ENVIRONMENTAL REPORT

on

The HI-STORE CIS FACILITY

by

Holtec International
Holtec Center
One Holtec Drive
Marlton, NJ 08053, USA
(holtecinternational.com)

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Revision 4: Revised Section 4.11 to include annual and total volume estimates for low-level radioactive wastes and nonhazardous solid wastes.

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
AADT	annual average daily traffic
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ALARA	as low as reasonably achievable
amsl	above mean sea level
APE	Area of Potential Effects
ARMS	Archaeological Records Management Section
BISON	Biota Information System of New Mexico
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	best management practices
BNSF	Burlington Northern-Santa Fe
CAA	Clean Air Act
CEC	Cavity Enclosure Containers
CEDE	committed effective dose equivalent
CESQG	Conditionally Exempt Small Quantity Generator
CFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CISF	Consolidated Interim Storage Facility
CLSM	Controlled Low Strength Material
CO	carbon monoxide
CO2e	carbon dioxide equivalent
CoC	Certificate of Compliance
CWA	Clean Water Act
D&D	decontamination and decommissioning
dB	decibel units
dBA	A-weighted decibels
DE	dose equivalent
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
EDE	effective dose equivalent
EIS	Environmental Impact Statement
ELEA	Eddy-Lea Energy Alliance
EMS	Emergency Medical Services
EMT	Emergency Medical Technician

EPA	U.S. Environmental Protection Agency
ER	Environmental Report
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FEP/DEP	Fluorine Extraction Process and Depleted Uranium De-conversion Plant
FLMPA	Federal Land Policy and Management Act
FR	Federal Register
FSAR	Final Safety Analysis Report
GCR	Geological Characterization Report
GHG	Greenhouse Gas
GNEP	Global Nuclear Energy Partnership
GPS	Global Positioning System
HI-STORM UMAX	Holtec International Storage Module Underground MAXimum Capacity
HLW	High-Level Waste
Holtec	Holtec International
HPD	Historic Preservation Division
HUD	Department of Housing and Urban Development
ICRP	International Commission on Radiation Protection
IIFP	International Isotopes Fluorine Production
IO	Isolated Occurrences
ISCORS	Interagency Steering Committee on Radiation Standards
ISFSI	Independent Spent Fuel Storage Installation
LLRW	Low-Level Radioactive Waste
MDC	Minimum Detectable Concentration
MEI	maximally exposed individual
MN	Midessa and Wink fine sandy loams
MOA	memorandum of agreement
MPC	Multi-Purpose Canister
mph	miles per hour
mrem	millirem
MRS	Monitored Retrievable Storage Installation
MTU	metric tons of uranium
MU	Mixed alluvial land
MW	Mobeetie-Potter association
NAAQS	National Ambient Air Quality Standards
NAC	NAC International
NBS	National Bureau of Standards Handbook

NEF	National Enrichment Facility
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMAAQS	New Mexico Ambient Air Quality Standards
NMCRIS	New Mexico Cultural Resources Information System
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environmental Department
NMHPD	New Mexico Historic Preservation Division
NMWQB	New Mexico Water Quality Bureau
NMRPTC	New Mexico Rare Plant Technical Council
NOI	Notice of Intent
NOx	oxide of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NUREG	U.S. Nuclear Regulatory Commission Regulation
NWS	National Weather Service
NWPA	Nuclear Waste Policy Act
O_3	ozone
OCD	Oil Conservation Division
OSHA	Occupational Safety and Health Administration
OSL	optically stimulated luminescence
Pb	lead
PFS	Private Fuel Storage
PGA	Peak Horizontal Ground Acceleration
PM	particulate matter
PM10	particulate matter less than or equal to 10 microns
PM2.5	particulate matter less than or equal to 2.5 microns
PPH	pounds per hour
PRA	probabilistic risk assessment
QA	quality assurance
QC	quality control
RBE	relative biological effect
RCRA	Resource Conservation and Recovery Act
REMP	Radiological Environmental Monitoring Program
ROI	region of influence
ROW	rights-of-way
RPA	Registered Professional Archaeologist

SAR	Safety Analysis Report
SDWA	Safe Drinking Water Act
SE	Simona fine sandy loam
SES	Self-Hardening Engineering Subgrade
SFP	Support Foundation Pad
SHPO	State Historic Preservation Officer
Site	Proposed CISF Site
SNF	Spent Nuclear Fuel
SO2	sulfur dioxide
SONGS	San Onofre Nuclear Generating Station
SPCC	Spill Prevention, Control, and Countermeasures Plan
SR	Simona-Upton association
SRI	Statistical Research, Inc.
SWAT	Special Weapons and Tactics
SWPP	Stormwater Pollution Prevention Plan
T&E	threatened and endangered
TEDE	total effective dose equivalent
TLDs	thermoluminescent dosimeters
TNMR	Texas-New Mexico Railroad
TPY	tons per year
TPWD	Texas Parks and Wildlife Department
TRU	transuranic
TSP	total suspended particulates
U.S.	United States
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USTs	Underground Storage Tanks
UWB	Underground Water Basin
VCT	Vertical Cask Transporter
VOCs	volatile organic compounds
VRM	Visual Resource Management
VVM	Vertical Ventilated Modules
WCS	Waste Control Specialist
WIPP	Waste Isolation Pilot Plant
WRCC	Western Regional Climate Center

CONVERSION CHART

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	**Multiply by**	**To get**	**If you know**	**Multiply by**	**To get**
		Length			
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
		Area			
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
		Volume			
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallons	3.785	liters	liters	0.2642	gallons
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
		Weight			
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
		Temperature			
Fahrenheit (ºF)	subtract 32, then multiply by 5/9	Celsius (ºC)	Celsius (ºC)	multiply by 9/5, then add 32	Fahrenheit (ºF)
Kelvin (K)	subtract 273.15	Celsius (ºC)	Celsius (ºC)	add 273.15	Kelvin (K)

Note: 1 sievert = 100 rem

CHAPTER 1: INTRODUCTION

1.0 INTRODUCTION

Holtec International (Holtec) has prepared a license application for a Consolidated Interim Storage (CIS) Facility for approval by the United States (U.S.) Nuclear Regulatory Commission (NRC) pursuant to the requirements specified in Title 10 of the Code of Federal Regulations (CFR), Part 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste*. The proposed site (hereafter, "Site") for the CIS Facility is located in southeastern New Mexico in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico (Figure 1.0.1).

Holtec has prepared this Environmental Report (ER) to evaluate the potential radiological and non-radiological impacts associated with the construction and operation of the CIS Facility for Spent Nuclear Fuel (SNF) and Reactor-Related Greater than Class C Low-Level Radioactive Waste (LLRW) (hereafter, referred to collectively as "SNF") in Lea County, New Mexico. Holtec is proposing to construct and operate Phase 1 of the CIS Facility within an approximately 1,040 acre parcel. Holtec is currently requesting authorization to possess and store 500 canisters of SNF containing 8,680 metric tons of uranium (MTUs), which includes spent uranium-based fuel from commercial nuclear reactors as well as a small quantity of spent mixed-oxide fuel. If the requested license is issued by the NRC, Holtec anticipates subsequently requesting an amendment to the license to request authorization to possess and store SNF containing additional 500 canisters for each of 19 subsequent expansion phases to be completed over the course of 20 years. Ultimately, Holtec anticipates that approximately 10,000 canisters of SNF would be stored at the CIS Facility upon completion of 20 phases. In total, this ER analyzes the environmental impacts of possession and storage of SNF containing 100,000 MTUs (each canister type contains different design basis MTUs).

This ER was prepared to support a License Application for review and approval by the NRC pursuant to the requirements specified in 10 CFR Part 72.34 and in 10 CFR Part 51.61, *Environmental Report—Independent Spent Fuel Storage Installation (ISFSI) or Monitored Retrievable Storage Installation (MRS) license.* Holtec prepared this ER consistent with the guidance provided in two regulatory documents:

Regulatory Guide 3.50, *Standard Format and Content for A Specific License Application for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Facility* (NRC 2014a);

U.S. Nuclear Regulatory Commission Regulation (NUREG)-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NRC 2003).

Holtec anticipates that the NRC would issue the Final Environmental Impact Statement (FEIS) and License in 2019. Phase 1 construction would begin after issuance of the license and after Holtec successfully enters into a contract for storage with the U.S. Department of Energy (DOE) or utility. Construction on Phase 1 is expected to begin in the first quarter of 2020 and be complete within 1.5 years. After preoperational testing, Phase 1 of the CIS Facility is expected to be operational in early 2022. In this ER, Holtec has assumed that SNF could be stored at the CIS Facility for approximately 120 years (40 years for initial licensing plus 80 years for life extensions). That storage period could be reduced if a final geologic repository is licensed and

operating in accordance with the Nuclear Waste Policy Act (NWPA) of 1982, as amended (Holtec 2016a).

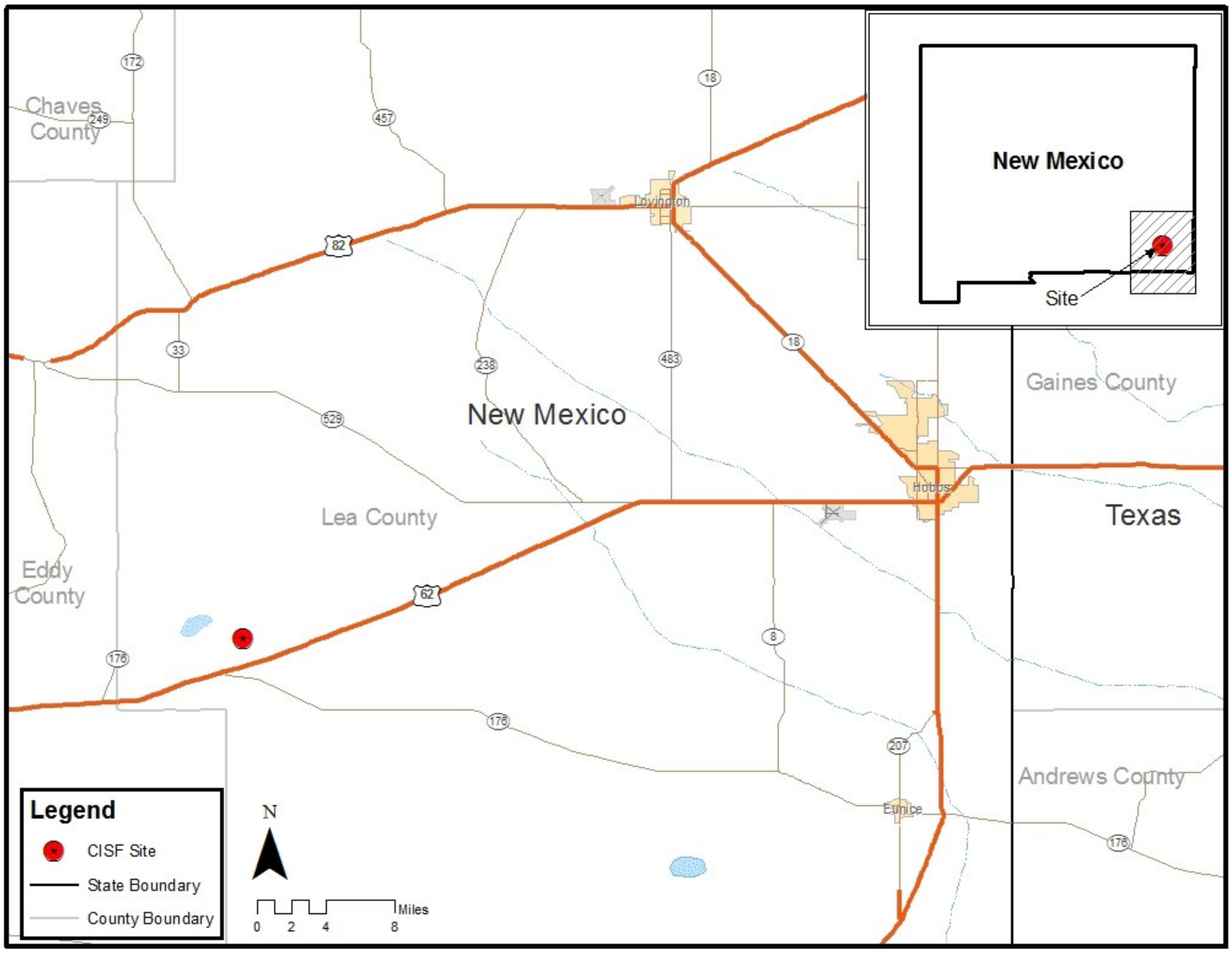


Figure 1.0.1: LOCATION OF PROPOSED CIS FACILITY

1.1 HISTORY AND BACKGROUND

The U.S. Congress enacted the NWPA of 1982 assigning DOE the task of developing a geologic repository for the disposal of SNF generated by commercial nuclear power plants located throughout the U.S. In 1987, Congress amended the NWPA to streamline and focus SNF management on developing the geologic repository at Yucca Mountain, located in Nye County, Nevada. Pursuant to the NWPA, DOE was responsible for obtaining required licenses for Yucca Mountain with operations to begin on January 31, 1998.

On July 23, 2002, President Bush approved Congressional legislation designating Yucca Mountain as the final geologic repository intended for the disposal of commercial SNF and high-level waste (HLW) generated by the Federal government. DOE submitted a license application to the NRC for authorization to construct and operate Yucca Mountain. The NRC reviewed the license application and issued a series of Safety Evaluation Reports addressing the long-term environmental performance of Yucca Mountain. However, much uncertainty remains as to whether or not the facility will open and begin accepting commercial SNF or HLW for disposal. In January 2010, President Obama established the Blue Ribbon Commission on America's Nuclear Future. The Commission was directed by the Secretary of Energy to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle and to recommend a new strategy. On January 26, 2012, the Blue Ribbon Commission issued a final report consisting of eight key recommendations. Of paramount importance to this licensing action was the Blue Ribbon Commission's recommendation to adopt a new consent-based approach to siting future nuclear waste management facilities in order to initiate prompt efforts to develop one or more consolidated storage facilities (BRC 2012, Chapter 6).

Consistent with the Blue Ribbon Commission's recommendation, on December 23, 2015, DOE announced that it would implement a consent-based siting process to establish an integrated waste management system to transport, store, and dispose of SNF and HLW. In a consent-based siting approach, DOE would work with communities, tribal governments and states across the country that express interest in hosting any of the facilities identified as part of an integrated waste management system. As part of this process, DOE solicited public comments and hosted a series of public meetings to engage communities and discuss the development of a consent-based approach to managing SNF and HLW (80 Federal Register [FR] 79872).

Although the consent-based approach applies to Federal proposals, that approach is indirectly applicable to private proposals such as Holtec's. For example, it is possible that DOE would evaluate proposals such as Holtec's for consistency with the Federal consent-based approach. To that end, Holtec's proposal has been vetted and discussed publicly both at the local and state-level, as discussed below and in Section 2.3 (Site Selection Process).

Development of Holtec's CIS Facility has support from the state, regional, and local communities located in southeastern New Mexico. In an April 10, 2015 letter, New Mexico Governor Martinez wrote to Energy Secretary Ernest Moniz, urging the administration to look to southeastern New Mexico to store the SNF. "Time and time again, the citizens of southeastern New Mexico have impressed me with their hard work ethic and willingness to tackle national problems that many others consider to be unsolvable," Martinez wrote. "In one of the most remote areas of the state, they have had the ingenuity and fortitude to carve out a niche in the nuclear industry to broaden

their economic base. They understand the benefits not only to their local economy, but also to our country" (Martinez 2015).

In February 2016, the New Mexico Senate Conservation Committee approved a nonbinding measure to signal support for the development of the CIS Facility. Although the measure does not hold any legal weight, supporters of the CIS Facility view it as an endorsement from the State Legislature that would help in what is likely to be a competitive process as the Federal government weighs proposals for storing SNF (ALBQ Journal 2016).

In April 2016, Holtec and the Eddy-Lea Energy Alliance[1] (ELEA) announced the signing of a memorandum of agreement (MOA) covering the design, licensing, construction and operation of the CIS Facility. Among other things, that MOA provides the means by which Holtec could purchase the Site proposed for the CIS Facility (ELEA 2016). On July 19, 2016, the New Mexico Board of Finance approved the sale of the Site to Holtec (NMBF 2016).

With regard to previous efforts to license a private storage facility for SNF, in December 2001, the NRC previously prepared the *Final Environmental Impact Statement (EIS) for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of the Goshute Indians and Related Transportation Facility in Tooele County, Utah*, NUREG-1714 (NRC 2001). The subject of that EIS, a facility referred to as the "Private Fuel Storage" (PFS) facility," was designed and licensed to store up to 40,000 MTUs of SNF in sealed metal casks (approximately 4,000 storage casks) for a term of 20 years. The PFS facility was never licensed or constructed.

More recently, the NRC directed staff to develop a waste confidence decision and promulgated the Continued Storage Rule to be supported by an environmental impact statement (SRM-COMSECY-12-0016) (NRC 2012a). As such, the NRC completed a *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NUREG-2157) (NRC 2014b) that addressed the impacts attributable to continued storage of SNF. The report was needed by the NRC to fulfill its responsibilities under the National Environmental Policy Act (NEPA). The environmental impacts evaluated in NUREG-2157 include those related to short-term (60 years), long-term (an additional 100 years), and indefinite storage of SNF at existing commercial nuclear power plants, as well as at an "away-from-reactor" storage facility.

In developing NUREG-2157, NRC referred to the previous environmental analyses that supported issuance of the FEIS for the PFS facility in Tooele, Utah. The NRC concluded that implementation of the Preferred Alternative to issue a license to the PFS authorizing construction and operation of an ISFSI in Tooele County, Utah would generally be small (NRC 2014b, Table ES-4).

This ER constitutes a site-specific analysis of the proposed CIS Facility at the southeastern New Mexico Site in Lea County. This ER incorporates relevant information and analyses from NUREG-2157 as appropriate, for purposes of completeness. For example, for most resources analyzed in Chapter 4 of this ER, there is a high-level comparison of the site-specific impact conclusions presented in this ER to the generic impact conclusions contained in NUREG-2157.

[1] The Eddy-Lea Energy Alliance is a limited liability company owned by the cities of Carlsbad and Hobbs, and Eddy County and Lea County.

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

DOE has not yet developed a permanent geologic repository to allow for the disposal of commercial SNF at Yucca Mountain in Nye County, Nevada, as required under the NWPA. DOE was required to open the repository and begin accepting SNF for disposal at Yucca Mountain on January 31, 1998. However, the earliest estimated time by which a permanent geologic repository could be licensed and operational is 2048 (DOE 2013, pg. 7). The only alternatives currently available to the commercial nuclear power utilities (whether currently operational or decommissioned and non-operational are to either continue to store SNF in onsite ISFSIs or at an “away-from-reactor” storage facility. However, there are currently no licensed away-from-reactor storage facilities for accepting SNF from commercial reactors.

At the time this ER was prepared, three nuclear power plants have been shut down and are in the process of being decommissioned and nine nuclear power plants across the U.S. have been decommissioned (hereafter referred to as the “decommissioned shutdown sites”) to levels that would allow for unrestricted release of the site in accordance with the NRC’s License Termination Rule (10 CFR 20, Subpart E). Even though in some cases the nuclear power plants, including the SNF pools, have been dismantled and decommissioned, the SNF remains and continues to be stored in onsite ISFSIs. Many policymakers and stakeholders in the communities that host shutdown reactors want to have the SNF removed to complete decommissioning of the site and to allow for more beneficial uses of the land.

While decommissioning activities have been completed at nine locations across the U.S. (except for removing the SNF from dry cask storage), other financial pressures are expected to cause utilities to shut down and begin decommissioning other commercial nuclear reactors. A CIS Facility is needed to ensure that the SNF at these commercial reactor sites can be safely removed so that the remaining lands can be returned to Greenfield status. This point is further underscored with the announcement by other electric utilities of their plans to shut down and decommission additional commercial reactors located throughout the U.S.

The nuclear power utilities continue to remain responsible for the surveillance, maintenance, emergency preparedness, and physical security of the SNF stored at their ISFSI (unless otherwise exempted by the NRC). These activities are estimated to cost each of the utilities at the decommissioned shutdown sites an estimated $4.5-8 million per year (BRC 2012, Section 5.2.1). Developing a CIS Facility in Lea County, New Mexico, in the most timely manner possible, serves a national strategic need by providing for an orderly transfer of SNF from the decommissioned shutdown sites to a safer and more secure centralized storage location (NRC 2003). In addition to serving the needs of the decommissioned shutdown sites, a CIS Facility also serves the needs of the existing operating commercial nuclear reactors in the U.S., until a permanent repository becomes available. A CIS Facility alleviates the need to construct new or expanded ISFSIs at these operating sites.

There are only two reasonable alternatives that would meet the purpose and need described in this section; (1) the No Action Alternative, described in Section 2.1 and (2) the Proposed Action, described in Section 2.2. Chapter 4 discusses the impacts associated with the two reasonable alternatives. Section 2.4 discusses alternatives that were considered but eliminated from detailed study, and explains why those alternatives were not reasonable.

1.3 THE PROPOSED ACTION

Pursuant to the requirements specified in Title 10 of CFR Part 72, Holtec is requesting a license from the NRC for authorization to construct and operate a CIS Facility in Lea County, New Mexico, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico (Figure 1.3.1). Accounting for the Protected Area (i.e., the area within the security fence containing the ISFSI Pads and the Cask Transfer Building), Phase 1 construction would disturb approximately 119.4 acres. Of this disturbance, 6.2 acres would be associated with constructing the Site access road and relocating the existing road that currently runs through the Site; 39.4 acres would be associated with constructing a railroad spur; and 1.4 acres would be associated with constructing the Security Building, Administrative Building, Parking Lot, and the concrete batch plant/laydown area. Holtec is requesting a license to store up to 8,680 MTUs in Phase 1, but has analyzed the environmental impacts of storing up to 100,000 MTUs at the CIS Facility.

Construction of Phases 2-20 would occur over approximately 20 years and would require an additional 210.6 acres of land. Such construction would occur adjacent to operational areas previously constructed. At full build-out, the CIS Facility would be constructed on approximately 330 acres. The Protected Area, which encloses the ISFSI Pads, would account for 283 acres of this total. Within the Protected Area, approximately 110 acres would be disturbed by the ISFSI Pads. There would be a buffer of more than 270 acres between the Protected Area boundary and the ISFSI Pads. All SNF stored within the Protected Area would be more than 500 feet from the Protected Area boundary and more than 1,000 feet from the property boundary. Phase 1 provides a bounding estimate for any construction impacts due to the associated support structures for these subsequent phases. The construction phases will be performed in sequence. Table 1.3 shows approximate durations for construction of phases 1-20 with the cumulative MTUs completed for each phase.

The major benefit of the Proposed Action is to authorize the receipt of the SNF currently in storage at the decommissioned shutdown sites, thus enabling the land at these sites to be returned to Greenfield status. After the land has been returned to Greenfield status, the communities that hosted the commercial reactor plants gain additional benefits as the land could potentially be redeveloped for other purposes. The Proposed Action also provides a regulatory path forward to receive SNF from other commercial reactors that may be decommissioned in the future, as well from operating commercial reactors prior to decommissioning. A CIS Facility serves as an interim storage facility until a geologic repository can be opened.

The proposed CIS Facility utilizes the technology licensed in Holtec's generic Certificate of Compliance for the Holtec International Storage Module Underground MAXimum Capacity (HI-STORM UMAX) Storage System, NRC docket number 72-1040. HI-STORM UMAX stores the canister containing SNF entirely below-ground to serve as a "security-friendly" storage facility, providing a clear, unobstructed view of the entire CIS Facility from any location and the closure lid is a massive steel weldment filled with concrete, virtually eliminating the storage contents as a target for malevolent acts. The CIS Facility does not require any utilities (water, compressed air, or electric power) for its operation post emplacement, eliminating any elements of vulnerability to terrorism. The subterranean stored contents emit a very small direct radiation dose to the facility workers and surrounding environment. See Section 2.2 of this ER for a detailed description of the CIS Facility. The only pathway for public exposure to radiation from routine operations at the CIS Facility is external exposure at the uncontrolled boundary from the SNF casks stored at the ISFSI.

There is no air pathway because the casks are sealed by being welded shut. There is no potential for a liquid pathway because the SNF contains no liquid component and the casks are sealed to prevent any liquids from contacting the SNF assemblies. Chapter 7 provides details regarding monitoring requirements for the CIS Facility.

The HI-STORM UMAX Storage System technology to be employed at the CIS Facility is currently licensed by the NRC in accordance with 10 CFR Part 72 and therefore complies with the NRC requirements for the independent storage of SNF. Holtec anticipates the SNF could be stored at the CIS Facility for up to 120 years, or until a permanent geologic repository is opened consistent with the NRC's Continued Storage Rule. The CIS Facility would be decommissioned at the end of facility life in accordance with 10 CFR 20, Subpart E.

Below is the anticipated schedule for the construction and operation of the proposed CIS Facility:

- Submit License Application in March 2017;
- Receive license 2019;
- Construction of Phase 1 of the CIS Facility begins in first quarter of 2020;
- Holtec CIS Facility commences operations in 2022.

Table 1.3

APPROXIMATE SCHEDULE OF ALL PROPOSED CONSTRUCTION PHASES FOR THE CIS FACILITY

Phase	Phase Construction Duration (Years)	CIS Facility Total Capacity Once Phase of Construction Completed (number of canisters)
1	2	500
2	1	1,000
3	1	1,500
4	1	2,000
5	1	2,500
6	1	3,000
7	1	3,500
8	1	4,000
9	1	4,500
10	1	5,000
11	1	5,500
12	1	6,000
13	1	6,500
14	1	7,000
15	1	7,500
16	1	8,000
17	1	8,500
18	1	9,000
19	1	9,500
20	1	10,000

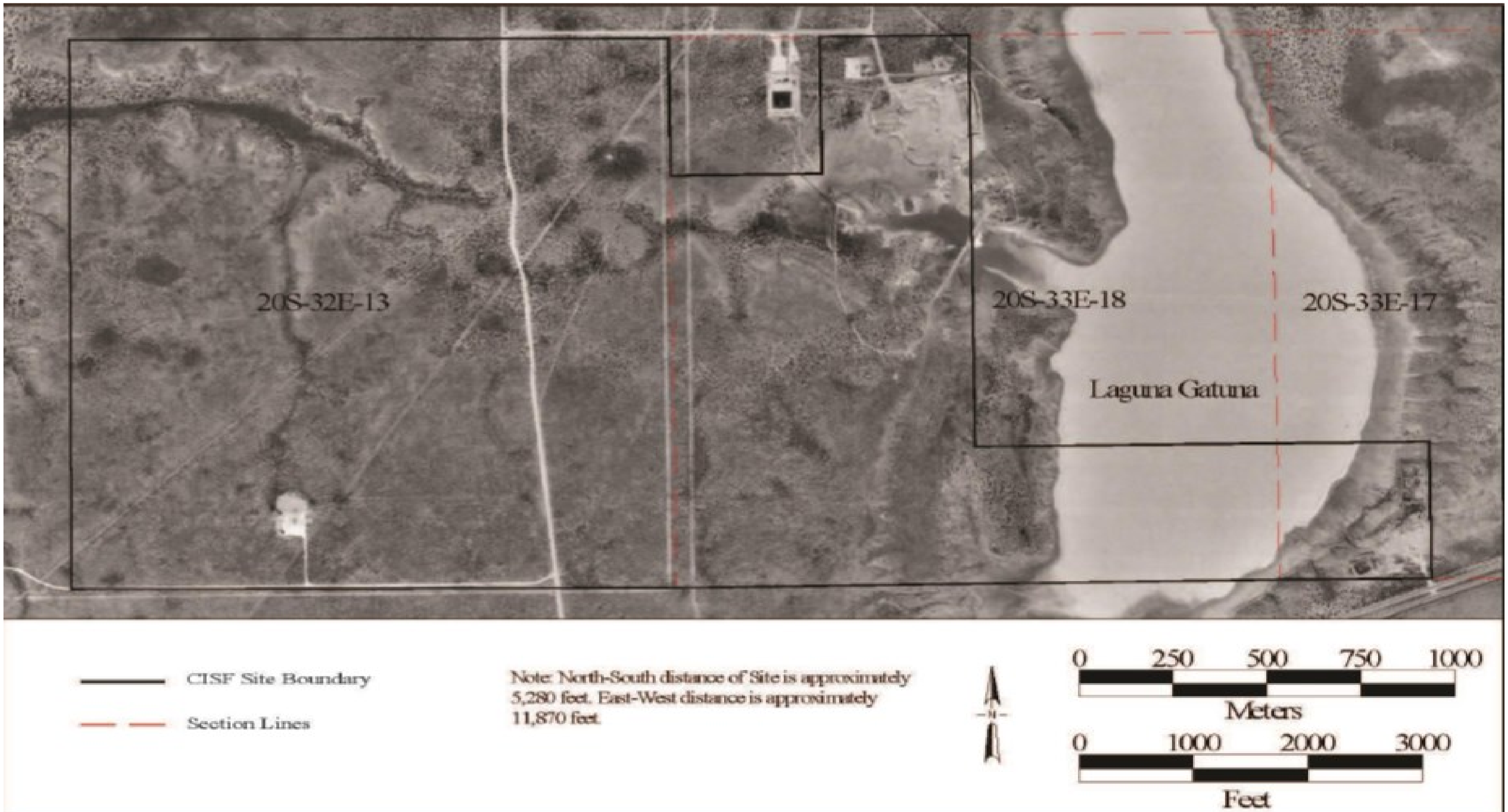


Figure 1.3.1: CIS FACILITY SITE BOUNDARIES

1.4 APPLICABLE REGULATORY REQUIREMENTS, PERMITS, AND REQUIRED CONSULTATIONS

This section provides a summary of the Federal, state, and local laws and regulations applicable the proposed CIS Facility. For each applicable law or regulation, the Site is evaluated to determine whether the available Site environmental characteristics support the regulatory requirements with respect to successfully licensing and permitting the facilities. This section also identifies any legislative or regulatory prohibitions that might prevent siting and permitting the CIS Facility at the Site. The role of the Federal, state, and local agencies involved with the licensing and permitting of the CIS Facility is also discussed. A list of pertinent Federal, state, and local authorizations and consultations applicable to the CIS Facility at the Site is provided in Table 1.4.1.

1.4.1 United States Government

The following is a summary of Federal agencies involved in the environmental approvals and consultation process for resources in their jurisdiction for the CIS Facility project construction and operations activities proposed by Holtec.

1.4.1.1 U.S. Nuclear Regulatory Commission

The Atomic Energy Act of 1954, as amended, gives the NRC regulatory jurisdiction over the design, construction, operation, and decommissioning of the facility specifically with regard to assurance of public health and safety. The NRC would perform periodic surveillance of construction, operation and maintenance of the proposed facility. The NRC establishes standards for protection against radiation hazards arising out of licensed activities. The NRC licenses are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Organization Act of 1974. The regulations apply to all persons who receive, possess, use or transfer licensed materials.

The NRC is responsible for the review and licensing of SNF storage facilities in accordance with 10 CFR Part 72. Submittal of a comprehensive license application, including, among other things, a Safety Analysis Report (SAR) and an ER that address safety and environmental issues, is required pursuant to 10 CFR Part 72. This ER and other required plans/documents are being submitted concurrently to the NRC for its review and approval. As part of the licensing process for the proposed facilities, the NRC will prepare an EIS in accordance with NEPA requirements and NRC regulations (10 CFR Part 51) for implementing NEPA. Other applicable NRC regulations include: Appendix B of 10 CFR Part 50 for Quality Assurance and 10 CFR Part 73 for physical protection.

Seven categories of NRC licensees are required to report annually on individual exposure in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR 20.2206, "Reports of Individual Monitoring"). These categories include independent spent fuel storage installations. The data submitted by licensees consist of radiation exposure records for each monitored individual. These data are analyzed and reported annually by the NRC in terms of collective dose and the distribution of dose among the monitored individuals (NRC 2016, Appendix A, Table A1). The limits for exposures are discussed in Section 3.12.2.1.

1.4.1.2 U.S. Environmental Protection Agency (EPA)

The EPA has primary authority relating to compliance with the Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), and Resource Conservation and Recovery Act (RCRA). EPA Region 6 has delegated regulatory jurisdiction to the New Mexico Environmental Department (NMED) for nearly all aspects of permitting, monitoring, and reporting activities relating to these statutes and associated programs. Consequently, compliance activities associated with these statutes are presented in Section 1.4.2.

The EPA has promulgated standards for a number of hazardous air pollutants, including radionuclides. Emission Standards for NRC Licensed Facilities (40 CFR 61 Subpart I) establishes limits on emission of radionuclides to air such that the public would not receive an effective dose equivalent exceeding 10 millirem/year. Because the CIS Facility will not emit radionuclides to the air during operations, this standard will not be exceeded.

1.4.1.3 U.S. Department of Transportation (DOT)

The transportation of SNF from a commercial nuclear power plant to the CIS Facility requires a transportation package that is approved and certified by the NRC in accordance with 10 CFR Part 71. The Certificate of Compliance (CoC) ensures the transport packages are designed to maintain confinement of the SNF during shipping and ensure there will not be any radiological release caused by hypothetical severe accident scenarios.

The transporters of SNF must submit applications to the NRC for review and approval of a transportation package in accordance with 10 CFR Parts 72 and 71, respectively. Upon approval of such applications, the NRC issues a CoC for the specific designs.

Transportation of SNF is regulated under 49 CFR Part 173, Shippers – *General Requirements for Shipments and Packagings*. Other requirements pertaining to the transportation of material to the proposed CIS Facility are:

- 49 CFR Part 171, General Information, Regulations, and Definitions;
- 49 CFR Part 172, *Hazardous Materials Tables, Special Provisions, Hazardous Material Communication, Emergency Response Information, and Training Requirements;*
- 49 CFR Part 177, *Carriage by Public Highway;*
- 49 CFR Part 107 Subpart G (registration/fee to DOT as a person who offers or transports hazardous materials).

All provisions of these enabling regulations are met prior to the transport of any SNF, LLRW, mixed waste, or hazardous material.

1.4.1.4 Occupational Safety and Health Administration (OSHA)

The Occupational Safety and Health Act of 1970 is designed to increase the safety of workers in the workplace. It provides that the Department of Labor is expected to recognize the dangers that may exist in workplaces and establish employee safety and health standards. Applicable regulations are found in 29 CFR 1910 for general industry and 29 CFR 1926 for construction activities. OSHA regulates mitigation requirements and mandates proper training and equipment for workers. A Memorandum of Understanding between OSHA and NRC allows NRC to identify

any violations to the licensee (in this case, Holtec) for correction, if correction does not occur, then NRC will notify the regional Federal OSHA office.

1.4.1.5 U.S. Department of Interior, U.S. Fish and Wildlife Service (USFWS)

The USFWS is responsible for the protection of threatened and endangered species. There are three Federally-listed species known to occur within Lea County, New Mexico. These include the Interior Least Tern (*Sternula antillarum athalassos*), the Northern Aplomado Falcon (*Falco femoralis septentrionalis*), and the Yellow-Billed Cuckoo (*Coccyzus americanus*). Additionally, the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) is also currently under review for listing consideration. A biological resource survey of the Site was completed in October 2016 and no significant biological resources were identified within the area surveyed (see Appendix B). As discussed in Section 3.4 of this ER, these species have not been located within the Site and regulatory reviews and field inspections do not support the belief that they are present within the CIS Facility Site. There is no designated or proposed critical habitat within Lea County.

In 2008, the Bureau of Land Management (BLM) established a Lesser Prairie-Chicken Habitat Preservation Area of Critical Environmental Concern (ACEC) to protect and enhance 58,000 acres of habitat for the species. The nearest ACEC straddles Lea and Eddy Counties and is about 58 miles from the Site (BLM 2008, Appendix 3).

1.4.1.6 U.S. Department of Interior, Bureau of Land Management (BLM)

Almost all of the land immediately surrounding the Site is owned and managed by the BLM. As described in Section 2.2.1 and shown on Figure 2.2.1, Holtec is proposing to construct an access road and railroad spur to the Site. The road and railroad spur would necessarily cross BLM land and would require BLM to issue rights-of-way (ROW) authorization to construct and operate the road and railroad spur, in accordance with Federal Land Policy and Management Act of 1976 (FLPMA) and the Mineral Leasing Act of 1920.

1.4.2 State of New Mexico

At the state level, the environmental permitting of the CIS Facility, which would be located on land owned by Holtec, is primarily governed by the NMED. NMED is charged with responsibility to manage and protect human health and the environment in the State of New Mexico. The NMED consists of several divisions that have responsibility for various permits and environmental programs. The following is a summary of environmental permitting activities to be undertaken with NMED.

1.4.2.1 Surface Water Protection

In order to protect jurisdictional waters from pollutants that could be conveyed in construction-related stormwater runoff, a NPDES Construction Stormwater Permit is required because construction of the CIS Facility involves the grubbing, clearing, grading or excavation of more than 1 acre of land. Various land clearing activities such as a borrow pit for fill material may also be covered under this general permit.

As part of this permitting process, a Stormwater Pollution Prevention Plan (SWPPP) is developed and a Notice of Intent (NOI) filed with the NMED Water Quality Bureau prior to the commencement of construction activities. Implementation of the SWPPP requirements occurs prior to any discharge and continue until permit termination. Within the SWPPP, there are

provisions outlining erosion and sediment controls, soil stabilization practices, structural controls, and other best management practices (BMPs) employed during construction to protect offsite waters from adverse impacts from construction-related activities and mitigate any storm water runoff. The SWPPP also outlines maintenance and inspection requirements and identify BMPs for the effective management of storm water runoff.

Once construction has been completed, a NPDES General Permit for Industrial Stormwater is required for point source discharge of stormwater runoff from industrial or commercial facilities to the waters of the state. Commonly, a general permit is available to almost any industry, but there is also an option to obtain an individual NPDES permit for the CIS Facility. The CIS Facility does not discharge process wastewater, and there are no potable surface water resources within the vicinity of the Site.

A Spill Prevention, Control, and Countermeasures Plan (SPCC) may need to be developed because all diesel fuel storage tanks at the CIS Facility are placed above the ground.

The NMED Water Quality Bureau requires that facilities that discharge an aggregate waste water of more than 2,000 gallons per day septic systems apply for and submit a groundwater discharge permit and plan.

1.4.2.2 Drinking Water and Groundwater Protection

No potable groundwater is known to exist in the immediate vicinity of the Site. The CIS Facility does not use Site groundwater or surface water supplies; rather, Holtec proposes to obtain potable water for the CIS Facility from the City of Hobbs Water Department.

Sanitary wastewater generation during CIS Facility construction is not expected as the use of portable toilets is likely, although use of sewage collection tanks, as planned for the operations phase, is another option. During CIS Facility operation, Holtec expects to dispose of sanitary wastewater using sewage collection tanks and underground digestion tanks similar to septic tanks but with no leach field. After testing the waste in the collection tanks to ensure release criteria are met, the sewage is disposed of at an off-site treatment facility.

1.4.2.3 Preservation of Air Quality

As discussed in Section 4.6 of this ER, construction and operation of the CIS Facility does not have any measurable impact on the local air quality, and no significant criteria or hazardous air pollution emissions occur. Any potential air quality-related impacts associated with construction of the CIS Facility result from gaseous pollutant emissions from diesel-powered construction equipment and from fugitive dust emissions from excavation activities and construction equipment. An onsite concrete batch plant during construction and operation requires a permit.

To minimize fugitive dust emissions, a BMP Emissions Control Plan provides assurance that fugitive dust emissions are effectively managed and minimized throughout all construction phases. This BMP Emission Control Plan includes dust control techniques, such as watering and/or chemical stabilization of potential dust sources.

During operations, gaseous criteria pollutant emissions at the CIS Facility are limited to small propane space heating furnaces, a standby emergency diesel generator, a fire pump diesel engine, heavy haul trucks, cask transporters, and workers' private vehicles. Refrigerants used for air

conditioning at the CIS Facility consist of Class II refrigerants (i.e., non-ozone depleting substances).

The NMED Air Quality Bureau Permitting Section processes permit applications for industries that emit pollutants to the air. New Mexico Statutes Annotated Chapter 74, “Environmental Improvement,” Article 2, “Air Pollution,” and implementing regulations in NMAC Title 20, Environmental Protection, Chapter 2, “Air Quality,” establishes air-quality standards and permit requirements prior to construction or modification of an air-contaminant source. These regulations also define requirements for an operating permit for major producers of air pollutants and imposes emission standards for hazardous air pollutants. Holtec intends to obtain any required air permits to support construction and operations at the CIS Facility from the NMED. Because there are no airborne effluents of radionuclides from normal operations at the CIS Facility, airborne effluent monitoring is not expected to be required.

1.4.2.4 Pollution Prevention and Waste Management

The CIS Facility project is committed to pollution prevention practices. Non-hazardous wastes from construction are disposed of appropriately at off-site facilities. As discussed in Section 4.11 of this ER, during operations, small quantities of LLRW, mixed waste, and hazardous wastes are generated.

The NMED Hazardous Waste Bureau mission is to provide regulatory oversight and technical guidance to New Mexico hazardous waste generators and treatment, storage, and disposal facilities as required by the New Mexico Hazardous Waste Act (HWA; Chapter 74, Article 4) and regulations promulgated under the Act. In general, the regulations promulgated pursuant to the Hazardous Waste Act incorporate the federal requirements under RCRA, 40 CFR 260-283, by reference. The Bureau issues hazardous waste permits for all phases, quantities and degrees of hazardous waste management including treating, storing and disposing of listed or hazardous materials.

The small quantities of hazardous wastes generated are expected to be less than 220 pounds/month. Thus, the CIS Facility qualifies as a Conditionally Exempt Small Quantity Generator (CESQG). All hazardous wastes generated are identified, stored, and disposed of in accordance with state and Federal requirements applicable to CESQGs. Because the CIS Facility design does not include Underground Storage Tanks (USTs), UST registration with NMED is not required. Any LLRW and mixed waste is disposed of at licensed disposal facilities.

1.4.2.5 Historic and Archeological Resources

The National Historic Preservation Act (NHPA) was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation (ACHP). Section 106 of the NHPA requires Federal agencies (in the case of licensing the CIS Facility, the NRC) to take into account the effects of their undertakings on historic properties.

Cultural properties, including prehistoric and historic archaeological sites, historic buildings and other structures, and traditional cultural properties located on state land in New Mexico are protected by the Cultural Properties Act. It is unlawful for any person to excavate, injure, destroy, or remove any cultural property or artifact on state land without a permit. It is also unlawful for any person to intentionally excavate any unmarked human burial, and any material object or

artifact interred with the remains, located on any non-Federal or non-Indian land in New Mexico without a permit.

Coordination with the New Mexico Historic Preservation Division (HPD) and New Mexico State Historic Preservation Officer (SHPO) is being conducted for the CIS Facility. Historical and cultural resources near and within the Site are described in Section 3.7 of this ER. A cultural resource survey of the Site was completed in December 2016 and no significant cultural resources were identified within the area surveyed (see Appendix C). No issues were identified to preclude licensing and permitting the proposed CIS Facility.

1.4.2.6 Site Access

Holtec and Lea County intend to obtain a permit from the New Mexico Department of Transportation (NMDOT) for constructing an access road and railroad spur to the Site. The permit, once issued, would stipulate any safety enhancements necessary.

Table 1.4.1:

FEDERAL, STATE, AND LOCAL AUTHORIZATIONS, PERMITS, AND CONSULTATIONS

Activity Covered	Agency	Status/Comments
Federal		
License Application	NRC	The CIS Facility would be licensed by the NRC. The license application was submitted to NRC in March 2017.
Land Use Permit	BLM	Land use permit required for access road and railroad spur across BLM land. Permit would be applied for during the NEPA process.
Endangered Species Act	USFWS	Surveys completed and informal consultation conducted (see Appendix B). NRC would conduct formal consultation as part of NRC NEPA process.
State		
National Historic Preservation Act	New Mexico State Historic Preservation Office	Surveys completed and informal consultation conducted (see Appendix C). NRC would conduct formal consultation as part of NRC NEPA process.
Access Permit	NMDOT	Holtec and Lea County would coordinate to obtain approval for a new Site access road. The permit, once issued, would stipulate any safety enhancements necessary to the highway. Permit would be applied for prior to construction.
Air Quality Permits	NMED	An onsite concrete batch plant during construction and operation would require a permit. If diesel generators are used during construction and operation, a permit may be required. Permit would be applied for prior to construction. Air Operation Permit requirements will be determined once design information on the facility is developed and emission rates quantified.
Groundwater Discharge Permit/Plan	NMED	A permit is required for facilities that discharge an aggregate waste water of more than 2,000 gallons per day to septic systems. A permit may also be required for discharges to surface impoundments such as evaporative basins. Permit would be applied for prior to construction.
National Pollutant Discharge Elimination System (NPDES) Industrial Stormwater	NMED (note 1)	The CIS Facility would be covered under a Multi-Sector General Permit or obtain individual NPDES permit. Permit would be applied for prior to construction.
NPDES Construction Stormwater Permit	NMED (note 1)	The CIS Facility would be covered under the General Construction Permit for all construction activities onsite. Holtec would develop a SWPPP and file a Notice of Intent at least two days prior to construction commencement.
Hazardous Waste Generation and Storage	NMED	Holtec would be a CESQG under NMED regulations. Holtec will obtain any necessary permits from NMED for the storage of accumulated wastes until they are shipped off-site for disposal. Permit would be applied for prior to construction.
Environmental Protection Agency (EPA) Notification of Hazardous Waste Activity to obtain an EPA Identification Number	NMED	This identification number is required for the off-site shipment of hazardous waste. Holtec would apply for an identification number prior to the generation of waste during facility construction and operation.
Petroleum Storage Tank Registration	NMED	Holtec would register petroleum storage tanks, as required.
Local — there are no additional permitting requirements related to the CIS Facility beyond Federal and State requirements (Lea County 2016).		

