhead shrike (*Lanius ludovicianus*), Baird's sparrow (*Ammodramus bairdii*), and vesper sparrow (*Pooecetes*

gramineus). Impacts to these species should be reduced by co-locating facilities for energy generation with existing development wherever possible, and siting areas for unavoidable new development adjacent to portions of KAFB that have already been disturbed and no longer serve as effective wildlife habitat or open space.

The KAFB INRMP *Management Goals and Objectives* Goal 3 (p. 105) states: "Conserve and enhance wildlife habitats to maintain and improve the sustainability and natural diversity of ecosystems on Kirtland AFB". Goal 2 states: "Kirtland AFB shall consider designating some areas as high priority for protection from development. These areas should include Tijeras Arroyo wildlife corridor and grasslands along the southern edge of the installation". The Department specifically requested implementation of Goal 2 to protect from development KAFB high priority habitats important for conservation of SGCN. These habitats include wetlands, riparian areas, pinyon-juniper woodlands and savannas (including within the U.S. Forest Service Withdrawal Area), Tijeras Arroyo, which is a documented wildlife corridor, and the relatively unfragmented desert grasslands within the southern portion of KAFB. Because of the need to protect these important habitats from development, the Department requests that future NEPA analyses for specific renewable energy projects include avoidance of these important habitats as a mitigation strategy to meet the intent of the INRMP.

Table 2.2 *Summary of Potential Impacts from the Proposed Action and No Action Alternative*, assesses effects of the Proposed Action on Biological Resources as: "Long-term, minor, adverse impacts on wildlife species from the loss or disturbance of habitat". Page 3-42 states: "Long-term, minor, adverse impacts on wildlife species would be expected from the loss or disturbance of grassland habitat, which could lead to displacement, and because of noise events that could cause wildlife to engage in escape or avoidance behaviors". While these statements might describe impacts specific to the construction phase of proposed project, the Department believes that development of up to 500 acres of SPV in the southwestern portion of the installation could cause long-term habitat modifications with significant adverse effects to the SGGN mentioned above. We request that these statements be modified to reflect the Department's concerns.

Page 3-43 states: "SPV arrays have the potential to have a lake-like appearance to birds and could cause them to accidentally strike the array leading to injury or death. Lake effect related mortalities are not known to be significant; however, using arrays with low reflectivity and providing structural elements or markings to break up the reflection could reduce birds approaching the array as if it was a lake. This would reduce impacts on migratory birds". KAFB is relatively close to the Rio Grande, which is a known flyway for migratory birds, including cranes, geese, ducks and other waterbirds that may be susceptible to mortality from attempting to land on photovoltaic panels, causing injury or inability to take flight after impact. Regardless of location on KAFB, the Department supports the recommendation to use low reflectivity and marking of photovoltaic panels to mitigate potential bird mortality, and requests that this mitigation strategy be carried forward in future NEPA analyses for specific renewable energy projects.

We appreciate the opportunity to review and comment on your proposed project. If you have any additional questions, please contact: Mark Watson, Terrestrial Habitat Specialist, at (505) 476-8115 or mark.watson@state.nm.us.

Sincerely,

Matt Wunder, Ph.D.
Chief, Ecological and Environmental Planning Division

cc: USFWS NMES Field Office
Melissa Clark (Civil Engineering, KAFB)
Jenny Davis (USFWS NMESO Biologist)
Leland Pierce (NMDGF Herpetologist)
Erin Duvuvuei (NMDGF Non-game Bird Biologist)

PNM Resources Inc. Draft PEA Review Response Letter

From:	377 MSG/CEIE NEPA Environmental
To:	Sloger, William
Cc:	Bare, Michelle
Subject:	FW: Draft Programmatic Environmental Assessment for renewable energy
Date:	Wednesday, July 18, 2018 4:21:40 PM

From: Campbell, Douglas <Douglas.Campbell@pnmresources.com>
Sent: Wednesday, July 18, 2018 11:31 AM
To: 377 MSG/CEIE NEPA Environmental <KirtlandNEPA@us.af.mil>
Subject: [Non-DoD Source] Draft Programmatic Environmental Assessment for renewable energy

NEPA Program Manager
377 MSG/CEIEC
KirtlandNEPA@us.af.mil

PNM Resources Inc. is in receipt of your letter dated 20 June 2018.

We have reviewed your request to provide additional information regarding the impacts of the Proposed Action in Draft Programmatic Environmental Assessment to evaluate the programmatic execution of various electricity-generating renewable energy technologies at Kirtland Air Force Base (AFB) on the natural environment or other environmental aspects.