Note 1: NMED has assumed NPDES permitting authority from EPA Region 6.

CHAPTER 2: ALTERNATIVES

2.0 INTRODUCTION

This chapter describes the two alternatives analyzed in detail in this Environmental Report (ER): (1) the No Action Alternative and (2) the Proposed Action. The No Action Alternative, which is described in Section 2.1, would occur if the proposed Consolidated Interim Storage Facility (CIS Facility) is not constructed and operated. Section 2.2 describes the Proposed Action and provides information related to construction and operation of the CIS Facility. Section 2.3 describes the site selection process that was employed for the Holtec CIS Facility, and Section 2.4 identifies other alternatives to the Proposed Action and explains why those other alternatives were eliminated from detailed analysis. Lastly, Section 2.5 presents a summary comparison of the No Action Alternative and the Proposed Action, based on the analysis contained in Chapter 4 of this ER.

2.1 NO ACTION ALTERNATIVE

Under the No Action Alternative, Holtec would not construct and operate the CIS Facility and spent nuclear fuel (SNF) would continue to be stored at commercial reactor sites in accordance with current management objectives. Because there are no currently licensed away-from-reactor facilities for accepting SNF from commercial reactors, the No Action Alternative assumes that onsite storage would continue until another away-from-reactor facility is available or a permanent geologic repository is ultimately licensed, constructed, and operating. It is estimated that the earliest time by which a geological repository could become available for permanent disposal of SNF would be 2048 (DOE 2013, pg. 7).

In the short-term under the No Action Alternative, the decommissioned shutdown sites and the existing commercial nuclear reactor sites would continue to store SNF in existing pools or at-reactor Independent Spent Fuel Storage Installation (ISFSIs). At all sites, SNF would continue to be stored onsite in accordance with regulatory and license requirements and maintain a physical security program to ensure the SNF remains adequately protected. In the long-term, all operating sites would require existing ISFSIs to be expanded or new ISFSIs to be constructed. The potential impacts of expanding ISFSIs or constructing new ISFSIs are presented in Section 4.14 of this ER. Additionally, under the No Action Alternative, the decommissioned shutdown sites would not be returned to a Greenfield condition and the land could not be further developed in a manner that would be most beneficial to the local communities. These local communities would be required to host the storage of SNF even if such action was not the preference of community members. A listing of the currently decommissioned shutdown sites is provided in Table 2.1.1.

The No Action Alternative would not be supportive of the Nuclear Regulatory Commission's (NRC) rulemaking on the Continued Storage of SNF and the recommendations from the Blue Ribbon Commission on America's Nuclear Future to promote efforts to develop one or more consolidated storage facilities in the United States (U.S.). The No Action alternative would not meet the purpose of and need for the Proposed Action (BRC 2012, Chapter 5).

Table 2.1.1:

DECOMMISSIONED SHUTDOWN SITES

Site	County	State
Big Rock Point	Charlevoix County	Michigan
Connecticut Yankee	Middlesex County	Connecticut
Crystal River	Citrus County	Florida
Kewaunee	Kewaunee County	Wisconsin
LaCrosse	Vernon County	Wisconsin
Maine Yankee	Lincoln County	Maine
Humboldt Bay	Humboldt County	California
Rancho Seco	Sacramento County	California
San Onofre	San Diego	California
Trojan	Columbia County	Oregon
Yankee Rowe	Franklin County	Massachusetts
Zion	Lake County	Illinois

2.2 PROPOSED ACTION

As described in Section 1.2, the Proposed Action is the issuance of an NRC license under 10 CFR 72 authorizing the construction and operation of a CIS Facility on approximately 1,040 acres of land controlled by Holtec in Lea County, New Mexico. The CIS Facility would receive, possess, and store SNF containing up to 100,000 metric tons of uranium (MTUs) of SNF.

2.2.1 Description of the Proposed Site

The center of the proposed CIS Facility site (hereafter, "Site") is at latitude 32.583 north and longitude 103.708 west, in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico. Larger population centers are Roswell, New Mexico, 74 miles to the northwest; Odessa, Texas, 92 miles to the southeast; and Midland, Texas, also to the southeast at 103 miles. The nearest international airport is located between Midland and Odessa, Texas 98 miles to the southeast. The Site, which would be purchased by Holtec from the Eddy-Lea Energy Alliance (ELEA), is bordered by Federal and state lands on all sides (ELEA 2007, Section 2.1).

The Site, which is situated 0.52 miles north of U.S. Highway 62/180, consists of mostly undeveloped land used for cattle grazing with the only boundary being a four-strand barb wire fence along the south side of the property until it nears Laguna Gatuna where it turns south to the highway. This fence is the boundary between two grazing allotments administered by the Bureau of Land Management (BLM). The majority of allotments are grazed year-round with some type of rotational grazing (ELEA 2007, Section 2.1).

As shown on Figure 3.1.3, the following facilities are situated on the Site:

- A communications tower in the southwest corner of the Site;
- A former producing gas and distillate well with associated tank battery is located near the communications tower;
- A small water drinker (livestock) is located along the aqueduct in the northern half of the Site;
- Oil recovery facility (abandoned) that still has tanks and associated hardware left in place in the northeast corner;
- An oil recovery facility with tanks and associated hardware still in place in the far southeast corner (ELEA 2007, Section 2.1).

No water wells are located on the Site. However, the Site has been associated with oil and gas exploration and development with at least 18 plugged and abandoned oil and gas wells located on the property. However, none of these plugged and abandoned oil and gas wells are located within the area where the ISFSI would be located or where any land would be disturbed and they are not expected to affect the construction and operation of the CIS Facility. The plugged wells are estimated to be 30-70 years old. It is possible that hydrocarbon contamination exists at the Site as a result of these past practices (ELEA 2007, Appendix 2G). There are no active wells on the Site and there are no plans to use any of the plugged and abandoned wells on the Site.

Land uses in the area are limited to oil and gas exploration and production, oil and gas related services industries, livestock grazing, and limited recreational activity. The only nearby residents

are ranchers that occupy several ranches as close as 1.5 miles away. A larger transient population exists in the form of potash mine workers, oil field workers, employees of an oil field waste treatment facility and an industrial landfill. One restaurant is nearby (3.5 miles) that serves travelers on U.S. Highway 62/180. The nearest population center is the village of Loving, New Mexico, 30 miles to the southwest (ELEA 2007, Section 2.1).

Lands within 5 miles of the Site are privately owned, state lands, or BLM lands. Land use within 5 miles of the Site falls into two categories; livestock grazing and mineral extraction. The nearest residence to the Site is located at the Salt Lake Ranch, 1.5 miles north of the Site. There are additional residences at the Bingham Ranch, 2 miles to the south, and near the Controlled Recovery Inc. complex, 3 miles to the southwest. There is an average population of less than 20 residents among five ranches within a five mile radius. This is a population density of less than five residents per square mile (ELEA 2007, Section 2.1).

Within 50 miles of the Site, except for the communities located in the area, the land use and ownership is essentially the same as within the 5 mile radius. Along with the mining, grazing, and oil/gas activity, agriculture is a major activity (ELEA 2007, Section 2.1).

An industrial railroad lies 3.8 miles to the west and a spur would have to be constructed to serve the Site. The railroad currently serves local potash mines by transporting ore to refineries and finished product to markets, refineries, and the agricultural sector. Construction would be across BLM lands. Construction of a railroad spur would not be inconsistent with agency land use, although additional National Environmental Policy Act (NEPA) analysis would likely be required for a right-of-way (ROW) on Federal lands. The construction route would be relatively level and would not have to cross major highways. Similarly, a new roadway of approximately one mile in length is proposed to be constructed to the Site from U.S. Highway 62/180. Construction would be across BLM lands and would not be inconsistent with agency land use, although additional NEPA analysis would likely be required for a ROW on Federal lands (ELEA 2007, Section 2.1).

Electric power is available from both the north and south. Power lines and a substation would be needed to serve the Site. The lines would be expected to be brought in from the south a distance of one mile to the center of the Site. There are several existing ROWs on the Site. These existing ROW include pipelines, roads, well pads, power lines, a telephone line, and a communications tower (ELEA 2007, Section 2.1).

The major roads in the area consist of county and state roads interconnecting the various population centers. U.S. Route 285 runs south to north along the Pecos River. U.S. Highway 62/180 runs southwest to the northeast through Carlsbad and Hobbs, New Mexico. U.S. Route 82 travels west to east from Artesia through Lovington, New Mexico. U.S. Route 380 traverses west to east from Roswell through Tatum, New Mexico (ELEA 2007, Section 2.1).

2.2.2 Description of the Facility

The CIS Facility would utilize the Holtec International Storage Module Underground MAXimum Capacity (HI-STORM UMAX) technology (certified in NRC docket number 72-1040), which is a dry, in-ground storage system that stores a hermetically-sealed canister[1] containing SNF in any

[1] Throughout this ER, the term "canister" means an all-welded vessel containing SNF that has been qualified to serve as a confinement boundary under the rules of 10CFR 72. The more general term "canister" is generally used herein in place of the terms "multi-purpose canister" ("MPC") and "dry storage canister" ("DSC"). A cask, which also provides shielding, can also be placed into a VVM.

number of Vertical Ventilated Modules (VVM). At full build-out, the CIS Facility would contain 10,000 VVMs that would be constructed in 20 phases over approximately 20 years, with a total disturbance of approximately 330 acres of land. Figure 2.2.1 presents an aerial view of the CIS Facility. The CIS Facility includes:

- HI-STORM UMAX SNF storage units licensed under 10 CFR 72;
- Cask Transfer Building where casks would be brought in and prepared for canister placement in permanent storage in the HI-STORM UMAX VVMs;
- Security Building;
- Administration Building;
- Railroad spur and Site access road; and
- Construction laydown area that would contain an equipment storage building and a concrete batch plant.

Figure 2.2.2 presents the CIS Facility layout and Figure 2.2.3 presents details of the building layout on the Site. More detailed descriptions of the facility components, as well as additional design features, can be found in Chapter 1 of the SAR (Holtec 2017).

2.2.2.1 HI-STORM UMAX SNF Storage System

Currently, the NRC has licensed and approved SNF storage systems owned by Holtec, AREVA, NAC International (NAC), and Energy*Solutions*. Each of these systems is engineered to safely store spent fuel for periods of up to 50 years or longer and this time can be extended almost indefinitely through rigorous inspections, aging management programs, maintenance, and re-licensing. SNF is stored horizontally in the AREVA system and vertically in the Holtec, NAC, and Energy*Solutions* systems

The HI-STORM UMAX (illustrated in Figure 2.2.4) has all the safety attributes that are attributed to in-ground storage, such as enhanced protection from incident projectiles and threats from extreme environmental phenomena such as hurricanes, tornado borne missiles, earthquakes, tsunamis, fires, and explosions. The HI-STORM UMAX has been engineered to:

- maximize shielding and physical protection for the canisters;
- minimize the extent of handling of the SNF;
- minimize dose to operators during loading and handling;
- require minimal ongoing surveillance and maintenance by plant staff;
- facilitate SNF transfer of the loaded canister to a compatible transport overpack for transportation (Holtec 2017, Section 1.2.1).

The HI-STORM UMAX is designed to be fully compatible with all HI-TRAC transfer casks and canisters previously certified for storage by the NRC. The proposed Holtec HI-STORM UMAX Storage System at the CIS Facility would be capable of storing the SNF from all existing SNF storage systems, and would be the only licensed technology with this universal capability (Holtec 2017, Section 1.2.1). Because the storage cavity of HI-STORM UMAX is sufficiently large to accommodate every canister type in use in the United States at this time, utilizing the Holtec HI-

STORM UMAX Storage System would allow removal of any SNF from existing reactor sites as well as the decommissioned shutdown sites per the Department of Energy's (DOE's) goal presented in *Strategy for the Management and Disposal of Used Nuclear Fuel and High Level Radioactive Waste* (DOE 2013, pg. 6).

The CIS Facility, when completely finished, would contain approximately 10,000 VVMs that would each store one canister of SNF. Each phase would consist of constructing 500 units with concrete approach aprons that surround two individual 250 units HI-STORM UMAX ISFSI Pads. The HI-STORM UMAX system would store the SNF underground, to a total depth of approximately 22.5 feet (see Figure 1.2.2(a) in the SAR [Holtec 2017]). The transfer cask is required for shielding and protection of the SNF during loading and closure of the canister.

2.2.2.2 Support Foundation Pad

The Support Foundation Pad (SFP) is the underground pad which supports the HI-STORM UMAX VVM (Figure 2.2.5). The SFP on which the VVM rests must be designed to minimize long-term settlement and must have sufficient strength to support the weight of all the loaded VVMs during long-term storage and earthquake conditions. Because of its underground staging in HI-STORM UMAX, tip-over of the VVM in storage is not possible. To exploit the biological shielding provided by the surrounding soil subgrade, the canister is entirely situated well below the top-of-grade level (Holtec 2017, Section 1.2.3). The open plenum above the canister also acts to boost the ventilation action of the coolant air. Because the VVM is rendered into an integral part of the subgrade, it cannot be located to another ISFSI site. It also cannot be lifted and, therefore, is not subject to the potential for a handling accident (Holtec 2016b, Section 1.2.3).

Steel, concrete, and the subgrade are the principal shielding materials in the HI-STORM UMAX.

The steel and concrete shielding materials in the closure lid provide additional gamma and neutron attenuation to reduce dose rates. Steel and lead are the principal shielding materials in the HI-TRAC transfer cask. The combination of these shielding materials ensures that the radiation and exposure objectives of 10 CFR 72.106 and "as low as reasonably achievable" (ALARA) are met (Holtec 2016b, Section 1.2.3.1).

2.2.2.3 Cask Transfer Building

The Cask Transfer Building is where casks would be brought in and prepared for permanent storage in the VVMs. The building, which would be approximately 400 feet long by 150 feet wide and would have a height of approximately 60 feet, would be south of the SFPs inside the Protected Area (see Figures 2.2.2 and 2.2.3). The Cask Transfer Building would likely contain two bays in a single building, but there is a possibility that the final design could contain multiple bays in multiple buildings for contingency or increased operational capacity. In either event, the footprint of the Cask Transfer Building would not be expected to change. The Cask Transfer Building would be the tallest structure at the CIS Facility (Holtec 2016a). The Cask Transfer Building would contain a service crane and gantry crane, which would run along independent rails. Only the gantry crane would be used to move casks.

Rail cars would enter the east side of the building and casks would be unloaded by the gantry crane. After unloading, rail cars would exit the Cask Transfer Building on the east side of the building. Along the rail line, inside the Cask Transfer Building, would be space for cask staging

and transporter loading. Once the transporter is loaded, it would exit the building and proceed to the appropriate storage module at the HI-STORM UMAX ISFSI Pad.

Preventative maintenance would be performed on a regular basis on the cranes, transfer equipment, shipping casks, and other equipment in this building. Additional storage would be provided for temporary staging of impact limiters and casks, as well as storage for maintenance tools and supplies. The Cask Transfer Building would also include waste management areas and chemical storage areas for cleaning supplies needed to support activities at the CIS Facility. A small storage building (55 feet by 75 feet) would be located northwest of the Cask Transfer Building inside the Protected Area.

2.2.2.4 Security Building and Administration Building

The Security Building would be located east of the Cask Transfer Building and would be part of the Protected Area (see Figures 2.2.2 and 2.2.3). The single-story building would be approximately 100 feet long by 100 feet wide. Included inside the building would be the surveillance and monitoring stations for the Central Alarm Station, access control, and the armory. Security personnel would monitor sensors and intrusion alarms, control employee access, process visitors into the CIS Facility, and control rail and vehicle access to the CIS Facility facilities. A parking lot would be located east of the Security Building outside the Protected Area.

The single-story Administration Building, approximately 100 feet long by 100 feet wide, would be outside the Protected Area, east of the parking lot (see Figures 2.2.2 and 2.2.3). It would contain offices for operations, maintenance, and material control personnel; administrative functions related to processing shipments; emergency equipment and operations; communication and tracking center/facility; training and visitor center; health physics area; records storage; conference room; break room; and restroom facilities.

2.2.2.5 Railroad Spur and Site Access Road

The CIS Facility would be serviced by a railroad spur and access road as discussed in Section 2.2.1 and as shown on Figure 2.2.1.

2.2.2.6 Concrete Batch Plant

Holtec intends to construct a concrete batch plant to facilitate storage module construction and future expansion of the Site. An onsite batch plant would provide operational efficiencies by producing concrete onsite, rather than transporting it to the Site. The batch plant would be located north of the parking lot outside of the Protected Area (see Figures 2.2.2 and 2.2.3).

2.2.2.7 Waste Management

The CIS Facility would be designed to minimize the volumes of radiological and non-radiological waste generated during operations. Disposal plans, waste minimization practices, and related environmental impacts are discussed in Section 4.13 of this ER.

2.2.2.8 Construction Process for CIS Facility

A summary of the construction process is described below. A more detailed explanation, including drawings, are provided in the SAR (Holtec 2017).

The location for the Phase 1 ISFSI would be prepared by excavating a pit that would house the SNF canisters in the VVMs. Once the excavation pit is completed, the subsurface would be compacted/proof-rolled to ensure a stable surface for concrete pours. After surface preparation, a mud mat (or leveling slab approximately 3 inches in thickness) would be poured to ensure there is an even surface to pour the HI-STORM UMAX SFP. Formwork would then be erected and reinforcing steel would be staged for the SFP concrete pour, followed by the actual concrete pour itself (Holtec 2016a).

Once the SFP is poured, the Cavity Enclosure Containers (CEC) would be staged and leveled using designed leveling bolts. Upon completion of the CEC leveling process, formwork would be erected to grout the CEC baseplates in place, followed by the actual grouting process itself. The Self-Hardening Engineering Subgrade (SES) Layer, composed of Engineered Backfill, Controlled Low Strength Material (CLSM) or Lean Concrete, would be installed to the appropriate elevation and the top surface would be prepped for the top slab or ISFSI Pad. After the concrete is poured for the ISFSI Pad, the HI-STORM UMAX system would be complete (Holtec 2016a).

Each HI-STORM UMAX ISFSI Pad would be surrounded on up to four sides by an Approach Apron, which would be a concrete pathway approximately 35 to 40 feet in width. The Approach Apron would allow the Vertical Cask Transporter (VCT) to rotate appropriately and navigate the HI-STORM UMAX CECs and download the SNF canisters in each CEC (Holtec 2016a).

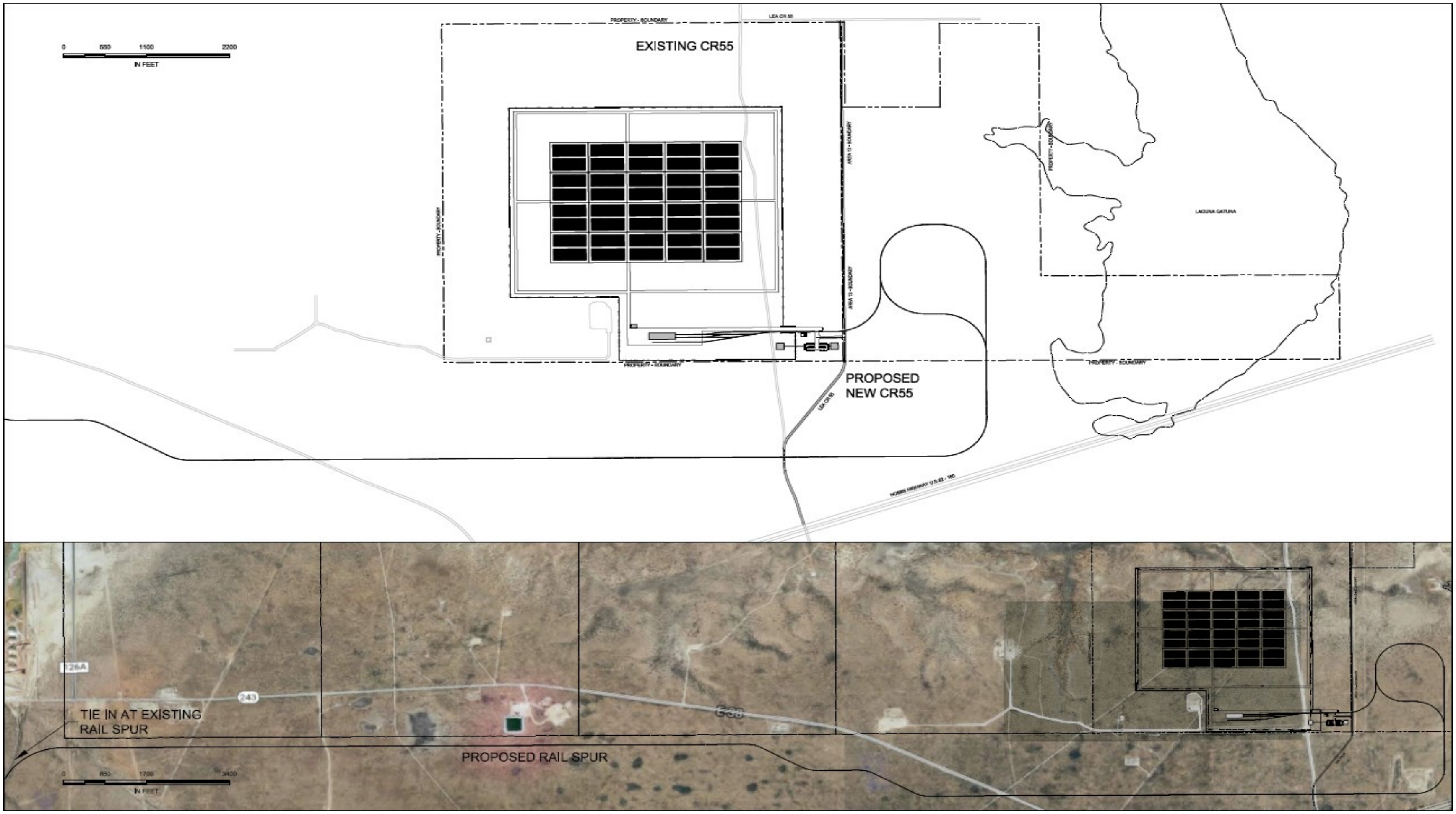
2.2.2.9 Operation of the CIS Facility

A high-level detail of the operational process is described below. A more detailed explanation, including drawings, is provided in the SAR (Holtec 2017).

Shipping casks containing canisters would arrive via rail car, or possibly heavy haul trailer, and operations would be similar for either transport system. Upon arrival, security personnel would perform an initial receipt inspection of the cask prior to transport into the Protected Area. The shipping cask would then be transported into the Cask Transfer Building and a receipt inspection of the cask by radiological personnel would be conducted. The inspection would include initial radiological surveys and an examination of the integrity of the shipping container. The cask would then be transferred to a receiving pad using the movable gantry crane. The shipping cask lid would be removed in the Cask Service Area.

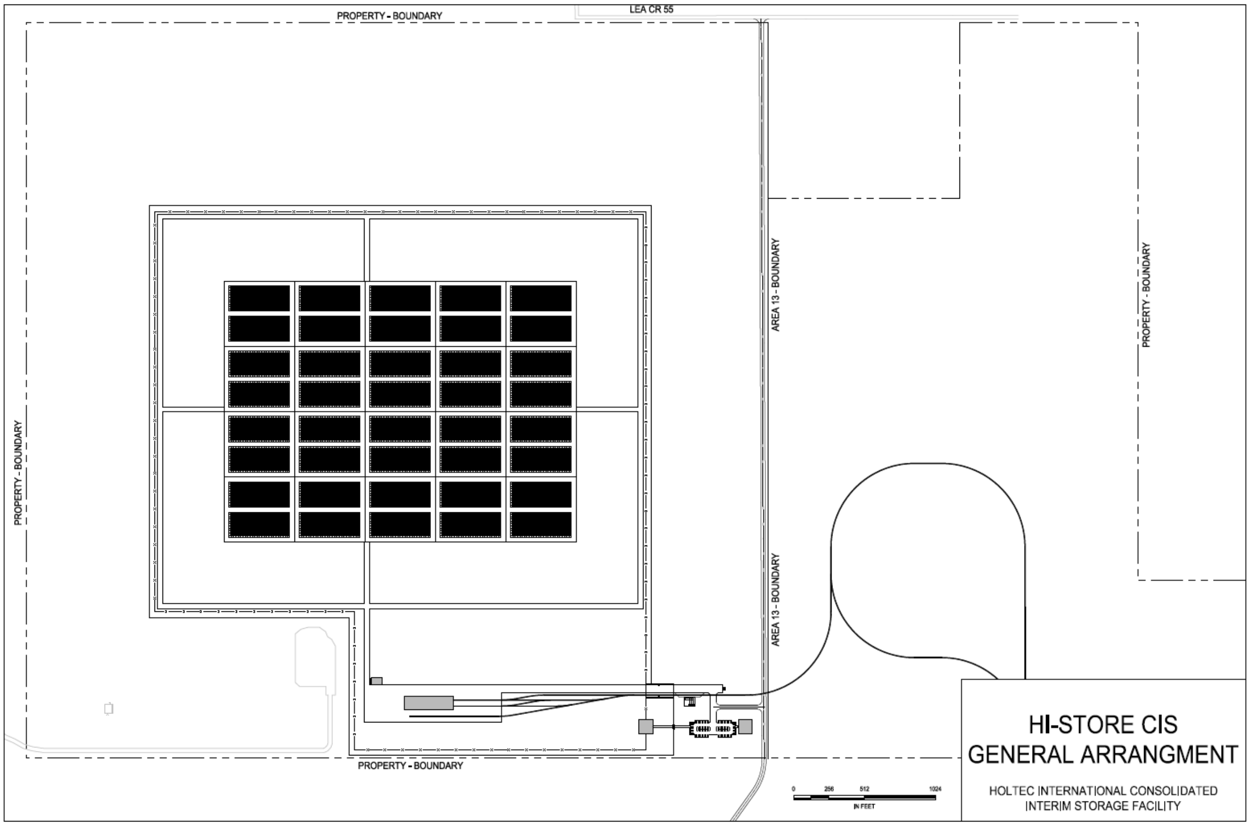
In what follows, the acronym VCT (for vertical cask transporter) is used to denote the hauling machinery (Holtec 2016a). (Note: a HI-PORT, which is a Holtec trade name for an engineered Low-Profile Transporter, could also be used to transport the cask to the ISFSI pad).

The cask would be transported to the ISFSI storage pad using the VCT. The cask would be aligned with the storage location, the lower lid of the shipping cask would be removed, and the cask would be lowered onto the storage pad using the raising/lowering capability of the VCT and the canister would be lowered into the VVM. The shipping cask would be disconnected and removed from the storage site and the lid and other necessary components on the storage pad would be installed using the VCT. Finally, the VCT, with the shipping cask, would be returned to the Cask Transfer Building (Holtec 2016a). Figure 1.2.3 in the SAR (Holtec 2017) illustrates the process of loading a canister into the VVM.



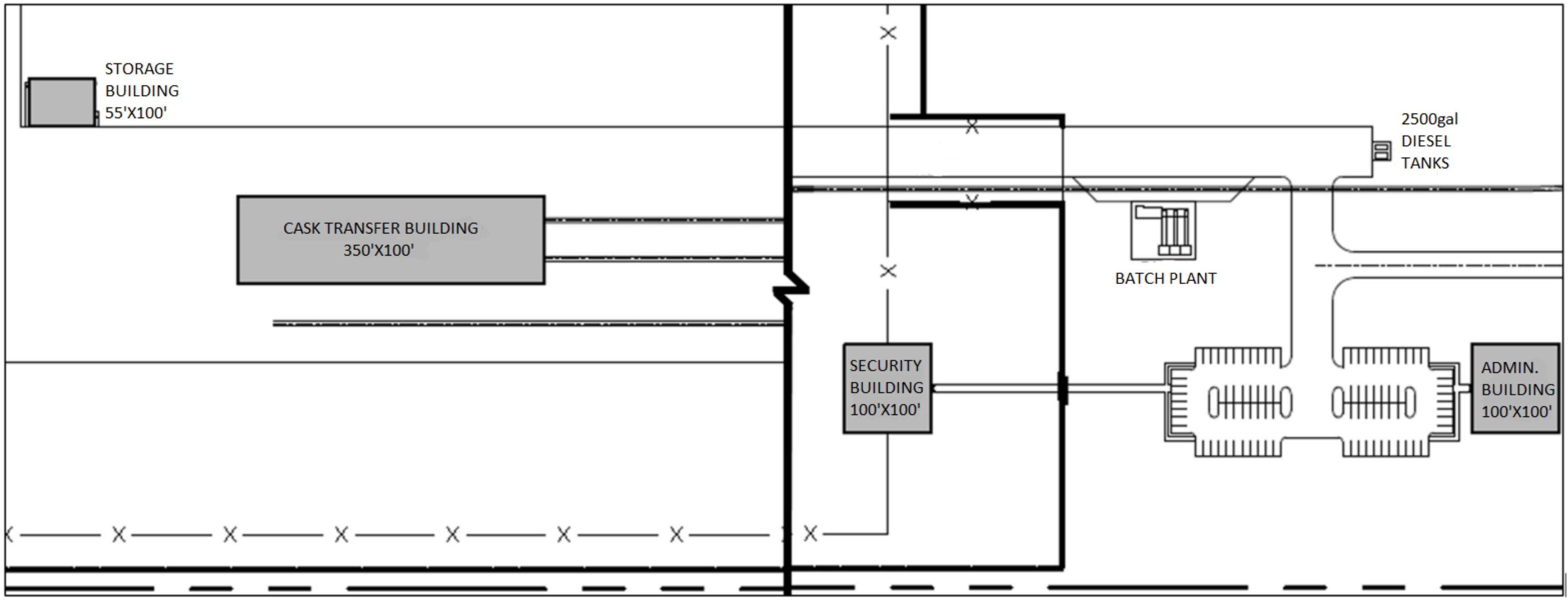
Source: Holtec 2017

Figure 2.2.1: AERIAL VIEW OF CIS FACILITY (FULL BUILD-OUT)



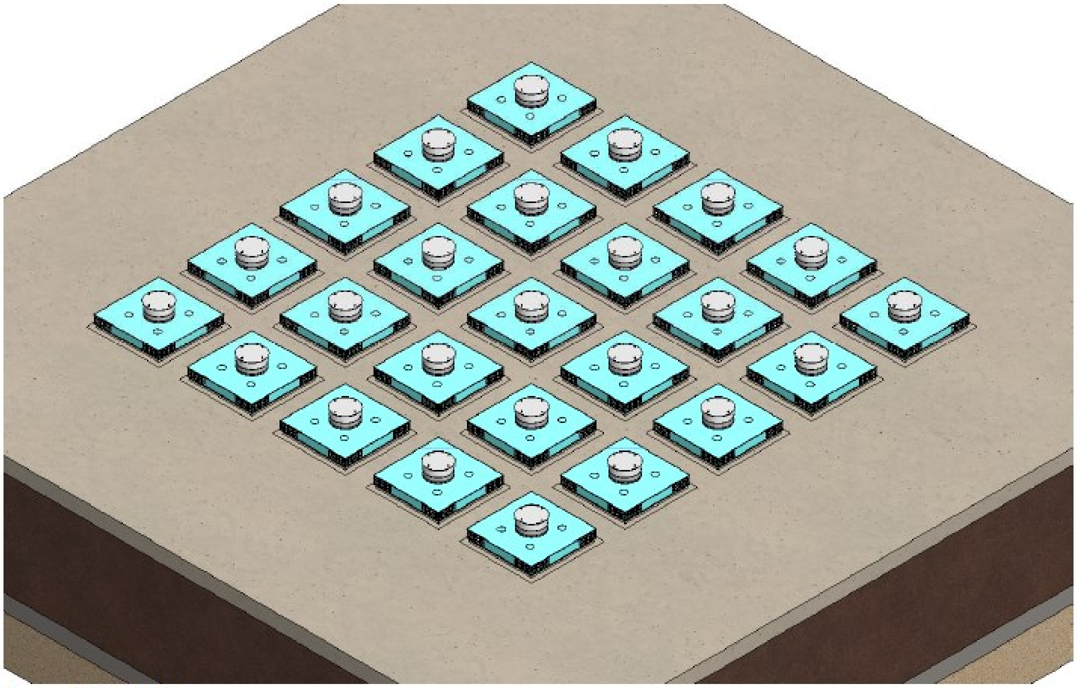
Note: The shown layout is for all 20 Phases at Site. Phase 1 only contains space for 500 canisters of SNF in a vertical underground configuration.

Figure 2.2.2: HI-STORE CIS FACILITY LAYOUT



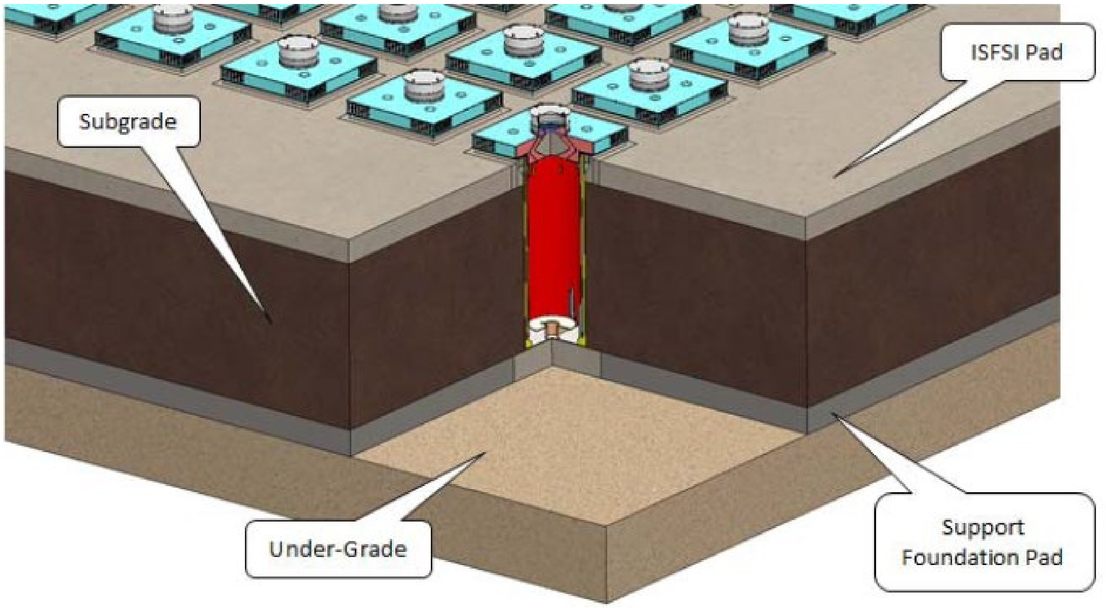
Source: Holtec 2017

Figure 2.2.3: DETAILS OF BUILDING LAYOUT



Source: Holtec 2017.

Figure 2.2.4: ILLUSTRATION OF ARRAY OF HI-STORM UMAX SYSTEM



Source: Holtec 2017.

Figure 2.2.5: HI-STORM UMAX ISFSI IN PARTIAL CUT-AWAY VIEW

2.3 Site Selection Process

The process of identifying a site for the CIS Facility is rooted in a process that began in March 2006, when then-Secretary of Energy, Samuel W. Bodman, announced that DOE was seeking expressions of interest from the public and private sectors to propose and evaluate sites suitable for activities under the Global Nuclear Energy Partnership (GNEP). GNEP was intended to close the nuclear fuel cycle by developing facilities to recycle SNF and reuse the usable constituents of the SNF to fuel other reactors and produce electricity. Under DOE's plan, communities and private-public consortia were encouraged to consider participation in the GNEP technology demonstration and submit ideas on how DOE should best solicit, evaluate and award site evaluation study contracts for the program (ELEA 2007, Appendix 2C).

In response, county officials in the southeastern New Mexico counties of Eddy and Lea, became aware of this opportunity and after educating local leaders and gaining community support, they determined to pursue this opportunity. Both counties are home to sites which host complimentary facilities, the Waste Isolation Pilot Plant (WIPP) site in Eddy County, and the National Enrichment Facility (NEF) which was being constructed in Lea County (ELEA 2007, Appendix 2C).

The counties realized they would have a better chance to be selected in this process if they joined together and submitted a response with a more regional perspective. In order to achieve this goal the counties formed a legal entity, ELEA, which could support the site study. ELEA had to determine which area in the region would be ideal to host the GNEP nuclear facilities. In order to do this, ELEA developed a set of screening criteria to apply to the prospective sites (ELEA 2007, Appendix 2C).

Site selection for the GNEP nuclear facilities was based on the following minimum criteria specified by DOE:

- **Size:** The area and linear dimensions of the site must accommodate one or both GNEP facilities. The proposed site must not be less than 300 contiguous acres for siting one facility and 500 contiguous acres for siting both facilities.
- **Hydrology**: The site must be sufficient to allow siting of the anticipated facilities above the 100-year flood plain.
- **Electricity Capability**: There must be an electrical transmission line able to provide 13kV available within 10 miles of the proposed site.
- **Population**: The population density, including weighted transient population, averaged over any radial distance out to 20 miles (cumulative population at a distance divided by the area at that distance), does not exceed 500 persons per square mile.
- **Zoning**: If zoning regulations apply to the proposed site, the site must be zoned for heavy industrial/industrial use. Alternatively, the applicant must demonstrate that the area could be zoned for heavy industrial/industrial use.
- **Road Access**: The proposed site must be within 5 miles of a highway capable of supporting a load of 80,000 pounds Gross Vehicle Weight.
- **Seismic Stability**: The proposed site must be free of risk from significant seismic events.

- **Water Availability**: The proposed site must have access to reliable supplies of water (ELEA 2007, Appendix 2C).

In developing the Proposed Action addressed in this ER, Holtec reviewed the eight criteria that were developed for the GNEP nuclear facilities and determined that electricity capacity and water availability were not as important as the other six criteria because the CIS Facility would not require significant quantities of electricity or water. Holtec determined that the remaining six criteria were appropriate criteria to apply to siting the proposed CIS Facility. Holtec also determined that no additional criteria were necessary to apply to siting the proposed CIS Facility.

During the GNEP site selection process, the eight criteria were translated into 31 specific site screening factors that required evaluation in order to select the site that best meet all of the criteria. The 31 specific screening factors are listed in Appendix 2C of reference ELEA 2007, which contains details regarding the site screening process. Six sites were offered by ELEA for evaluation (see Figure 2.3.1) (ELEA 2007, Appendix 2C).

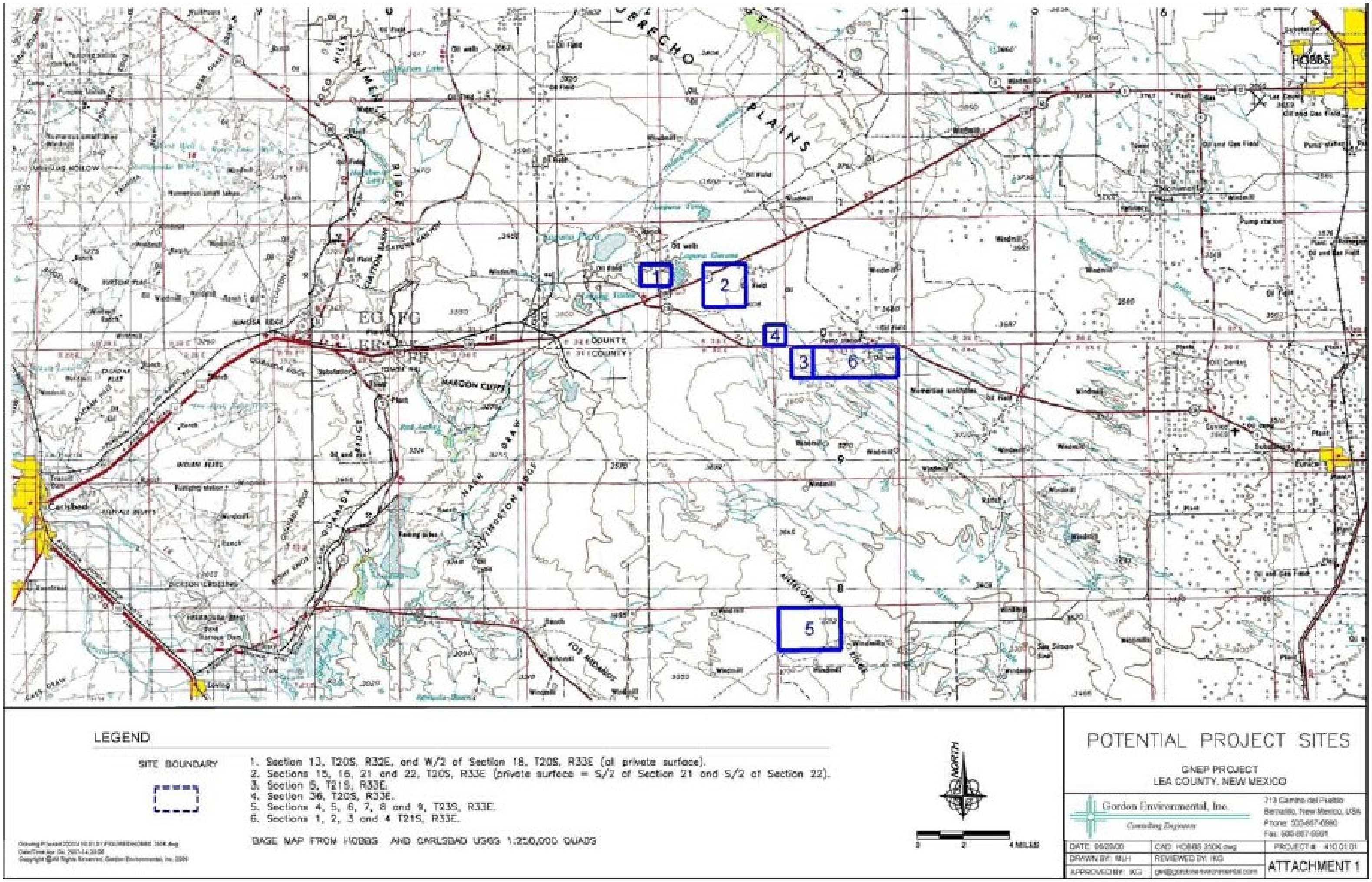
Four of the six sites ranked about equally. Of these, Site 1 was selected because of the following favorable factors.

- Private ownership of the land was considered to be an advantage from the standpoint of acquisition for construction of the facilities.
- Equal distance between the cities of Hobbs and Carlsbad optimizes access for housing, jobs, supplies and other support.
- Proximity to U.S. Highway 62/180 provides an advantage for transporting nuclear materials since this highway is part of the transportation route developed for hauling waste to the WIPP.
- Federal lands south of Site 1 may be available for expansion of the facilities if needed (ELEA 2007, Appendix 2C).

Neither electricity capacity nor water availability were factors that affected the selection of Site 1 for the GNEP nuclear facilities.

On June 29, 2009, DOE announced the GNEP program was cancelled because of a change in policy to no longer pursue domestic commercial SNF reprocessing, which was the primary focus of the prior Administration's domestic GNEP program (74 FR 31017). The cancellation was not the result of any site selection-related reasons.

In considering the most appropriate site for the proposed CIS Facility, Holtec reviewed the site selection process and outcome described above for the GNEP nuclear facilities and determined that the selected site in the process (Site 1) would also be the best site for the CIS Facility (Holtec 2016a). Consequently, Holtec is proposing to locate the CIS Facility at that site.



Source: ELEA 2007, Appendix 2C

Figure 2.3.1: POTENTIAL SITES EVALUATED BY ELEA

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED

Alternatives to the proposed design that alter the design or the location or layout of the project were identified. Ultimately, none were carried forward for detailed analysis. The range of reasonable design, location, and layout alternatives considered and the reasons for eliminating them from detailed analysis are presented here.

2.4.1 Design Alternative

Currently, the NRC has licensed and approved SNF storage systems owned by Holtec, AREVA, NAC, and Energy*Solutions*. Holtec has proposed to use its proprietary system to store SNF at the CIS Facility and use of its system is analyzed as part of the Proposed Action. A potential design alternative would be to use the AREVA, NAC, and Energy*Solutions* systems. Holtec considered this alternative, but rejected these systems because Holtec's proprietary design is the only licensed technology with the universal capability to store all SNF from all commercial reactors. Consequently, a design alternative utilizing a different SNF storage system was not carried forward for detailed analysis.

2.4.2 Location Alternatives

The site proposed for the CIS Facility in Lea County, New Mexico was identified through the process described in Section 2.3. Holtec supports the Blue Ribbon Commission's recommendation to only site a CIS Facility in a state and community willing to host such a facility. ELEA's success in proposing the Lea County site for the GNEP program was predicated on the tremendous support provided by New Mexico, the regional and local communities in southeastern New Mexico and Eddy and Lea counties. Holtec agrees with the findings of the Blue Ribbon Commission (BRC 2012, Chapter 6) that many of the failures to site nuclear and radioactive waste disposal facilities, including the proposed repository at Yucca Mountain, Nevada, are directly attributable to the failure to garner the support of the host state and local communities. Accordingly, Holtec adopted a site selection process geared to identify a ROI focused upon states and communities that have expressed their willingness to host nuclear facilities.

As an indication of the community support for a project like the proposed CIS Facility in southeastern New Mexico, Holtec recognizes the following nuclear facilities located within the general proposed area: WIPP, NEF, and the International Isotopes Fluorine Production (IIFP) facility. All three of these facilities are located in southeastern New Mexico within approximately 40 miles of the proposed CIS Facility site.

The proposed CIS Facility site has the following attributes that lead to the conclusion that it is suitable for its intended purpose:

- The topography of the land is relatively flat lending to effective intrusion detection by camera surveillance;
- The water table is sufficiently below the bottom of the subterranean HI-STORM UMAX system to preclude the possibility of any groundwater intrusion in the storage cavity spaces;
- The land is fallow with limited vegetation to support cattle herds;
- The annual rainfall is meager requiring a modest water drainage infrastructure;

- The tornadic activity in the region is infrequent. The strength of the tornadoes is bounded by the national meteorological tornadic data which has been used to define the Design Basis Missiles for both the HI-STORM FW system and the HI-STORM UMAX system. Therefore, the storage system's ability to withstand the site specific tornados is axiomatically satisfied;
- There are no active volcanoes in the area;
- The area has a stable tectonic plate profile. As a result, the 10,000 year-return earthquake for the site is quite modest and well below the range for which HI-STORM UMAX as licensed in Docket 72-1040;
- There are no chemical plants in the area that would spew aggressive species into the environment. As a result, the ambient air is non-aggressive and a long service life of the stored stainless-steel canisters can be predicted with confidence;
- There is no air force base or a major civilian airport in the vicinity of the site and the area is ostensibly not used for any aerial training exercises by the U.S. military;
- The local area has a well-developed rail road infrastructure. The length of additional rail spur required for the site in less than 10 miles; and
- By agreement with the applicable third parties, the oil drilling and phosphate extraction activities have been proscribed at and around the site and would not affect the activities at the site.

In addition to the community support for the proposed CIS Facility, there is a significant amount of data associated with the proposed site that was developed as part of the GNEP program. Pursuing a different site alternative could increase costs unreasonably and could result in delays to the licensing, construction, and operation of the proposed CIS Facility, thus preventing Holtec from achieving the stated purpose and need. Consequently, the proposed site in Lea County is considered to be the superior site location and no other location could reasonably serve as the location for the CIS Facility site. Thus, other alternative site locations were eliminated from detailed analysis.

2.4.3 CIS Facility Layout Alternatives

The layout of the CIS Facility on the Site was influenced by the following factors: (1) Site access, (2) regulatory requirements, (3) operational efficiencies, and (4) environmental, safety, and security considerations. These factors affected the layout of the CIS Facility as follows:

- Site access considerations (for both workers, materials, and SNF deliveries) dictated that support facilities (i.e., Security Building, Administration Building, and the Cask Transfer Building) be located on the southern boundary of the Site.
- Regulatory requirements (10 CFR 72.106) required any facility or storage location for SNF to be no closer than 100 meters from the Protected Area boundary.
- Operational efficiencies and worker dose considerations dictated that the ISFSI Pad be located in close proximity to the Cask Transfer Building. Additionally, Phase 1 storage locations for SNF were located at the northeastern most point of the ISFSI Pad in order that

subsequent phases of construction would have minimal interference with ongoing operations.

- Environmental, safety, and security considerations dictated that the ISFSI Pad be a compact design to minimize infrastructure requirements, with minimal land disturbance within the Protected Area, and with clear sight lines around the perimeter. A compact design would also minimize any potential impacts related to ecological and cultural resources, and would minimize ground disturbance and air quality impacts.

Based on these factors, the layout presented in Figure 2.2.2 was developed and was deemed to represent the optimum configuration for the CIS Facility (Holtec 2016a).

2.5 SUMMARY COMPARISON OF THE ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

This comparison of potential environmental impacts is based on the information in Chapter 3, Affected Environment, and analyses in Chapter 4, Environmental Impacts. Its purpose is to present the impacts of the alternatives in comparative form. Table 2.5.1 presents the comparison summary of the environmental impacts for the Proposed Action and the No Action Alternative.

Table 2.5.1:

SUMMARY COMPARISON OF THE ALTERNATIVES

Resource	Proposed Action	No Action Alternative[a]
Land Use	Land disturbance of 330 acres during construction of the full (10,000 canister) CIS Facility, with an insignificant loss of grazing area. Land uses would remain compatible with surrounding areas and land use plans. No impacts on offsite land use.	Short-term continued at-reactor storage in a SNF or ISFSI would not require disturbance of any new land or result in operational or maintenance activities that would change land use. Any construction required for long-term storage would impact a small fraction of the land committed for a nuclear power plant.
Visual and Scenic Resources	The HI-STORM UMAX is a particularly low-visibility SNF storage system compared to aboveground systems. CIS Facility would be visible only from fairly close vantage points and would result in an insignificant impact to visual and scenic resources. The most visible structure would be the Cask Transfer Building. No change to visual resource management (VRM) classification.	No changes to the visual profile are likely to occur as a result of the continued operation and maintenance of the existing SNF pool and at-reactor ISFSI. In the long-term, periodic construction, replacement, and operation activities would not significantly alter the landscape of an ISFSI.
Geology and Soils	Minimal impacts limited to soil disturbance and a temporary increase in soil erosion at the CIS Facility.	Impacts to soil from small spills and leaks during operation and maintenance of ISFSIs would be minor because of monitoring and environmental protection regulations. No new land would be disturbed for continued operation of SNF pools and ISFSIs. Any construction required for long-term storage would have minimal impacts to soils on the small fraction of land committed for the facilities.
Ecological Resources	Minimal impacts would include a loss of grazing area and open area for wildlife. There are no habitats for threatened and endangered species on the land proposed for the CIS Facility.	Normal operations and replacement of ISFSI facilities would not significantly affect the area available for terrestrial wildlife, and would not adversely impact terrestrial environments or their associated plant and animal species.
Water Resources	No impacts to surface water or groundwater. Proposed Site has no floodplains or jurisdictional wetlands.	Potential impacts to surface water quality and consumptive use from the continued operation of SNF pools and ISFSIs would be less than for normal plant operations. Continued storage of SNF could result in non-radiological and radiological impacts to groundwater quality. Potential consumptive-use and water quality impacts from construction and operation of an ISFSI would be less intense than assumed for initial construction of these facilities.

Table 2.5.1:

SUMMARY COMPARISON OF THE ALTERNATIVES

Resource	Proposed Action	No Action Alternative[a]
Climatology, Meteorology, Air Quality, and Noise	Temporary increases in hydrocarbons, particulate matter, and fugitive dust due to vehicle emissions, concrete batch plant operations, and ground disturbance. No substantial impacts would occur and visibility would not be impacted. There are no sensitive receptors (e.g., hospitals, churches, and schools) within 10 miles of the Site. Noise levels would increase during construction and during operation, but not to a level that would cause significant impact to nearby residents.	Air emission impacts from SNF activities from spent fuel pools and ISFSIs during short-term storage would be substantially smaller than air emissions during power generation. Any construction required for long-term storage would result in minor and temporary air emissions. Normal operations and replacement of ISFSI facilities would not generate significant noise.
Cultural Resources	Minimal cultural resources were identified during the site-specific survey and potential impacts are considered low. To minimize any potential impact on cultural resources, accidental discovery procedures would be in place.	Because no ground-disturbing activities are anticipated during the short-term storage timeframe, impacts to cultural resources associated with continued operations and maintenance would be small. If construction of a replacement of the ISFSI occurs in an area with no cultural resource present or construction occurs in a previously disturbed area that allows avoidance of cultural resources then impacts would be small. By contrast, a moderate or large impact could result if cultural resources are present at a site and, because they cannot be avoided, are impacted by ground-disturbing activities during the long-term timeframe.
Socioeconomics and Environmental Justice	Construction and operation would result in positive direct and indirect economic benefits within the ROI. There would be minimal demands on local social resources and infrastructure to meet housing and other social infrastructure needs. With regard to environmental justice, no significant disproportionate impacts to low-income or minority persons are anticipated.	A small number of workers would be required to maintain and monitor spent fuel pools and an at-reactor ISFSI, tax payments to local jurisdictions would continue, and there would be no increased demand for housing and public services. Any construction required for long-term storage would be small and there would be no increased demand for housing and public services. Minority and low-income populations are not expected to experience disproportionately high and adverse human health and environmental effects from the continued storage of SNF.
Transportation (Non-radiological)	Increase in traffic from heavy haul vehicles and construction workers would not change traffic patterns. Operational work force of less than 40 personnel and 15 security personnel would not change traffic on area roads.	A low volume of traffic and shipping activities is expected with the continued storage of SNF in pools and at-reactor ISFSIs. There would be small workforce requirements for continued storage and aging management activities (relative to the power plant workforce).

Table 2.5.1:

SUMMARY COMPARISON OF THE ALTERNATIVES

Resource	Proposed Action	No Action Alternative[a]
Transportation (Radiological)	Transportation would result in 172 person-rem dose annually during normal operations. The radiological accident risks to the population would be approximately 5.9 person-rem, which is small. The larger impact would be associated with potential traffic fatalities. Statistically, 2.9 fatalities from traffic accidents would be expected over the 20-year transportation period. Because the risks are for the entire population of individuals along the transportation routes, the risk to any single individual would be small.	A low volume of traffic and shipping activities is expected with the continued storage of SNF in pools and at-reactor ISFSIs. There would be small workforce requirements for continued storage and aging management activities (relative to the power plant workforce) and a low frequency of supply shipments and shipments of low-level radiological waste (LLRW) from activities, continued dry cask storage operations, and ISFSI replacement activities.
Infrastructure	No notable impact on infrastructure resources; existing infrastructure providers of potable water and electricity have adequate capacity to support the CIS Facility.	Not evaluated in NUREG-2175, but continued SNF storage is not expected to result in any additional infrastructure demands.
Waste Management	CIS Facility would generate only minimal amounts of hazardous waste and a small amount of LLRW from contamination survey rags, anti-contamination garments, and other health physics materials. With regard to non-hazardous waste, waste generated would be commensurate with typical office/personnel waste generation rates.	Continued at-reactor storage of SNF would generate much less LLRW, mixed, and nonradioactive waste than an operating facility, and licensees would continue to implement Federal and State regulations and requirements regarding proper management and disposal of wastes. The replacement of the ISFSI, repackaging of SNF canisters, and construction, operation, and replacement of the ISFSI would generate a fraction of the LLRW generated during reactor decommissioning.
Human Health, Normal Operations (Non-radiological)	As presented in Section 4.12.1, there would be no chemical substances, airborne particulates, or gases or liquid effluents that could contribute to offsite exposures. Worker impacts were estimated as follows: 0.007 fatalities and 1.8 non-fatal injuries annually during construction; and 0.005 fatalities and 1.3 non-fatal injuries annually during operations.	Not evaluated in NUREG-2175, but continued SNF storage is not expected to result in any additional non-radiological impacts to health. Any construction required for long-term storage would be expected to have similar impacts as presented for the Holtec CIS Facility.

Table 2.5.1:

SUMMARY COMPARISON OF THE ALTERNATIVES

Resource	Proposed Action	No Action Alternative[a]
Human Health, Normal Operations (Radiological)	As presented in Section 4.12.2, potential impacts to the public and workers would be small. The dose to the MEI would be 2.5 mrem/year. The average exposure for the construction and operations workforces would be 0.25 rem/year and the exposure for the high-exposure workers is estimated to be less than 0.5 rem/year. This maximum dose of 0.5 rem/year is a factor of ten below the 5 rem/year total effective dose regulatory limit specified in 10 CFR 20.1201(a) for occupational exposure.	Annual public and occupational doses would be maintained below the annual dose limits established by 10 CFR Part 72 for the public and 10 CFR Part 20 for occupational personnel. Licensed facilities would also be required by these regulations to maintain an ALARA program to ensure radiation doses are maintained as low as is reasonably achievable.
Human Health (Accidents)	The postulated design basis accidents include hazards from natural phenomena, such as earthquakes, floods, tornadoes, and hurricanes; and fuel handling-related accidents. The results demonstrate that the HI-STORM UMAX storage system can withstand the effects of all credible and hypothetical accident conditions and natural phenomena without affecting its safety function. There are no credible mechanisms (either from off-normal operations or from hypothetical accidents) that would result in the release of radioactive SNF contents, including airborne radioactive material, into the environment.	The postulated design basis accidents include hazards from natural phenomena, such as earthquakes, floods, tornadoes, and hurricanes; hazards from activities in the nearby facilities; and fuel handling-related accidents. The environmental impacts of these postulated accidents involving continued storage of SNF are small because all important safety structures, systems, and components involved with the SNF storage are designed to withstand these design basis accidents without compromising the safety functions. The probability-weighted environmental impact of severe accidents is also small because of the low probability that such events would occur.

a The No Action Alternative impacts are summarized from NUREG-2157 (NRC 2014b). In that document, NRC evaluated the continued storage of SNF for: (1) a short-term period (e.g., 60 years after the end of a reactor's licensed life for operation); (2) a long-term period, which NRC defined as "an additional 100 years after the short-term timeframe for a total of 160 years after the end of a reactor's licensed life for operation"; and (3) indefinite storage. For purposes of this ER, the short-term and long-term storage impacts would best match the 120 years storage period for the proposed Holtec CIS Facility. Consequently, the impacts of short-term and long-term storage are included.

CHAPTER 3: AFFECTED ENVIRONMENT

3.0 INTRODUCTION

This chapter provides the context for understanding the environmental consequences described in Chapter 4 of this Environmental Report (ER). The affected environment serves as a baseline from which any environmental changes that would result from implementing the alternatives can be evaluated. The baseline conditions are the currently existing conditions. The affected environment at the proposed Consolidated Interim Storage (CIS) Facility site is described for the following areas: land use; visual and scenic resources; geology and soils; water resources; ecological resources; climatology, meteorology, air quality, and noise; cultural resources; socioeconomics and environmental justice; transportation; site infrastructure; waste management; and public and occupational health and safety. This chapter accurately reflects the current conditions at the site and its surroundings. Data sources used are generally less than 4 years old; justifications for older sources can be found in Appendix A.

3.1 LAND USE

This section describes the physical location and characteristics of the proposed CIS Facility site and the current land uses. The section also discusses land uses of off-site areas and the regional setting. The Site for the CIS Facility is located in southeastern New Mexico in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico (Figure 3.1.1).

Lea County is approximately 2.8 million acres in size. Property ownership is 17 percent Federal government, 31 percent state government, and 52 percent private. The Federally-owned land is primarily located in the southwestern portion of the county, the state-owned land is predominately located throughout the middle, and the privately owned land primarily extends from north to south in the county's eastern portion. Large tracts of land in Lea County are privately owned by farmers, ranchers, oil, gas, and mining companies. Urbanized areas near cities and towns include ownership of smaller tracts of land for residential, municipal, and commercial purposes. Approximately 93 percent of Lea County is used as range land for grazing, and approximately 4 percent is used for crop farming. Urban areas and the roadway system account for the remaining land use. Most of the land actively farmed in Lea County is irrigated (IIFP 2009, Section 3.1.1).

The CIS Facility would largely be constructed and operated on an approximately 119.4-acre initial footprint within an approximately 1,040-acre parcel within United States (U.S.) Department of Interior (DOI), Bureau of Land Management (BLM) Section 13. As shown on Figure 3.1.2, almost all of the land immediately surrounding the Site is owned and managed by the BLM. Larger population centers are Roswell, New Mexico, 74 miles to the northwest; Odessa, Texas, 92 miles to the southeast; and Midland, Texas, also to the southeast at 103 miles. The nearest international airport is located between Midland and Odessa, Texas 98 miles to the southeast.

3.1.1 Onsite Land Use

The CIS Facility proposed site consists of mostly undeveloped land (See Figure 3.1.3) primarily used for cattle grazing with the only boundary being a four-strand barb wire fence along the south

side of the property until it nears Laguna Gatuna where it turns south to the highway (ELEA 2007, Section 2.1.1.1). This undeveloped land contains sparse scrub-brush vegetation with a relatively flat topography, that gradually slopes to the north (GEI 2017, Section 2.1).

This fence is the boundary between two grazing allotments administered by the DOI, BLM. The majority of allotments are grazed year-round with some type of rotational grazing. The Site is comprised of 1,040 acres of patented land spread across three sections of land running west to east.

Rangelands comprise a substantial portion of the CIS Facility proposed site and provide forage for livestock. Pasture rotation, with some of the pastures being rested for a least a portion of the growing season, is standard management practice for grazing allotments. Vegetative monitoring studies to collect data on the utilization of the land, and the amount of precipitation by pasture from each study allotment are conducted annually on Federal lands to compare production with consumption. Currently, the BLM permits nine animal unit months per 640 acres (ELEA 2007, Section 2.1.2.4). An animal unit month is one cow and one calf for one month. Because the Site is privately held, it does not fall under the BLM range management rules, although the rules apply to most of the adjacent lands that are managed by the same rancher. The entire Site is used for grazing (ELEA 2007, Section 2.1.2.4).

With regard to potential future drilling on the Site, Holtec has an agreement with Intrepid Mining LLC (Intrepid) such that Holtec controls the mineral rights on the Site and Intrepid will not conduct any potash mining on the Site. Additionally, any future oil drilling or fracking beneath the Site would occur at greater than 5,000 feet depth, which ensures there would be no subsidence concerns (Holtec 2016a).

3.1.2 Surrounding Land Use

Surrounding the Site are BLM lands and two small parcels of state land. The surface estate is privately owned (ELEA 2007, Section 2.1.1.1), and the subsurface minerals are owned by the state of New Mexico. Mineral rights available for leasing are potash and oil/gas. There are several existing rights-of ways (ROWs) in the Site. These existing ROWs include pipelines, roads, well pads, power lines, telephone lines, and a communications tower (ELEA 2007, Section 2.1.1.1).

The oil and gas industry is well established in the area surrounding the Site, with producing oil and gas fields, support services, and compressor stations. Nearly all phases of oil and gas activities have occurred in the locality. These phases include seismic exploration, exploratory drilling, field development (comprised of production and injection wells) and other sundry activities associated with hydrocarbon extraction. One gas well is present on the Site along with numerous plugged and abandoned wells. Further oil and gas development is not allowed by the New Mexico Oil Conservation Division (OCD) due to the presence of potash ore on the Site.

Lands within 6 miles of the Site are privately owned, state lands, or BLM lands. Land use within 6 miles of the Site falls into two categories: livestock grazing and mineral extraction. Only one small area is not being leased to grazing (potash tailings dam). There are five ranch headquarters located in the area which are associated with five of the grazing allotments.

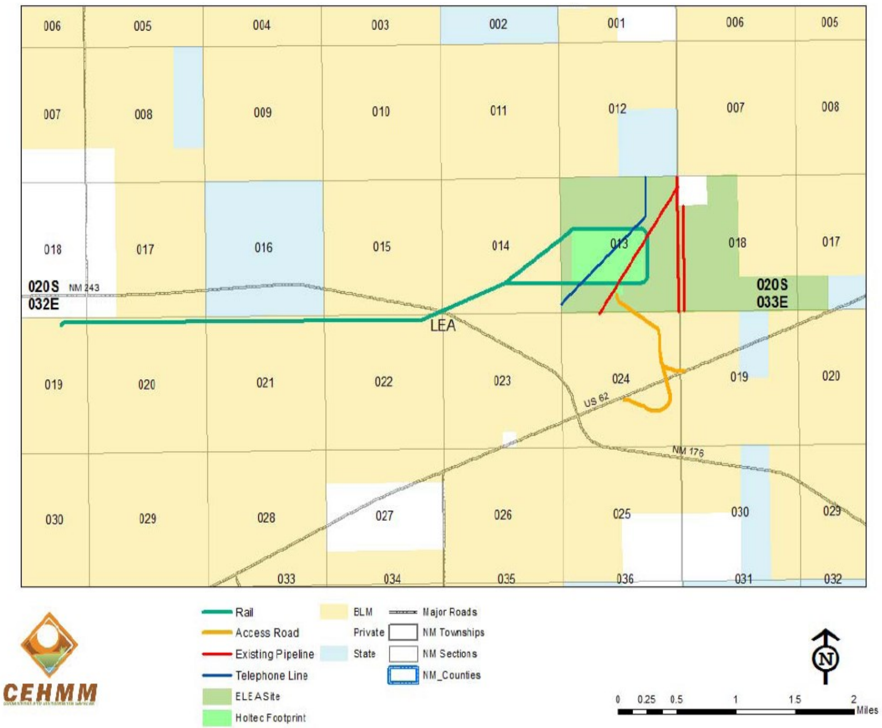
Mineral extraction in the area consists of underground potash mining and oil/gas extraction. Both industries support major facilities on the surface, although mining surface facilities are confined to a fairly small area. Intrepid owns both mines located within 6 miles of the Site. The Intrepid

North mine, located to the west, is no longer actively mining potash underground. However, the surface facilities are still being used in the manufacture of potash products. The Intrepid East facility is still mining its underground potash ore (ELEA 2007, Section 2.1.2.1).

The nearest residents to the proposed CIS Facility site are located at the Salt Lake Ranch, 1.5 miles north of the Site. There are additional residences at the Bingham Ranch, 2 miles to the south and at the Controlled Recovery Inc. complex, three miles to the southwest.

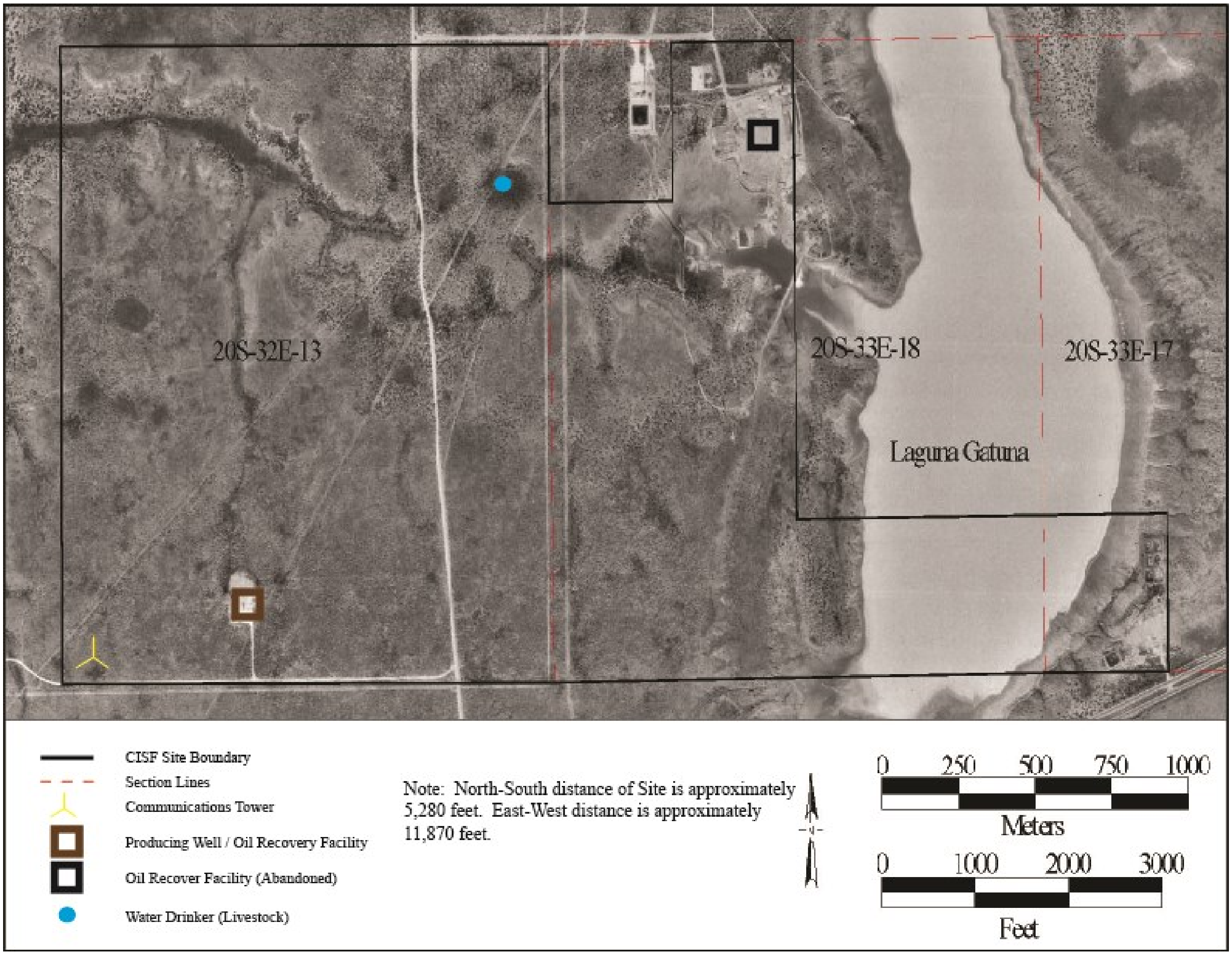
Source: ELEA 2007, Section 2.1.1.

Figure 3.1.1: LOCATION OF CIS FACILITY PROPOSED SITE



Source: CEHMM 2016.

Figure 3.1.2: SURFACE LAND OWNERSHIP IN THE VICINITY OF THE CIS FACILITY PROPOSED SITE



Source: ELEA 2007, Section 2.1.1.1.

Figure 3.1.3: CIS FACILITY SITE BOUNDARIES

3.2 Visual and Scenic Resources

The proposed CIS Facility site exhibits a very nondescript appearance with open, vacant land. This is common for areas in the Querecho Plains of southeastern New Mexico. Surrounding landscapes are similar in appearance with the exception of man-made structures located at neighboring properties. The only activities currently occurring at the Site are cattle grazing and oil and gas production (ELEA 2007, Section 2.1.3).

The following structures are situated on the Site (ELEA 2007, Section 2.1.1.1 & GEI 2017, Section 2) (See Figure 3.1.3):

- A communications tower in the southwest corner of the site;
- A producing well is located near the communications tower;
- A small water drinker (livestock) is located along the aqueduct in the northern half of the property;
- Oil recovery facility (abandoned) that still has tanks and associated hardware left in place in the northeast corner; and
- An oil recovery facility with tanks and associated hardware still in place in the far southeast corner.

According to the DOI and BLM, visual resources consist of landscape or visual character, and visual sensitivity and exposure. The BLM provides a means for determining visual values in their Visual Resource Management (VRM) Manual 8410. This inventory-like system of evaluation consists of three determinations: (1) Scenic Quality, (2) Sensitivity Level Analysis, and (3) Delineation of Distance Zones. Based on these categories the BLM places land into one of four visual resource inventory classes. Four Management objectives have been established based on scenic quality, visual sensitivity, and distance from key observation points. These objectives (classes) describe the different degrees of modification allowed in the basic elements of the landscape. Classes I and II are the most valued, Class III is of moderate value and Class IV is of least value.

Visual resource management objectives have been determined for all public lands in the Carlsbad Resource Area (BLM 1986, page 3-29). These objectives were derived from previous land use planning and visual resource inventories for lands west of the Pecos River. The Site has been determined to be in the range of a Class IV (BLM 1986, page 3-29, 3-31), meaning that level of change allowable to the characteristic landscape can be high, and that these changes may dominate the view and be the major focus of viewer attention as demonstrated below.

Evaluation of the scenic quality of a landscape the visual sensitivity of that landscape to change and the distance of the landscape from a viewer determines the final VRM class. A discussion of each aspect of this evaluation follows.

3.2.1 Scenic Quality

Scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, lands are given an A, B, or C rating based upon the apparent scenic quality which is determined using seven factors. These factors include landform, vegetation, water resource features, color, adjacent scenery, scarcity, and cultural modifications (that either add to or detract from visual quality). The overall impression of an area, composed of the elements above, is referred to as the “visual character.” Based upon this process, the Site received the lowest scenic-quality rating, there are no regionally or locally important or high quality views associated with the Site. This rating means that the level of change to the characteristic landscape can be high and allows for the greatest level of landscape modification (ELEA 2007, Section 2.1.3.1).

3.2.2 Sensitivity Level Analysis

Sensitivity levels are a measure of public concern for scenic quality. Public lands are assigned high, medium, or low sensitivity levels by analyzing the various indicators of public concern. These types of indicators include type of users, amount of use, public interest, adjacent land use, special areas, and other factors specific to the location.

Because the Site is located in a sparsely populated area more inclined to be used for cattle grazing or oil and gas exploration and production, the sensitivity level analysis for this location was determined to be low (ELEA 2007, Section 2.1.3.2).

3.2.3 Delineation of Distance Zones

Landscapes are subdivided into three distance zones based on relative visibility from travel routes or observation points. These three zones are foreground-middleground, background, and seldom seen. The Site is not visible from any city, township, borough or identifiable population center. The Site boundary is located one-half mile north of Highway 62/180. Visibility of the Site is confined to east and west traffic on Highway 62/180 and is similar from either direction.

Half of the Site lies within the foreground-middleground due to the Site exhibiting a slight crest in the center of the location. The remaining half of the Site lies in the seldom seen zone on the opposite side of the crest from the highway. Neighboring properties include various oil and gas well locations surrounding the Site, a restaurant one-and-a-half miles to the west of the Site, a hydrocarbon remediation land farm to the southwest of the Site, and an area potash mine to the west of the Site along with a communication tower (ELEA 2007, Section 2.1.3.3).

3.2.4 Visual Resource Management Classes

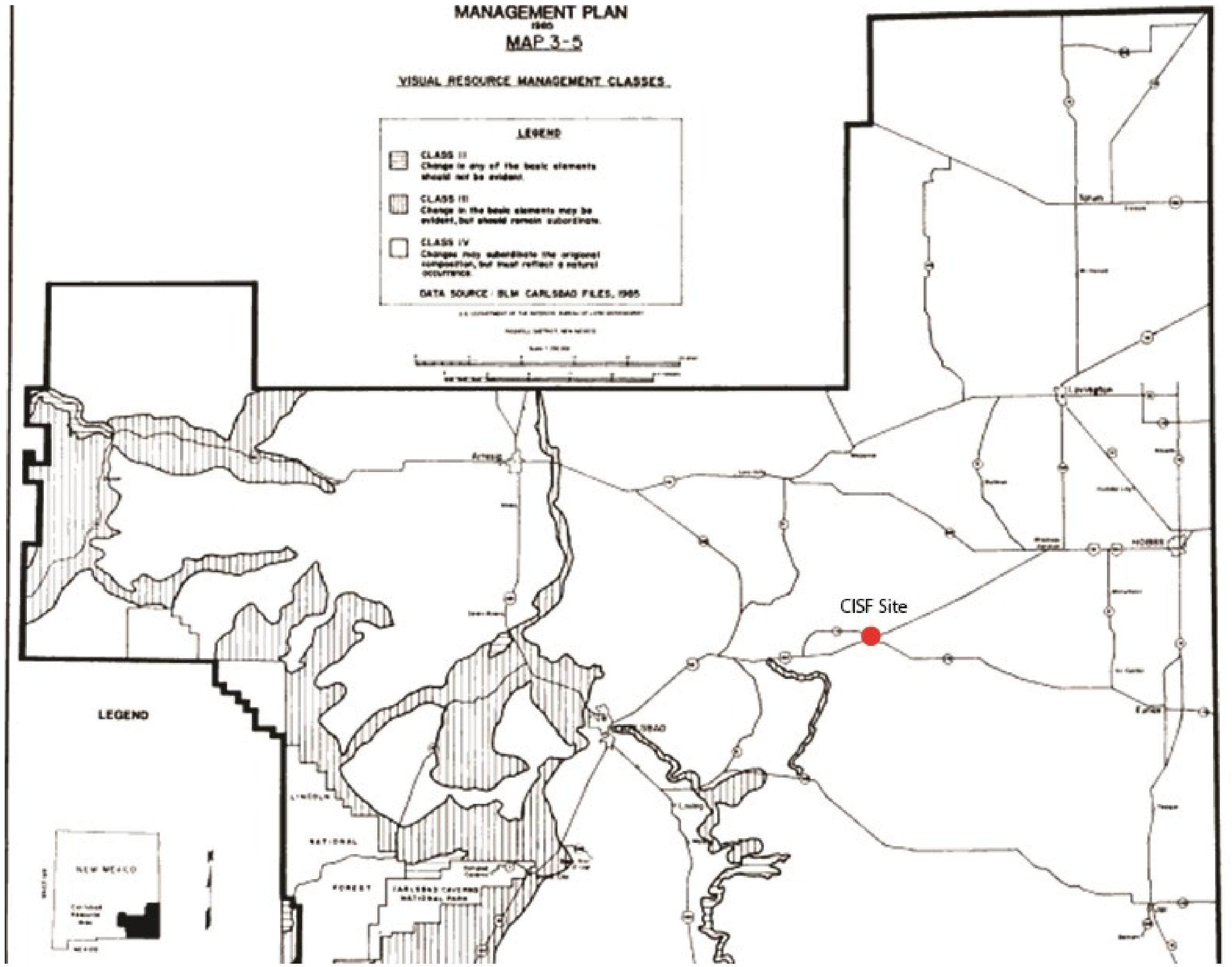
VRM classes describe the different degrees of modification allowed in the basic elements of the landscape. These classes are determined through a matrix which combines scenic quality visual sensitivity and distance zones. The resulting classes are mapped and become the basis used to assess the impact of proposed activities. The following defines the VRM classes and how visual class ratings are developed. Figure 3.2-1 illustrates the VRM classes as a result of the inventory and evaluating process for the Carlsbad Resource Areas (BLM 1986, Appendix I).

Class I	Applies only to classified special areas (e.g., Wilderness Primitive and Natural Areas). This quality standard is established through legislation or policy. Only natural ecological changes are allowed.
Class II	Landscapes with Class A scenery quality or Class B scenery quality in the foreground middleground zone with high visual sensitivity. Changes in any of the basic elements (e.g., form, line, color, and texture) caused by a management activity should not be evident in the characteristic landscape.
Class III	Landscapes with Class B scenery quality and high visual sensitivity in the background zone or with Class B scenery quality and medium visual sensitivity in the foreground middleground zone or with Class C scenery of high visual sensitivity in the foreground middleground zone. Changes in the basic elements (form, line, color, and texture) caused by management activity may be evident in the characteristic landscape, however the changes should remain subordinate to the visual strength of the existing character.
Class IV	Landscapes with Class B scenery quality and high visual sensitivity in the seldom seen visual zone or with Class B scenery quality and medium or low visual sensitivity in the background or seldom seen zones or with Class C scenery quality except with high sensitivity in the foreground middleground zone. Changes may subordinate the original composition and character but must reflect what could be a natural occurrence within the characteristic landscape.

Contrast Rating System. The degree to which a proposed project affects the visual quality of the landscape depends on the amount of visual contrast that is created between the activity and the existing landscape. The contrast rating system is used to assess this contrast.

The system reduces a landscape to its major features land and water vegetation and structures and each feature into its basic elements (form, line, color, and texture). The predicted contrast of the proposal against each landscape feature then indicates the total anticipated visual impact.

For each management class there are maximum acceptable ratings for each element and any one feature.



Source: BLM 1986, page 3-31.

Figure 3.2.1. VISUAL RESOURCE MANAGEMENT CLASSES

3.3 GEOLOGY AND SOILS

This section identifies the geological, seismological, and geotechnical characteristics of the CIS Facility Site and its vicinity.

3.3.1 Regional and Site Specific Geology

3.3.1.1 Structural Features

The Site is located in the northern portion of the Delaware Basin, a northerly-trending, southward plunging asymmetrical trough with structural relief of greater than 20,000 feet on top of the Precambrian basement rock. The Basin was formed by early Pennsylvanian time, followed by major structural adjustment from Late Pennsylvanian to Early Permian time. During the Triassic period, the area was uplifted, resulting in deposition of clastic continental shales (redbeds). Continuing uplift resulted in erosion and/or non-deposition until the middle to late Cenozoic period, when regional eastward tilting completed structural development of the basin as it exists today. Shallow subsurface structure at the Site consists of gently east sloping beds of Triassic age redbeds, dipping two degrees to the east. Faulting has not occurred in the northern Delaware Basin in the area of the Site. The regional geology suggests that there have been no recent, dramatic changes in geologic processes and rates in the vicinity of the Site (ELEA 2007, Section 2.3.4.1.2).

During most of the Permian period, the Delaware Basin was the site of a deep marine canyon that extended across southeastern New Mexico and west Texas. Major structural elements of the Delaware Basin area are shown in Figure 3.3.1. The major structures of the basin include the Guadalupe Mountains on the west side, the Central Basin Platform on the east side, and the Capitan Reef Complex on the west and north sides of the basin. The reef created steep slopes toward the basin and the thickness of sediments grows precipitously toward the center of the basin from the margin of the reef. The Central Basin Platform forms an abrupt eastern terminus to the Delaware Basin; it is a steeply fault-bound uplift of basement rocks that grew through the early and middle Paleozoic period such that most of the pre-Permian sedimentary section is missing from its apex. Great thickness of organic-rich marine deposits in the basin and the presence of abrupt structures in the Capitan Reef Complex and Central Basin Platform combined to produce a prolific oil and gas province. These areas have been the focus of intense petroleum exploration and development activities since approximately 1920. Surficial geology and subsurface structure across the Delaware Basin are depicted in the map and cross section in Figure 3.3.2. Thickness of sediments in the basin exceeds 20,000 feet, and Permian strata alone account for more than 13,000 feet of sedimentary materials (ELEA 2007, Section 2.3.2.3).

3.3.1.2 Regional Stratigraphy

This section discusses the regional geology ascending from a depth of approximately 13,000 feet. The geologic formations of concern beneath the Site comprise, from oldest to youngest, consist of Permian-aged rocks (Wolfcamp series, Leonard series, Guadalupe series, Ochoa series); Triassic-aged rocks (Dockum Group); and Tertiary and Quaternary rocks (Lower Gatuna Formation, Upper Gatuna Formation), and alluvium. A stratigraphic column for the above units in provided in Figure 3.3-3 with brief descriptions of the units provided below.

Permian Rocks

Wolfcampian Series. The Wolfcamp varies in lithology, grading from primarily limestone that thins or is absent along the crest of the Central Basin Platform to dark shale and sandstone in the Delaware Basin. Both the clastic and limestone facies of the Wolfcamp have been recognized as oil and gas exploratory targets.

Leonardian Series. The Leonardian consists mostly of the Bone Springs limestone, which is dark gray thinly-bedded argillaceous limestone containing thin beds of fine sandstone and interbedded black calcareous cherty shale sequence that is as great as 3,000 feet in thickness.

Guadalupian Series. The Guadalupian series consists mostly of sandstones and shales in the basin facies and limestones in the shelf facies. The basin facies are known as the Delaware Mountain Group, consisting of light gray, very fine grained sandstone and siltstones separated by grey shales or limestones, dolomites, or evaporates. The Delaware Mountain Group contains important oil and gas exploratory targets in the Delaware Basin. The lateral equivalent for the Delaware Mountain Group is the Capitan Limestone. The Capitan limestone is a light-colored, fossiliferous, locally vuggy limestone and breccia. The Capitan limestone forms an arc around the west, north, and east margins of the Delaware Basin.

Ochoan Series. The Ochoan series is composed primarily of evaporite deposits that formed during regressive events of shallow sea waters.

Triassic Rocks

Upper Triassic rocks rest unconformably on late Permian aged Dewey Lake Redbeds in the area. The upper Triassic section consists of up to 1,500 feet of reddish brown shales, siltstones, and fine grained sandstones known as the Dockum Group.

Tertiary-Quaternary Rocks

The Gatuna Formation is likely of early to middle Pleistocene age and is up to several hundred feet thick. Depending upon the location and nearby sediment source rocks, the Gatuna Formation consists of reddish brown friable sandstone, siltstone, siliceous conglomerate, and locally; gypsum and claystone. Above the Gatuna Formation and on other pediment alluvial materials, laterally extensive caliche deposits called the Mescalero are present across much of southeastern New Mexico. The Mescalero is described as a sandy light gray to white lower nodular and upper laminar caliche zone that ranges in thickness from 3 to 10 feet.

3.3.1.3 Site Specific Geology

The entire Site is underlain by Triassic bedrock consisting of shale, siltstone, and minor, fine-grained, poorly sorted sandstone. Most of the proposed operational area is relatively flat and the shale bedrock is covered by a laterally extensive veneer of 25 feet of Quaternary pediment deposits consisting of well sorted eolian sand and sandy-gravelly materials near the bedrock interface. The Mescalero Caliche unit is near the surface and is about 10 feet thick at the Site.

3.3.2 Seismic Information

3.3.2.1 Earthquake Activity

Earthquakes of low to moderate magnitude have been documented within a 200-mile radius of the Site. The vast majority of the earthquake activity is located southeast of the Site in west Texas, and west/northwest of the Site in central New Mexico. The U.S. Geological Survey (USGS) earthquake database was used to query historical earthquakes within a 200-mile radius of the Site (USGS 2016a). Results of the search of the 200-mile radius yielded a total of 244 historical earthquakes with magnitude 2.5 or greater between 1900 and the most recent update of the database in 2016. The results indicate the closest earthquake to the Site was 24 miles southwest with a magnitude of 3.1 that occurred on March 18, 2012. Two earthquakes with magnitudes greater than 5.0 were recorded within 200 miles of the Site. An earthquake with magnitude 6.5 occurred on August 16, 1931, located 140 miles southwest of the Site; and an earthquake with magnitude 5.7 occurred on April 14, 1995, located 165 miles south of the Site. The results of the USGS earthquake search are plotted on a regional map in Figure 3.3.4.

There are three seismic source zones within a 200-mile radius of the Site: the northern and southern regions of the Southern Basin and Range – Rio Grande rift zone located west and southwest of the Site; and the Central Basin Platform zone located east of the Site. The most active seismic area within 200 miles of Site is the Central Basin Platform east of the Site. Large magnitude earthquakes are not occurring or have not occurred within the recent geologic past along the Central Basin platform due to the absence of Quaternary faults. The seismicity in west Texas, southeast of the Site, is hypothesized as being a result of fluid pressure build-up from fluid injection, and consequential reduction in effective stress across pre-existing fractures and associated decrease in frictional resistance to sliding. Similarly, recent records (1998 through 2005) from the Waste Isolation Pilot Plant (WIPP) seismic monitoring network indicate that the strongest events recorded annually in 1999, 2000, and 2002 through 2005 (typically of 2.5 to 4.0 magnitude during this time period) have been located about 50 miles west of the Site. This seismic activity is suspected to be induced by injection of waste water from natural gas production into deep well or wells (ELEA 2007, Section 2.3.4.1.4).

3.3.2.2 Earthquake Potential

A review of the seismic risk was based on USGS Geologic Hazards Science Center's 2009 Earthquake Probability Mapping (USGS 2009), which generates maps that show the probability of a magnitude 5.0 or higher earthquake within a 30-mile radius of any location within the next 50 years. On a scale of 0.00 (the lowest probability of earthquake) to 1.00 (the highest probability), all Project facilities are within the low probability range of 0.01 to 0.02 as shown in Figure 3.3.5 (USGS 2009).

3.3.2.3 Probabilistic Ground Motion

Probabilistic ground motion for the Site was determined using information from the USGS (USGS 2014). Figure 3.3.6 is a probabilistic ground motion map of the Site, illustrating peak horizontal acceleration with a 2 percent probability of exceedance in 50 years (2,500 year return interval). The Peak Horizontal Ground Acceleration (PGA) value of 0.04 of the acceleration due to gravity (g) to 0.06g estimated by the regional USGS algorithm is similar to values suggested by several

site-specific studies for nearby locations. The Geological Characterization Report (GCR) for the WIPP Site (Powers et al., 1978) determined acceleration of ≤0.06g for a return interval of 1,000 years, and ≤0.1g for a return interval of 10,000 years (WIPP is located approximately 16 miles southwest of the Site); the results of the GCR were reviewed and confirmed by Sanford et al. (1993), which estimated a maximum expected acceleration of 0.1g for the WIPP, and again in the Safety Evaluation Report for the WIPP (DOE 2016b, Section 3.2), which describes the GCR results as conservative. The seismic hazard for the National Enrichment Facility (NEF) uranium enrichment facility predicts 0.15g for a return interval of 10,000 years (LES 2005, Section 3.3.1.1.5.1). The NEF facility is about 38 miles southeast of the Site (ELEA 2007, Section 2.3.4.1.1).

3.3.2.4 Faulting

Quaternary-age faulting is not present in the vicinity of the Site. The nearest Quaternary-age fault is located 85 miles southwest of the Site (USGS 2016b). Little is known about this fault except that it is a normal fault, 3.6 miles in length, and has a slip rate of less than 0.01 inch per year. The Guadalupe fault forms a scarp on unconsolidated Quaternary deposits at the western base of the Guadalupe Mountains in the Basin and Range physiographic province. The same USGS database shows numerous other Quaternary-age faults within a 200-mile radius of the Site, located to the west and southwest, most of which are at the distal end of the radius and are near the Rio Grande Rift of central New Mexico. Figure 3.3.7 is a map of New Mexico and West Texas showing Quaternary-age faulting as cataloged by the USGS, and as down-loaded from the database referenced above. The database contains locations and information on faults and associated folds that have been active during the Quaternary (the past 1.6 million years).

In all, there are a total of 27 Quaternary faults or fault zones within a 200-mile radius of the Site. A total of four “capable” faults were identified, including the Guadalupe fault. A “capable” fault is one that has exhibited one or more of the following characteristics (10 CFR 100 Appendix A.III [Definitions]):

- Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years.
- Macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault.
- A structural relationship to a capable fault according to the previous two characteristics such that movement on one could be reasonably expected to be accompanied by movement on the other.