PNM Resources Inc. has transmission facilities on the Kirtland AFB, however those transmission lines, approximately 10 linear miles, were placed in service in 1952 and the early 1980's and PNM Resources Inc. has no unique knowledge of environmental conditions on Kirtland AFB.

Please let us know if we can be of further assistance in your evaluation.

Doug Campbell
Manager, Environmental Planning and Permitting
PNM - Environmental Services
505-241-2025 (w)
doug.campbell@pnmresources.com

Ysleta del Sur Pueblo Draft PEA Review Response Letter

Ysleta del Sur Pueblo
Tribal Council – Javier Loera (War Captain/Tribal Historic and Preservation Officer) E-mail jloera@ydsp-nsn.gov
117 South Old Pueblo Road * P.O. Box 17579 * El Paso, Texas 79917 * (915) 859-8053 * Cell (915) 497-3853

July 5, 2018

Colonel Richard W. Gibbs, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd. SE
Kirtland Air Force Base NM 87117

Dear Colonel Gibbs:

This letter is in response to the correspondence received in our office in which you provide the Ysleta del Sur Pueblo the opportunity to comment on the U. S. Air Force (USAF) Programmatic Environmental Assessment (PEA), Kirtland Air Force Base (AFB) NM.

The Ysleta del Sur Pueblo does not have any comments nor does it request consultation on this project.

Thank you for allowing us the opportunity to comment on this project.

Sincerely,

Javier Loera

Javier Loera
War Captain/THPO
Ysleta del Sur Pueblo

B

Air Quality Calculations

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
200-Acre SPV Array

1. General Information

- Action Location
Base: KIRTLAND AFB
County(s): Bernalillo
Regulatory Area(s): Albuquerque, NM

- Action Title: Construct and Operate Solar Photovoltaic Systems

- Project Number/s (if applicable):

- Projected Action Start Date: 1 / 2019

- Action Purpose and Need:
The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB.

The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including EO 13693; Title II—Renewable Energy (42 USC § 15851 (2012)) of the EPAct 2005 (109 P.L. 58, 119 Stat. 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB IDP.

- Action Description:
The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation. It includes renewable energy technology categories that meet general selection standards for suitability.

- Point of Contact

Name: Timothy Didlake
Title: Contractor
Organization: HDR
Email: timothy.didlake@hdrinc.com
Phone Number: 484-612-1124

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	Construct a 200-acre Solar Photovoltaic Array

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Bernalillo
Regulatory Area(s): Albuquerque, NM

- Activity Title: Construct a 200-acre Solar Photovoltaic Array

- Activity Description:
Construct a 200-acre Solar Photovoltaic Array in 9 months
Grade entire site in 3 months
Trench interconnection for 1 mile over 6 months

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
200-Acre SPV Array

- Activity Start Date
Start Month: 1
Start Month: 2019

- Activity End Date
Indefinite: False
End Month: 12
End Month: 2019

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.393903
SO_x	0.021022
NO_x	10.306964
CO	6.880364
PM 10	260.731497

Pollutant	Total Emissions (TONs)
PM 2.5	0.408878
Pb	0.000000
NH_3	0.016070
CO_2e	2175.7

2.1 Site Grading Phase

2.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 1
Start Quarter: 1
Start Year: 2019

- Phase Duration
Number of Month: 3
Number of Days: 0

2.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 8712000
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Graders Composite	2	8
Other Construction Equipment Composite	2	8
Rollers Composite	1	8
Rubber Tired Dozers Composite	3	8
Scrapers Composite	6	8
Tractors/Loaders/Backhoes Composite	2	8

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0982	0.0014	0.6490	0.5786	0.0316	0.0316	0.0088	132.96
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0595	0.0012	0.3971	0.3522	0.0158	0.0158	0.0053	122.63
Rollers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0631	0.0007	0.4127	0.3859	0.0260	0.0260	0.0057	67.184
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2226	0.0024	1.6948	0.8387	0.0682	0.0682	0.0200	239.58
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2020	0.0026	1.4692	0.8161	0.0594	0.0594	0.0182	262.94
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**Pb**	**NH_3**	**CO_2e**
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.2 Trenching/Excavating Phase