For the purposes of this assessment, capable faults were identified based solely upon the first characteristic above.

3.3.3 Salt Dissolution and Sink Holes

Comparison of conditions at the Site with those conditions favorable to karst development indicates that conditions at the Site are not conducive to karst development. No thick sections of soluble rock are present at or near land surface; the shallowest soluble bedrock materials are gypsum and halite beds in the Rustler Formation, which is located at least 1,100 feet below land

surface at the Site. Additionally, rainfall rates in the area are low. Mescalero caliche is soluble and situated at or near land surface; however this unit is no more than 10 feet in thickness. Local dissolution of this unit may have resulted in the development of a number of small shallow depressions in the area; however this is not regarded as an active or significant karst process at the Site (ELEA 2007, Section 2.3.4.2).

During site reconnaissance, detailed inspection of the areas around the margins of Laguna Gatuna and tributary drainages was performed to identify any tension cracks, disrupted soils, tilting, or other evidence of rapid earth displacement. No tension cracks or other evidence of displacement was observed. Additionally, older cultural features in the area were inspected to identify evidence of tilting, offset, or displacement that could indicate recent land movement. A number of oil wells were drilled along the west flank of Laguna Gatuna beginning in the early 1940's. Most of the wells were abandoned by 1975 and well monuments were installed; several of the well monuments were identified during site reconnaissance. None of the monuments displayed evidence of tilting that might be associated with local earth movements (ELEA 2007, Section 2.3.4.2).

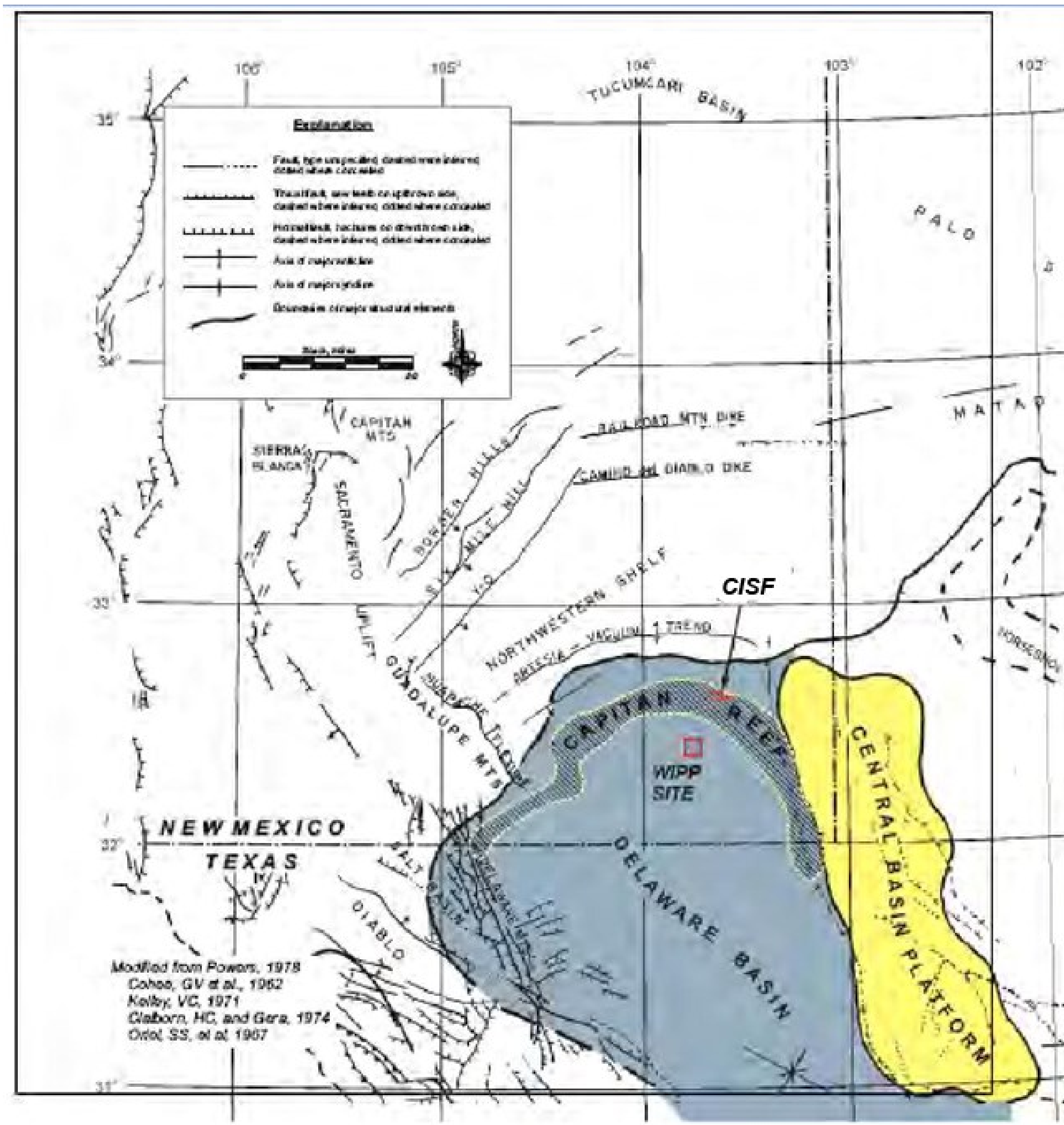
3.3.4 Soils

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Maps of Lea County, New Mexico (USDA/NRCS 2016) were reviewed in order to identify the soil units present at the Site. A Soil Survey Map is provided as Figure 3.3.8. The majority of onsite soils (60 percent) consist of Simona fine sandy loam (SE) and Simona-Upton association (SR). Simona soils are calcareous eolian deposits derived from sedimentary rock and consist of fine sandy loam underlain by gravelly fine sandy loam and cemented material, and gravelly fine sandy loam underlain by fine sandy loam and cemented material.

As shown on Figure 3.3.8, the construction zones for the Site largely include the SR and SE soils, as well as: Midessa and Wink fine sandy loams (MN), Mixed alluvial land (MU), Mobeetie-Potter association (MW), and Kimbrough gravelly loam (KO). MN soils are calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock and consist of fine sandy loam underlain by clay loam. MU soils are mixed alluvium derived from sedimentary rock; they consist of stratified sand to loamy fine sand to loam to sandy clay loam to clay loam to clay. MW soils are calcareous sandy alluvium derived from sedimentary rock and consist of fine sandy loam. KO soils are calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock and consist of gravelly loam underlain by cemented material (ELEA 2007, Section 2.3.3).

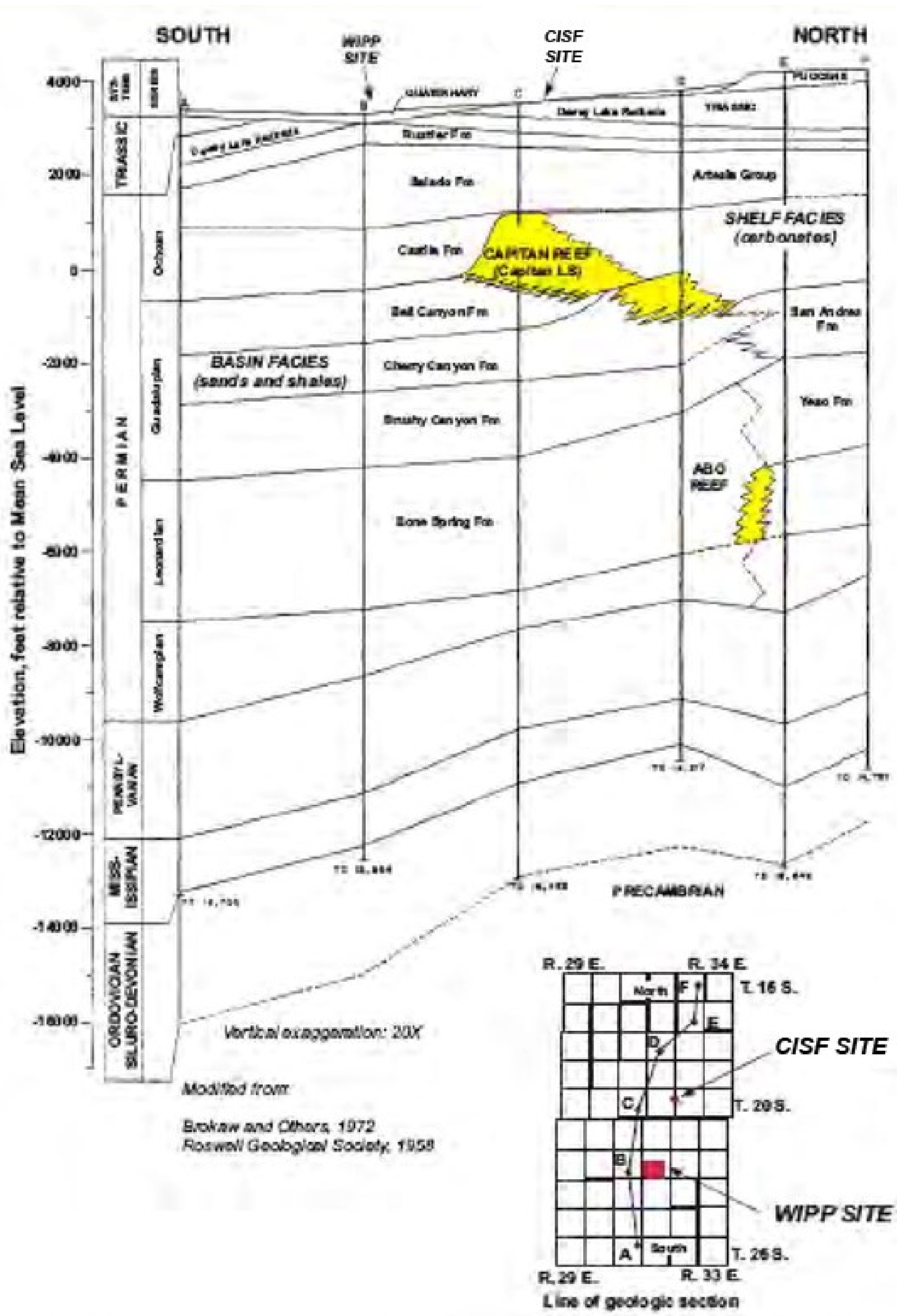
Appendix D provides additional information regarding soil descriptions, soil features, and physical, chemical, and engineering properties, including soil salinity. A review of the available soil data, including engineering properties of the Site soils indicates favorable conditions for foundations, utilities, surface pavement, and other improvements (ELEA 2007, Section 2.3.3).

The geotechnical site characterization completed by GEI provides field and laboratory data on soil and rock obtained for design Phase 1 of the proposed HI-STORE confirmed the results of previous investigations in the area. A thin layer of top soil underlain by caliche caprock and clayey sand/sandy clay residual soil was observed. Beneath the soil was bedrock consisting of Chinle mudstone underlain by Santa Rosa sandstone(GEI 2017).



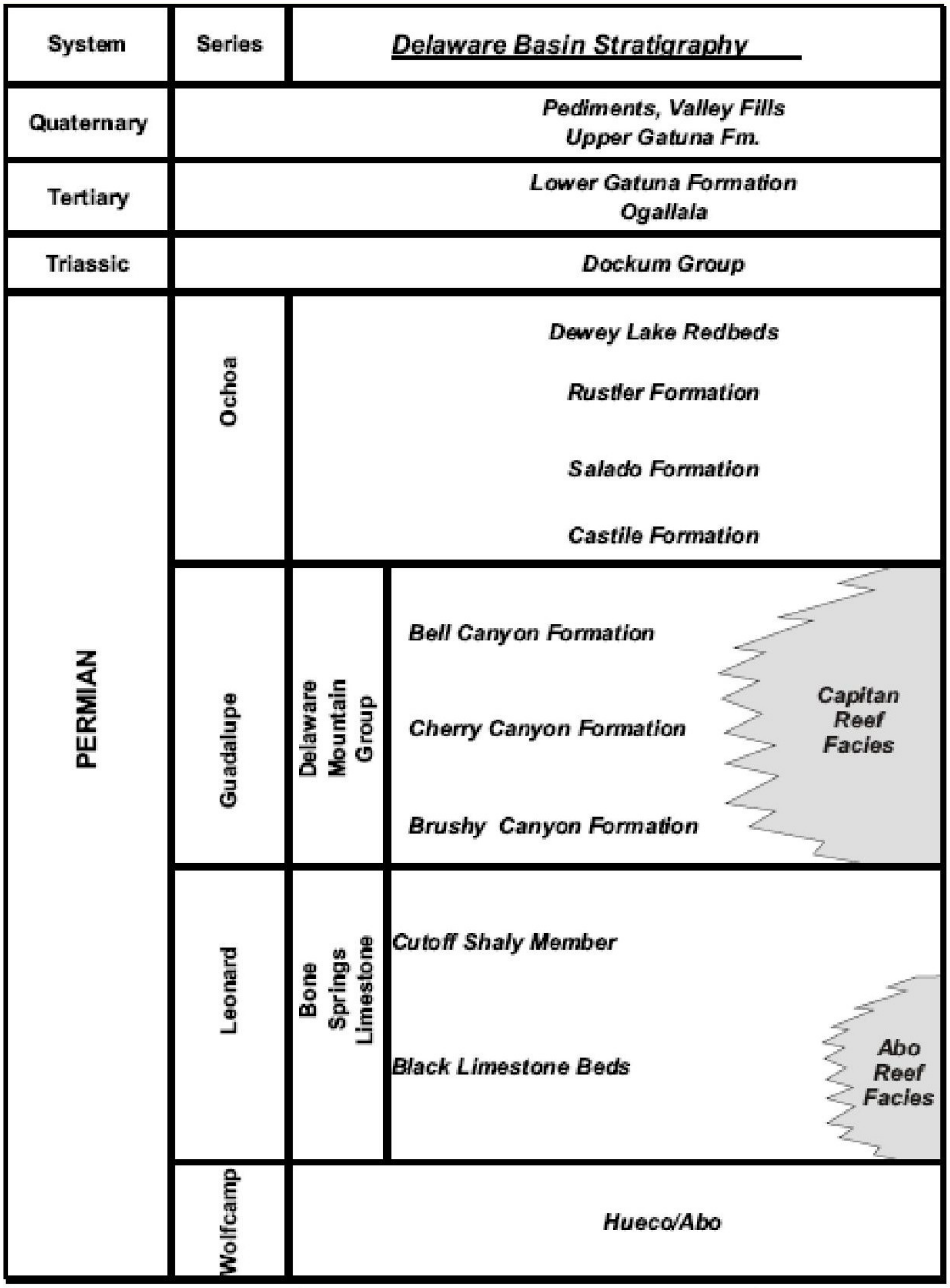
Source: ELEA 2007, Section 2.3.2.2.

Figure 3.3.1: MAJOR REGIONAL GEOLOGICAL STRUCTURES NEAR THE SITE



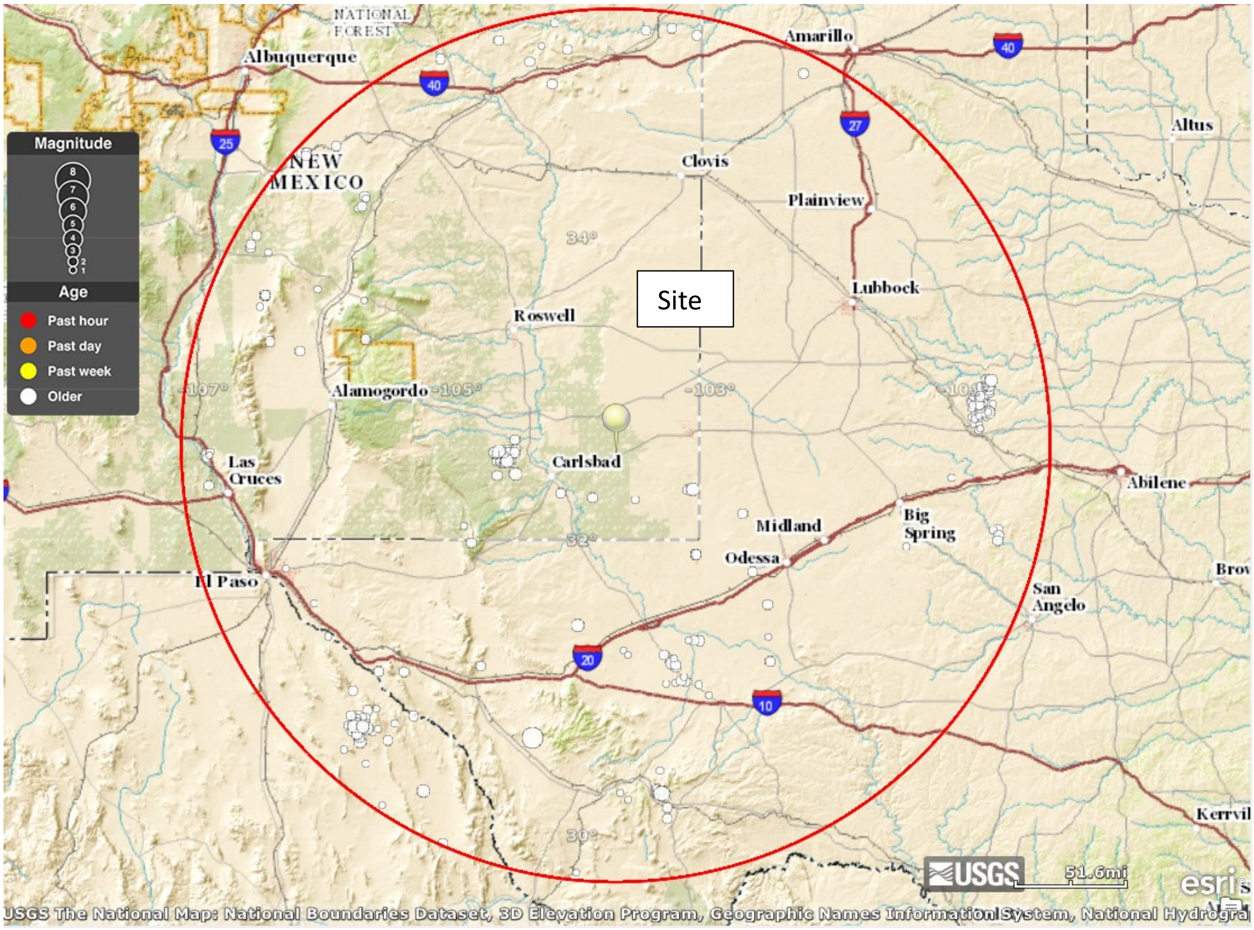
Source: ELEA 2007, Section 2.3.2.2.

Figure 3.3.2: GEOLOGIC CROSS SECTION THROUGH THE CAPITAN REEF AREA, EDDY AND LEA COUNTIES, NM



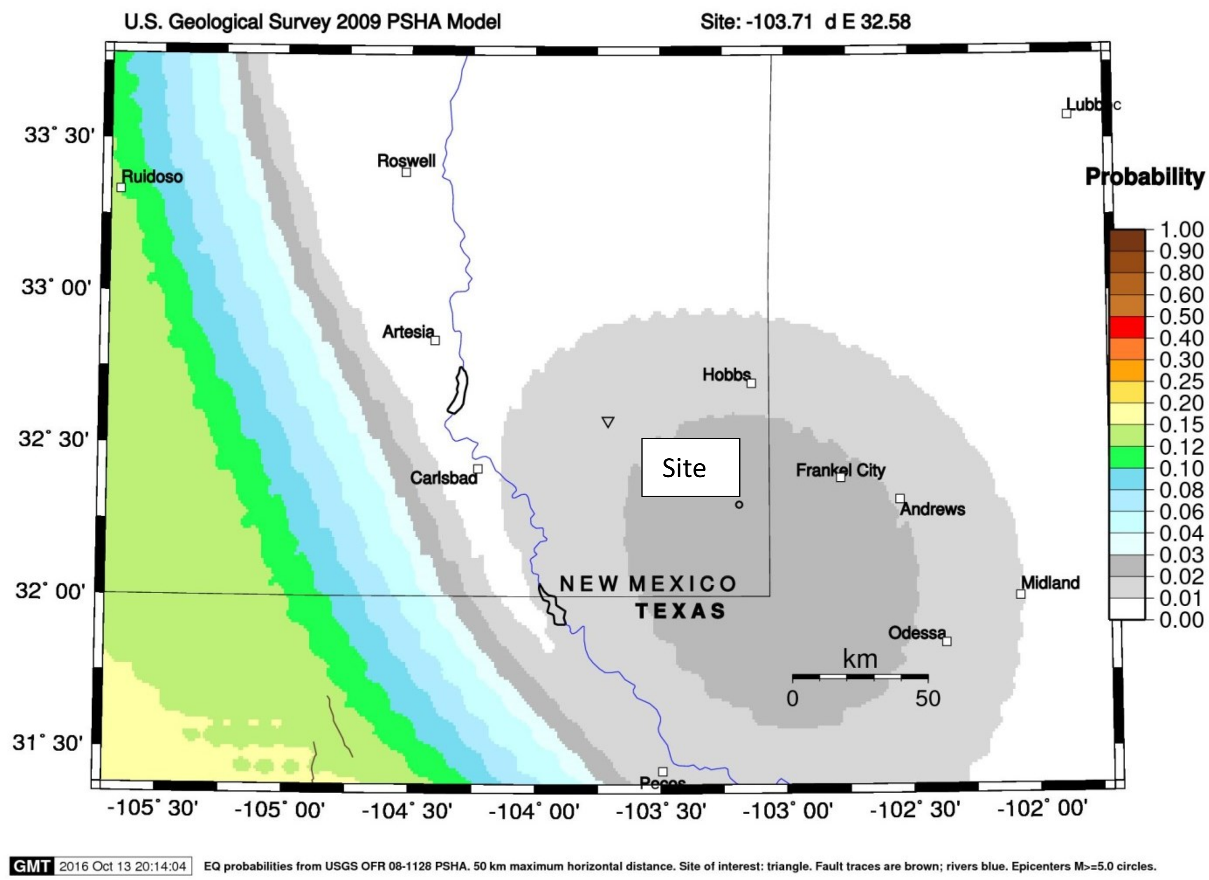
Source: ELEA 2007, Section 2.3.2.2.

Figure 3.3.3: PERMIAN TO QUATERNARY-AGED STRATIGRAPHY OF THE DELAWARE BASIN



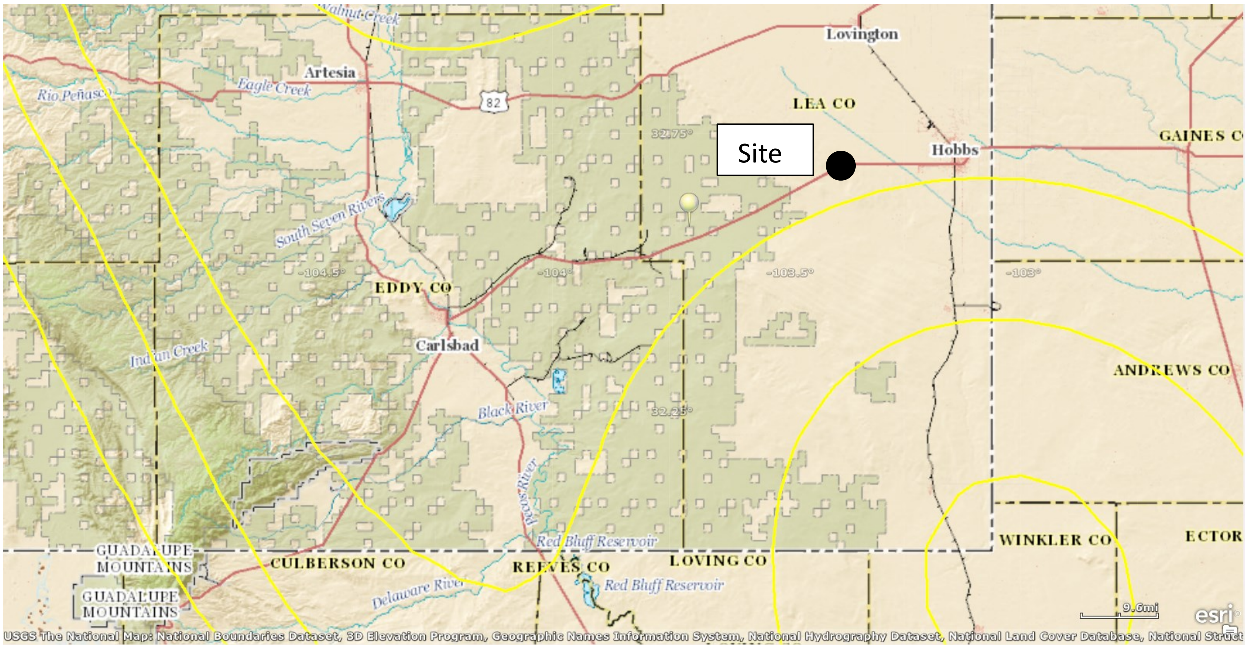
Source: USGS 2016a.

Figure 3.3.4: EARTHQUAKES (MAGNITUDE 2.5 OR GREATER) WITHIN 200 MILES OF THE SITE



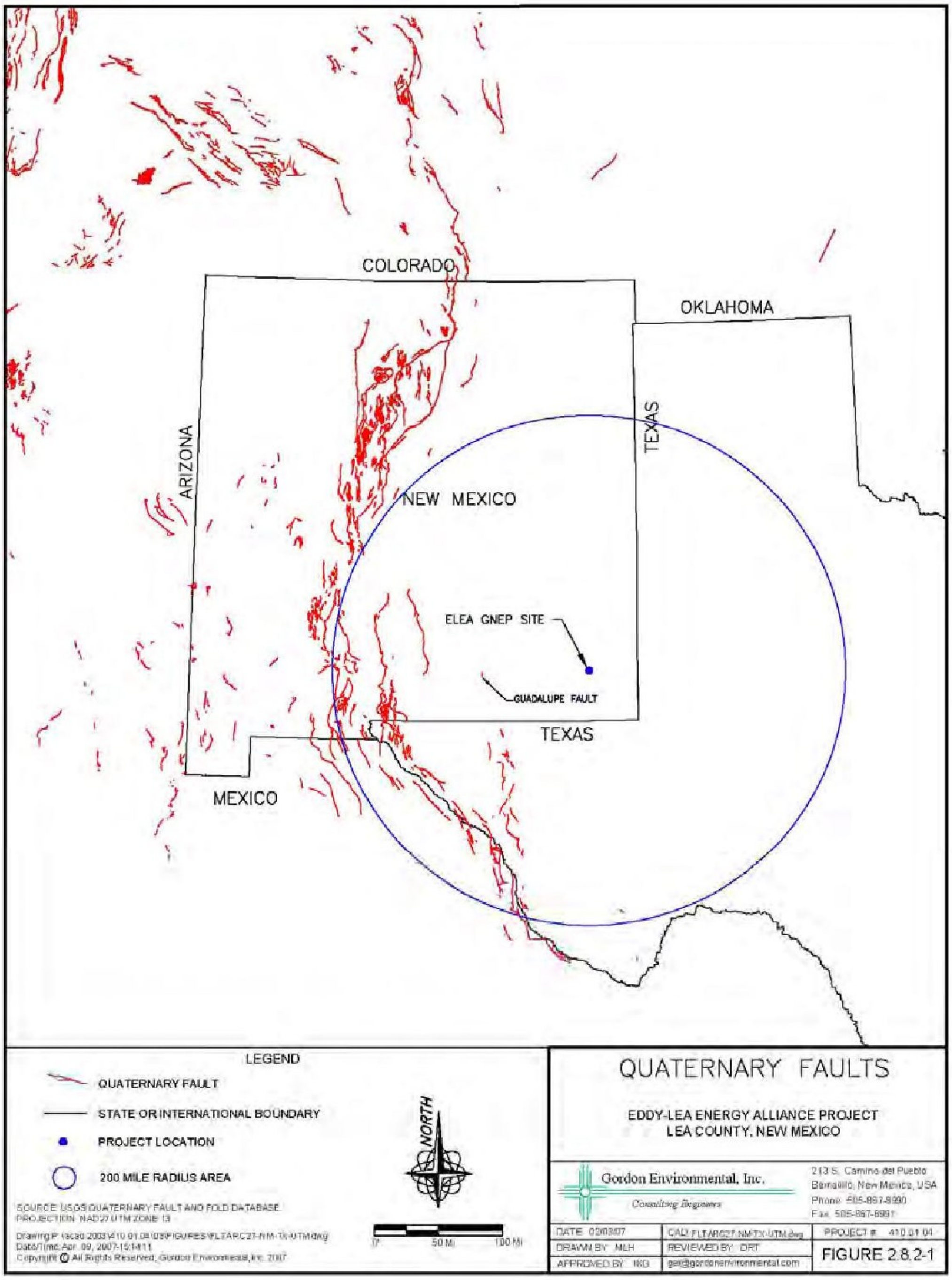
Source: USGS 2009.

Figure 3.3.5: PROBABILITY OF EARTHQUAKE WITH MAGNITUDE GREATER THAN 5.0 WITHIN 50 YEARS AND 30 MILES OF THE SITE



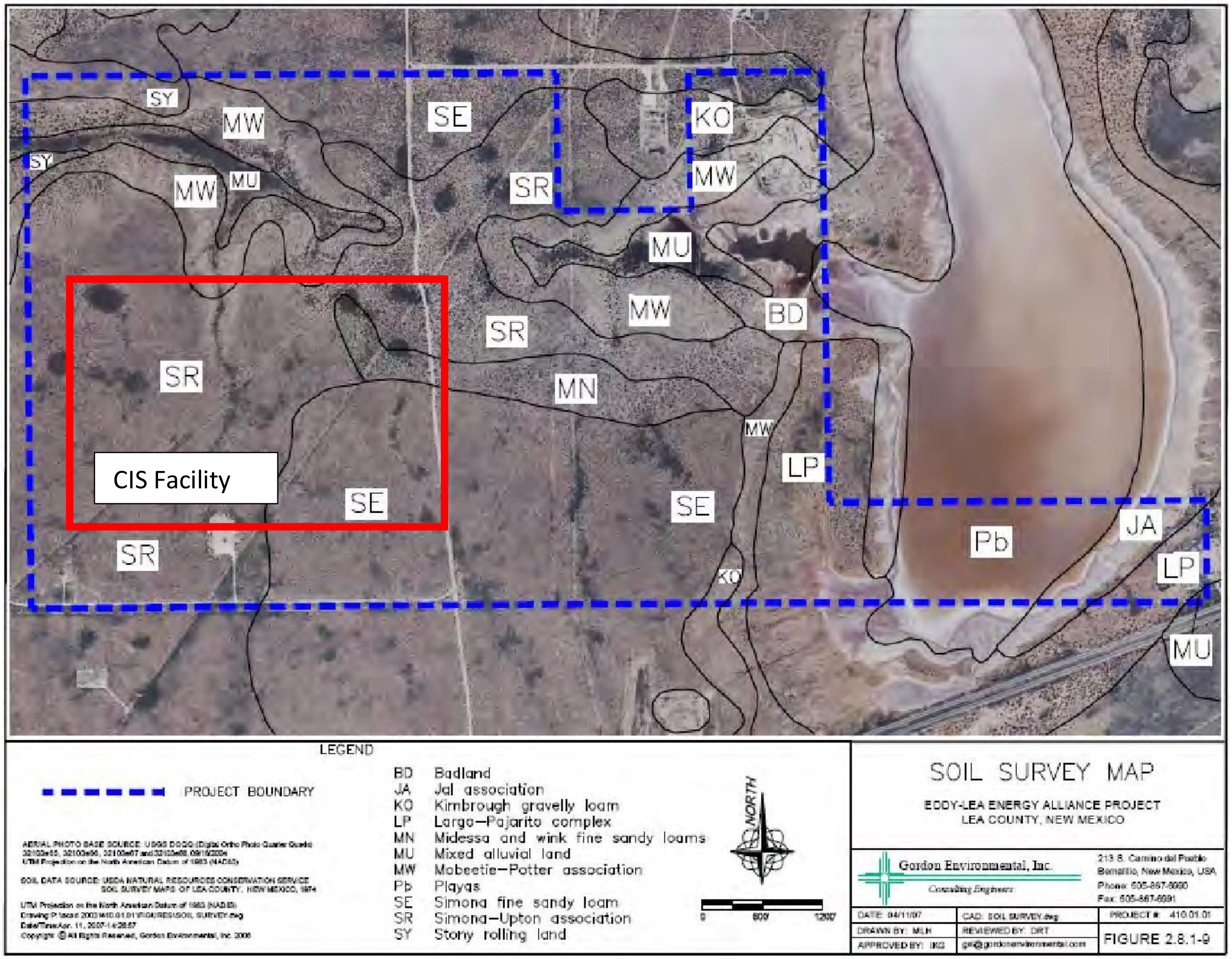
Source: USGS 2014.

Figure 3.3.6: PEAK GROUND ACCELERATION (PERCENT OF GRAVITY) (2,500 YEAR RETURN INTERVAL)



Source: USGS 2016b.

Figure 3.3.7: QUATERNARY FAULTS WITHIN A 200-MILE RADIUS OF THE SITE



Source: ELEA 2007, Section 2.3.3.

Figure 3.3.8: SOIL SURVEY MAP

3.4 ECOLOGICAL RESOURCES

This section describes the ecological communities in the area and is intended to provide a baseline characterization of the ecology prior to any disturbances associated with construction or operation of the project. The plant and animal species associated with this major community are identified and their distributions are discussed. Those species that are considered important to the ecology at the Site are described in detail, including the species' habitat requirements and life history. Also, as part of the evaluation of important species at the CIS Facility, pre-existing environmental conditions that may have impacted the ecological integrity of the CIS Facility and affected important species are considered. An in-field ecological survey of the Holtec Underground CIS Facility project in Lea County, New Mexico was conducted on October 14, 2016 (Appendix B). The ecologic survey was conducted across the approximately 330-acre footprint that could be disturbed by the proposed CIS facility (all phases). The 2016 survey findings were consistent with the prior 2007 ecological survey (See Section 3.4.1.1) conducted on the entire 1,040-acre parcel. Because there was nothing remarkable about the comparison of results, there was no need to survey a greater area, as the combined results of the 2007 and 2016 ecological surveys adequately characterize the ecological environment of the Site. Figure 3.4.1 is a topographic map of the project boundary and surrounding area. This topographic map is enhanced with focus on the CIS Facility for Figure 3.4.2 and Figure 3.4.3.

3.4.1 Ecological Systems

3.4.1.1 Prior Ecological Studies

An ecological study for the Eddy-Lea Energy Alliance (ELEA) Global Nuclear Energy Project (GNEP) was conducted in 2007 (ELEA 2007, Section 2.6). The facilities proposed for GNEP were nuclear-related and were expected to have a similar footprint as the proposed CIS Facility.

3.4.1.2 General Ecological Conditions

The Project area is classified as Apacherian-Chihuahuan mesquite upland scrub (NatureServe 2016). This ecosystem often occurs as invasive upland shrublands such as those that are concentrated in the foothills and piedmonts of the Chihuahuan Desert (NatureServe 2009). Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. Deep-rooted shrubs are able to access the deep-soil moisture that is unavailable to grasses and cacti. Vegetation is dominated typically by honey mesquite (*Prosopis glandulosa*) or velvet mesquite (*Prosopis velutina*) and succulents. Grass cover is typically low and composed of desert grasses such as low woollygrass (*Dasyochloa pulchella*), bush muhly (*Muhlenbergia porteri*), curlyleaf muhly (*Muhlenbergia setifolia*), and tobosagrass (*Pleuraphis mutica*) (NatureServe 2016). During the last century, the area occupied by this ecosystem has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and decreases in fire frequency (NatureServe 2009).

Common mammals in the Project area include mule deer, antelope, coyote, skunks, cottontail, jackrabbits, pocket gophers, foxes, woodrats and various small rodents. Many species of lizards and snakes are also common. Various sized active burrows, tracks and scat seen in the field implied

the presence of small mammals, coyote, foxes and lizards (ELEA 2007, Section 2.6.1.1). Birds common in habitat typical of the proposed Site include quail, doves, various hawks, sparrows, loggerhead shrike, flycatchers, thrashers and cowbirds.

3.4.1.3 Important Ecological Systems

Based on recent field studies and the published literature, there are no onsite important ecological systems that are especially vulnerable to change or that contain important species habitats such as breeding areas, nursery, feeding, resting, and wintering areas, or other areas of seasonally high concentrations of individuals of important species.

3.4.1.4 Important Travel Corridors

The Site does not pass through any designated wildlife corridors (NM CHAT 2016). The terrestrial wildlife species that potentially inhabit this area do not have established migratory corridors through the Site. The Project would not block terrestrial species travel, as they could easily move around the Site.

Southeastern New Mexico, including Lea County, is within the Central Flyway, one of the four major North American bird migration corridors between nesting and wintering grounds. Depending on the availability of food and water that may be temporarily present in the playas in the vicinity of the Site during seasonal migrations, migratory birds such as these could occasionally be present on or in the vicinity of the Site.

3.4.1.5 Ecological Succession

Long-term ecological studies of the Site are not available for analysis of ecological succession at this specific location. The property is located in a Desert Grasslands vegetation community (Dick-Peddie et al. 1993), within the Apacherian-Chihuahuan mesquite upland scrub classification (NatureServe 2013), which is a climax community that has been established in western Lea County for an extended period. With the exception of areas along maintained road and pipeline ROW's, the project area is in a climax successional stage, as evidenced by the presence of honey mesquite and broom snakeweed (Appendix B).

3.4.1.6 Indications of Ecological Stress

Pre-existing environmental stresses on the plant and animal communities at the Site consists of ROWs for pipelines, roads, well pads, power lines, telephone lines, and a communications tower, and domestic livestock grazing (ELEA 2007, Section 2.1.1). The impact of road installation and maintenance of the ROW is colonization of the disturbed areas by local plant species, typically by lower successional state species (i.e., weeds). As long as ROW maintenance activities continue, this pattern of succession is expected to continue.

Historical domestic livestock grazing and partial fencing of the Site constitute a pre-existing and continuing environmental stress. Heavily grazed native grasslands tend to exhibit changes in vegetation communities that move from mature, climax conditions to mid-successional stages with the invasion of woody species such as honey mesquite and sagebrush. The Site has stands of mesquite indicative of long-term grazing pressure that has changed the vegetative community from

one dominated by climax grasses to a sand scrub community and the resulting changes in wildlife habitat.

Another periodic environmental stress is changes in local climatic and precipitation patterns. The Site is located in an area of the Pecos Valley of New Mexico that experiences shifts in precipitation amounts that can affect plant community diversity and production on a short-term seasonal basis and also on a long-term basis that may last for several years. Below average precipitation that negatively impacts the plant community also directly alters wildlife habitat and may severely reduce wildlife populations.

Past livestock grazing, fencing, and the maintenance of access roads and pipeline ROWs represent the primary pre-existing environmental stress on the wildlife community of the Site. The probable result of the past and current use of the Site is a shift from wildlife species associated with mature desert grassland to those associated with a grassland shrub community. Large herbivore species such as the pronghorn antelope (*Antilocapra americana*) that require large, open prairie areas with few obstructions such as fences have decreased. Other mammalian species that depend on open grasslands, such as the black-tailed prairie dog (*Cynomys ludovicianus*), are also no longer present in the immediate area. Bird species that depend on the mature grasslands for habitat, such as the lesser prairie chicken (*Tympanuchus pallidicinctus*), have decreased in the region and at the Project area. Other species that thrive in a mid-successional plant community, such as the black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and mule deer (*Odocoileus hemionus*), have probably increased. No other environmental stresses on the terrestrial wildlife community (e.g., disease, chemical pollutants) have been documented at the Project area.

3.4.2 Vegetation

3.4.2.1 Major Vegetation Characteristics

The Site is in the primary vegetation community of Desert Grasslands (Dick-Peddie et al. 1993), which is widespread at lower elevations in southern and western New Mexico. These communities are characterized by significant amounts of grasses and less than 10 percent of total cover being forbs and shrubs (Dick-Peddie et al. 1993).

Typical vegetation in Desert Grassland communities include black grama (*Bouteloua eriopoda)*, blue grama (*Bouteloua gracilis)*, bluestem, buffalo grass (*Bouteloua dactyloides)*, western wheatgrass (*Pascopyrum smithii*), galletas (*Hilaria spp.)*, tobosa grass (*Pleuraphis mutica)*, alkali sacaton (*Sporobolus airoides*), three-awn (*Aristida spp*.), mesquite (*Prosopis spp*.), serviceberry (*Amelanchier denticulate)*, skunkbush sumac (*Rhus trilobata*), sand sagebrush (*Artemisia filifolia)*, Apache plume (*Fallugia paradoxa*), creosotebush (*Larrea tridentata)*, and cliffrose (*Purshia mexicana*). With appropriate moisture (generally more than is typically experienced) sunflower (*Helianthus annuus*), croton (*Croton spp.)*, and pigweed (*Amaranthus palmeri)* may grow in disturbed or ponded depressions.

Surveys of the area have not documented traditional grassland species in this area. A survey conducted in March of 2007 (ELEA 2007, Section 2.6.1.2) at this same site documented vegetation more typical of mesquite scrubland communities, including small soapweed (*Yucca glauca),* globemallow *(Sphaerakea sp.),* dwarf desert holly *(Acourtia nana),* threeawn, ragweed *(Ambrosia sp.),* black grama, broom snakeweed *(Gutierrezia sarofhrae),* blue grama, spiny dogweed

(Thymophylla acerosa), muhly *(Muhlenbergia sp.),* cowpen daisy *(Verbesina encelioides),* vine mesquite *(Panicum obtusum),* Panicgrass (*Panicum sp*.), bladderpod (*Lesguerella sp*.), burrograss (*Scleropogon brevifolius*), plains bristlegrass (Setaria leucopila), james' nailwort (*Paronychia jamesii*), fourwing saltbush (*Atriplex canescens),* lotebush (*Condelia erkokfes),* joint fir *(Ephedra sp.),* buffalobur (*Solanum rostraturn),* potts' leatherweed (*Croton pottsii),* mock vervain (*Glandularia sp.),* milkvetch (*Astragaius sp.),* and honey mesquite.

A survey in October of 2016 (Appendix B) also documented a variety of mesquite scrubland and very few grassland species. This further indicates that vegetation in the area has changed from a desert grassland to mesquite scrubland due to overgrazing. The dominant species documented during this survey include broom snakeweed, honey mesquite, prairie verbena *(Glandularia bipinnatifida)*, prickly pear (*Opuntia engelmannii)*, scarlet globemallow *(Sphaeralcea coccinea)*, silverleaf nightshade *(Solanum elaeagnifolium)*, tobosa grass, western peppergrass *(Lepidium montanum)*, and wooly croton *(Croton capitatus)*.

3.4.2.2 Important Habitat

Vegetation and habitats within the Site and immediately surrounding area are common within the region. The Site does not support any vegetation of significance. Significance is defined in this document as any plant, animal, or habitat that: (1) has high public interest or economic value or both; or (2) may be critical to the structure and function of the ecosystem or provide a broader ecological perspective of the region.

No riparian habitat exists in or near the Site. There are two playas (Laguna Gatuna and Laguna Plata) in the vicinity of the Project area (within two miles), but neither supports riparian habitat or other habitat for wildlife because of the lack of food and high salinity of the soils and water. (ELEA 2007; Section 2.6.1.2). There are several low-lying areas near the northern border of the project area that show evidence of water collection during heavy rain events, resulting in thicker upland vegetation communities in these areas, but no riparian vegetation (Appendix B).

For most of the threatened, endangered, and other important species, the importance of the habitat on the proposed Project area relative to the habitat of those species throughout their entire range is rather low. Most of these species have little or no suitable habitat on the proposed Project area and the habitats present are not rare or uncommon in the local area or range-wide for these species.

Although the proposed Project area contains fair to poor quality wildlife habitat for most species, there are some species of conservation or management concern are associated with this ecological system, and may utilize it for some portions of their life cycle (nesting, foraging, cover, burrows). These species are of conservation or management concern due primarily to their relative vulnerability to extinction through alteration of other ecosystems but mesquite scrub may replace lost habitat in some cases (NatureServe 2013). Some of the species of concern that are associated with the mesquite upland scrub ecosystem include Ferruginous Hawk (*Buteo regalis*) (breeding population only), Mourning dove (*Zenaidura macroura*), Northern Aplomado Falcon (*Falco femoralis septentrionalis*), White-winged dove (*Zenaidura astiatica*), scaled quail (*Callipepla squamata*), Banner-tailed Kangaroo Rat (*Dipodomys spectabilis*), Black-tailed Prairie Dog, Collared Peccary (*Tayassu tajacu*), Mule deer, White-tailed deer (*Odocoileus virginianus*), Slevin's Bunchgrass Lizard (*Sceloporus slevini*), among others (NatureServe 2013).

This area historically supported lesser prairie-chickens, but their population has decreased in the region, as it typically depends on the mature grasslands for habitat, which has largely been converted to mesquite scrubland in this area. The project area no longer consists of grassland vegetation, and lesser prairie-chickens were not observed during recent surveys (see section 3.4.3). The majority of the project area is within the outer limits of a BLM Isolated Population Area and Timing and Noise Restriction Zone for this species. The timing restriction would entail certain activity restrictions between 3:00 A.M. – 9:00 A.M. from March 1 to June 15. However, the portion of the project area that is within this restriction zone is on private property and the restrictions would not be enforced by the BLM. In 2007, several disjunct parcels in the region were proposed as Lesser Prairie-Chicken Habitat Preservation Area of Critical Environmental Concern (ACEC) (BLM 2008). One of these parcels was 2.2 miles north of the project area. However, the final 58,000-acre lesser prairie-chicken habitat preservation ACEC was established approximately 58 miles north of the project area (BLM 2008).

3.4.3 Wildlife

During survey conducted in March of 2007 (ELEA 2007, Section 2.6.1.1), 16 bird species and 4 mammal species were recorded. No reptiles or amphibians were observed. Bird species encountered were Northern harrier (*Circus cyaneus),* ferruginous hawk (*Buteo regalis),* killdeer (*Charadrius vociferous),* Greater yellowlegs (*Tringa melanoleuca),* Western snowy plover (*Charadrius alexandtinus nivosus),* Eurasian collared dove (*Streptopelia decaocto),* Ladder-backed woodpecker (*Picoides scaralis),* loggerhead shrike (*Lanius ludovicianus),* Horned lark (*Eremophila alpestris),* cactus wren (*Campylorhynchus brunneicapillus),* Crissal thrasher (*Toxostoma crissale),* Cassin's sparrow (*Aimophila cassinii),* lark bunting (*Calamospiza melanocorys), s*avannah sparrow (*Passerculus sandwichensis),* white-crowned sparrow (*Zonottichia leucophtys),* and Western meadowlark *(Sturnella neglecta)*. Mammals encountered were black-tailed jackrabbit*,* desert cottontail*,* woodrate (*Neotoma sp.),* and coyote (*Canis latrans)*.

Most bird species observed were typical year-round residents or wintering species for mesquite-grassland habitats in southern New Mexico. All the wildlife species observed during the surveys were typical of the habitat. Additional surveys conducted during all seasons and times of day in more than one year could reveal additional species.

A list of similar bird and mammal species was observed during the October 2016 survey. Eight birds and three mammals were observed: lark sparrow (*Chondestes grammacus)*, loggerhead shrike, mourning dove *(Zenaida macroura)*, northern harrier, red-tailed hawk (*Buteo jamaicensis)*, scaled quail *(Callipepla squamata)*, western meadowlark, white-winged dove *(Zenaida asiatica)*, black-tailed jackrabbit, desert cottontail, and Mearn's grasshopper mouse *(Onychomys arenicola*) (Appendix B).

3.4.3.1 Threatened and Endangered Species

The list of Federally-listed threatened and endangered (T&E) species having the potential to occur in the vicinity of the Project area was developed via reviews of online and hard copy resources, agency database requests, and agency consultation. Initially, the Biota Information System of New Mexico (BISON) (BISON 2016), New Mexico Rare Plant Technical Council (NMRPTC) New Mexico Rare Plants Website (NMRPTC 1999), and USFWS county-based internet search engine

were reviewed for Federally- and state-listed T&E species by county and the Site (USFWS 2016a and USFWS 2016b). Results from this search revealed three Federally-listed special status species and 22 state-listed special status species that occur in Lea County, New Mexico. These species, along with their habitat and life history requirements are listed in Table 3.4.1. There is no designated or proposed critical habitat within Lea County. However, in 2008, BLM established the Lesser Prairie-Chicken Habitat Preservation Area of Critical Environmental Concern (ACEC) in the region. The nearest ACEC is about 58 miles from the proposed CIS Facility site.

3.4.3.2 Threatened and Endangered Species Sightings

No rare, threatened, or endangered species have been observed in the vicinity of the proposed CIS Facility (ELEA 2007, Section 2.6.3 and Appendix B). However, during the October 2016 survey, a loggerhead shrike, a state-listed Sensitive Taxa with Full Protection species, was observed (Appendix B).

3.4.4 Aquatic Systems

3.4.4.1 Characterization of the Aquatic Environment

The proposed Project area contains no aquatic habitat (ELEA 2007, Section 2.4.1). The two playas in the vicinity contain a small amount of water for several days following a major precipitation event. However, these feature does not support aquatic life, and no rare, threatened, or endangered species are present. There also is a small, shallow “canyon” that drains the northwest quarter of section 13 of the Project area and empties into Laguna Plata. This drainage does not exhibit suitable bed and bank morphology and is within a topographically closed basin, and not a tributary to a Water of the United States (U.S.), which excludes it from consideration as a Water of the U.S. (ELEA 2007, Section 2.5.2 and Appendix B).

There is no hydrological/chemical monitoring station onsite, and no data have been recorded in the past.

3.4.4.2 Key Aquatic Organism Indicators

There are no key aquatic indicator organisms due to lack of habitat.

3.4.4.3 Significance of Aquatic Habitat

There is no significant aquatic habitat in the Project area due to lack of perennial water sources. However, there are several seasonally aquatic species that may be present in the Project area are during rain events or when ephemeral water is present in the nearby playas. The BISON database (BISON 2016) lists six amphibian species that could potentially be present. These are listed in Table 3.4.2 along with their preferred habitat (BISON-M). All six species are provided limited protection by the State of New Mexico, but all are listed as demonstrably secure in the state (BISON 2016). However, no amphibian species were observed during the March 2007 or October 2016 surveys.

3.4.4.4 Important Aquatic Ecological Systems

There are no important aquatic ecological systems onsite or in the local area that are especially vulnerable to change or that contain important species habitats, such as breeding areas, nursery

areas, feeding areas, wintering areas, or other areas of seasonably high concentrations of individuals of important species.

3.4.4.5 Commercial and Sport Fisheries

There are no commercial or sport fisheries located on the Project area or in the vicinity. There is no aquatic habitat or any perennial surface water. The closest fishery areas are the Pecos River and Lake Avalon located approximately 30 miles west of the Project area.

3.4.5 Recent Ecological Survey

In October 2016, Tetra Tech conducted an ecological survey of the Site, focusing on the areas proposed for Phase 1 facilities as well as the proposed rail spur and Site access road. The results of that survey are included in Appendix B. Overall, that survey corroborated the information from the 2007 survey, and the information in Section 3.4 is consistent with the results of the October 2016 survey.

Table 3.4.1:

FEDERALLY- AND STATE-LISTED SPECIES AND THEIR HABITATS EVALUATED FOR THE HOLTEC CIS FACILITY PROJECT, LEA COUNTY, NEW MEXICO

Common Name	Scientific Name	Federal Status[1]	State Status[2]	Habitat and Life History Requirements
Mammals				
Black-tailed prairie dog	*Cynomys ludovicianus*	NL	LP	The range of the black-tailed prairie dog appears to have expanded from Great Plains grasslands onto former shinnery savannahs which have been converted by livestock grazing into shortgrass-like habitat. In the Trans-Pecos of Texas, black-tailed prairie dogs favor grassy areas associated with alluvial fans at the mouths of draws, hardpan flats where brush is thin or absent, and the edges of shallow valleys. Colonies have been reported in plant associations ranging from mesquite-creosote-bush to grama-needlegrass and burrowgrass-cholla.
Cave myotis	*Myotis velifer*	NL	LP	Caves are the main roosts for this southwestern species, although it also uses mines, and occasionally buildings and bridges. It is primarily a "crevice dweller," preferring "crevices, pockets, and holes in the ceilings of its underground retreats". In all likelihood these animals hibernate in the numerous caves of the limestone country of Lincoln, Chaves, and Eddy counties. It is found in areas dominated by creosote bush, palo verde, brittlebush, and cactus (Texas Parks and Wildlife Department [TPWD] 2016b).
Common hog-nosed skunk	*Conepatus leuconotus*	NL	LP	Common hog-nosed skunks have been found to inhabit Chihuahuan Desert Scrub habitat in New Mexico. Hog-nosed skunks are especially found in oak and juniper woodlands. They are also found in shortgrass plains, sacaton grassland, sycamore, cottonwood, rabbitbrush, oak savanna, chaparral, and coniferous forest. Within the seven eco-zones in which they are found in New Mexico, their preferred habitat has rocky areas which are used for denning. Residential areas and farmlands are classified as secondary habitat.
Ringtail	*Bassariscus astutus*	NL	FP	Ringtail cats are found in riparian habitats primarily in montane habitats, but are also found in lowlands in rough, rocky country. It stays close to the cliffs and canyons it inhabits. It uses a variety of habitats, but it prefers rocky areas including rock piles, stone fences, canyon walls, and talus slopes (TPWD 2016c). It is also found in semi-arid country, deserts, chaparral, oak woodlands, pinyon pine woodlands, juniper woodlands, and montane conifer forests (Goldberg 2003).
Sandhill white-tailed deer	*Odocoileus virginianus texanus*	NL	FP	In eastern New Mexico, sandhill white-tailed deer are found most often in riparian communities on the eastern sides of the mountains, as well as in the sandhills east of Roswell.
Swift fox	*Vulpes velox*	NL	FP	The swift fox is found to inhabit Plains-Mesa Sand Scrub and Grasslands habitat and occupies shortgrass and midgrass prairies. It is rare in terrain that is highly eroded with gullies, washes, and canyons.
Western spotted skunk	*Spilogale gracilis*	NL	LP	Occurs throughout the Trans-Pecos and is most often found in association with rocky canyons, cliffs, or brushy gulches where thickets or rock piles afford protection. It occupies a wide variety of habitats, including desert, grassland, montane areas, and low rough, rocky terrain. This skunk is especially abundant in agricultural areas and around human constructions.

Table 3.4.1:

FEDERALLY- AND STATE-LISTED SPECIES AND THEIR HABITATS EVALUATED FOR THE HOLTEC CIS FACILITY PROJECT, LEA COUNTY, NEW MEXICO

Common Name	Scientific Name	Federal Status[1]	State Status[2]	Habitat and Life History Requirements
Birds				
Arctic peregrine falcon	*Falco peregrinus tundrius*	DL	T	Nests in the arctic islands and tundra regions of Alaska, Canada, and Greenland. Migrates through New Mexico twice a year to and from wintering areas in South America.
Baird's sparrow	*Ammodramus bairdii*	NL	T	Breeds in native mixed-grass and fescue prairie, winters in grasslands; does not inhabit prairie lands where fire suppression and changes in grazing patterns have allowed excessive growth of woody vegetation.
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges and pirates food from other birds.
Bell's vireo	*Vireo bellii*	NL	T	Dense, low, shrubby vegetation, generally early successional stages in riparian areas, brushy fields, young second-growth forest or woodland, scrub oak, coastal chaparral, and mesquite brushlands, often near water in arid regions.
Broad-billed hummingbird	*Cynanthus latirostris*	NL	T	Arid scrub, open deciduous forest, semi-desert and other open situations in arid habitats.
Burrowing owl	*Athene cunicularia*	NL	FP	Utilizes farms and annual grasslands with less than 5 percent wood cover. Breeds in grasslands, prairies, or open areas near human habitation, especially golf courses and airports.
Interior least tern	*Sternula antillarum athalassos*	LE	E	Subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams and rivers; also known to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc.); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony.
Lesser prairie-chicken	*Tympanuchus pallidicinctus*	UR[3]	FP	Arid grasslands, generally interspersed with shrubs such as sand sagebrush, sand plum, skunkbush sumac, and shinnery oak shrubs, but dominated by sand dropseed, sideoats grama, sand bluestem, and little bluestem grasses; nests in a scrape lined with grasses.
Loggerhead shrike	*Lanius ludovicianus*	NL	FP	Occurs in a range of habitat types including forested and non-forested to agricultural areas. Forested habitat may be of various canopy types, commonly with an herbaceous understory. Non-forested habitat may be open to dense stands of shrubs and low trees. Additional habitat types include semi-arid stands of native grasses and forbs or open stands of shrubs and succulents on dry, shallow, rocky, soils of mesas, benches, and canyon walls.
Mountain plover	*Charadrius montanus*	NL	FP	Migratory species found in lowland shortgrass prairies, dry playas and oftentimes on fallow agricultural fields. Appears to require some degree of bare ground which may be provided by livestock activity or disturbed areas around windmills and water tanks.
Northern aplomado falcon	*Falco femoralis septentrionalis*	LEXPN, XN	E	Wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats, open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species.

Table 3.4.1:

FEDERALLY- AND STATE-LISTED SPECIES AND THEIR HABITATS EVALUATED FOR THE HOLTEC CIS FACILITY PROJECT, LEA COUNTY, NEW MEXICO

Common Name	Scientific Name	Federal Status[1]	State Status[2]	Habitat and Life History Requirements
Northern goshawk	*Accipiter gentilis*	NL	FP	Occurs in mature, closed canopied coniferous forests of mountains and high mesas, hunting in an open understory or openings often with water nearby.
Peregrine falcon	*Falco peregrinus anatum*	DL	T	Year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in U.S. and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands. The subspecies *Falco peregrinus tundrius* is not easily distinguishable at a distance, so reference is generally made only to the species level.
Sprague's pipit	*Anthus spragueii*	C	N/A	Only in New Mexico during migration and winter, mid-September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.
Yellow-billed cuckoo (western population)	*Coccyzus americanus*	LT	FP	Migrates to North America throughout summer months, April through November; habitat includes open deciduous cottonwood-dominated woodlands with dense undergrowth, overgrown orchards and pastures, and moist thickets and willow groves along stream beds.
Reptiles				
Dunes sagebrush lizard	*Sceloporus arenicolus*	NL	E	Appears to be confined to areas of active sand dunes specifically vegetated by shinnery oak; adjacent open habitats of sand sagebrush and yuccas may be used in some places.

1 C – Candidate, DL – Delisted, LE – Listed Endangered, LEXPN, XN – Listed Experimental Population, Nonessential, LT – Listed Threatened, UR – Under Review, NL – Not Listed
2 E – Endangered, FP – Sensitive taxa (informal) Full Protection, LP – Sensitive taxa (informal) Limited Protection, N/A – Not Applicable, T – Threatened
3 The lesser prairie-chicken was listed as a threatened species under the federal Endangered Species Act on May 11, 2014. This listing was challenged and subsequently vacated (Permian Basin vs. USFWS, September 2015). On July 20, 2016, the species was removed from listing as a threatened species, but remains under review by USFWS. Although protections for the bird have ceased under the authority of the Endangered Species Act, the lesser prairie-chicken is still afforded protection by the State of New Mexico under "Full Protection" status.

Sources: Biota Information System of New Mexico (BISON) 2016, Goldberg 2003, Natural Heritage New Mexico (NHNM) 2016, Texas Parks and Wildlife Department (TPWD) 2016a, U.S. Fish and Wildlife Service (USFWS) 2016a,b.

Table 3.4.2:

AMPHIBIANS POTENTIALLY PRESENT AT THE SITE AND VICINITY AND THEIR HABITAT

Common Name	Scientific Name	Preferred Habitat
Couch's Spadefoot	*Scaphiopus couchii*	Shallow to standing pools of water
Great plains toad	*Anaxyrus cognatus*	Desert Grassland, creosote bush, grassland flats, mesquite dominated flats
New Mexico spadefoot	*Spea multiplicata*	Shallow to standing pools of water
Plains spadefoot toad	*Spea bombifrons*	Shallow to standing pools of water
Tiger Salamander	*Ambystoma mavortium; nebulosum*	Tall grass prairie and desert grasslands
Western green toad	*Anaxyrus debilis*	Desert Grassland habitat

Source: BISON 2016.

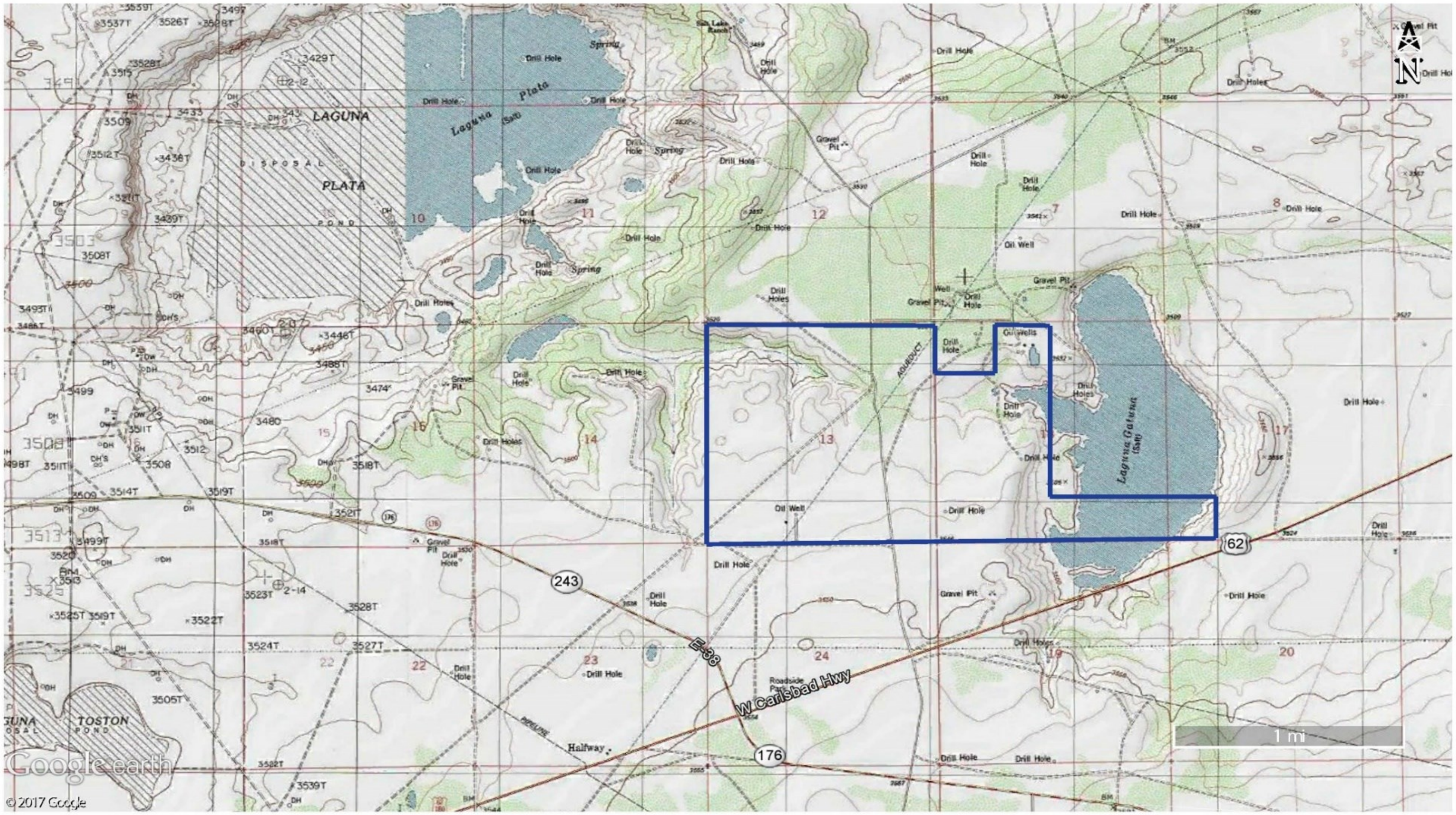


Figure 3.4.1: TOPOGRAPHY OF SITE AND SURROUNDING AREA (1)

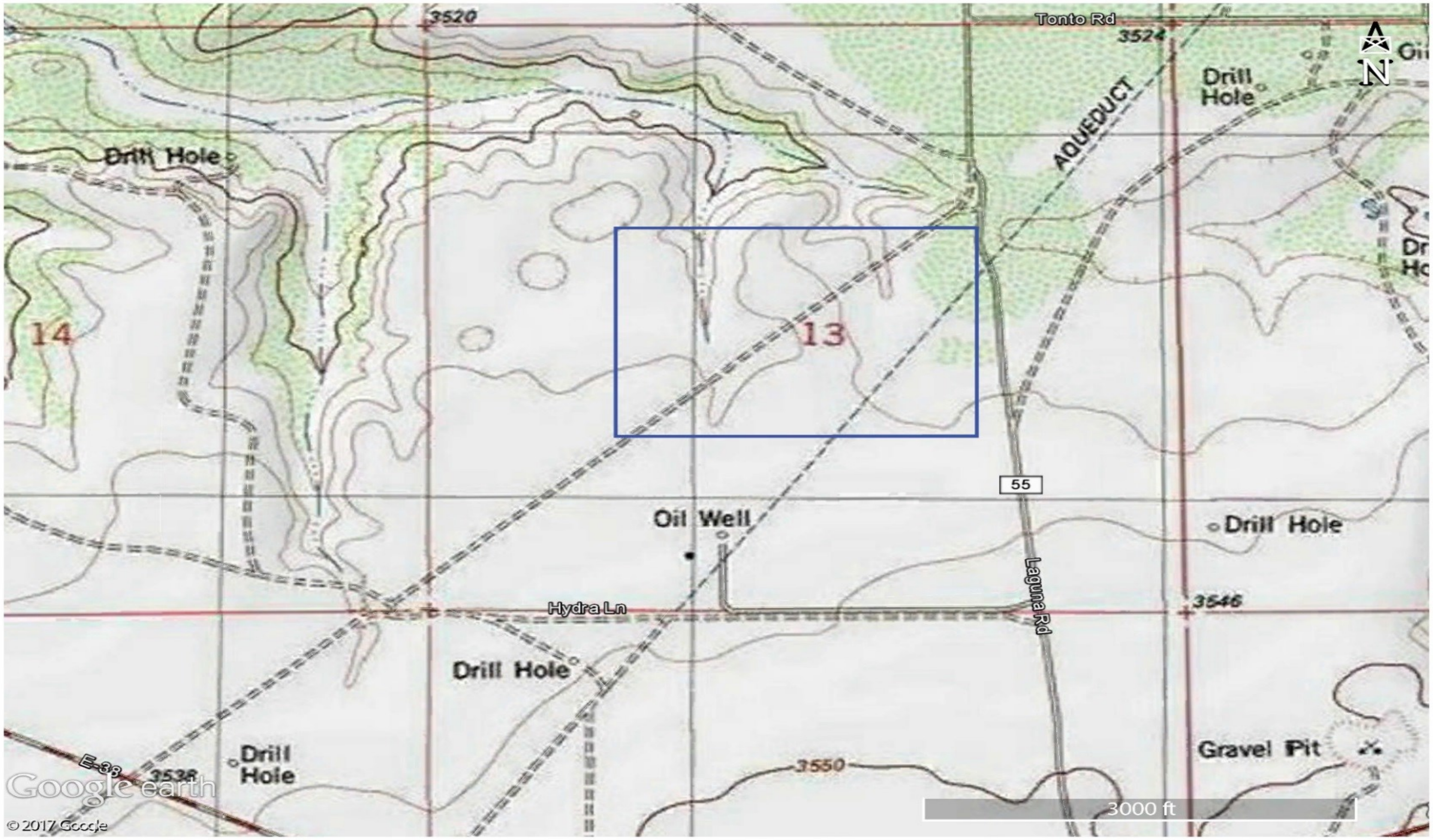


Figure 3.4.2: TOPOGRAPHY OF SITE AND SURROUNDING AREA (2)

Figure 3.4.3: TOPOGRAPHY OF SITE AND SURROUNDING AREA (3)

3.5 WATER RESOURCES

This section describes the water resources, including surface and ground water hydrology, water use, and water quality.

3.5.1 Surface Water Resources

Surface water generally consists of lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. Waters of the U.S. are defined within the Clean Water Act (CWA), as amended, and jurisdiction is addressed by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) (33 CFR Part 328).

Surface drainage at the proposed CIS Facility site is contained within two local playa lakes that have no external drainage. Runoff does not drain to one of state's major rivers. The only major natural lakes or ponds within 6 miles of the Site include Laguna Gatuna, Laguna Tonto, Laguna Plata, and Laguna Toston which are ephemeral playas. Surface runoff from the Site flows into Laguna Gatuna to the east and Laguna Plata to the northwest (ELEA 2007, Section 2.4.1). Surface water is lost through evaporation, resulting in high salinity conditions in soils associated with the playas (see Appendix D for more information concerning salinity in Site soils). These conditions are not favorable for the development of viable aquatic or riparian habitats. Other than the playas, the nearest surface water is the Pecos River which is west of the Site. At its nearest approach, the distance from the Site to the Pecos River is 26 miles. Like most rivers in New Mexico, the Pecos River is described as "extremely variable from year-to-year" due to its dependence on runoff. The principle use of Pecos River water is for agriculture. There are no sensitive or unique aquatic or riparian habitats or wetlands at the Site, nor is there surface water in the vicinity that is potable (ELEA 2007, Section 2.4).

The Site lies within the Pecos River Basin as presented in Figure 3.5.1, which has a maximum basin width of 130 miles, and a drainage area of 44,535 square miles. The Pecos River is the closest surface water feature to the Site. The principle use of Pecos River water is for agriculture. The main stem of the Pecos River and its major tributaries have low flows, and the tributary streams are frequently dry. Seventy-five percent of the total annual precipitation and 60 percent of the annual flow result from intense local thunderstorms between April and September (ELEA 2007).

The Pecos River originates in the mountains of northeast New Mexico. The northern most major reservoir is Santa Rosa Lake located on the Pecos River, 225 miles north of Carlsbad. The flow in the Pecos River below Fort Sumner is regulated by storage in Sumner Lake, Brantley Reservoir, Lake Avalon, and several other smaller dams, such as Tansill and Lower Tansill Dams in the City of Carlsbad. The vast majority of tributaries to the river flowing westward are unnamed arroyos. An exception is Pierce Canyon south of Malaga Bend that provides drainage into the Pecos River. Nash Draw, the largest surface drainage feature east of the Pecos River in the region, is a closed depression and does not provide surface flow into the Pecos (ELEA 2007, Section 2.4.1).

Water quality in the Pecos River basin is affected by mineral dissolution from natural sources and from irrigation return flows. At Santa Rosa, New Mexico, the average suspended-sediment discharge to the river is 1,650 tons per day. Large amounts of chlorides from Salt Creek and Bitter

Creek enter the river near Roswell. River inflow in the Hagerman area contributes increased amounts of calcium, magnesium, and sulfate; and waters entering the river near Lake Arthur are also high in chloride (ELEA 2007, Section 2.4.1).

Below Brantley Reservoir, springs that were sampled had total dissolved solid concentrations of 3,350 to 4,000 mg/l. Brine is generated and enters the Pecos River at Malaga Bend as the river contacts the Salado Formation adding an estimated 370 tons/day of chloride to the Pecos River (ELEA 2007, Section 2.4.1).

3.5.2 Groundwater

Groundwater is water that exists in the saturated zone beneath the earth's surface and includes underground streams and aquifers. It is an essential resource that functions to recharge surface water and is used for drinking, irrigation, and industrial processes. Groundwater features include depth from the surface, aquifer or well capacity, quality, recharge rate, and surrounding geologic formations.

3.5.2.1 Site Groundwater

The Site is located in the Capitan Underground Water Basin (UWB) as shown in Figure 3.5.2 (NMOSE 2016). A declared groundwater basin is an area of the state proclaimed by the State Engineer to be underlying a groundwater source having reasonably ascertainable boundaries. By such proclamation, the State Engineer assumes jurisdiction over the appropriation and use of groundwater from the source. The Capitan UWB covers approximately 731,500 acres in the south-central portion of Lea County. It is located within a geologic province known as the Delaware Basin, a subdivision of the Permian Basin. The Capitan UWB is oriented in a northwest-southeast alignment above an arc-shaped section of a formation known as the Capitan Reef Complex. The Capitan aquifer occurs within dolomite and limestone strata deposited as an ancient reef. The groundwater quality of the Capitan in Lea County is very poor, with total dissolved solids ranging from 10,065 to 165,000 mg/L.

Other aquifers in the Capitan UWB are found in the overlying Rustler Formation, Santa Rosa Sandstone, Ogallala Formation, and Cenozoic alluvium and are important sources of groundwater in the Capitan UWB. The depth to the top of the Rustler Formation ranges from 900 to 1,100 feet. Applications for new appropriations in the Capitan UWB are accepted by the Office of the State Engineer, although the high total dissolved solids and depth to water have restricted the use of the water.

Evapo-transpiration at the Site is five times the precipitation rate, indicating that there is little infiltration of precipitation into the subsurface. Furthermore, the near surface water table appears to be 35-50 feet deep, where present and is likely controlled by the water level in the playa lakes. Groundwater encountered on the east side of the Site is brackish, exceeding 10,000 parts per million in total dissolved solids which is the New Mexico regulatory threshold (NM Water Quality Control Commission Regulations, 20.6.2.3101A) for protected water. No groundwater has been encountered on the west side of the Site. There are numerous low permeability layers between the surface and the expected groundwater level (ELEA 2007, Section 2.4.2).

Well drilling was conducted at the Site in 2007. Two wells, ELEA-1 and ELEA-2 were drilled on the Site to identify the depth and character of water-bearing rocks. The goals of the drilling investigation were to identify the potential for thin groundwater saturation in lower alluvium perched on the Triassic shale, or deeper groundwater saturation in the Triassic shale. Locations of these wells and other wells in the vicinity are shown on the well location map in Figure 3.5.3.

Additionally, GEI Consultants drilled 3 monitoring wells to measure depth periodically during the subsurface exploration completed in December of 2017. Groundwater was observed in B107 from a depth range of 93.1 to 100 feet, and in B101 from a depth range of 253.4 to 263.7 feet. No groundwater was encountered in B106 (GEI 2017, Section 5.3). See Figure 3.5.4 for boring locations. Figure 3.5.5, 3.5.6, and 3.5.7 show the subsurface profiles for B101, B106, and B107.

Piezometer ELEA-1. A small amount of water was initially detected in the well; however the water has steadily declined to within a few inches of the bottom of the well and is attributed to the small amount of bentonite hydration water that was placed in the well to seal the upper annulus during completion. Based on the data obtained from ELEA-1, no shallow groundwater saturation is present at the top of the Triassic shale at the location (ELEA 2007, Section 2.4.2.2).

Piezometer ELEA-2. Water level in this well rose slowly over several days to a static depth of 34 feet below land surface (3,497 feet above mean sea level [amsl]). The water-bearing zone in this well consists of either fractures or tight sandy zones between the depths of 85 and 100 feet; water in this zone is under artesian head of 50 feet. Laboratory analyses of water samples from the well indicate that the water is highly mineralized brine (ELEA 2007, Section 2.4.2.2).

Based upon information obtained from the onsite drilling, shallow alluvium is likely non-water-bearing at the Site. Groundwater saturation in the Triassic shale appears to be limited to small amounts of highly mineralized water likely associated with the brine in Laguna Gatuna, where the brine is 3,500 feet amsl (ELEA 2007, Section 2.4.2.2).

3.5.2.1 Regional Groundwater

Potable groundwater is available from three geologic units in southern Lea County; the Triassic Dockum shale, the Tertiary Ogallala, and Quaternary alluvium (Nicholson and Clebsch 1961). No potable groundwater is known to exist in the immediate vicinity of the Site. Shallow groundwater is present in a number of locations in the area, but water quality and quantity are marginal at best and most, if not all, shallow wells that have been drilled in the area are either abandoned or not currently in use. Potable water for the area is generally obtained from potash company pipelines that convey water to area potash refineries from Ogallala High Plains aquifer on the caprock area of eastern Lea County. At present, water is generally obtained from these pipelines for other area users.

Much of the shallow groundwater near the Site has been directly or indirectly influenced by brine discharges from potash refining or oil and gas production. Potash mines have discharged thousands of acre-feet of near-saturated refinery process brine to Laguna Plata and to Laguna Toston for many years. But discharges ceased in Laguna Plata in the mid-1980s and in Laguna Toston by 2001. Laguna Gatuna was the site of multiple facilities for collection and discharge of brines that were co-produced from oil and gas wells in the entire area; facility permits authorized discharge of almost one million barrels of oilfield brine per month between 1969 and 1992. As a result,

saturations of shallow groundwater brine have been created in a number of areas associated with the playa lakes (ELEA 2007, Section 2.4.2.1).

3.5.3 Wetlands

Wetlands are identified as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The USACE regulates the discharge of dredged or fill material into waters and wetlands of the U.S. pursuant to Section 404 of the CWA. No USACE jurisdictional wetlands were identified on the Site (ELEA 2007, Section 2.5).

3.5.4 Floodplains

Floodplains are areas of low-level ground present along rivers, stream channels, or coastal waters subject to periodic or infrequent inundation due to rain or melting snow. Risk of flooding typically depends on local topography, the frequency of precipitation events, and the size of the watershed above the floodplain. Flood potential is evaluated by the Federal Emergency Management Agency (FEMA), which defines the 100-year floodplain as an area that has a one percent chance of inundation by a flood event in any given year. Federal, state, and local regulations often limit floodplain development to passive uses such as recreational and preservation activities to reduce the risks to human health and safety. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, nutrient cycling, water quality maintenance, and diversification of plants and animals.

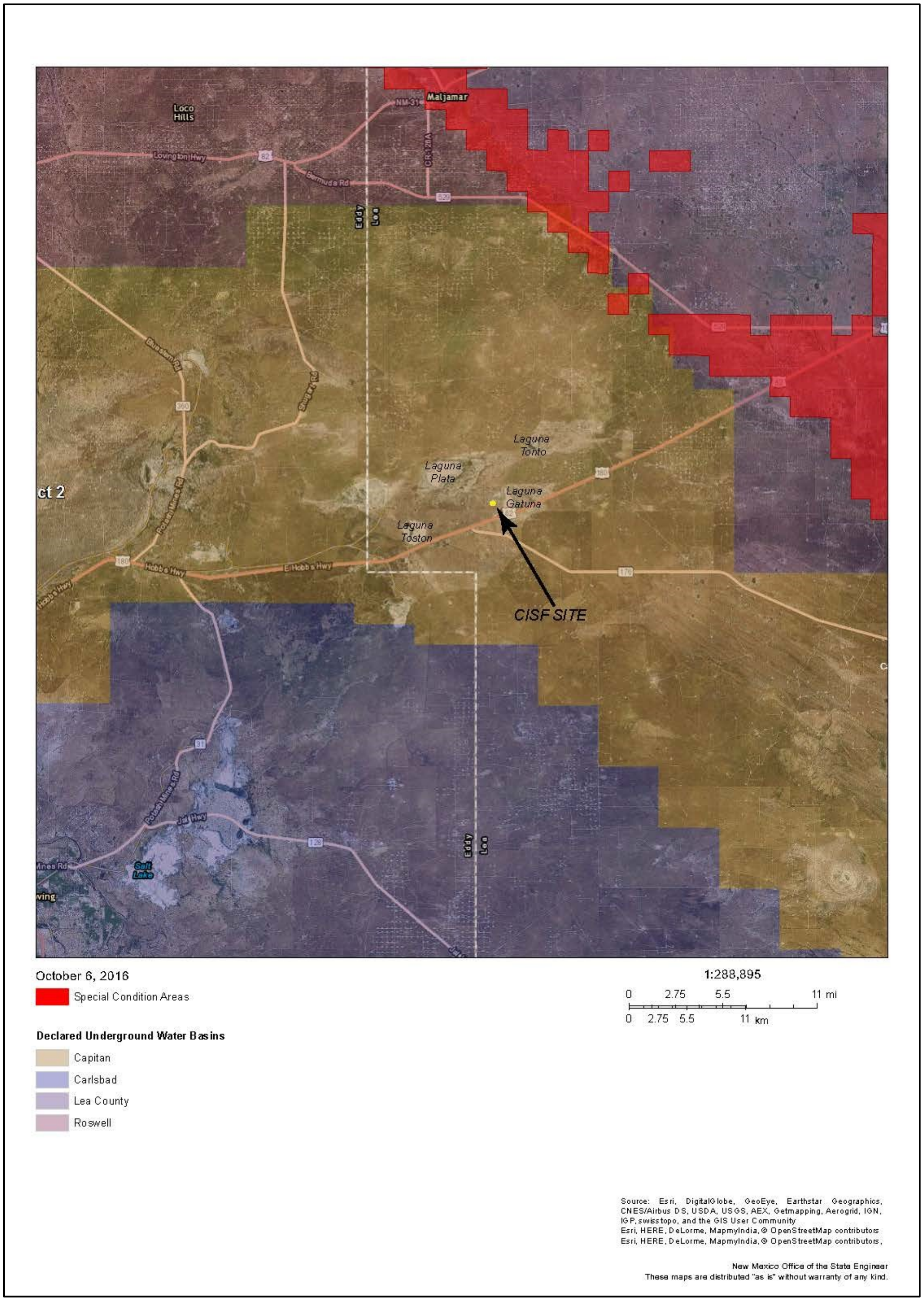
The proposed CIS Facility site or Lea County has no floodplain identified or mapped for Lea County, New Mexico (FEMA 2008, Section 6.0; FEMA 2016). Elevations in Lea County vary from 2,900 feet in the southeast to 4,400 feet in the northwest. This relief provides two surface water drainage basins in the county. The Texas Gulf Basin, located in the northern portion of Lea County, and the Pecos River Basin, located in the southern portion of the county, is separated by the Mescalero Ridge and its extended escarpment (ELEA 2007, Section 2.5.1).

In Lea County neither of the two major drainage basins, the Texas Gulf Basin in the north and east and the Pecos River Basin in the south and west, contain large-scale surface-water bodies or through-flowing drainage systems. The surface water supplies that exist are transitory and limited to quantities of runoff impounded in short drainage ways, shallow lakes, and small depressions, including various playas and lagunas. The Texas Gulf Basin contains a lake, the Llano Estacado, and the Simona Valley. The Pecos River Basin contains the Querecho Plains, the Eunice Plains, and the Antelope Ridge (ELEA 2007, Section 2.5.1).

The topography of the Site shows a high point located on the southern border of the Site and gentle slopes leading to the two drainages (Laguna Plata and Laguna Gatuna). Both of these drainages would be able to accept a one-day severe storm total within the 7.5 inch range with excess free board space. The natural drainage of the Site is useful by providing a natural area for impoundment of excess runoff during severe storms (ELEA 2007, Section 2.5.1).

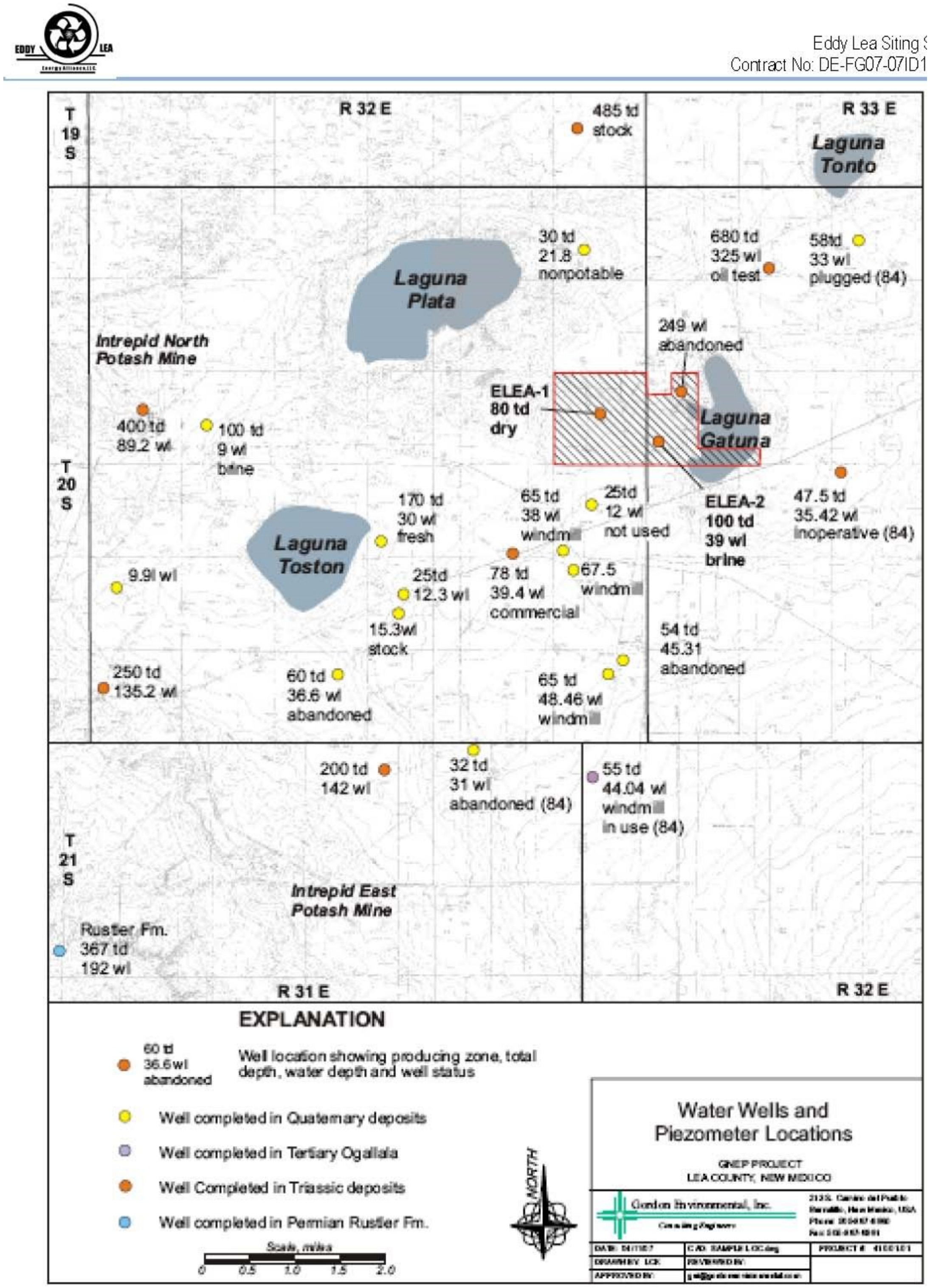
Source: ELEA 2007, Section 2.4.1.

Figure 3.5.1: PECOS RIVER BASIN DRAINAGE AREA



Source: NMOSE 2016.

Figure 3.5.2: ADMINISTRATIVE UNDERGROUND WATER BASINS IN THE STATE OF NEW MEXICO



Source: ELEA 2007, Section 2.4.2.2.