2.2.1 Trenching / Excavating Phase Timeline Assumptions

- Phase Start Date

Start Month: 1
Start Quarter: 1
Start Year: 2019

- Phase Duration

Number of Month: 6
Number of Days: 0

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
200-Acre SPV Array

2.2.2 Trenching / Excavating Phase Assumptions

- General Trenching/Excavating Information

Area of Site to be Trenched/Excavated (ft^2): 5280
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Trenching Default Settings

Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	2	8
Other General Industrial Equipment Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.2.3 Trenching / Excavating Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0982	0.0014	0.6490	0.5786	0.0316	0.0316	0.0088	132.96
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0595	0.0012	0.3971	0.3522	0.0158	0.0158	0.0053	122.63
Rollers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0631	0.0007	0.4127	0.3859	0.0260	0.0260	0.0057	67.184
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2226	0.0024	1.6948	0.8387	0.0682	0.0682	0.0200	239.58
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2020	0.0026	1.4692	0.8161	0.0594	0.0594	0.0182	262.94
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.2.4 Trenching / Excavating Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD)/2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb/1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip/HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Building Construction Phase

2.3.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 4
Start Quarter: 1
Start Year: 2019

- Phase Duration
Number of Month: 9
Number of Days: 0

2.3.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 8712000
Height of Building (ft): 3
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	7
Forklifts Composite	3	8
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	3	7
Welders Composite	1	8

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.3.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Cranes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0953	0.0013	0.7235	0.3981	0.0286	0.0286	0.0086	128.84
Forklifts Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0344	0.0006	0.1923	0.2166	0.0085	0.0085	0.0031	54.473
Generator Sets Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0430	0.0006	0.3483	0.2755	0.0168	0.0168	0.0038	61.089
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904
Welders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0343	0.0003	0.1832	0.1842	0.0116	0.0116	0.0031	25.680

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.3.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
200-Acre SPV Array

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip/1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip/1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
200-Acre SPV Array

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
500-Acre SPV Array

1. General Information

- Action Location
Base: KIRTLAND AFB
County(s): Bernalillo
Regulatory Area(s): Albuquerque, NM

- Action Title: Construct and Operate Solar Photovoltaic Systems

- Project Number/s (if applicable):

- Projected Action Start Date: 1 / 2019

- Action Purpose and Need:
The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB.

The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including EO 13693; Title II—Renewable Energy (42 USC § 15851 (2012)) of the EPAct 2005 (109 P.L. 58, 119 Stat. 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB IDP.

- Action Description:
The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation. It includes renewable energy technology categories that meet general selection standards for suitability.

- Point of Contact

Name: Timothy Didlake
Title: Contractor
Organization: HDR
Email: timothy.didlake@hdrinc.com
Phone Number: (484) 612-1124

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	Construct a 500-acre Solar Photovoltaic Array

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Bernalillo
Regulatory Area(s): Albuquerque, NM

- Activity Title: Construct a 500-acre Solar Photovoltaic Array

- Activity Description:
Construct a 500-acre Solar Photovoltaic Array in 9 months
Grade entire site in 3 months
Trench interconnection for 1 mile over 6 months

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
500-Acre SPV Array

- Activity Start Date
Start Month: 1
Start Month: 2019

- Activity End Date
Indefinite: False
End Month: 12
End Month: 2019

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.821287
SO_x	0.030013
NO_x	14.590478
CO	8.296676
PM 10	650.866351

Pollutant	Total Emissions (TONs)
PM 2.5	0.532667
Pb	0.000000
NH_3	0.036816
CO_2e	3226.5

2.1 Site Grading Phase

2.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 1
Start Quarter: 1
Start Year: 2019

- Phase Duration
Number of Month: 3
Number of Days: 0

2.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 21780000
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Graders Composite	2	8
Other Construction Equipment Composite	2	8
Rollers Composite	1	8
Rubber Tired Dozers Composite	3	8
Scrapers Composite	6	8
Tractors/Loaders/Backhoes Composite	2	8

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0982	0.0014	0.6490	0.5786	0.0316	0.0316	0.0088	132.96
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0595	0.0012	0.3971	0.3522	0.0158	0.0158	0.0053	122.63
Rollers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0631	0.0007	0.4127	0.3859	0.0260	0.0260	0.0057	67.184
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2226	0.0024	1.6948	0.8387	0.0682	0.0682	0.0200	239.58
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2020	0.0026	1.4692	0.8161	0.0594	0.0594	0.0182	262.94
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**Pb**	**NH_3**	**CO_2e**
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb/1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip/HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.2 Trenching/Excavating Phase