Figure 3.5.3: WATER WELLS AND PIEZOMETER LOCATIONS

Security-Related Information Withheld under 10 CFR 2.390

Figure 3.5.4: BORING LOCATION PLAN

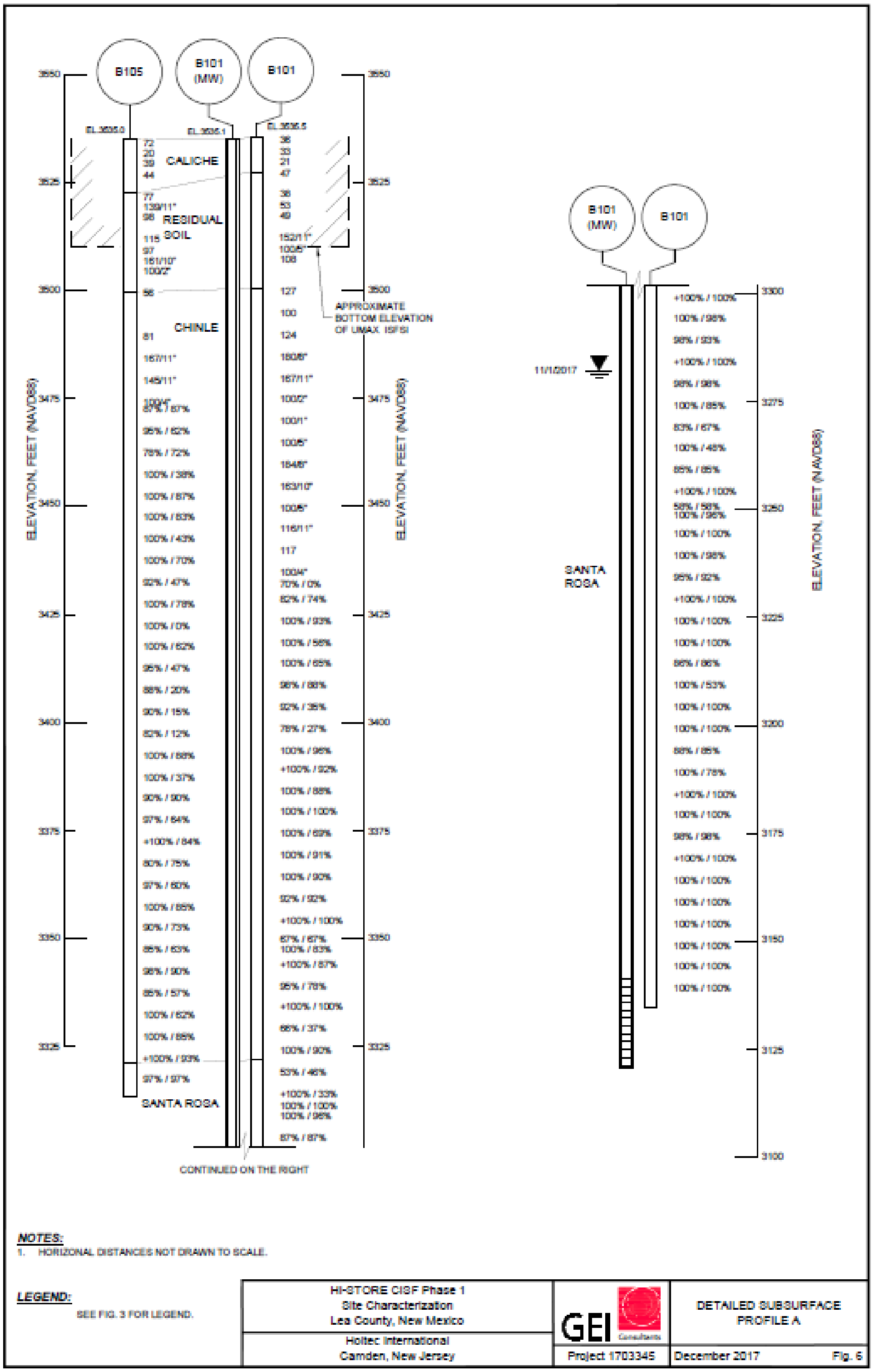


Figure 3.5.5: DETAILED SUBSURFACE PROFILE A

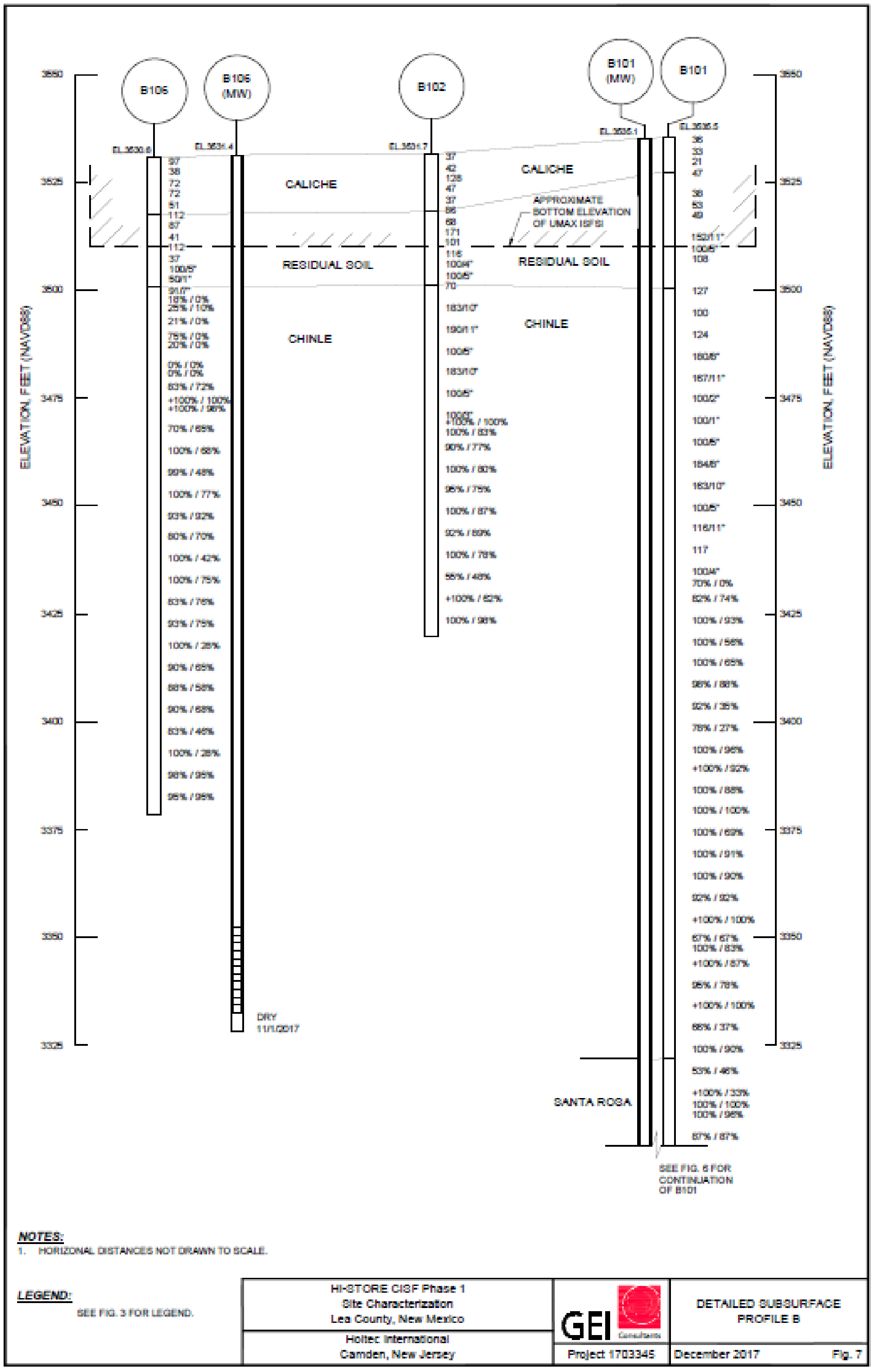


Figure 3.5.6: DETAILED SUBSURFACE PROFILE B

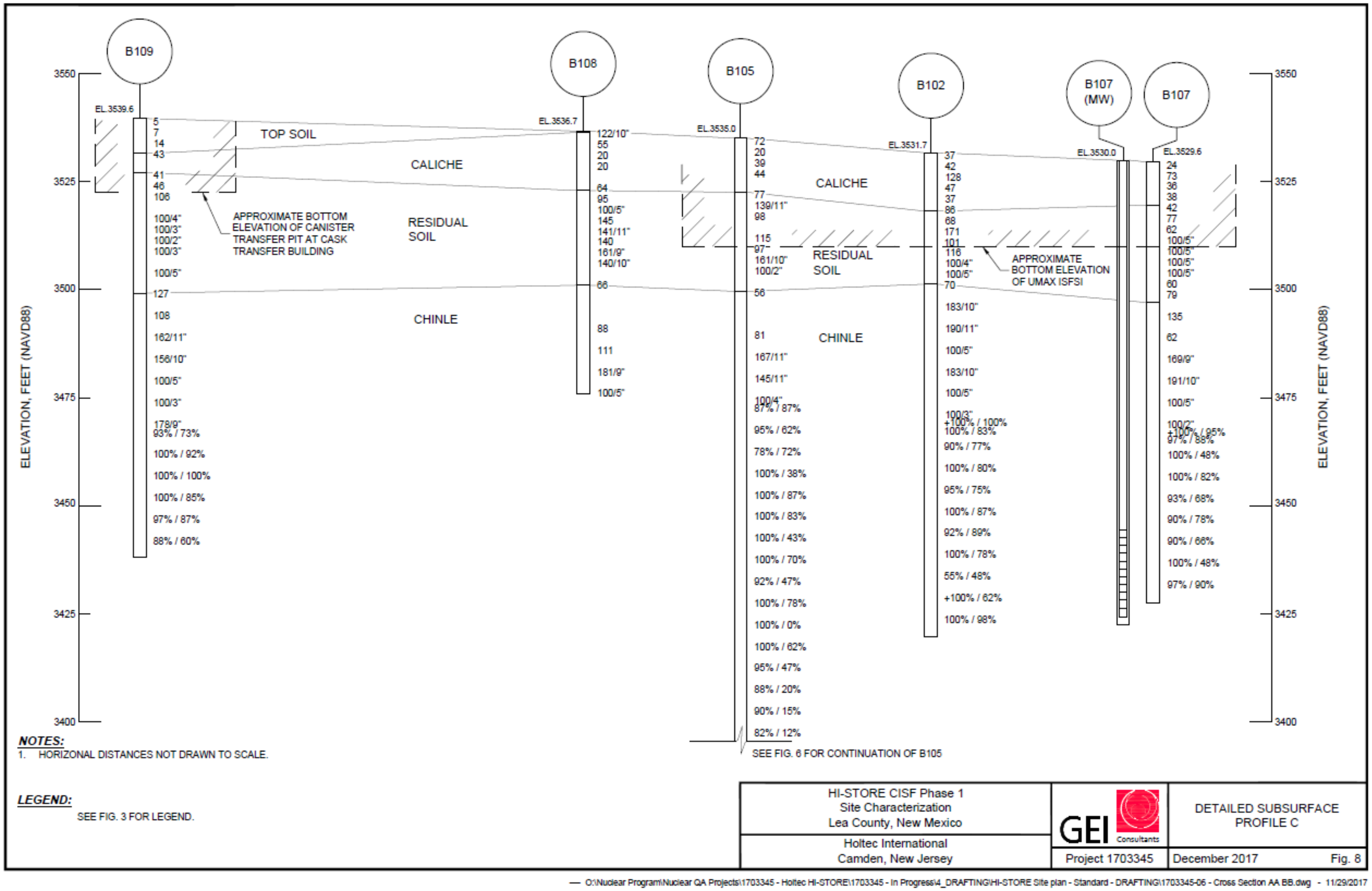


Figure 3.5.7: DETAILED SUBSURFACE PROFILE C

3.6 CLIMATOLOGY, METEOROLOGY, AIR QUALITY, AND NOISE

This section presents data and information of the regional climatology, meteorology, air quality, and noise around the Site. Information in this section will be used to evaluate the air quality and noise impacts of constructing and operating the CIS Facility at the Site. A key metric for the air quality analysis is to ensure that emissions are maintained below the National Ambient Air Quality Standards (NAAQS) for criteria pollutants and the New Mexico Ambient Air Quality Standards (NMAAQS) for all listed pollutants.

3.6.1 Regional Climatology and Meteorology

The climate at the Site is typically semi-arid with generally mild temperatures, low precipitation, low humidity, and with a high evaporation rate. The winter weather typically has high pressure systems that are located in the central part of the western U.S. and low-pressure systems located in north-central New Mexico. In the summer, the region is typically affected by low pressure systems located over Arizona. Overall, precipitation is low and storms are infrequent. Winds during the spring may cause dust during construction periods; however, it is anticipated to be a minimal and temporary impact in comparison to the naturally occurring dust.

Based on the season and the affected of high pressure systems or low-pressure systems, the pressure can affect temperature and cause cloud formation. Clouds are formed when warm, moist air rises into the atmosphere and the droplets are cooled. When the droplets cool, the water from the air condenses into tiny droplets and forms clouds. This occurs during low pressure system. These low-pressure systems typically occur during the spring and summer.

Meteorological information was obtained from various sources, including the Western Regional Climate Center (WRCC) and other sources as noted in this section. The use of the data from the WRCC and other sources are appropriate due to proximity to the proposed CIS Facility site and are expected to have similar climates (see Appendix A, Section A.2).

3.6.1.1 Temperatures

Based on data collected over approximately the past 75 years at the Lea County Regional Airport station, the annual mean average temperature is approximately 61° Fahrenheit (°F) with the monthly mean average temperatures ranging from 42°F in January to 80°F in July. The highest mean average monthly maximum temperature is approximately 94°F and the lowest mean average monthly minimum temperature is approximately 28°F. The highest maximum temperature was 108°F occurring in July of 2000 and again in 2001, and the lowest minimum temperature was -11°F occurring in February of 1951. A summary of this information is presented in Table 3.6.1 and depicted graphically in Figure 3.6.1 (WRCC 2016).

3.6.1.2 Winds

Prevailing wind directions and wind speeds at the Lea County Regional Airport station are presented in Table 3.6.2 and depicted graphically in Figure 3.6.2. Table 3.6.2 and Figure 3.6.2 are summaries of all data collected from 1948 to 2014. Annual Wind Rose data from 1948 to 2014 can be found in Appendix E; data was not available for every year in that time frame. The average wind speed is approximately 12 miles per hour (mph) and the prevailing wind direction is from

the south. Winds are typically moderate, between 1 mph and 19 mph blowing 84 percent of the time, with calm winds (winds less than 1.3 mph) occurring only approximately 8 percent of the time (WRCC 2016).

With respect to wind gusts, the average wind speed of the all the maximum gusts is approximately 25 mph. The prevailing wind direction for wind gusts is wind from southwest during 11 percent of the observations; however, the wind gusts are out of the south, south-southeast, and southeast during 30 percent of the observations. Typical gusts range in speed from 13 mph to 32 mph, comprising of 86 percent of the gusts. Gusts range in speed from 32 mph to 47 mph occurred during 13 percent of the observations, and less than 1 percent of the gusts observed were over 47 mph (WRCC 2016).

3.6.1.3 Mixing Heights

Mixing height is the height above the ground where the strong, vertical mixing of the atmosphere occurs. G.C. Holzworth developed mean annual morning and afternoon mixing heights for the contiguous United States (Holzworth 1972, Appendix B). The results of Holzworth's calculation methods for mixing heights include mean annual morning and afternoon mixing heights at the Site of approximately 1,430 feet and 6,854 feet, respectively. Table 3.6.3 (Holzworth 1972, Appendix B) shows the average morning and afternoon mixing heights for Midland-Odessa, Texas, which is the nearest available area with mixing height data, located approximately 100 miles southeast.

3.6.1.4 Tornadoes

Tornadoes are typically classified by the F-Scale classification. The F-Scale classification of tornadoes is based on the appearance of the damage that the tornado causes. The six classifications range from F0 to F5 with an F0 tornado having winds of 40-72 mph and an F5 tornado having winds of 261-318 mph (Geer 1996). Note that as of February 1, 2007, an enhanced F-scale for tornado damage went into effect in the United States. The switch to the enhanced F-scale involves:

1 Changing the averaging interval for wind speed estimates from the fastest quarter-mile wind speed to a maximum three-second average wind speed.

2 Changing the minimum tornado wind speed from 40 mph to 65 mph.

3 Changing the wind speed intervals associated with each F scale class.

The enhanced F-scale uses three-second wind gusts estimated at the point of damage based on a judgment of eight levels of damage to 28 indicators. The enhanced F-scale has six classifications, EF0 to EF5, with an EF0 tornado having three-second gusts of 65-85 miles per hour and an EF5 tornado having three-second gusts of over 200 miles per hour (NOAA 2016).

Based on a U.S.-wide study performed on a state by state basis, the average tornado probability for any F-scale tornado for the Site is between $1x10^{-6}$ and $2x10^{-4}$, as is presented in Figure 3.6.3 (ELEA 2007, Section 2.2.1.4). No tornadoes of F0 or higher scale have occurred within 1,000 square miles (comprised of portions of Eddy and Lea counties) of the Site in the five years ending in 2015 (THP 2016).

Ninety two tornados have occurred in Eddy and Lea counties since 1954. The highest number of tornados in any given year was 15 in 1991; of which, 14 occurred over a two day period. The

lowest number of tornado in a year has been zero, with a mean average of 1.5 tornados occurring in a year. Most tornados recorded were F0 in scale and occur in the spring (THP 2016).

3.6.1.5 Hurricanes

The Site is located over 500 miles from the oceanic coast. Because hurricanes lose their intensity quickly once they pass over land, impacts from a hurricane at the Site are unlikely.

3.6.1.6 Thunderstorms

Thunderstorms can occur during every month of the year, but generally occur from March through October of each year. Thunderstorms occur an average of 39 days per year in Carlsbad, New Mexico. The seasonal averages are: 2.7 days in spring (March through May); 8.3 days in summer (June through August); 2.3 days in fall (September through November); and less than 1 day in winter (December through February) (WRCC 2016).

3.6.1.7 Precipitation

A summary of rainfall data collected at the Lea County Regional Airport station resulted in an annual mean average total rainfall of 10.2 inches with monthly mean average totals ranging from 0.24 inches in March to 1.9 inches in September. The monthly minimum total is 0.00 inches and the monthly maximum total is 6.2 inches. The highest daily total is 3.6 inches occurring in December of 2015. A summary of this information is presented in Table 3.6.4 and depicted graphically with monthly average total rainfall in Figure 3.6.4. (WRCC 2016).

A summary of snowfall data collected at the Lea County Regional Airport station resulted in an annual mean average total rainfall of 5.13 inches with monthly mean average totals ranging from 1.84 inches in February to 0.0 inches from May to October. The monthly minimum total is 0.00 inches and the monthly maximum total is 21.2 inches. The highest daily total is 10.00 inches occurring in February of 1956. A summary of this information is presented in Table 3.6.5. (WRCC 2016).

3.6.2 Air Quality

To assess air quality, the EPA uses six criteria air pollutants with maximum concentrations as a baseline. The criteria pollutants are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_s), particulate matter (PM), and lead (Pb). The maximum allowable concentrations for these criteria pollutants are the NAAQS. The current NAAQS are presented in Table 3.6.5 (EPA 2016a).

The State of New Mexico also has New Mexico Ambient Air Quality Standards (NMAAQS) and Significance Levels to assess air quality. The NMAAQS pollutants are carbon monoxide, hydrogen sulfide, nitrogen dioxide, total suspended particulate matter, sulfur dioxide, and total reduced sulfur (except for hydrogen sulfide). New Mexico also has Significance Levels to assess air quality for nonattainment areas. The pollutants with Significance Levels are carbon monoxide, hydrogen sulfide, lead, nitrogen dioxide, ozone, particulate matter, total suspended particulate matter, sulfur dioxide, and non-methane hydrocarbons. The current NMAAQS and Significance Levels maximum allowable concentrations are presented in Table 3.6.6 (NMED 2010, Section 2.5).

One exceedance of the NAAQS maximum 24-hour limit was reported in Hobbs, New Mexico, for particulate matter in 2003 due to a natural event – a dust storm. Corrective actions were taken by the state of New Mexico. According to NAAQS, one exceedance of this limit is allowed per year (EPA 2016a).

The NMED collects data from emission sources each year to determine compliance with NAAQS. These emissions are also considered background emissions and are presented in Table 3.6.7 for Lea County, location of the proposed Site; and the surrounding New Mexico Counties of Eddy, Roosevelt, and Chaves (NMED 2016).

Based on EPA information, the region within 50 miles of the Site is in attainment for all of the criteria pollutants as demonstrated in Figure 3.6.6 (EPA 2016b).

3.6.2.1 Dispersion

For normal and off-normal conditions, an atmospheric dispersion coefficient is calculated using D-stability and a wind speed of 5m/sec and a 100m distance to the controlled area boundary. The controlled area boundary is more than 100m from the site so the use of 100m is conservative. For accident conditions, a dispersion coefficient is calculated using F-stability and a wind speed of 1 m/sec. These atmospheric conditions are consistent with the guidance of NUREG-1536 (NRC 2010) and NUREG-1567 (NRC 2000a). The smallest vertical plane cross-sectional area of one horizontal underground storage module (SM) is conservatively used as the vertical plane cross-sectional area of the underground storage module (SM): area = SM Width X SM Height; thus: 2.95m X 0.38m = 13.47m^2. The atmospheric dispersion coefficients can be determined through selective use of Equations 1, 2, and 3 of Regulatory Guide 1.145 (NRC 1981).

With the three values of χ/Q determined, the higher χ/Q value of the first two (Equation 1 and Equation 2) is compared with the last one (Equation 3) and the lower of those two is evaluated as the appropriate atmospheric dispersion coefficient per in Regulatory Guide 1.145 (NRC 1981). The parameters used and the calculated atmospheric dispersion coefficients are summarized in Table 3.6.8.

3.6.2.2 Stability

Stability classes can be used to assess dispersion of materials released into the atmosphere. Dispersion of materials is affected by the stability class of the atmosphere. The Pasquill-Gifford stability categories (Table 3.6.9) are used to determine stability. Distributions of wind speed and direction, the amount of incoming solar radiation, and other factors are used to determine the stability of the atmosphere. Pasquill-Gifford have defined atmospheric stability classes, each representing a different degree of turbulence in the atmosphere. When moderate to strong incoming solar radiation heats air near the ground, causing it to rise and generate large eddies, the atmosphere is considered unstable, or relatively turbulent. Unstable conditions are associated with atmospheric stability classes A and B. When solar radiation is relatively weak or absent, air near the surface has a reduced tendency to rise, and less turbulence develops. In this case, the atmosphere is considered stable, or less turbulent, and the stability class would be E or F. Stability classes D and C represent conditions of more neutral stability, or moderate turbulence. Neutral conditions are associated with relatively strong wind speeds and moderate solar radiation. Atmospheric stability classes are listed in Table 3.6.10.

3.6.3 Noise

The purpose of this section is to provide information to assess the impacts of noise at the Site during construction, operation, and decommissioning. Noise levels at the Site will be principally created by construction equipment and traffic on nearby roads. After construction, most noise is expected to be traffic related. Since the Site is over one-half mile from U.S. Highway 62/180 and the surrounding area is comprised of rural land with oil and gas well development, construction noise impacts are expected to be low. A list of typical community sound levels and noise levels of common sources is shown on Table 3.6.11 (IIFP 2009, Section 3.7).

The Noise Control Act of 1972 requires the EPA to publish information on the acceptable levels of environmental noise for the protection of the public (ELEA 2007, Section 2.9). Following these guidelines, the Department of Housing and Urban Development (HUD) developed Noise Assessment Guidelines presented in Table 3.6.12 (HUD 2016). The EPA has defined a goal of 55 A-weighted decibels (dBA) for L_{dn} in outdoor spaces, as described in the EPA Levels Document (EPA 1973, Section 5). HUD has developed land use compatibility guidelines for acceptable noise versus the specific land use. However, both the Noise Control Act and the HUD Noise Assessment Guidelines do not provide guidance for areas away from population areas such as the Site. Because no guidelines exist for construction activities in non-populated areas and no guidelines exist for the county or state control of noise levels, the Site is not subject to noise requirements; however, the HUD Noise Assessment Guidelines will be used in assessing noise from the Site.

Table 3.6.1:

LEA COUNTY REGIONAL AIRPORT STATION TEMPERATURE DATA (09/01/1941-06/09/2016)

Month	Average Monthly Minimum Temperature °F	Average Monthly Maximum Temperature °F	Average Monthly Temperature °F	Extreme Minimum Temperature °F	Extreme Maximum Temperature °F
January	27.72	56.25	41.98	4.00	81.00
February	30.68	61.12	45.90	-11.00	84.00
March	35.67	67.32	51.53	14.00	86.00
April	44.32	75.05	59.69	24.00	93.00
May	53.77	84.05	68.91	28.00	103.00
June	63.71	92.90	78.31	51.00	107.00
July	66.73	93.62	80.17	52.00	108.00
August	65.50	92.57	79.04	55.00	104.00
September	58.29	86.47	72.37	41.00	104.00
October	47.82	75.76	61.79	24.00	94.00
November	34.23	64.42	49.33	4.00	85.00
December	28.78	59.04	43.91	7.00	79.00
Annual	46.34	76.03	61.19	-11.00	108.0

Source: WRCC 2016.

Table 3.6.2:

LEA COUNTY REGIONAL AIRPORT STATION ALL WIND DATA (12/01/1948-12/31/2014)

Wind Speed (mph)	N (%)	NNE (%)	NE (%)	ENE (%)	E (%)	ESE (%)	SE (%)	SSE (%)	S (%)	SSW (%)	SW (%)	WSW (%)	W (%)	WNW (%)	NW (%)	NNW (%)	Total (%)
1.3-4	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	2.5
4-8	1	0.8	0.9	0.7	1.8	1.3	1.4	1.4	2.7	1.7	1.3	0.9	0.6	0.5	0.6	0.5	18.2
8-13	2	1.5	1.7	1.5	3	2.8	3.9	4.5	6.2	3.4	2.8	2.3	1.7	1.2	1.1	0.9	40.4
13-19	1.4	1.2	1.1	0.6	1.1	1.2	2.2	2.8	2.9	1.6	1.9	1.8	1	0.7	0.6	0.5	22.7
19-25	0.5	0.4	0.2	0.1	0.1	0.1	0.3	0.6	0.4	0.4	0.7	0.7	0.4	0.3	0.2	0.2	5.6
25-32	0.2	0.1	0.1	0	0	0	0	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.1	1.7
32-39	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0.4
39-47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
47+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (%)	5.3	4.1	4.1	3.1	6.2	5.7	7.9	9.5	12.6	7.5	7.2	6.4	3.9	3	2.7	2.3	91.5
Avg. Wind Speed (mph)	12.6	12.4	11.4	10.5	10.0	10.5	11.3	11.9	11.0	11.3	12.9	14.1	12.8	13.4	11.9	12.3	10.8

Source: WRCC 2016.

NOTE: Total Calm Winds (Calm Winds is defined as less than 1.3 mph) is 8.4 percent.
NOTE 2: The meteorological tower wind data height was 10 meters.

Table 3.6.3:

AVERAGE MORNING AND AVERAGE AFTERNOON MIXING HEIGHTS

	Winter (feet)	Spring (feet)	Summer (feet)	Autumn (feet)	Annual (feet)
Morning	951	1,407	1,988	1,375	1,430
Afternoon	4,186	8,035	9,003	6,191	6,854

Source: Holzworth 1972, Appendix B.

Table 3.6.4:

LEA COUNTY REGIONAL AIRPORT STATION PRECIPITATION DATA (09/01/1941-06/09/2016)

Month	Monthly Minimum Totals (Inches)	Monthly Maximum Totals (Inches)	Monthly Average Totals (Inches)	Extreme Daily Maximum Totals (Inches)
January	0.00	2.09	0.31	0.68
February	0.00	1.02	0.32	0.68
March	0.00	1.41	0.24	0.52
April	0.00	2.26	0.65	1.40
May	0.00	5.02	1.43	1.72
June	0.00	3.19	0.75	1.77
July	0.00	3.49	1.17	1.98
August	0.04	4.08	1.32	2.28
September	0.05	5.84	1.85	2.13
October	0.00	3.81	1.52	1.73
November	0.00	1.07	0.26	0.95
December	0.00	6.21	0.56	3.63
Annual	2.81	18.66	10.16	3.63

Source: WRCC 2016.

Table 3.6.5:

LEA COUNTY REGIONAL AIRPORT STATION SNOWFALL DATA (09/01/1941-06/09/2016)

Month	Monthly Minimum Totals (Inches)	Monthly Maximum Totals (Inches)	Monthly Average Totals (Inches)	Extreme Daily Maximum Totals (Inches)
January	0.00	9.00	1.06	6.00
February	0.00	21.20	1.84	10.00
March	0.00	13.00	0.97	8.00
April	0.00	0.80	0.05	1.00
May	0.00	0.00	0.00	0.00
June	0.00	0.00	0.00	0.00
July	0.00	0.00	0.00	0.00
August	0.00	0.00	0.00	0.00
September	0.00	0.00	0.00	0.00
October	0.00	0.00	0.00	0.00
November	0.00	7.00	0.44	4.00
December	0.00	8.30	0.61	9.00
Annual	0.00	29.00	5.13	10.00

Source: WRCC 2016.

Table 3.6.6:

NATIONAL AND NEW MEXICO AMBIENT AIR QUALITY STANDARDS AND NEW MEXICO SIGNIFICANCE LEVELS

Pollutant	Primary/ Secondary	Averaging Time	NAAQS	Significance Level [1] ($\mu g/m^3$)	NMAAQS
Carbon Monoxide (CO)	primary	8 hours	9 ppm [2]	500	8.7 ppm
		1 hour	35 ppm [2]	2000	13.1 ppm
Hydrogen Sulfide (H_2S)		1 hour		1.0	0.010 ppm [2, 3]
		½ hour		5.0	0.10 ppm [4]
		½ hour		5.0	0.030 ppm [6]
Lead (Pb)	primary and secondary	Rolling 3 month average		0.03	
Nitrogen Dioxide (NO_2)	primary and secondary	1 year	53 ppb [7]	1.0	0.050 ppm
		24 hours		5.0	0.10 ppm
	primary	1 hour	100 ppb	1.0	
Ozone (O_3)	primary and secondary	8 hours	0.070 ppm [8]		
Particulate Matter (PM) – **$PM_{2.5}$**	primary	1 year	12.0 $\mu g/m^3$		
	secondary	1 year	15.0 $\mu g/m^3$	0.30	
	primary and secondary	24 hours	35 $\mu g/m^3$	1.17	
Particulate Matter (PM) – **PM_{10}**		1 year		1.0	
	primary and secondary	24 hours	150 $\mu g/m^3$ [2]		
Total Suspended Particulates (TSP)		1 year		1.0	60 $\mu g/m^3$
		30 day			90 $\mu g/m^3$
		7 day			110 $\mu g/m^3$
		24 hour		5.0	150 $\mu g/m^3$
Sulfur Dioxide (SO_2)		1 year		1.0	0.02 ppm
		24 hour		5.0	0.10 ppm
	secondary	3 hours	0.5 ppm	25.0	
	primary	1 hour	75 ppb [9]		
Total Reduced Sulfur Except Hydrogen Sulfide		½ hour			0.003 ppm [3]
		½ hour			0.010 ppm [4]
Non-Methane Hydrocarbons		3 hours		5.0	

Source EPA 2016a and NMED 2010, Section 2.5.

1 Significance levels as listed in 20.2.72.500 NMAC.

2 Not to be exceeded more than once per year.

3 For the state, except for the Pecos-Permian Basin Interstate Air Quality Control Region (AQCR).

4 For the Pecos-Permian Basin Interstate AQCR.

5 In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.

6 For within 5 miles of the corporate city limits of municipalities within the Pecos-Permian Basin Interstate AQCR or of municipalities with a population greater than 20,000.

7 The level of the annual NO2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

8 Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

9 The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

Table 3.6.7:

NMED EMISSION TOTALS BY COUNTY FOR 2015

County	Total Emission (Tons Per Year)					
	CO	NO_2	SO_2	VOC	PM	Pb
Lea	2,903.8	7,684.7	6,389.6	1,542.1	197.7	0.0
Eddy	1,409.7	2,315.3	1,051.6	2,267.2	195.3	0.0
Roosevelt	21.4	22.6	3.4	1.3	18.7	0.0
Chaves	99.9	233.5	0.1	85.4	1.3	0.0

Source: NMED 2016.

Table 3.6.8

ATMOSPHERIC DISPERSION COEFFICIENTS PARAMETER NORMAL/OFF-NORMAL ACCIDENT

Parameter	Normal/Off-Normal	Accident
Stability	D	F
U (m/sec)	5	1
A ($m^{2)}$	13.47	13.47
σ_y (m)	8	4
σ_z (m)	4.6	2.3
M	1.122	4
Equation 1 (sec/m^3)	0.001635	0.02806
Equation 2 (sec/m^3)	0.0005766	0.01153
Equation 3 (sec/m^3)	0.001542	0.00865
χ/Q (sec/m^3)	0.001542	0.00865

Source: Regulatory Guide 1.145 (NRC 1981)

Table 3.6.9:

PASQUILL-GIFFORD STABILITY CATEGORIES

Surface Wind (Measured at 10m) (mph)	Day Incoming Solar Radiation (Insolation) (Strong)	Day Incoming Solar Radiation (Insolution) (Moderate)	Day Incoming Solar Radiation (Insulation) (Slight)	Night* (Thin Overcast or >= 4/8 Cloudiness)	Night* (<= 3/8 Cloudiness)
<4.5	A	A-B	B	E	E
4.5-6.7	A-B	B	C	E	E
6.7-11.2	B	B-C	C	D	E
11.2-13.4	C	C-D	D	D	D
13.4	C	D	D	D	D

*Night is defined as the period from 1 hour before sunset to 1 hr after sunrise

Source: UTED 2017

Table 3.6.10

PERCENT FREQUENCY OF OCCURENCE OF ATMOSPHERIC STABILITY CLASSES FOR HOBBSs, NEW MEXICO AREA

Stability Class	Percent Frequency of Occurrence
A	0.4
B	3.8
C	12.3
D	52.1
E	18.4
F	13.7

Table 3.6.11:

NOISE LEVELS OF COMMON SOURCES

Sound Source	Sound Pressure Level (dBA)
Air Raid Siren at 50 Feet	120
Maximum Levels at Rock Concerts (Rear Seats)	110
On Platform by Passing Subway Train	100
On Sidewalk by Passing Heavy Truck or Bus	90
On Sidewalk by Typical Highway	80
On Sidewalk by Passing Automobiles with Mufflers	70
Typical Urban Area	60-70
Typical Suburban Area	50-60
Quiet Suburban Area at Night	40-50
Typical Rural Area at Night	30-40
Isolated Broadcast Studio	20
Audiometric (Hearing Testing) Booth	10
Threshold of Hearing	0

Source: IIFP 2009.

Table 3.6.12:

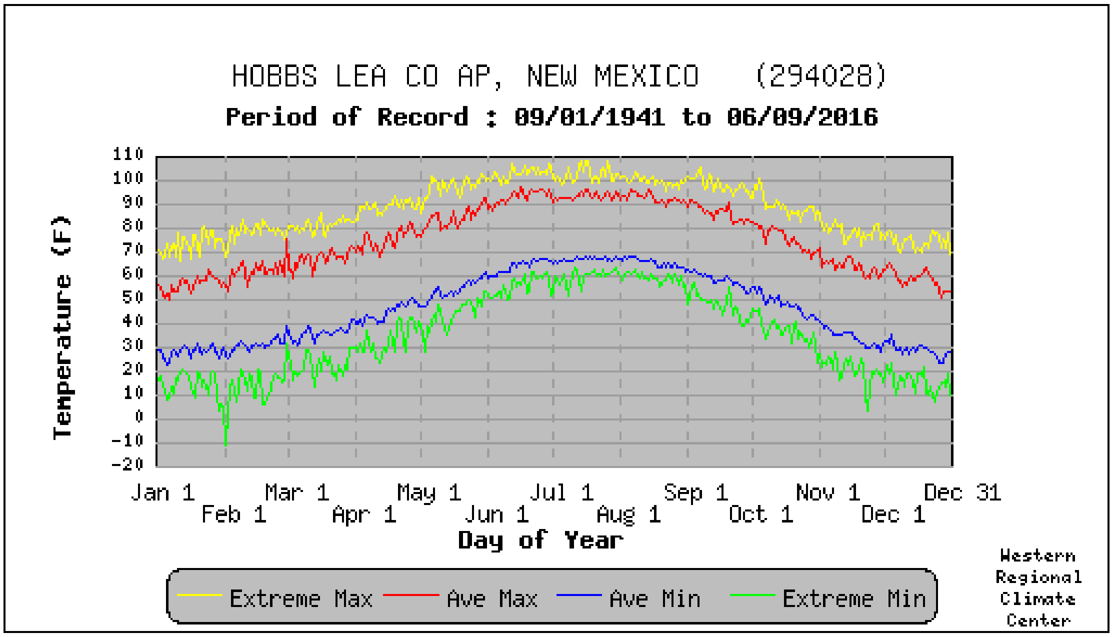
HUD NOISE ASSESSMENT GUIDELINES

HUD Land Use Compatibility Guidelines for Noise				
	Sound Pressure Level (dBA L_{dn})			
Land Use Category	**Clearly Acceptable**	**Normally Acceptable**	**Normally Unacceptable**	**Clearly Unacceptable**
Residential	<60	60-65	65-75	>75
Livestock Farming	<60	60-75	75-80	>80
Office Buildings	<65	65-75	75-80	>80
Wholesale, Industrial, Manufacturing, & Utilities	<70	70-80	80-85	>85

Source: HUD 2016.

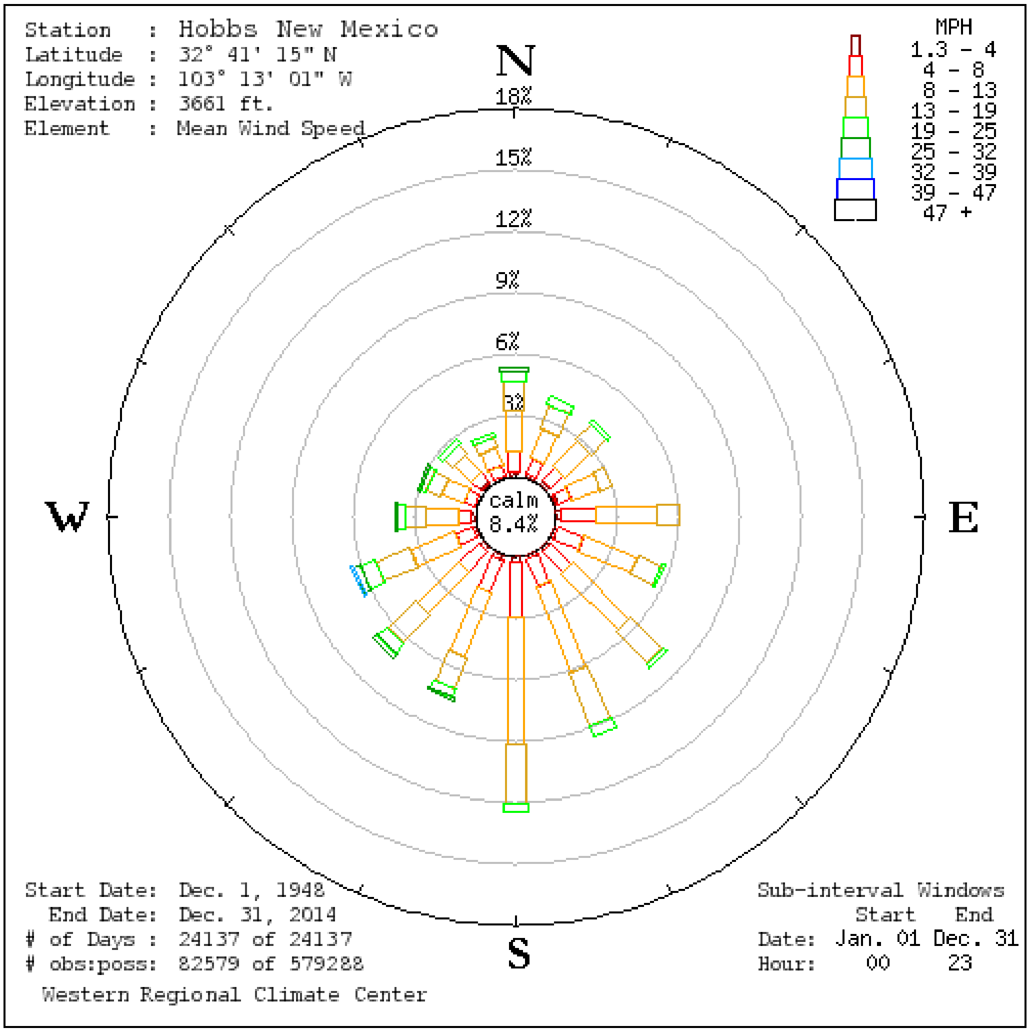
dBA = decibels A-weighted.

L_{dn} = day-night sound level



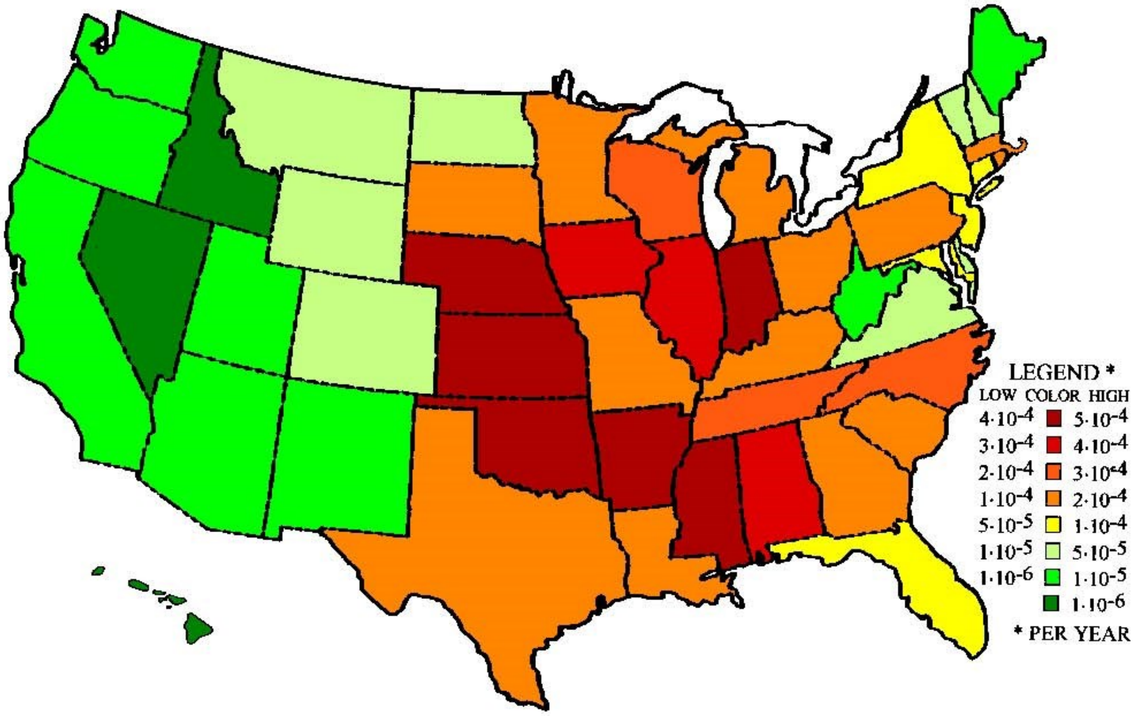
Source: WRCC 2016.

Figure 3.6.1: LEA COUNTY REGIONAL AIRPORT STATION TEMPERATURE DATA (09/01/1941-06/09/2016)



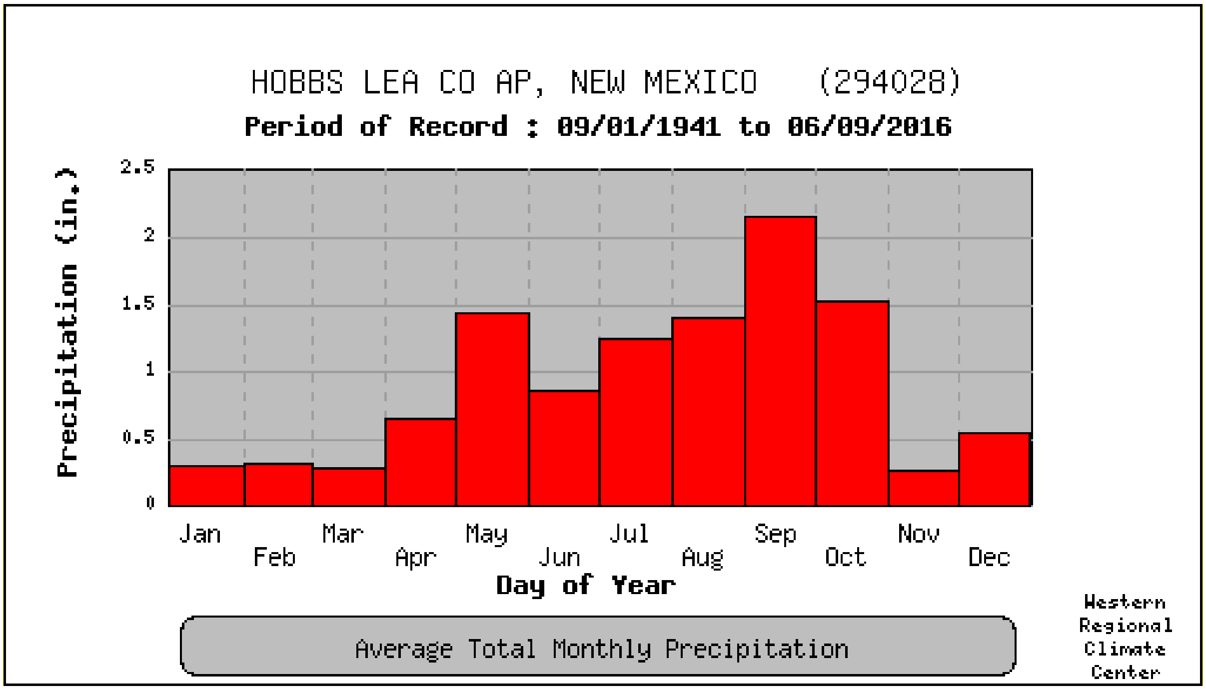
Source: WRCC 2016.

Figure 3.6.2: LEA COUNTY REGIONAL AIRPORT STATION ALL WIND ROSE (12/01/1948-12/31/2014)



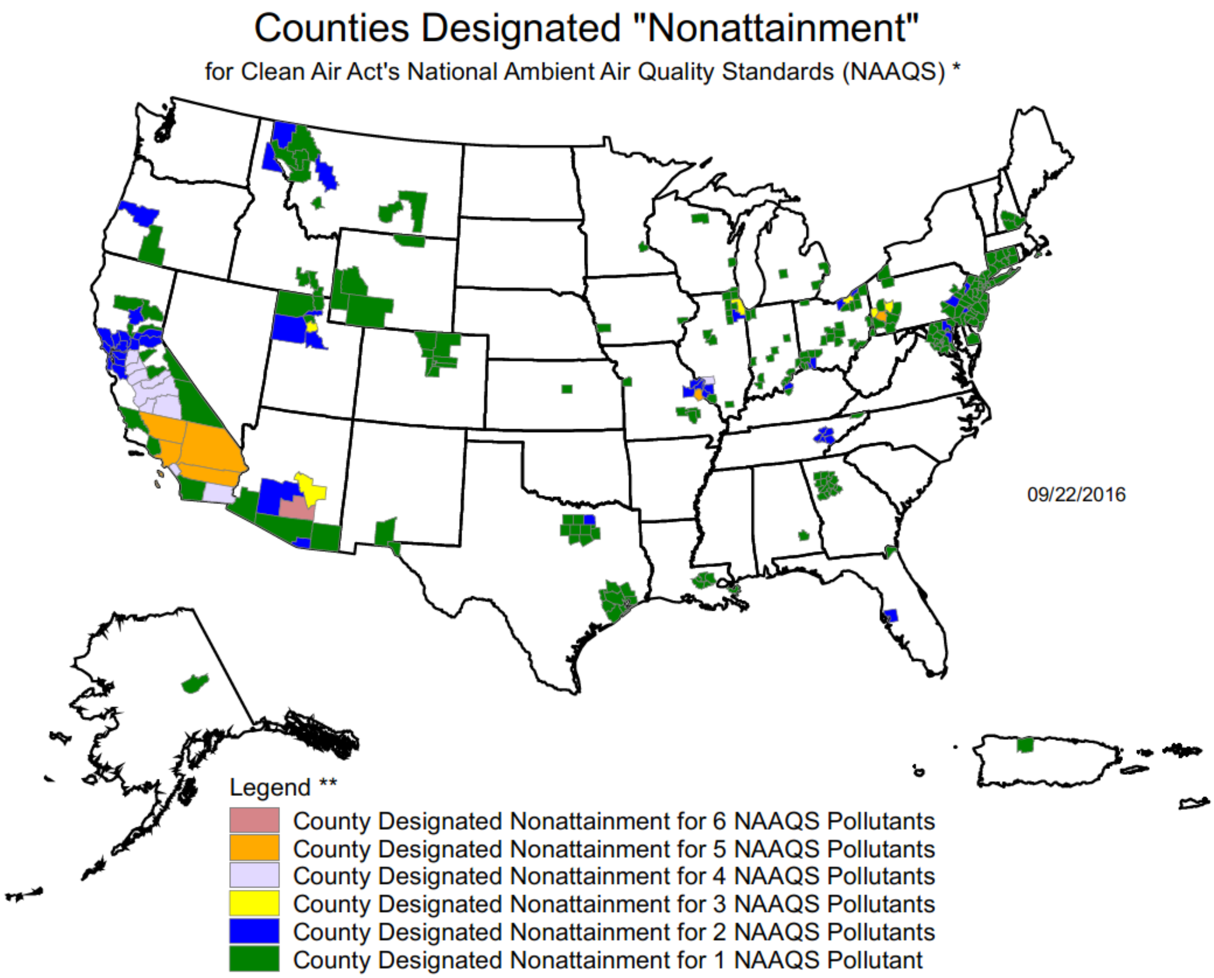
Source: ELEA 2007, Section 2.2.1.4.

Figure 3.6.3: TORNADO PROBABILITY MAP



Source: WRCC 2016.

Figure 3.6.4: MONTHLY AVERAGE TOTAL PRECIPITATION LEA COUNTY REGIONAL AIRPORT STATION (09/01/1941-06/09/2016)



Guam - Piti and Tanguisson Counties are designated nonattainment for the SO2 NAAQS

* The National Ambient Air Quality Standards (NAAQS) are health standards for Carbon Monoxide, Lead (1978 and 2008), Nitrogen Dioxide, 8-hour Ozone (2008), Particulate Matter (PM-10 and PM-2.5 (1997, 2006 and 2012), and Sulfur Dioxide.(1971 and 2010)

** Included in the counts are counties designated for NAAQS and revised NAAQS pollutants. Revoked 1-hour (1979) and 8-hour Ozone (1997) are excluded. Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.

Source EPA 2016b.

Figure 3.6.5: NONATTAINMENT AREAS MAP

3.7 CULTURAL RESOURCES

3.7.1 Background

Due to the required licensing by the Nuclear Regulatory Commission (NRC), this project is subject to Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and its implementing regulations in Title 36, Section 800 (and following section), of the Code of Federal Regulations (CFR) (36 CFR § 800 et seq.). Pursuant to these regulations, the NRC must take into account the effects of the proposed undertaking on "historic properties"; that is, cultural resources included in or eligible for listing in the National Register of Historic Places (NRHP). To accomplish this, the NRC must first identify cultural resources that may be affected by the undertaking and then evaluate these resources to determine whether they are historic properties and, which are prehistoric and historical-period sites, buildings, structures, districts, and objects listed in, or eligible for listing in the NRHP. Holtec anticipates that the NRC would issue the Final Environmental Impact Statement and License by 2019. Thus, cultural resources that will be 45 years or older by 2019 will need to be evaluated for listing in the NRHP as part of the identification of historic properties.

The Area of Potential Effects (APE) for direct impacts to historic properties is the project footprint, which includes the CIS Facility and appurtenant infrastructure such as access roads and fence lines. With respect to the APE for direct impacts, this ER contains information for the main CIS Facility site where facilities would be located, as well as the rail spur and access road corridors (see Figure 2.1). The APE for indirect or visual impacts to historic properties is dependent on the location, size, and scale of the project. Because of the extremely low height of facilities associated with the CIS Facility, this ER uses a 1-mile radius around the Project footprint for the APE for indirect or visual impacts to historic properties.

3.7.2 Cultural Setting

The APE is situated within the Mescalero Plain of southeastern New Mexico in Lea County. The earliest evidence of human occupation in the Mescalero Plain dated to the Paleoindian period (ca. 10,000–6000 B.C.). Paleoindian period populations are traditionally characterized as highly mobile groups that primarily hunted bison. The Archaic period (ca. 6000 B.C.–A.D. 500) encompasses a wide time-depth and is traditionally divided into Early, Middle, and Late periods, based on variations in projectile point typology and paleo-environmental conditions. The Formative period (pre-A.D. 500–1500) is marked by the introduction of ceramic technology, the appearance of the bow and arrow, the intensification of maize agriculture, and the adoption of a more-sedentary way of life. Early Spanish explorers travelled through portions of southeastern New Mexico during expeditions conducted around the mid-sixteenth century, while the period from 1650 to 1800 was host to several Spanish military expeditions that entered southeastern New Mexico to commercially engage with the Jumanos. Recorders of those expeditions also described encounters with Apache groups. Subsequently, Euro-American settlers attracted by available grazing land migrated into southeastern New Mexico and had established livestock ranches in the area by the mid-nineteenth century. Potash mining became a prominent industry in the area during the 1920s and continues into the present day. The Carlsbad area became the focus of oil and gas development with the establishment of the El Paso Natural Gas Company in 1928, and an emphasis

on extractive activities has remained a mainstay of the local economy for almost a century (Murrell 2015).

3.7.3 Analyses

The analytical process to identify historic properties in this ER included performing a search of existing records, conducting an intensive pedestrian survey, evaluating cultural resources identified within the direct APE for listing in the NRHP, and providing previous recorders' NRHP recommendations for the cultural resources within the indirect APE.

3.7.4 Records Search

On November 30, 2016, Statistical Research, Inc. (SRI), performed a records search of the land within the direct and indirect APEs through the New Mexico Cultural Resources Information System (NMCRIS), a digital repository of the Archaeological Records Management Sections (ARMS) of the New Mexico Historic Preservation Division (NMHPD)/office of the State Historic Preservation Officer.

The direct APE boundary for this search was based on an approximately 290-acre extent for the CIS Facility facilities, as derived from proposed layout documentation provided by Holtec. The indirect APE is a 1-mile buffer around the direct APE and totals 10,891 acres.

The record search revealed that 91 cultural resource investigations have been conducted within the APEs (Table 3.7.1), with portions of 12 investigations extending into the APE of direct impacts. The records search provide that 42 cultural resources have been previously identified within the APEs (Table 3.7.2), with two of them intersecting the APE of direct impacts. These two sites area a prehistoric artifact scatter and a historical-period rail line segment; both have an undetermined NRHP eligibility status. Of the 40 cultural resources identified within the indirect APE, 14 are eligible for listing in the NRHP, seven are not eligible for listing in the NRHP, 18 have an undetermined NRHP status, and one site has no NRHP status.

3.7.5 Pedestrian Survey

From December 6 to 9, 2016, SRI conducted an intensive pedestrian survey of the 290.11 acres of the CIS Facility and appurtenant facilities. SRI holds a General Archaeological Permit (No. 17-135) with the NMHPD and a Cultural Resource Use Permit (No. 159-2920-14-M) with the U.S. Department of the Interior Bureau of Land Management (BLM). All cultural resource fieldwork and subsequent reporting entirely conformed to the New Mexico Standards for Survey and Inventory (*New Mexico Administrative Code,* Title 4, Chapter 10, Part 15 [4.10.15 NMAC]). Methods derived from BLM Manual Supplement H-8100-1 and BLM–Carlsbad Field Office (BLM-CFO) standards were also applied to the entire project area, for consistency. The survey was directed by Dr. Timothy Mills (Registered Professional Archaeologist [RPA] No. 28577206) and Amanda Hernandez (RPA No. 37450280), who are both listed in the NMHPD's Directory of Qualified Supervisory Personnel under Archaeology.

The primary goal of conducting the survey was to identify and document all cultural manifestations within the APE for direct impacts. Transects were spaced at 15 m. The crew's positions were monitored using a mapping-grade Trimble GeoXH Global Positioning System (GPS) unit that included the location of the survey parcel and any previously recorded cultural resources. All

cultural manifestation that qualified as Isolated Occurrences (IOs) observed at the proposed Site were recorded as they were encountered during the pedestrian survey. These instances were point-provenienced and fully documented, in terms of the range of items present, including characteristics that are temporally diagnostic. Archaeological sites discovered during the survey were plotted using a Trimble GPS unit, and marked using pin flags and flagging tape. A permanent datum consisting of a capped rebar, including the SRI field site number and recording date, were set at each archaeological site recorded in the Site.

The survey resulted in the identification of 17 IOs and 4 cultural resources: 1 previously recorded prehistoric archaeological site (artifact scatter), 1 newly discovered archaeological site (campsite), 1 previously recorded historical-period linear resource (rail-line segment), and 1 newly discovered historical-period linear resource (two-track-road segment). SRI recommends the two archaeological sites (artifact scatter and campsite) eligible for listing in the NRHP.

The results of this survey are included in Appendix C.

3.7.6 Historic Properties

Through the records search and the intensive pedestrian survey, SRI identified two historic properties that could be directly affected by this project.

Table 3.7.1:

CULTURAL RESOURCE INVESTIGATIONS WITHIN THE APE

Activity No.	Author	Year	Title	APE
393	Laumbach, K. W.	1979	Laguna Plat Archaeological District Form for Bureau of Land Management	indirect only
394	Brett, Linda, and William B. Sanders	1982	Archaeological Clearance Report for the State Highway Department Proposed Widening of State Highway 62-180	indirect only
411	Hilley, Carol G.	1982	An Archaeological Clearance Survey of Seismic Testing Transects in Chaves, Eddy and Lea Counties, New Mexico	indirect only
493	Towner, R. H.	1982	El Paso Natural Gas Company	indirect only
1151	Haskell, J. Loring	1980	Archaeological Clearance Report for Bass Enterprises Production Company Quarry, Section 15, T20S, R32E, NMPM, Lea County, New Mexico	indirect only
1175	Clifton, Don	1982	Cultural Resource Investigations at Ten Proposed Materials Pits in Lea County, New Mexico	indirect only
1226	Jones, D., and others	197	Site Survey, Laguna Toston	indirect only
1232	Drobka, Dianna	1982	Miss Connection Pipeline to Existing Trough	indirect only
1235	Botsford, M. L.	1977	Easement for General Telephone Company of the Southwest	indirect only
1525	Clifton, Don	1983	A Cultural Resource Survey of Borrow Pit B Extension, Borrow Pit C Extension, and the Waste Isolation Project Entrance in Lea County, New Mexico	indirect only
1625	Haskell, J. L.	1982	El Paso Natural Gas Company	indirect only
1627	Clifton, Don	1982	Cultural Resource Investigations at a Proposed Materials Pit and Associated Haul Road in Lea County, New Mexico, NMSHD Project No. ST-(F)-022-2(203)	indirect only
1632	Kyte, M.	1982	Western Geophysical Line C Segment No. 1 and No. 2 Line Segment No. 1	indirect only
1843	Brett, L.	1984	Texaco Seismic Line 98	indirect only
2795	Haskell, J. L.	1984	Saltwater Disposal Line for Tenneco Oil	indirect only
7584	Michalik, Laura	1983	An Archaeological Survey of Seven Borrow Pits, Nine Haul Roads, One Yard Area and A Caliche Pit in Lea County, New Mexico	indirect only
10700	Duran, M. S., and others	1985	Five Seismic Testing Transects for Strata Search	direct and indirect
11369	Martin, Joseph P.	1985	Archaeological Clearance Report for Geo-Search Corporation Teas Deep Recon NM4642-1 Teas Deep Recon NM4642-2	indirect only
16811	Bradley, B. A.	1982	Water Pipeline Waste Isolation Pilot Project for U.S. Army Corps of Engineers	direct and indirect
18597	Haskell, J. L.	1987	Tract B Plata Waste Water Disposal Project for Petro-Thermal Corporation	indirect only
21560	Martin, R. J.	1988	Snyder Ranches Saltwater Line	indirect only
23164	Botsford Manton	1977	C. W. Trainer	indirect only
23997	Haskell, J. L.	1987	Tract A Plata Waste Water Disposal Project for Petro-Thermal Corporation	indirect only
26194	MacLennan, R. B.	1980	ROW No. 791034/DWG 3745.O-64-1,2,3 for El Paso Natural Gas Company	indirect only

Table 3.7.1:

CULTURAL RESOURCE INVESTIGATIONS WITHIN THE APE

Activity No.	Author	Year	Title	APE
27957	Martin, R. J.	1989	Salt Water Disposal Pipeline for Laguna Gatuna, Inc.	indirect only
28259	Haskell, J. L.	1989	7427-195 Power Line for Southwestern Public Service Company	indirect only
31565	Doebley, John F.	1975	An Archaeological Survey of the Proposed Caprock Watersystem Pipeline ROW in Southeastern New Mexico	direct and indirect
32437	Hunt, J. E., and others	1990	Seismic Testing Line No. 5B for Western Geophysical	direct and indirect
32605	Hunt, J. E.	1990	Seismic Testing Line No. 38 for Western Geophysical	direct and indirect
32901	Hunt, J. E., and others	1990	Spec Seismic Testing Line for Western Geophysical	direct and indirect
36238	Haskell, J. L.	1991	7694-195 Power Line and 7701-195 Power Line for Southwestern Public Service Company	indirect only
36941	Haskell, J. L.	1991	No. 1 Belco Aia Federal Power Line for Yates Petroleum	indirect only
37615	Hunt, J. E., and others	1992	Seismic Testing Lines 20-NM-92 and 21-NM-92 for Dawson Geophysical	direct and indirect
37617	Hunt, J. E.	1992	Lusk No. 2 Saltwater Disposal Pipeline for Yates Petroleum	direct and indirect
39483	Abbott, R. O.	1992	Belco Aia Federal No. 2 and Flow Line for Yates Petroleum	indirect only
39484	Abbott, R. O., and others	1992	Belco Aia Federal No. 3: Access and Flow Line for Yates Petroleum	indirect only
39485	Abbott, R. O.	1992	Belco Aia No. 4: Access Road and Flow Line for Yates Petroleum	indirect only
39852	Haskell, J. L.	1992	No. 1 Belco Aia Federal Gas Gathering and Water Disposal Line for Yates Petroleum	indirect only
42244	Haskell, J. L.	1992	Water Station and Access Road for B & E, Inc.	indirect only
42256	Haskell, J. L.	1993	Control No. 7986-195/Power Line Station, Hat Mesa Lease for Southwest Public Service	indirect only
45090	Hunt, James E.	1993	Archeological Inventory Report for Scurlock Permian Corporation's Truck Loading Station and Access Road Situated on Public Lands in Lea County, New Mexico	indirect only
46296	Griffiths, Dorothy M., and James V. Sciscenti	1994	Archaeological Survey of the Scurlock Permian Corporation Truck Loading Site Area T20S, R32E, Section 17 (NW1/4SE1/4), Lea County, New Mexico	indirect only
49377	Staley, David P., and Kathleen A. Adams	1995	Cultural Resource Survey of a Powerline Route Between Potash Junction and Cunningham Station Eddy and Lea Counties, New Mexico	indirect only
50647	Reid, Kathleen C.	1994	A Cultural Resources Survey of Barbara Fasken's Proposed Baetz 23 Federal Well No. 2 Well Pad and Access Road	indirect only
50891	Hunt, James E.	1994	Archeological Clearance Report for C. W. Trainer's Pipeline Easement in Section 13 Situated on Public Lands in Lea County, New Mexico	direct and indirect
51738	Adams, Kathleen A.	1995	Cultural Resource Survey for a Proposed 115 kV Powerline Lea County, New Mexico	indirect only
55547	Dillington, Eric	1997	Cultural Resources Survey for Three BLM Range Projects Near Laguna Toston, T20S, R32E, Lea County, New Mexico	indirect only
57188	Wilcox, David, and Jon R. Blackwelder	1997	Archaeological Survey of the Southwestern Public Service Company's Proposed Electric Line to Serve Western Wireless (Control No. 195-B295) in Sections 23 and 24, T20S, R32E, NMPM, Lea County, New Mexico	indirect only

Table 3.7.1:

CULTURAL RESOURCE INVESTIGATIONS WITHIN THE APE

Activity No.	Author	Year	Title	APE
58640	Clifton, Don	1997	An Archaeological Survey of Three Proposed Water Pipe Lines, Lea and Eddy Counties, New Mexico	indirect only
59474	Michalik, Laura	1998	An Archaeological Clearance Survey of the Proposed GTE Fiber Optic Line Along US 62-180 and NM 360 Between Hobbs and Carlsbad, Eddy and Lea County, New Mexico	indirect only
60817	Wilcox, David, and Peter C. Condon	1998	Archaeological Survey of Mesquite SWD, Inc.'s Proposed 200'x200' Tank Battery, 3,696' Access Road/Electric Line and 250' Line to Laguna Toston Disposal Pond, Sections 17 and 20, T20S, R32E, Lea County, New Mexico	direct and indirect
61526	Wilcox, David	1998	Archaeological Survey of Southwestern Public Service Company's Proposed Electrical Distribution Line to Serve the Mesquite Services, Inc.'s Brine Station in Section 20, T20S, R32E, NMPM, Lea County, New Mexico	indirect only
63808	Sullivan, Tiffany Sue	1999	An Archaeological Survey of the Bureau of Land Management's 8100 Range Improvement Estes Water Pipeline and Troughs (Allotment No. 6022) located in T20S, R32E, Sections 22, 27, 28, Lea County, New Mexico	indirect only
71314	Michalik, Laura	2000	Cultural Resources Class III Inventory and Significance Evaluation of a Proposed Buried Fiber Optic Cable in Eddy and Lea Counties, New Mexico	indirect only
71698	Michalik, Laura	2000	Cultural Resources Inventory of a Proposed Waterline ROW Near Laguna Toston, Lea County, New Mexico	direct and indirect
74608	Kearns, Timothy M., Dianne M. Berrigan, Dorothy L. Webb, Steven F. Mehls, and Bob Estes	2003	An Archaeological Survey of the New Mexico Portion of Link One of the AT&T NexGen/Core Project	indirect only
77191	Michalik, Laura	2001	Cultural Resources Inventory of an Electric Line ROW South of Laguna Gatuna, Lea County, New Mexico	indirect only
77398	Baker, Kathleen A., and Timothy Kearns	2001	Archaeological Survey or Inspection of Access Roads Rejected or Recommended Cleared for Traffic: Addendum 1 to An Archaeological Survey of New Mexico Portion of Link One of the AT&T NexGen/Core Project	indirect only
78662	Smith, Stephen, and Theresa Straight	2002	Survey for the Baetz 23 Federal No. 9 Well Pad and the Baetz 23 Federal No. 3 Well Pad and Access Road	indirect only
88111	Gregory, Danny	2004	Cultural Resource Survey for Shoulder Rehabilitation Along NM 243, Eddy and Lea Counties, New Mexico	indirect only
89664	Gregory, Danny	2004	Cultural Resource Inventory along Smith Ranch Road in Lea County, New Mexico	indirect only
89953	Higgins, Howard C., Robert Hall, and Mark Sale	2004	Archaeological Inventory Survey in the Laguna Plata Archaeological District, Lea County, New Mexico	indirect only
93986	Railey, Jim A., and Patrick O. Mullen	2006	Cultural Resources Survey of the Intrepid Potash Land Exchange, Eddy and Lea Counties, New Mexico	indirect only

Table 3.7.1:

CULTURAL RESOURCE INVESTIGATIONS WITHIN THE APE

Activity No.	Author	Year	Title	APE
100474	Sanders, Joe Ben, Doralene Sanders, and Gail Wimberly	2006	A Class III Cultural Resource Inventory Report for the Lusky Federal Number 1 Proposed Well Location, Section 15, T20S, R32E, Lea County, New Mexico	indirect only
100590	Pangburn, Jeffrey	2006	A Class III Archaeological Survey of the Belco AIA Federal Well 2H Pad and Associated Access Road	indirect only
100842	Sanders, Joe Ben, Doralene Sanders, and Staci Sanchez	2006	A Class III Cultural Resource Inventory Report for the Permian Basin Pipeline ROW, Eddy and Lea Counties, New Mexico	indirect only
101277	Clifton, Don	2006	A Cultural Resource Survey of the Halfway Communications Tower, Lea County, New Mexico	indirect only
101929	Pangburn, Jeffrey, and Dagmar Youngberg	2006	A Class III Archaeological Survey for a Powerline Easement	indirect only
107422	Boone, Ann, and Danny Boone	2007	Belco Aia Federal Well No. 3-H	indirect only
109158	Boone, Ann, and Danny Boone	2008	Belco Aia Federal Well No. 4H, Surface Location	indirect only
113755	Robinson, Lynn	2009	Archaeological Clearance for the Laguna Fence Reconstruction	indirect only
114011	Robinson, Lynn	2009	Class III Archaeological Survey for the South Trap Fence Line	indirect only
115107	Smith, Stephen	2009	Archaeological Monitoring and Survey for Yates Petroleum Corporation's Proposed Pipeline Reroutes for the Belco Battery BPL Loop	indirect only
115461	Hroncich, Maria, Toni Goar, and Scott Walley	2009	A Class III Cultural Resource Survey for a Proposed Fiber Optic C able, US 62/180, Eddy and Lea Counties, New Mexico	indirect only
116048	Walker, Patricia	2009	A Class III Cultural Resources Inventory of the Proposed North Mine Gas Pipeline for Intrepid Potash–NM, LLC, Eddy and Lea Counties, New Mexico	indirect only
116891	Goar, Toni R.	2010	An Addendum to a Class III Cultural Resource Survey for a Proposed Penasco Valley Telephone Cooperative Fiber Optic Cable, US 62/180, Eddy and Lea Counties, New Mexico	indirect only
118942	Walker, Patricia, and Robert Dello Russo	2010	A Cultural Resources Inventory of Four Proposed Van Sickle Coreholes: IP-075, IP-076, IP-077, and IP-078 and Associated Access Roads, Eddy County, New Mexico, for Intrepid Potash–NM, LLC	indirect only
121906	Okun, Adam	2011	Archaeological Survey for the Carlsbad Double Eagle Water System Improvement Project, Eddy County, New Mexico	indirect only
123058	Cribbin, Brian	2012	A Class I and Class III Survey of 214 Acres for Two Southwestern Public Service 115 kV Circuits in Lea County, New Mexico	indirect only
123200	Sullivan-Owens, Tiffany	2012	A Class III Pedestrian Survey of the Proposed Excel Energy Manzano Queenie 15 No. 1H Power Line, Lea County, New Mexico	indirect only

Table 3.7.1:

CULTURAL RESOURCE INVESTIGATIONS WITHIN THE APE

Activity No.	Author	Year	Title	APE
125675	Cordua, Teresa	2012	Cultural Resource Survey of 8.72 Acres for the Proposed Intrepid North Compaction Powerline in Sections 18 and 19, Township 20 South, Range 32 East, Lea County, New Mexico	indirect only
126039	Travis, Cathy	2013	Revised Cultural Resource Survey of 12.87 Acres for the Proposed Intrepid North Compaction Powerline, Lea County, New Mexico	indirect only
126789	Hill, Rebecca L., and Joshua Broxson	2013	Class III Archaeological Survey for Agave Energy Company's Pipeline to Green Frog Cafe Fed Com No. 1H	indirect only
127779	Carlson, C., C. Walth, J. Walborn, and M. Bandy	2013	A Class III Survey for the Proposed Zia II Natural Gas Plant and Pipeline in Eddy and Lea Counties, New Mexico	indirect only
128094	Stowe, Michael	2013	Cultural Resource Survey for Souder Miller and Associates for Proposed Road Improvements to NM State HWY 176 from the Intersection of US HWY 62/180 extending East Roughly 10 Miles to MP 10, Lea County, New Mexico	indirect only
128168	Kerr, R. Stanley, and Toni R. Goar	2013	A Cultural Resource Survey for 4.5 Miles of Proposed Double Eagle Waterline in Carlsbad, Eddy and Lea Counties, New Mexico	indirect only
128460	Smith, Stephen	2013	Class III Archaeological Survey for Yates Petroleum Corporation's Proposed Well Pad to Serve the Anise ANI Federal Com No. 3H Well	indirect only
128497	Smith, Stephen	2013	Class III Archaeological Survey for Yates Petroleum Corporation's Proposed Access Road and Well Pad to Serve the Anise ANI Federal Com No. 4H Well	indirect only
129109	Mavrick, Christine A.	2013	A Class III Archaeological Survey for the Fasken Oil Laguna 2H Pipeline	indirect only
129407	Rein, Justin	2014	A Class III Cultural Resource Survey for the BOPCO, LP Laguna State No. 2 Drilling Island	indirect only
n/a	Condie, Carol J.	2007	Cultural Resources in the Eddy-Lea Energy Alliance Project Area, Lea County, New Mexico, for Gordon Environmental, Inc.	direct and indirect

Table 3.7.2:

CULTURAL RESOURCES IDENTIFIED WITHIN THE APE

State Site No. (LA)	Temporal Affiliation	Site Components	Year Recorded	Eligibility	APE
8058	prehistoric	artifacts and features	1963	undetermined	indirect only
22107	prehistoric	artifacts and features	1979	eligible	indirect only
22108	unknown	artifacts and features	1979	eligible	indirect only
22109	unknown	artifacts and features	1979	eligible	indirect only
22110	unknown	artifacts and features	1979	eligible	indirect only
22111	unknown	artifacts and features	1979	eligible	indirect only
22112	prehistoric	artifacts and features	1979	eligible	indirect only
22114	unknown	artifact scatter	1979	eligible	indirect only
34667	prehistoric	artifacts and features	1982	undetermined	indirect only
34668	unknown	artifact scatter	1982	undetermined	indirect only
35654	prehistoric	artifact scatter	1973	undetermined	indirect only
35655	unknown	artifacts and features	unknown	unknown	indirect only
43355	prehistoric and historical period	artifact scatter	1960	undetermined	indirect only
47384	prehistoric	artifacts and features	1984	eligible	indirect only
57150	unknown	artifact scatter	1970	undetermined	indirect only
57151	unknown	artifact scatter	1970	undetermined	indirect only
60817	unknown	artifacts and features	1987	undetermined	indirect only
60818	unknown	artifact scatter	1987	undetermined	indirect only
68669	prehistoric	artifacts and features	1988	eligible	indirect only
70084	unknown	artifacts and features	1988	undetermined	indirect only
70085	unknown	artifact scatter	1987	undetermined	indirect only
70086	prehistoric	artifacts and features	1987	undetermined	indirect only
70087	unknown	artifact scatter	1987	undetermined	indirect only
70088	unknown	artifact scatter	1987	undetermined	indirect only
89619	prehistoric	artifact scatter	1992	eligible	indirect only
89675	prehistoric	artifact scatter	1992	eligible	indirect only
89676	unknown	artifact scatter	1992	undetermined	direct and indirect
109924	historical period	artifacts and features	1995	not eligible	indirect only
109925	prehistoric	artifact scatter	1995	not eligible	indirect only
120944	prehistoric	artifacts and features	1997	undetermined	indirect only
120945	prehistoric	artifacts and features	1997	undetermined	indirect only
130744	historical period	buried cable	2000	not eligible	indirect only

Table 3.7.2:

CULTURAL RESOURCES IDENTIFIED WITHIN THE APE

State Site No. (LA)	Temporal Affiliation	Site Components	Year Recorded	Eligibility	APE
143904	historical period	artifacts and features	2004	not eligible	indirect only
149297	prehistoric and historical period	artifacts and features	2005	undetermined	indirect only
149298	historical period	artifact scatter	2005	not eligible	indirect only
149299	historical period	artifacts and features	2005	undetermined	direct and indirect
149302	prehistoric	artifact scatter	2005	not eligible	indirect only
149303	prehistoric	artifacts and features	2005	undetermined	indirect only
153898	prehistoric	artifacts and features	2006	eligible	indirect only
163183	prehistoric	artifacts and features	2009	eligible	indirect only
163231	prehistoric	artifacts and features	2009	not eligible	indirect only
177043	prehistoric	artifacts and features	2013	eligible	indirect only

3.8 SOCIOECONOMICS

This section describes social and economic characteristics for the 50-mile region of influence (ROI) surrounding the proposed CIS Facility site including Lea and Eddy Counties in New Mexico and Andrews and Gaines Counties in Texas (see Figure 3.8.1). The ROI reflects an area where anticipated CIS Facility workers reside and includes the area in which these workers would spend much of their wages. Information is provided for socioeconomic characteristics and include population, housing, community services, employment, and regional economy for the ROI. This section also includes a discussion of environmental justice populations.

3.8.1 Population Characteristics

Lea County is primarily rural, as are the other counties in the ROI. Between 2000 and 2010, the population in the ROI has grown at a slower rate in comparison to New Mexico-wide population growth. Population estimates in the ROI are projected to grow at a slower rate than New Mexico, increasing 10 percent between 2015 and 2025 while New Mexico is projected to increase 19 percent during the same time period. Table 3.8.1 lists historical population and Table 3.8.2 lists projected population in the ROI and New Mexico and Texas.

The population in the ROI in 2015 was estimated to be 166,914 (USCB 2016a). In 2015, 43 percent of the population of the ROI resided in Lea County, New Mexico. Between 2010 and 2015, the counties within the ROI all experienced an increase in population. Gaines County, Texas had the greatest increase at 14 percent, while Eddy County, New Mexico had the lowest increase at seven percent during the same time period.

The county seat of Lea County, New Mexico is located in Lovington, New Mexico and covers 2,822,522 acres with a population density of 14.7, the highest in the ROI. The county seat and largest city of Eddy County, New Mexico is Carlsbad. The county has a total area of 2,675,200 acres with a population density of 5.4, the lowest in the ROI. The county seat of Andrews County, Texas is Andrews. The county's area comprises 960,640 acres with a population density of 9.9. The county seat of Gaines County, Texas is Seminole. The county's area comprises 496,000 acres with a population density of 11.7. Table 3.8.3 presents the density per square mile for the ROI and county subdivisions.

3.8.1.1 Minority Population

The term minority population is defined by the U.S. Census Bureau to include the five racial categories of black/African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, some other race, and two or more races. NUREG-1748 defines minority populations to include individual of Hispanic or Latino origin. Table 3.8.4 presents the demographic profile of the ROI.

3.8.1.2 Low-Income Population

Low-income populations are defined using statistical poverty thresholds used by the U.S. Census Bureau. Information on low-income populations was developed from 2013 incomes reported in the 2010-2014 American Community Survey selected economic characteristics. The poverty

weighted average threshold for unrelated individual was $12,071 (USCB 2014). Table 3.8.5 presents the percentage of individuals below the poverty level.

3.8.2 Housing Characteristics

Detailed housing characteristics for the ROI are presented in Table 3.8.6. Between 2000 and 2014, Lea County, New Mexico and Gaines County, Texas had a decrease in the total number of owner-occupied housing units, while Eddy County showed no change. Lea and Eddy counties in New Mexico and Gaines County, Texas had a decrease in the number of renter-occupied units during the same period. Eddy County, Texas accounts for 38 percent of the housing units in the region, followed by Lea County, New Mexico (41 percent), Gaines County, Texas (31 percent) and Andrews County, Texas (10 percent).

The median home value ranges from $89,500 in Gaines County, Texas to $101,400 in Lea County, New Mexico. The median cost of a home in New Mexico in 2014 was $159,300 and $131,400 in Texas. The variation in housing units between the counties and the state is reflective of the rural nature of the county areas.

3.8.3 Community Characteristics

The community characteristics in the ROI include public schools, law enforcement, fire suppression, medical services, and recreation resources. Figure 3.8.2 depicts the community services in the vicinity of the CIS Facility.

3.8.3.1 Education

The ROI has 12 public school districts with a total of 80 schools serving a student population of 32,669 during the 2014-2015 school year, as presented in Table 3.8.7 (NCES 2016). Lea and Eddy Counties in New Mexico had student/teacher ratios greater than the state average of 15.1 while Andrews and Gaines Counties in Texas had student/teacher ratios less than the state average of 15:1. The ROI had an average student/teacher ratio of 15.1.

Lea and Eddy County in New Mexico school enrollment makes up six percent of enrollment for New Mexico and Andrews and Gaines County in Texas makes up less than one percent of enrollment for Texas. Table 3.8.8 summarizes the school enrollment data for the ROI.

3.8.3.2 Health Care and Public Safety

<u>**Health Care**</u>

There are two hospitals in Lea County, New Mexico. The Lea Regional Medical Center is located in Hobbs, New Mexico. Lea Regional Medical Center is a 201-bed hospital that can handle acute and stable chronic care patients (LRMC 2016). In Lovington, New Mexico, Covenant Medical Systems manages Nor-Lea Hospital, a small, 27-bed critical access facility. The emergency room has a basic trauma unit for critical care. Patients needing more extensive treatment can be transported to Lubbock, Texas or Albuquerque, New Mexico. Other clinics are located in Jal and Tatum (ELEA 2007, Section 2.7.4.6.3).

There are two hospitals in Eddy County, New Mexico. The Carlsbad Medical Center is a 115-bed facility with inpatient, outpatient, diagnostic, medical, surgical and emergency services located in

Carlsbad, New Mexico. The Carlsbad Medical Center has one main site and two medical office buildings. Carlsbad Medical Center's sister facility is the Lea Regional Medical Center in Hobbs, New Mexico. The Artesia General Hospital is a 34-bed critical access hospital. The emergency room is open 24-hours and has six beds. Patients needing more extensive treatment are usually transported to Lubbock, Texas or Albuquerque, New Mexico (ELEA 2007, Section 2.7.4.6.1).

There is one hospital in Andrews County, Texas. The Permian Regional Medical Center is a 42-bed facility in Andrews, Texas with inpatient, outpatient, diagnostic, medical, surgical and emergency services located in Andrews, Texas (AHD 2016). There is one hospitals in Gaines County, Texas. The Yoakum Community Hospital is a small 25-bed critical access facility in Yoakum, Texas (AHD 2016).

Public Safety

Table 3.8.9, shows the number of police and fire departments in each county within the ROI. There are a total of 18 police departments and 22 fire departments serving the counties in the ROI.

Fire support service for the Hobbs area is provided by the Hobbs Fire and Rescue. It is staffed by a full-time Fire Chief with 72 employees and a class rating of 4. The Hobbs Fire Department has 19 paramedics and 43 Emergency Medical Technicians (EMT) EMT-1, and 2 Special Weapons and Tactics (SWAT) Medics serving with the Hobbs Fire Department. The Hobbs Fire Department inventory of Emergency Medical Services (EMS) units has increased to seven (IIFP 2009, Section 3.10.3.4).

The Hobbs Police Department, with five full-time officers, provides local law enforcement. The Lea County Sheriff's Department also maintains a substation in the community of Hobbs. If additional resources are needed, officers from mutual aid communities within Lea County, New Mexico can provide an additional level of response. The New Mexico State Police provides a third level of response.

3.8.4 Economic Characteristics

3.8.4.1 Employment

Employment by sector is presented in Table 3.8.10. The agriculture, forestry, fishing, hunting, and mining industry provides the highest percentage of the employment in the ROI, 21 percent, followed by the educational services, and health care and social assistance, retail trade, and construction, with 17.2 percent, 9.7 percent, and 8.7 percent, respectively (USCB 2016b).

Since 2005, the ROI labor force grew from 62,926 in 2005 to 77,433 in 2015, for a growth rate of 23 percent for that period. Employment for the ROI declined from 70,360 in 2009 to 67,140 in 2010 for a decrease of nearly five percent for that period. The ROI unemployment rate, which was 4.4 percent in 2005, was five percent as of 2015, as presented in Table 3.8.11. The average unemployment rate for the New Mexico was 6.6 percent in 2015 and 4.5 in Texas during the same time period (BLS 2016a).

3.8.4.2 Income

Table 3.8.12 presents the median household and per capita incomes for 2014. Andrews County, Texas has the highest median household income and per capita income in the ROI and also exceeds

the values for Texas. Eddy County, New Mexico has the lowest median household income within the ROI while Gaines County, Texas has the lowest per capita income in the ROI (USCB 2016b).

3.8.4.3 Tax Structure

New Mexico's property tax rate is perennially ranked among the three lowest in the nation, with any change requiring an amendment to the state constitution. The property assessment rate is uniform, statewide, at a rate of 1/3 of the value (except oil and gas properties), which means that the net taxable value is one third of the assessed value minus allowable exemptions. The maximum operating levy that may be imposed by a county in New Mexico is 11.85 mils per $1,000 of net taxable value of a property, while the maximum for a municipality is 7.65 mils per $1,000 of net taxable value of a property (NMDFA 2016). The tax applied is a composite of state, county, municipal, school district and other special district levies. Properties outside city limits are taxed at lower rates. Major facilities may be assessed by the New Mexico State Taxation and Revenue Department instead of by the county. The Lea County, New Mexico tax rate for non-residential property outside the city limits of Hobbs is 27.4 mils per $1,000 of net taxable value of a property (EDCLC 2016). New Mexico communities can abate property taxes on a plant location or expansion for a maximum of 30 years, (usually 20 years in most communities), controlled by the community (NM Partnership 2016).

New Mexico also has a Gross Receipts Tax paid by product producers. This tax is imposed on businesses in New Mexico, but in almost every case it is passed to the consumer. In that way, the gross receipts tax resembles a sales tax. Certain deductions may apply to this tax for plant equipment (Finance NM 2015).

New Mexico counties have more limited general authority to impose a county gross receipts tax and they do not receive a state-shared distribution. However, counties have numerous options to impose taxes for other purposes. Some of these taxes, e.g., fire protection, county environmental gross receipts tax, may only be imposed on residents of the unincorporated area. Some, like that for jails and hospital and health care, reflect county responsibilities and are imposed county-wide (Finance NM 2015).

Property taxes provide a majority of revenue for local services in Texas. Property taxes are based on the most current year's market value. Any county, municipality, school district or college district may levy property taxes. Texas local governments make much more use of the property tax than is true of their New Mexico counterparts. According to the Tax Foundation, property taxes per capita in Texas were $1,562, versus $633 in New Mexico in 2010. Texas ranked 14th among the states, while New Mexico ranked 48th (Tax Foundation 2016a). By contrast, state and local gross receipts taxes per capita in Texas in fiscal year 2011 were $856, giving the state a ranking of 18th, while per capita gross receipts taxes in New Mexico were $907, putting the state in 15th place (Tax Foundation 2016b). While not a local government revenue source, New Mexico’s personal income tax per capita in 2011 ranked it 39th among the states (Tax Foundation 2016c). Texas has no personal income tax.

3.8.5 Environmental Justice

Under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Federal agencies are responsible for identifying and

addressing the possibility of disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. Minority populations refer to persons of any race self-designated as Asian, Black, Native American, or Hispanic. Low-income populations refer to households with incomes below the Federal poverty thresholds.

For this analysis, the populations of counties or block groups that intersected or were within the 50-mile radius were wholly included in population counts. Block groups that fell within a 50-mile radius and which met the criteria described below were identified as minority or low-income populations. Such a methodology is conservative, in that it could include higher populations than may actually exist within the 50-mile radius.

The threshold used for identifying minority and low-income communities surrounding specific sites were developed consistent with CEQ guidance (CEQ 1997, Section 1-1) for identifying minority populations using either the 50 percent threshold or another percentage deemed "meaningfully greater" than the percentage of minority or low-income individuals in the general population. CEQ guidance does not provide a numerical definition of the term "meaningfully greater." CEQ guidance was supplemented using the NRC, *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* (69 FR 52040). The policy statement directs analysts to consider environmental justice matters in greater detail "if the percentage in the impacted area significantly exceeds that of the state or county percentage for either the minority or low-income population." "Significantly" is defined by staff guidance to be 20 percentage points. The percentage of minority or low-income individuals in the general population is defined in this ER as the lower of the average percentage of minority or low-income individuals living in the state(s) in which the ROI lies or in the counties that are at least partially included within the ROI.

For the impact assessment, the analysis of environmental justice used block groups for minority populations and census tracts for low-income populations. Table 3.8.13 presents the site-specific thresholds in New Mexico and Texas for minority and low-income populations. The ROI for the environmental justice analysis was defined as an area within a 50-mile radius surrounding the proposed CIS Facility site that encompasses three counties in New Mexico and six counties in Texas. Because the Site is located in a rural area, a 50-mile radius surrounding the Site was used to present a sample of the surrounding population.

3.8.4.1 Minority Population

In 2010, minorities made up approximately 54 percent of the population of the three-county area surrounding the Site in New Mexico and 56.9 percent in the six-county area in Texas. During this time period, Hispanics were the largest minority group within the three-county area in New Mexico, consisting of approximately 49.4 percent of the population and 53 percent within the six-county area in Texas. Black or African Americans made up approximately 2.2 and 2.3 percent in New Mexico and Texas, respectively (USCB 2016e, f). Table 3.8.14 presents block groups identified to contain minority populations that exceed the site-specific thresholds for minority populations identified in Table 3.8.13.

There were 35 block groups identified to contain minority populations that exceed the site-specific thresholds for minority populations within the 50-mile radius. Within a smaller ROI, no minority populations were identified that exceed the site-specific threshold within a 4-mile or a 25-mile radius of the Site. The closest minority populations that exceed the site-specific threshold were located in the population centers of Artesia and Carlsbad in Eddy County and Hobbs in Lea County.

3.8.4.2 Low-Income Population

In 2010, the poverty threshold was $12,071 for unrelated individual (USCB 2014). There were no low-income populations identified in the three-county area surrounding the proposed CIS Facility site in New Mexico or the six-county area in Texas that exceed the site-specific threshold for low-income populations (USCB 2016g, h) identified in Table 3.8.13. Within a smaller ROI, no low-income populations were identified that exceed the site-specific threshold within a 4-mile or a 25-mile radius of the Site.

Table 3.8.1:

POPULATION ESTIMATES FOR THE REGION OF INFLUENCE

Area	Census 1990	Census 2000	Census 2010	Population Estimates as of July 1				
				2011	2012	2013	2014	2015
Lea	55,765	55,528	64,727	63,690	64,670	65,681	66,876	71,180
Eddy	48,605	51,633	53,829	53,288	53,693	54,284	54,834	57,578
Andrews	14,338	13,004	14,786	14,500	15,006	15,554	16,126	18,105
Gaines	14,123	14,467	17,526	17,123	17,572	18,019	18,496	20,051
Total ROI	**132,831**	**134,632**	**150,868**	**148,601**	**150,941**	**153,538**	**156,332**	**166,914**
New Mexico	1,515,069	1,819,046	2,059,179	2,037,136	2,055,287	2,069,706	2,080,085	2,085,109
Texas	16,986,510	20,851,820	25,145,561	24,774,187	25,208,897	25,639,373	26,092,033	27,469,114

Source: NMDWS 2015, USCB 2016a, Texas 2016.

Table 3.8.2:

POPULATION PROJECTIONS FOR THE REGION OF INFLUENCE

Area	2020	2025	2030	2035	2040
Lea	78,407	85,773	93,712	102,090	110,661
Eddy	57,908	59,945	61,836	63,595	65,258
Andrews	16,450	17,244	17,973	18,695	19,378
Gaines	20,064	21,420	22,858	24,316	25,644
Total ROI	172,829	184,382	196,379	208,696	220,941
New Mexico	2,351,724	2,487,227	2,613,332	2,727,118	2,827,692
Texas	27,238,610	28,165,689	28,994,210	29,705,207	30,305,304

Source: NMDWS 2015, Texas 2016.

Table 3.8.3:

POPULATION DENSITY PER SQUARE MILE OF LAND FOR THE REGION OF INFLUENCE, 2010

Area	2010
County	
Lea	14.7
Eddy	5.4
Andrews	9.9
Gaines	11.7
County Subdivision and Place	
Eunice City, Lea County	970.6
Hobbs City, Lea County	1,424.4
Jal City, Lea County	446.4
Lovington City, Lea County	2,320.9
Carlsbad City, Eddy County	903.3

Source: USCB 2010.

Table 3.8.4:

DEMOGRAPHIC PROFILE OF THE REGION OF INFLUENCE, 2014

Minority	Lea County, New Mexico		Eddy County, New Mexico		Andrews County, Texas		Gaines County, Texas		New Mexico		Texas	
Minority	**39,720**	**59.4%**	**27,093**	**49.4%**	**8,945**	**55.5%**	**7,666**	**41.4%**	**1,255,794**	**60.4%**	**14,529,580**	**55.7%**
Hispanic or Latino (of any race)	35,747	53.5%	24,840	45.3%	8,359	51.8%	7,082	38.3%	978,189	47.0%	9,962,643	38.2%
Black or African American alone	2,061	3.1%	783	1.4%	292	1.8%	281	1.5%	37,519	1.8%	3,015,767	11.6%
American Indian and Alaska Native alone	445	0.7%	536	1.0%	46	0.3%	90	0.5%	177,555	8.5%	65,974	0.3%
Asian alone	120	0.2%	339	0.6%	105	0.7%	82	0.4%	26,991	1.3%	1,053,474	4.0%
Native Hawaiian and Other Pacific Islander alone	0	0.0%	38	0.1%	0	0.0%	58	0.3%	942	0.0%	18,730	0.1%
Some other race alone	97	0.1%	206	0.4%	0	0.0%	51	0.3%	3,718	0.2%	33,114	0.1%
Two or more races	1,250	1.9%	351	0.6%	143	0.9%	22	0.1%	30,880	1.5%	379,878	1.5%
White alone	**60,769**	**90.9%**	**49,227**	**89.8%**	**14,947**	**92.7%**	**17,061**	**92.2%**	**1,575,631**	**75.7%**	**20,027,796**	**76.8%**
Total population	**66,876**	**100.0%**	**54,834**	**100.0%**	**16,126**	**100.0%**	**18,496**	**100.0%**	**2,080,085**	**100.0%**	**26,092,033**	**100.0%**

Source: USCB 2016a.