2.2.1 Trenching / Excavating Phase Timeline Assumptions

- Phase Start Date

Start Month: 1
Start Quarter: 1
Start Year: 2019

- Phase Duration

Number of Month: 6
Number of Days: 0

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
500-Acre SPV Array

2.2.2 Trenching / Excavating Phase Assumptions

- General Trenching/Excavating Information

Area of Site to be Trenched/Excavated (ft^2): 5280
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Trenching Default Settings

Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	2	8
Other General Industrial Equipmen Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.2.3 Trenching / Excavating Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0982	0.0014	0.6490	0.5786	0.0316	0.0316	0.0088	132.96
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0595	0.0012	0.3971	0.3522	0.0158	0.0158	0.0053	122.63
Rollers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0631	0.0007	0.4127	0.3859	0.0260	0.0260	0.0057	67.184
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2226	0.0024	1.6948	0.8387	0.0682	0.0682	0.0200	239.58
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2020	0.0026	1.4692	0.8161	0.0594	0.0594	0.0182	262.94
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.2.4 Trenching / Excavating Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb/1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip/HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Building Construction Phase

2.3.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 4
Start Quarter: 1
Start Year: 2019

- Phase Duration
Number of Month: 9
Number of Days: 0

2.3.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 21780000
Height of Building (ft): 3
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	7
Forklifts Composite	3	8
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	3	7
Welders Composite	1	8

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.3.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Cranes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0953	0.0013	0.7235	0.3981	0.0286	0.0286	0.0086	128.84
Forklifts Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0344	0.0006	0.1923	0.2166	0.0085	0.0085	0.0031	54.473
Generator Sets Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0430	0.0006	0.3483	0.2755	0.0168	0.0168	0.0038	61.089
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904
Welders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0343	0.0003	0.1832	0.1842	0.0116	0.0116	0.0031	25.680

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.3.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
500-Acre SPV Array

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip/1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
Geothermal Energy System

1. General Information

- Action Location
Base: KIRTLAND AFB
County(s): Bernalillo
Regulatory Area(s): Albuquerque, NM

- Action Title: Construct and Operate Solar Photovoltaic Systems

- Project Number/s (if applicable):

- Projected Action Start Date: 1 / 2019

- Action Purpose and Need:
The purpose of the Proposed Action is to implement installation energy goals to increase installation energy security, provide strategic flexibility in energy generating sources, allow for predictable and potentially reduced operational costs, and maximize resource availability through the development of renewable energy-generating assets at Kirtland AFB.

The Proposed Action is needed to meet renewable energy standards put forth by federal directives, including EO 13693; Title II—Renewable Energy (42 USC § 15851 (2012)) of the EPAct 2005 (109 P.L. 58, 119 Stat. 594); Energy Independence and Security Act of 2007 (42 USC § 17001 et seq. (2012); 110 P.L. 140); "Goal Regarding Use of Renewable Energy To Meet Facility Energy Needs" (10 USC § 2911(e)(2012)); and the Kirtland AFB IDP.

- Action Description:
The Proposed Action is the programmatic execution of various electricity-generating renewable energy technologies at the installation. It includes renewable energy technology categories that meet general selection standards for suitability.

- Point of Contact
Name: Timothy Didlake
Title: Contractor
Organization: HDR
Email: timothy.didlake@hdrinc.com
Phone Number: 484-612-1124

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	Construct Geothermal Energy Project

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Bernalillo
Regulatory Area(s): Albuquerque, NM

- Activity Title: Construct Geothermal Energy Project

- Activity Description:
Construction of a typical geothermal energy system would disturb a 10 acre area in 9 months
Grade entire site in 3 months
Trench interconnection for 1 mile over 6 months

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
Geothermal Energy System

- Activity Start Date
Start Month: 1
Start Month: 2019

- Activity End Date
Indefinite: False
End Month: 12
End Month: 2019

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.619772
SO_x	0.008629
NO_x	3.946569
CO	3.682743
PM 10	13.498037

Pollutant	Total Emissions (TONs)
PM 2.5	0.182447
Pb	0.000000
NH_3	0.002403
CO_2e	834.2

2.1 Site Grading Phase

2.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 1
Start Quarter: 1
Start Year: 2019

- Phase Duration
Number of Month: 3
Number of Days: 0

2.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 435600
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	1	8
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Tractors/Loaders/Backhoes Composite	3	8

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Excavators Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0786	0.0013	0.4574	0.5139	0.0214	0.0214	0.0070	119.75
Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0982	0.0014	0.6490	0.5786	0.0316	0.0316	0.0088	132.96
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0595	0.0012	0.3971	0.3522	0.0158	0.0158	0.0053	122.63
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2226	0.0024	1.6948	0.8387	0.0682	0.0682	0.0200	239.58
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb/1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)

NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip/HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.2 Trenching/Excavating Phase

2.2.1 Trenching / Excavating Phase Timeline Assumptions

- Phase Start Date

Start Month: 1
Start Quarter: 1
Start Year: 2019

- Phase Duration

Number of Month: 6
Number of Days: 0

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT
Geothermal Energy System

2.2.2 Trenching / Excavating Phase Assumptions

- General Trenching/Excavating Information

Area of Site to be Trenched/Excavated (ft^2): 5280
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Trenching Default Settings

Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	2	8
Other General Industrial Equipmen Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.2.3 Trenching / Excavating Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Excavators Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0786	0.0013	0.4574	0.5139	0.0214	0.0214	0.0070	119.75
Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0982	0.0014	0.6490	0.5786	0.0316	0.0316	0.0088	132.96
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0595	0.0012	0.3971	0.3522	0.0158	0.0158	0.0053	122.63
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.2226	0.0024	1.6948	0.8387	0.0682	0.0682	0.0200	239.58
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.2.4 Trenching / Excavating Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)

1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Building Construction Phase

2.3.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 4
Start Quarter: 1
Start Year: 2019

- Phase Duration
Number of Month: 9
Number of Days: 0

2.3.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 435600
Height of Building (ft): 3
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	7
Forklifts Composite	2	7
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.3.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Cranes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0953	0.0013	0.7235	0.3981	0.0286	0.0286	0.0086	128.84
Forklifts Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0344	0.0006	0.1923	0.2166	0.0085	0.0085	0.0031	54.473
Generator Sets Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0430	0.0006	0.3483	0.2755	0.0168	0.0168	0.0038	61.089
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0471	0.0007	0.3018	0.3630	0.0159	0.0159	0.0042	66.904
Welders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0343	0.0003	0.1832	0.1842	0.0116	0.0116	0.0031	25.680

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.340	000.002	000.276	003.604	000.008	000.007		000.024	00328.206
LDGT	000.416	000.003	000.480	005.057	000.010	000.009		000.025	00423.247
HDGV	000.764	000.005	001.218	016.264	000.023	000.020		000.044	00760.998
LDDV	000.119	000.003	000.146	002.473	000.004	000.004		000.008	00318.976
LDDT	000.281	000.004	000.446	004.521	000.007	000.006		000.008	00458.185
HDDV	000.618	000.013	006.194	002.048	000.195	000.179		000.030	01519.413
MC	002.745	000.003	000.847	013.480	000.027	000.024		000.054	00396.763

2.3.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

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Geothermal Energy System

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase

$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

C

Species of Concern for Bernalillo County

APPENDIX C: SPECIES OF CONCERN FOR BERNALILLO COUNTY

Table C-1. State and Federally-listed Species in Bernalillo County, New Mexico

Common Name	*Scientific Name*	Status	
		USFWS (Federal)	NMDGF (State)
Fish			
Rio Grande Silvery Minnow	*Hyboganthus amarus*	E	E
Birds			
Aplomado Falcon	*Falco femoralis*	E	E
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	-	T
Baird's Sparrow	*Ammodramus bairdii*	-	T
Bald Eagle	*Haliaeetus leucocephalus*	-	T
Bell's Vireo	*Vireo bellii*	-	T
Broad-billed Hummingbird	*Cynanthus latirostris*	-	T
Brown Pelican	*Pelecanus occidentalis*	-	E
Common Black Hawk	*Buteogallus anthracinus*	-	T
Gray Vireo	*Vireo vicinior*	-	T
Least Tern	*Sternula antillarum*	E	E
Mexican Spotted Owl	*Strix occidentalis lucida*	T	T
Neotropic Cormorant	*Phalacrocorax brasilianus*	-	T
Peregrine Falcon	*Falco peregrinus*	-	T
Southwestern Willow Flycatcther	*Empidonax traillii extimus*	E	E
White-eared Hummingbird	*Hylocharis leucotis*	-	T
Yellow-billed Cuckoo (western population)	*Coccyzus americanus occidentalis*	T	T
Mammals			
Spotted Bat	*Euderma maculatum*	-	T
New Mexico Meadow Jumping Mouse	*Zapus hudsonius luteus*	E	E

Sources: USFWS 2017, NMDGF 2017
Key: E = Endangered; T = Threatened

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