Table 3.8.5:

PERCENT OF PEOPLE BELOW THE POVERTY LEVEL IN THE REGION OF INFLUENCE, 2014

State/County	Percent of People Below Poverty Level
Lea County, New Mexico	16.4%
Eddy County, New Mexico	13.0%
Andrews County, Texas	11.4%
Gaines County, Texas	14.9%
New Mexico	20.9%
Texas	17.7%

Source: USCB 2016b.

Table 3.8.6:

ROI HOUSING CHARACTERISTICS, 2014

County	Total housing units	Occupied housing units	Owner-occupied units	Renter-occupied units	Vacant units	Owner vacancy rate	Rental vacancy rate	Median home value
Lea	24,993	21,331	15,050	6,281	3,662	2.2%	9.3%	$101,400.00
Eddy	22,960	20,190	14,849	5,341	2,770	0.4%	7.5%	$116,200.00
Andrews	5,935	5,414	4,161	1,251	523	2.6%	0.0%	$95,500.00
Gaines	6,322	5,483	4,299	1,184	839	0.5%	7.0%	$89,500.00
Total ROI	**60,210**	**52,418**	**38,359**	**14,057**	**7,794**	**1.4%**	**7.7%**	**$98,450.00**

Source: USCB 2016c.

Table 3.8.7:

PUBLIC EDUCATION STATISTICS FOR THE 2014-2015 SCHOOL YEAR

County	Number of School Districts	Number of Schools	Student Enrollment	Number of Teachers	Student/Teacher Ratio
Lea	5	37	14,661	849	17:1
Eddy	3	27	10,802	651	17:1
Andrews	1	6	3,764	257	14:1
Gaines	3	10	3,442	291	12:1
Total ROI	**12**	**80**	**32,669**	**2,048**	**15:1**
New Mexico	152	881	339,019	22,222	15:1
Texas	1,244	9,282	5,144,745	333,959	15:1

Source: NCES 2016.

Table 3.8.8:

EDUCATION CHARACTERISTICS IN THE REGION OF INFLUENCE, 2014

Area	School Enrollment	Grades <8 (%)	Grades 9-12 (%)	College/Graduate (%)
Lea	18,178	60.0	23.3	16.9
Eddy	13,863	59.0	24.4	16.5
Andrews	3,963	65.7	26.4	7.9
Gaines	4,709	75.0	20.7	4.4
Total ROI	**40,713**	**79.1**	**33.7**	**25.3**
New Mexico	567,018	50.4	20.6	29.1
Texas	7,366,632	54.6	20.5	24.9

Source: USCB 2016d.

Table 3.8.9:

POLICE AND FIRE DEPARTMENTS BY COUNTY

County	Police Departments	Fire Departments
Lea	10	6
Eddy	3	13
Andrews	1	1
Gaines	4	2
Total ROI	**18**	**22**

Source: HomeFacts 2016.

Table 3.8.10:

CIVILIAN EMPLOYMENT BY INDUSTRY SECTOR

Industry	Eddy County, New Mexico		Lea County, New Mexico		Andrews County, Texas		Gaines County, Texas		New Mexico		Texas	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Agriculture, forestry, fishing and hunting, and mining	4,552	18.4%	5,900	20.9%	2,148	28.3%	1,733	23.0%	38,509	4.4%	386,778	3.3%
Construction	1,744	7.1%	2,480	8.8%	610	8.0%	1,075	14.3%	60,090	6.9%	921,062	7.8%
Manufacturing	1,437	5.8%	1,295	4.6%	437	5.8%	385	5.1%	43,074	4.9%	1,095,393	9.3%
Wholesale trade	590	2.4%	1,263	4.5%	201	2.6%	178	2.4%	18,038	2.1%	352,721	3.0%
Retail trade	2,622	10.6%	2,805	9.9%	454	6.0%	725	9.6%	98,645	11.3%	1,365,482	11.6%
Transportation and warehousing, and utilities	1,572	6.4%	2,249	8.0%	651	8.6%	643	8.5%	39,326	4.5%	639,379	5.4%
Information	339	1.4%	303	1.1%	42	0.6%	47	0.6%	13,961	1.6%	212,915	1.8%
Finance and insurance, and real estate and rental and leasing	989	4.0%	1,030	3.7%	326	4.3%	78	1.0%	39,473	4.5%	779,765	6.6%
Professional, scientific, and management, and administrative and waste management services	1,356	5.5%	1,833	6.5%	531	7.0%	298	4.0%	95,808	10.9%	1,288,141	10.9%
Educational services, and health care and social assistance	4,674	18.9%	4,435	15.7%	1,349	17.8%	1,268	16.9%	220,881	25.2%	2,569,387	21.8%
Arts, entertainment, and recreation, and accommodation and food services	2,062	8.3%	2,123	7.5%	374	4.9%	374	5.0%	95,461	10.9%	1,038,023	8.8%
Other services, except public administration	1,154	4.7%	1,312	4.7%	369	4.9%	576	7.7%	41,932	4.8%	636,462	5.4%
Public administration	1,627	6.6%	1,171	4.2%	105	1.4%	144	1.9%	70,749	8.1%	523,502	4.4%

Source: USCB 2016b.

Table 3.8.11:

ANNUAL AVERAGE LABOR FORCE AND UNEMPLOYMENT RATES (2005-2015)

State/County		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Lea County, New Mexico	Labor Force	25,780	26,605	27,686	29,278	28,329	26,349	27,297	28,403	29,329	30,544	29,428
	Unemployment Rate	4.1	3.1	2.5	2.9	7.9	7.9	5.6	4.7	4.5	4.4	6.2
Eddy County, New Mexico	Labor Force	24,586	25,144	26,054	27,311	28,005	25,736	26,493	26,845	27,670	28,848	29,366
	Unemployment Rate	4.6	3.5	3.0	3.0	5.9	6.4	5.1	4.7	4.6	4.5	4.9
Andrews County, Texas	Labor Force	6,337	6,786	6,678	6,871	6,985	7,120	7,794	8,552	9,198	9,527	9,303
	Unemployment Rate	4.0	3.5	3.2	3.3	7.0	6.2	5.0	4.0	3.8	3.0	3.5
Gaines County, Texas	Labor Force	6,223	6,040	6,399	6,794	7,041	7,935	8,508	8,794	8,941	9,366	9,336
	Unemployment Rate	4.8	4.6	3.7	3.8	6.3	5.9	5.1	4.2	4.1	3.3	3.2
New Mexico	Labor Force	918,156	928,094	934,027	944,548	940,352	936,088	930,356	928,739	923,685	921,380	919,889
	Unemployment Rate	5.1	4.2	3.8	4.5	7.5	8.1	7.5	7.1	7.0	6.7	6.6
Texas	Labor Force	11,124,240	11,327,995	11,431,631	11,664,390	11,910,799	12,241,970	12,504,498	12,682,204	12,891,255	13,022,851	13,078,304
	Unemployment Rate	5.4	4.9	4.3	4.8	7.6	8.1	7.8	6.7	6.2	5.1	4.5

Source: BLS 2016a.

Table 3.8.12:

MEDIAN HOUSEHOLD AND PER CAPITA INCOMES IN THE REGION OF INFLUENCE, 2014

State/County	Median Household Income	Per Capita Income
Lea County, New Mexico	55,248	22,962
Eddy County, New Mexico	51,303	27,630
Andrews County, Texas	61,250	29,363
Gaines County, Texas	54,434	21,690
New Mexico	44,968	23,948
Texas	52,576	26,513

Source: USCB 2016b.

Table 3.8.13:

SITE-SPECIFIC THRESHOLDS FOR IDENTIFICATION OF MINORITY AND LOW-INCOME COMMUNITIES WITHIN THE 50-MILE REGION OF INFLUENCE (PERCENTAGE)

Population	New Mexico	Texas
Minority Population	80.4	75.7
Low-Income Population	40.9	37.7

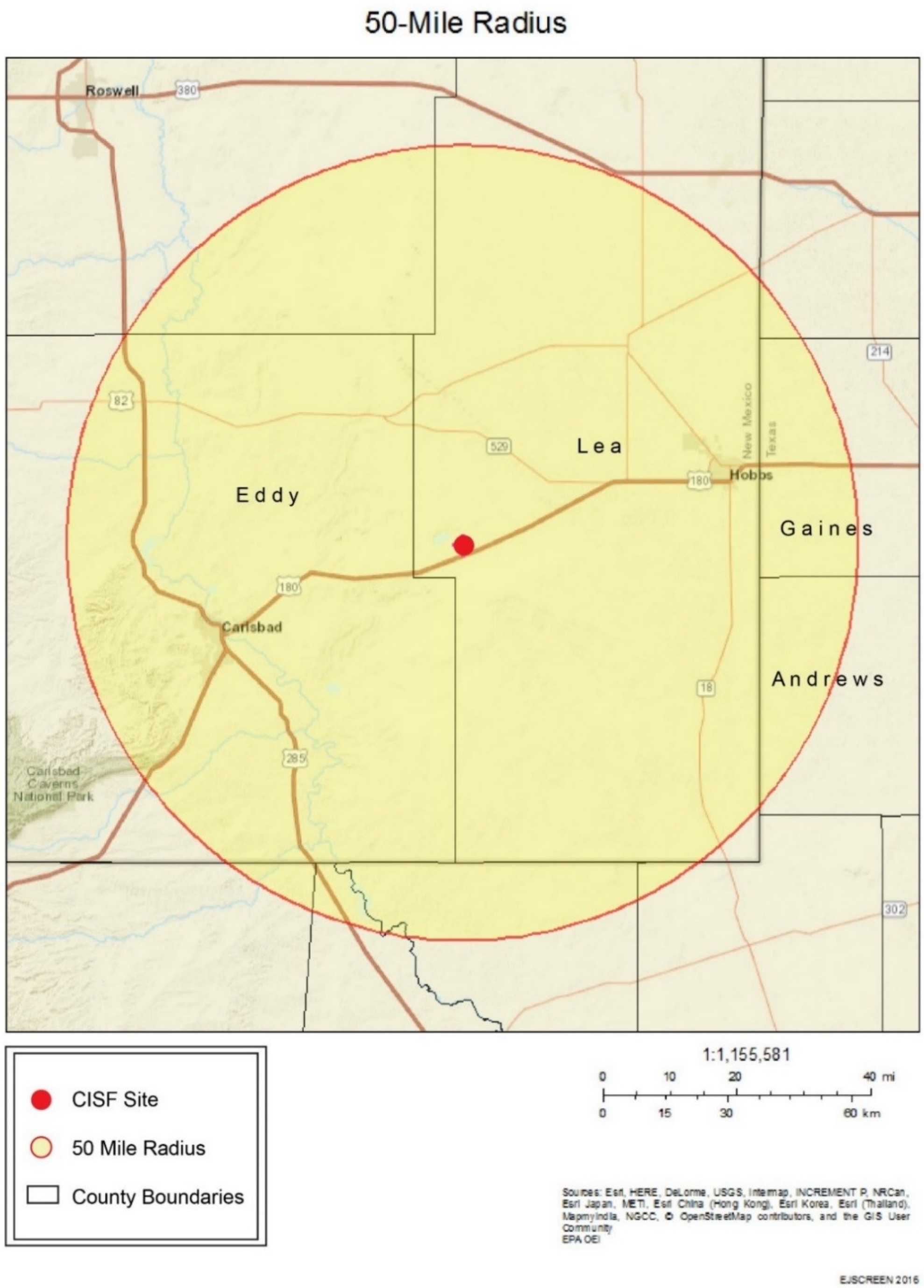
Source: USCB 2016b.

Table 3.8.14:

MINORITY POPULATIONS EXCEEDING SITE-SPECIFIC THRESHOLDS WITHIN THE 50-MILE REGION OF INFLUENCE (PERCENTAGE)

Block Group	Census Tract	County	State	Percent Minority
Block Group 3	Census Tract 4	Chaves	New Mexico	80.7%
Block Group 2	Census Tract 6	Chaves	New Mexico	94.8%
Block Group 3	Census Tract 6	Chaves	New Mexico	94.6%
Block Group 4	Census Tract 6	Chaves	New Mexico	90.5%
Block Group 5	Census Tract 6	Chaves	New Mexico	93.4%
Block Group 1	Census Tract 7	Chaves	New Mexico	83.8%
Block Group 4	Census Tract 11.01	Chaves	New Mexico	85.3%
Block Group 3	Census Tract 5	Eddy	New Mexico	82.3%
Block Group 2	Census Tract 10	Eddy	New Mexico	89.1%
Block Group 4	Census Tract 10	Eddy	New Mexico	84.7%
Block Group 3	Census Tract 1	Lea	New Mexico	81.0%
Block Group 1	Census Tract 2	Lea	New Mexico	75.5%
Block Group 2	Census Tract 2	Lea	New Mexico	77.9%
Block Group 3	Census Tract 2	Lea	New Mexico	75.7%
Block Group 1	Census Tract 3	Lea	New Mexico	92.2%
Block Group 2	Census Tract 3	Lea	New Mexico	88.7%
Block Group 3	Census Tract 3	Lea	New Mexico	85.6%
Block Group 1	Census Tract 4	Lea	New Mexico	81.3%
Block Group 3	Census Tract 4	Lea	New Mexico	94.4%
Block Group 5	Census Tract 6	Lea	New Mexico	85.1%
Block Group 6	Census Tract 6	Lea	New Mexico	82.6%
Block Group 2	Census Tract 9503	Culberson	Texas	88.8%
Block Group 3	Census Tract 9503	Culberson	Texas	80.6%
Block Group 4	Census Tract 9503	Culberson	Texas	77.9%
Block Group 4	Census Tract 9501	Gaines	Texas	85.6%
Block Group 1	Census Tract 9502	Reeves	Texas	94.6%
Block Group 2	Census Tract 9502	Reeves	Texas	95.8%
Block Group 3	Census Tract 9502	Reeves	Texas	86.5%
Block Group 1	Census Tract 9503	Reeves	Texas	95.5%
Block Group 2	Census Tract 9503	Reeves	Texas	84.8%
Block Group 1	Census Tract 9504	Reeves	Texas	89.1%
Block Group 3	Census Tract 9504	Reeves	Texas	86.6%
Block Group 4	Census Tract 9504	Reeves	Texas	79.6%
Block Group 1	Census Tract 9505	Reeves	Texas	78.3%
Block Group 1	Census Tract 9503	Winkler	Texas	75.9%

Source: USCB 2016e, f.



Source: EJScreen 2016.

Figure 3.8.1: REGION OF INFLUENCE WITHIN A 50-MILE RADIUS OF THE CIS FACILITY

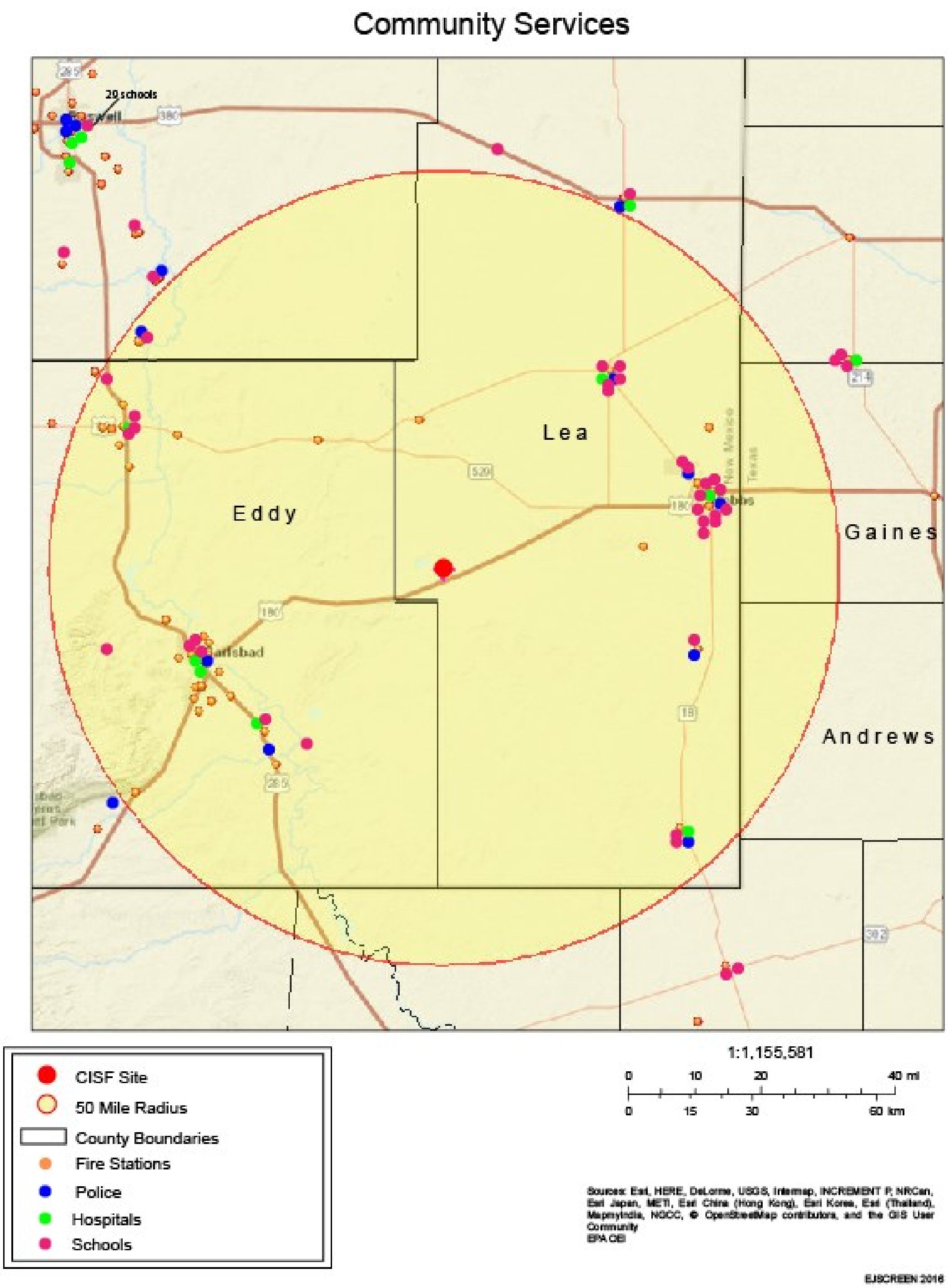


Figure 3.8.2: COMMUNITY SERVICES IN THE VICINTY OF THE CIS FACILITY

3.9 TRANSPORTATION

Transportation services to the CIS Facility would include the delivery of equipment, supplies, and staff, including contractors, needed to work and provide miscellaneous maintenance activities at the CIS Facility. The mode of transportation for these types of services would be by road. The offsite transportation of solid and radioactive waste generated at the CIS Facility would also be by road.

DOE or utility licensees would be responsible for transporting SNF from existing commercial nuclear power reactor storage facilities to the CIS Facility. SNF would be transported to the CIS Facility by rail. Approximately 3,000 canisters are expected to be transported over 40 years. SNF would be shipped in transportation packages licensed pursuant to 10 CFR Part 71 and in compliance with requirements established by the DOT.

In order to support the transportation needs of the CIS Facility, this section describes the roads and railroads, from county roads to U.S. highways in the vicinity of the Site and on the Site. Figure 3.9.1 shows the roads and railroads in the area.

3.9.1 Roads

The major roads in the area consist of county and state roads interconnecting the various population centers, but only four U.S. highways traverse the area.

- U.S. Highway 285 runs south to north along the Pecos River through Carlsbad;
- U.S. Highway 62/180 runs southwest to the northeast through Carlsbad and Hobbs, New Mexico;
- U.S. Highway 82 travels west to east from Artesia through Lovington, New Mexico;
- U.S. Highway 380 traverses west to east from Roswell through Tatum, New Mexico (ELEA 2007, Section 2.1.2.2).

The nearest highway to the Site is U.S. Highway 62/180 (1/2 mile to the south), which is of four lane construction and the major route between Carlsbad and Hobbs. In 2015, the annual average daily traffic (AADT) on U.S. Highway 62/180 ranged from approximately 9,952 vehicles per day near Hobbs, to 5,696 vehicles per day in the vicinity of the proposed Site (near the Eddy-Lea County line), to 7,273 vehicles per day near Carlsbad. Approximately 43 percent of vehicles in the vicinity of the proposed Site were associated with commercial trucks (NMDOT 2016). U.S. Highway 62/180 is also the final major highway segment on the WIPP Transportation Route. From 1999 to 2014, there have been almost 12,000 shipments of waste to WIPP covering over 14 million miles (DOE 2016a).

Laguna Road, which connects to U.S. Highway 62/180, currently provides access to the Site from the south. Laguna Road runs south-north through the Site and connects to small county roads north of the Site. As discussed in Section 4.9 of this ER, a new roadway is proposed to be constructed to the Site from U.S. Highway 62/180. The nearest Interstate Highway is Interstate-20, approximately 95 miles to the southeast in Odessa, Texas (ELEA 2007, Section 2.7.7.1).

3.9.2 Railroads

Two railroads service the area. One railroad company operates to the west of the Site and the other to the east. Southwestern Railroad operates the Burlington Northern-Santa Fe (BNSF) Carlsbad Subdivision (Carlsbad to Clovis, New Mexico, plus industrial spurs serving potash mines east of Carlsbad and east of Loving, New Mexico) under a lease agreement. Customers include potash mines, a petroleum refinery in Artesia, New Mexico, and various feed mills and agricultural-related businesses in Roswell and Portales, New Mexico. The Carlsbad spur ends at the Intrepid Mining LLC North facility which is 3.8 miles due west of the Site (ELEA 2007, Section 2.7.7.2). As discussed in Section 4.9 of this ER, a spur from this railroad would be constructed to serve the Site.

East of the Site, the Texas-New Mexico Railroad (TNMR) operates 104 miles of track near the Texas-New Mexico border from a Union Pacific connection at Monahans, Texas to Lovington, New Mexico. The railroad serves the oil fields of West Texas and Southeast New Mexico. The primary commodities hauled are oilfield chemicals and minerals, construction aggregates, industrial waste, and scrap (ELEA 2007, Section 2.7.7.2). Approximately 400 railroad cars per year travel on this rail (IIFP 2009, Section 3.2.1).

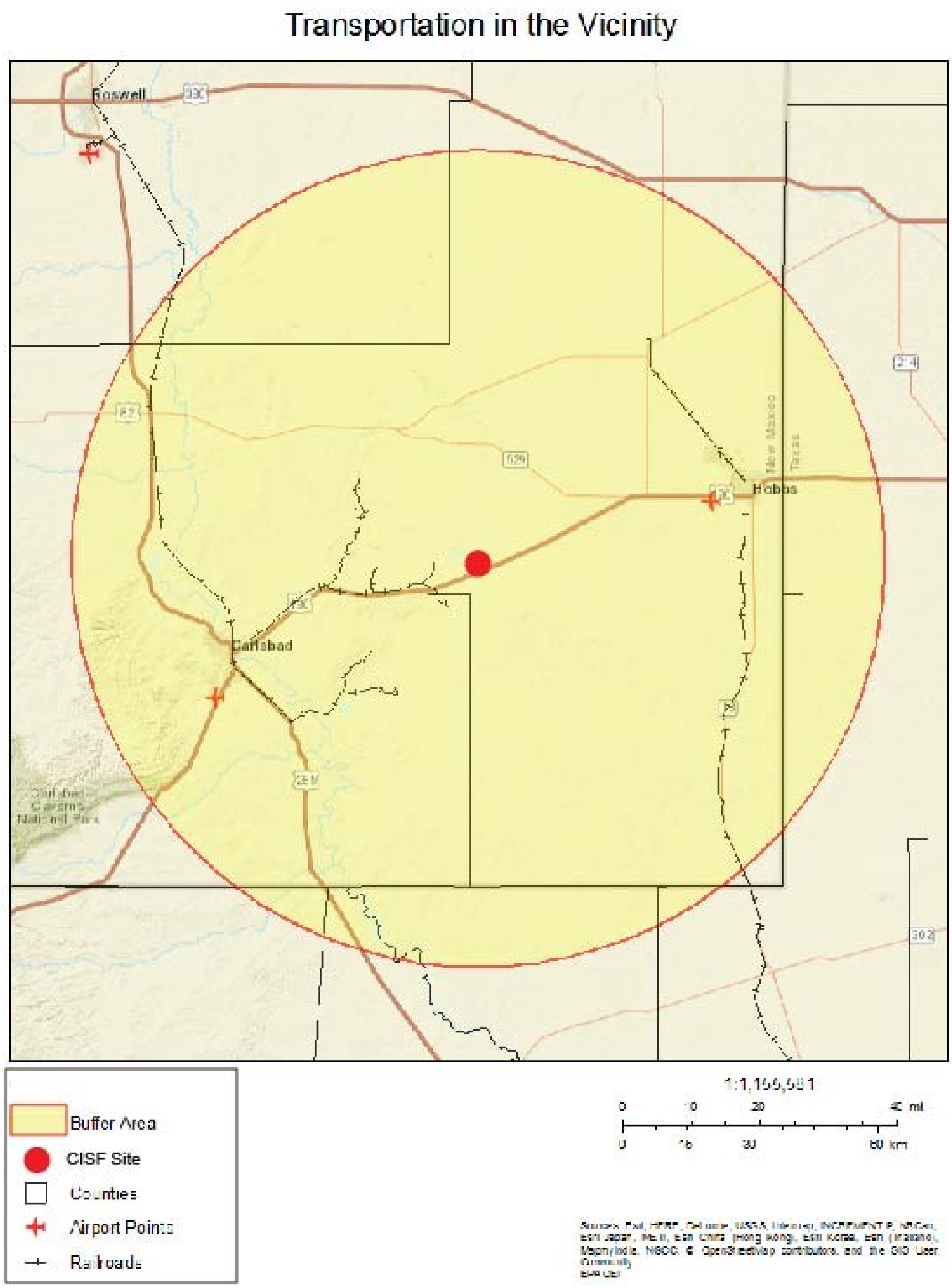


Figure 3.9.1: TRANSPORTATION IN THE VICINITY OF THE SITE

3.10 INFRASTRUCTURE

This section describes the existing services available to the proposed CIS Facility. These services include water and electricity. The information is necessary to evaluate the availability of infrastructure (power and water) to support construction, operation and decommissioning activities.

The Site is located in southeastern New Mexico in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico. Both locations are nearby population centers to the Site. Larger population centers are Roswell, New Mexico, 74 miles to the northwest; Odessa, Texas, 92 miles to the southeast; and Midland, Texas, also to the southeast at 103 miles.

Oil and gas extraction provides most of the activity in the vicinity. Roads are built and maintained to provide access to the various wells. Pipelines are installed to move the product efficiently from one area to the next. Where pipelines are not used, access for heavy trucks to haul the oil produced is required. Compressor stations are needed to pump the product through the pipelines. Electric power is required at the individual well pads to provide the electricity necessary to operate the pumps, compressors, and other equipment as needed. There are two major facilities related to oil/gas activity in the area. The Zia Gas Plant is located northwest of the Site, while Controlled Recovery Incorporated is southwest of the Site (ELEA 2007, Section 2.1).

3.10.1 Water

The Site and immediate vicinity contain no significant sources of potable water, either as groundwater or surface water. The Site's proximity to the Ogallala Aquifer and the presence of a 24-inch diameter water line on site assures a plentiful supply of water for operation. The Ogallala Aquifer is estimated to contain 14,000,000 acre-feet of recoverable water in Lea County portion (ELEA 2007, Section 1.7).

The City of Hobbs Water Department would provide the potable water needed for the construction and operation of the CIS Facility.

3.10.2 Electricity

Numerous power transmission lines exist within the region assuring plentiful electricity to meet the demands of the CIS Facility. Xcel Energy is very active in the area and is planning a major addition to the power system as part of its Power for the Plains grid enhancement initiative that will deliver a more reliable and abundant electricity supply to customers in New Mexico and Texas (Hobbs News 2016).

Xcel Energy is currently seeking route approvals in both New Mexico and Texas for a 345-kilovolt transmission line, a similar transmission project was completed in 2014. By 2020, a 345-kilovolt line will stretch more than 400 miles from western Oklahoma to southeastern New Mexico (Hobbs News 2016). Xcel energy would provide the electrical power needed for the construction and operation of the CIS Facility.

3.11 WASTE MANAGEMENT

This section describes the waste management capability in the vicinity of the Site. The purpose of this information is to provide a basis to assess potential impacts associated with the timely and proper disposal of waste resulting from construction, operation, and decommissioning of the CIS Facility. Based on the available information, several facilities are available to handle the small quantities of hazardous and non-hazardous waste that would be expected from the proposed CIS Facility. This includes low-level radioactive waste, radioactive mixed waste, hazardous waste, solid (sanitary) waste, and industrial waste.

There are currently no existing facilities or structures on the proposed CIS Facility site; therefore, no waste is currently produced and no waste management services provided. There are three facilities that have permits from the state of New Mexico to handle non-hazardous waste. Two are permitted municipal landfills and the third is an industrial waste landfill (ELEA 2007, Section 2,8).

The Sandpoint Landfill is 25 miles west of the Site and serves Eddy County. The service area covers 4,200 square miles and has a population of 49,000. The County and the City of Carlsbad jointly own the Landfill, which is operated by Waste Connections, Inc. The City of Artesia operates a transfer station, as does the County at the Village of Loving. Commercial collection services are available to most county residents living outside the incorporated areas of the county (ELEA 2007, Section 2.8).

The Lea County Solid Waste Authority has a service area that covers 4,400 square miles and has a population of 55,800. The Lea County Solid Waste Authority consists of Lea County and all of the incorporated municipalities in the County. Commercial collection service is available to County residents living outside of the incorporated areas. The Authority's landfill is east of Eunice New Mexico, opened in July 1999 and is operated by Waste Connection, Inc. (ELEA 2007, Section 2.8).

Lea Land, Inc. operates an industrial waste landfill three miles from the Site. The landfill is permitted to take non-hazardous industrial waste under a permit issued by NMED (ELEA 2007, Section 2.8). The Lea Land landfill has plenty of available capacity and is projected to remain open for 40 years (Lea Land 2016). With regard to Resource Conservation and Recovery Act (RCRA) wastes, the Waste Control Specialist (WCS) facility in Andrews County, Texas, approximately 39 miles from the proposed Holtec CIS Facility, includes a RCRA Subtitle C landfill.

3.12 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

This section describes existing public and occupational health issues that relate to the location and operations at the CIS Facility. It begins with a description of the general radiological environment in the U.S., followed by a discussion of background levels and sources of radiation and historic exposures near the CIS Facility. This section also presents public and occupational dose limits applicable to the CIS Facility, and summarizes health effects studies related to the radiation exposure.

3.12.1 Radiological Exposure

All members of the public are exposed to sources of ionizing radiation that occur naturally in the environment and as a result of human activities. Relative concentrations of radionuclides in different environmental media around the U.S. (e.g., air, soil, ground water) vary by geographic location.

Table 3.12.1 identifies background doses to a typical member of the U.S. population. In the table, the annual values are rounded to the nearest 1 percent. An average annual total effective dose equivalent to members of the U.S. population (i.e., 624.8 millirem [mrem]/year) comes from two primary sources: (1) naturally occurring background radiation and (2) medical exposure to patients (NRC 2014b, Table 6-3). Because the proposed CIS Facility site has not been used previously for activities that involve radioactive materials, the background exposure levels in Table 3.12.1 provide a baseline for the CIS Facility project. Table 3.12.1 provides the best approximation of radiological conditions for the following reasons:

- There are no legacy activity issues since the Site has not been previously used for activities that involve radioactive materials.
- Nuclear facilities in the vicinity will not provide any significant radiological doses because the maximally exposed individual (MEI) exposures at those facilities are small (See Table 5.2.3).
- The DOE established radiological monitoring programs in southeastern New Mexico prior to the WIPP project to determine the widespread impacts of nuclear testing at the Nevada Test Site on the background radiation. The DOE estimated an annual dose of approximately 65 millirem is received from atmospheric particulate matter, ambient radiation, soil, surface water and sediment, groundwater, and biota. These values fall within expected ranges and do not indicate any unexpected environmental concentrations (NRC 2012b, Section 3.14.1).
- A major proportion of natural radiation comes from naturally occurring airborne sources such as radon and thoron (an isotope of radon). The proposed site is in an area characterized by radon concentrations of 2 to 4 picocuries per liter (pCi/L) and is defined as moderate radon potential. Moderate radon potential indicates that 1/3 to 1/2 of the structures have more than 4 pCi/L of indoor radon. In May 2004, direct background radiation was measured by the NMED Radiation Control Bureau to be 8 to 10 microrad per hour, which corresponds to 70 to 88 millirem per year. This range falls within the NRC's estimation of the average annual direct background radiation for the United States (NRC, 2012b,Section 3.12.1).

3.12.2 Public and Occupational Dose Limits

This section provides the radiation standards and dose limits applicable to CIS Facility, describes occupational injury and fatality rates related to the CIS Facility, and summarizes health effects studies related to radiation exposure.

3.12.2.1 Applicable Standards and Dose Constraints

Radiation exposure limits for the workers and general public have been established by the NRC and the EPA in the following:

- 10 CFR Part 20, Standards for Protection Against Radiation;
- 410 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste.

The radiation protection standards for members of the public apply to any real individual located at or beyond the nearest boundary of the controlled area for the facility. The controlled area is defined as "that area immediately surrounding an ISFSI…for which the licensee exercises authority over its use and within which…operations are performed." (10 CFR 72.3) Radiation protection standards are summarized in Table 3.12.2.

3.12.2.2 Occupational Injury and Fatality Rates

Potential health impacts to workers during the construction and operation of the proposed CIS Facility would be those normally associated with construction and industrial activities. The U.S. Department of Labor, Bureau of Labor Statistics (BLS) compiles annual data on nonfatal and fatal occupational injuries in various industries. Incidence rates of nonfatal occupational injuries in New Mexico are presented in Table 3.12.3 for 2009–2014 and fatal occupational injuries rates by industry in New Mexico are shown in Table 3.12.4 (DOL 2009-2014, New Mexico).

3.12.3 Health Effects Studies

Knowledge of the effects of ionizing radiation comes primarily from studying groups of people who have received high doses. The risks associated with large doses of ionizing radiation like X-ray and gamma radiation are relatively well established and have been reported in numerous publications by national and international organizations including the National Academy of Sciences (NAS), the NRC, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and the International Commission on Radiation Protection (ICRP).

There are several studies of occupationally exposed persons, who generally receive low doses of ionizing radiation at low dose rates. Radiation is a weak carcinogen, but undue exposure can certainly increase health risks. Radiation protection standards assume that any dose of radiation, no matter how small, involves a possible risk to human health.

Radiation epidemiology has provided clear insights into radiation exposures and risks. A single radiation exposure can increase cancer risk for life and the young are more susceptible than the elderly. In utero, susceptibility to radiation-induced cancer is no greater than in early childhood, and females are more susceptible than males. Radiation cancer risks differ by organ and tissue and some sites have not seen a convincing increase after exposure. Radiation epidemiology is highly uncertain about low dose and low-dose rate risks. However, available scientific evidence does not indicate any cancer risk or immediate effects at doses below 10 rem per year. At low levels of exposure, the body's natural mechanisms repair radiation damage to cells soon after it occurs.

In the U.S., cancer is the second most common cause of death in the U.S., exceeded only by heart disease, and accounts for nearly 1 in every 4 deaths. Cancers can be caused by external factors,

such as tobacco, infectious organisms, and an unhealthy diet, as well as internal factors, such as inherited genetic mutations, hormones, and immune conditions (ACS 2016, page 1). The American Cancer Society reports that an estimated 9,750 new cancer cases were expected for the state of New Mexico in 2016, and nearly 1.7 million new cases were expected for the entire U.S. (ACS 2016, Table 2 for New Mexico). Table 3.12.5 shows the cancer incidence rate for New Mexico and surrounding states for the period 2008–2012 for selected cancer sites.

Table 3.12.1:

AVERAGE ANNUAL EFFECTIVE DOSE EQUIVALENT OF IONIZING RADIATION TO A MEMBER OF THE U.S. POPULATION

Source	Effective Dose Equivalent	
	mrem	Percent of Total
Radon and thoron	228	37
Cosmic	33	5
Terrestrial	21	3
Internal	29	5
Subtotal for ubiquitous background	**311**	**50**
Computed tomography	147	24
Nuclear medicine	77	12
Interventional fluoroscopy	43	7
Conventional radiography and fluoroscopy	33	5
Subtotal for medical	**300**	**48**
Consumer products	13	2
Industrial, security, medical, educational and research	0.3	0.05
Occupational	0.5	0.08
Total	**624.8**	**100**

Source: NRC 2014b, Table 3-3.

Table 3.12.2:

SUMMARY OF RADIATION PROTECTION STANDARDS

Individual	Annual Dose Limit	Reference
Worker	5 rems TEDE	10 CFR 20.1201
	50 rems CDE to any organ	10 CFR 20.1201
	15 rems dose equivalent (DE) lens of eye	10 CFR 20.1201
	50 rems DE skin	10 CFR 20.1201
General Public	0.1 rem TEDE all man-made sources	10 CFR 20.1301
	0.002 rem EDE in any 1-hour period	10 CFR 20.1301
	25 mrems CDE whole body	10 CFR 72.104
	25 mrems CDE any other critical organ	10 CFR 72.104
	75 mrems CDE thyroid	10 CFR 72.104

Table 3.12.3:

NONFATAL OCCUPATIONAL INJURIES RATES BY INDUSTRY IN NEW MEXICO[a]

Industry	2014	2013	2012	2011	2010	2009
All industries	1.6	1.7	2.0	2.2	2.0	2.1
Agriculture-crop production	1.3	4.8	4.9	1.3	2.0	--[b]
Agriculture-animal production	2.8	2.9	0.7	2.4	1.7	2.8
Construction	1.7	1.5	1.9	2.0	2.1	1.7
Mining (except oil & gas)	0.9	1.2	1.5	2.0	2.0	1.9

a Incidence rates represent the number of injuries and illnesses per 100 fulltime workers (working 40 hours per week x 50 weeks per year = 200,000 worker hours) reported as cases with days away from work, job transfer, or restriction rate (DOL 2009-2014, New Mexico, first column of link, page 1).

b Values were not reported for New Mexico for this industry for this year.

c Values were not reported for "Mining (except oil & gas)" for this year and values reported here are for the most relevant industry reported, which is "Mining, quarrying, and oil and gas extraction."

Table 3.12.4:

FATAL OCCUPATIONAL INJURIES RATES BY INDUSTRY IN NEW MEXICO [a]

Industry	2013	2012	2011	2010	2009
Overall rate	6.7	4.8	6.6	4.9	5.2
Construction	15.6	15.7	18.4	17.1	12.1
Mining	37.3	28.0	37.3	--[b]	--[b]
Manufacturing	--[b]	--[b]	17.1	12.5	--[b]
Transportation and utilities	55.4	--[b]	36.6	20.7	21.0

a From the U.S. DOL Bureau of Labor Statistics, in cooperation with state and Federal agencies, Census of Fatal Occupational Injuries (DOL 2009-2014, New Mexico, last column of links). The rate represents the number of fatal occupational injuries per 100,000 full-time equivalent workers and can be used to compare the risk among worker groups with varying employment levels.

b Values were not reported for New Mexico for this industry for this year.

Table 3.12.5:

INCIDENCE RATES FOR SELECTED CANCERS BY STATE, 2008–2012[a]

State	All Sites		Lung & Bronchus		Breast	Prostate	Non-Hodgkin Lymphoma	
	Male	Female	Male	Female	Female	Male	Male	Female
Arizona	420.4	373.9	59.2	47.0	111.0	89.8	18.3	13.3
Colorado	473.7	396.5	52.8	43.3	125.2	133.2	22.1	15.5
New Mexico	**431.2**	**367.2**	**49.7**	**37.4**	**112.1**	**110.4**	**18.0**	**13.8**
Oklahoma	520.1	411.8	90.1	60.2	119.2	128.8	21.9	15.4
Texas	488.5	384.4	73.0	46.7	113.1	115.7	21.8	15.4
Utah	480.6	368.0	34.7	23.7	113.8	156.8	23.9	15.4

a From ACS 2016, Table 4. Incidence rate per 100,000, age-adjusted to the 2000 U.S. standard population.

CHAPTER 4: ENVIRONMENTAL IMPACTS

4.0 INTRODUCTION

This chapter presents the potential environmental impacts of the Proposed Action and the No Action Alternative. For the Proposed Action, the potential impacts are presented in Sections 4.1-4.13 for the following areas: land use; visual and scenic resources; geology and soils; water resources; ecological resources; climatology, meteorology, air quality, and noise; cultural resources; socioeconomics and environmental justice; transportation; site infrastructure; waste management; public and occupational health and safety; and accidents. Section 4.14 presents the potential environmental impacts of the No Action Alternative.

For the Proposed Action, the analysis addresses the potential impacts associated with construction, operations, and decontamination and decommissioning (D&D). Construction impacts are presented for: (1) Phase 1, which accounts for the greatest amount of construction because all support facilities (e.g., Cask Transfer Building, Security Building, and Administration Building) and supporting infrastructure (e.g., railroad spur and Site access road); and (2) Phases 2-20, which would occur concurrently with operations of any phases previously constructed. Operational impacts account for Phase 1 as well as the full build-out of the Consolidated Interim Storage Facility (CIS Facility) (i.e., storing 10,000 Vertical Ventilated Modules [VVMs] containing 100,000 metric tons of uranium [MTUs] of spent nuclear fuel [SNF]). In order to provide a context for the impacts of the Proposed Action, each resource section also includes a comparative analysis against previous, relevant Nuclear Regulatory Commission (NRC)/other agency environmental reviews.

4.1 LAND USE

This section describes the potential impacts to land use associated with the Proposed Action. Construction impacts for Phase 1 are presented in Section 4.1.1; concurrent impacts from operations and construction of Phases 2-20 are presented in Section 4.1.2; full facility build-out operations are presented in Section 4.1.3; NRC analysis related to land use is presented in 4.1.4; and D&D impacts are presented in Section 4.1.5. Chapter 6 describes proposed mitigation measures that would be in place to reduce adverse impacts that could occur during construction, routine, and non-routine operation of the CIS Facility.

4.1.1 Construction (Phase 1)

During Phase 1, the initial Independent Spent Fuel Storage Installation (ISFSI) Pads (for the first 500 canisters of SNF that would be stored in the VVMs) and all supporting facilities (e.g., Cask Transfer Building, Security Building, and Administrative Building) and supporting infrastructure (e.g., railroad spur and Site access road) would be constructed. Phase 1 accounts for the greatest amount of construction during any phase of construction and, thus, bounds the construction impacts for any subsequent phase of construction that might occur. Accounting for the Protected Area (i.e., the area within the security fence containing the ISFSI Pads and the Cask Transfer Building), Phase 1 construction would disturb approximately 119.4 acres. Of this disturbance, 6.2 acres would be associated with constructing the Site access road and relocating the existing road

that currently runs through the site; 39.4 acres would be associated with constructing the railroad spur; and 1.4 acres would be associated with constructing the Security Building, Administrative Building, Parking Lot, and the concrete batch plant/laydown area.

During construction of the CIS Facility, conventional earthmoving and grading equipment would be used. The removal of very dense soil or caliche may require the use of heavy equipment with ripping tools. Soil removal work for foundations will be controlled to minimize excavation. In addition, loose soil and/or damaged caliche would be removed prior to installation of foundations for seismically designed structures.

The CIS Facility would require the installation of water, natural gas, and electrical utility lines, which would result in land disturbance and short-term impacts to vegetation. The construction activities would also include construction of a railroad spur, which would be routed across relatively level land and would not have to cross major highways. Similarly, a new roadway of approximately one mile in length would be constructed to the Site from United States (U.S.) Highway 62/180. Construction of both the railroad spur and roadway would be across Bureau of Land Management (BLM) lands and would not be inconsistent with BLM-designated land use, although additional National Environmental Policy Act (NEPA) analysis would likely be required for a right-of-way (ROW) on Federal lands (ELEA 2007, Section 2.1).

No water wells are located on the Site. However, the Site has been associated with oil and gas exploration and development with at least 18 plugged and abandoned oil and gas wells located on the property. However, none of these plugged and abandoned oil and gas wells are located within the area where the ISFSI would be located or where any land would be disturbed and they are not expected to affect the construction and operation of the CIS Facility. The plugged wells are estimated to be 30-70 years old. It is possible that hydrocarbon contamination exists at the Site as a result of these past practices (ELEA 2007, Appendix 2G). There are no active wells on the Site and there are no plans to use any of the plugged and abandoned wells on the Site.

4.1.2 Concurrent Operation and Additional Construction (Phases 2-20)

Construction of Phases 2-20 would occur in 20 phases over approximately 20 years and would require an additional 210.6 acres of land. Such construction would occur adjacent to operational areas previously constructed. Holtec would have procedures in place to ensure that the construction activities of Phases 2-20 do not adversely affect operations. In terms of land use, this means ensuring an adequate buffer is maintained between operational and construction areas. The construction process for Phases 2-20 would consist of constructing additional ISFSI Pads (each of which would accommodate 500 canisters of SNF). The construction process for additional phases would be the same as that for Phase 1 CIS Facility, with similar impacts to land use. At full build-out, the CIS Facility would contain 10,000 VVMs that would be constructed on approximately 330 acres. The Protected Area would account for 283 acres of this total. Within the Protected Area, approximately 110 acres would be disturbed by the ISFSI once all 20 phases are constructed.

4.1.3 Operation

The operation of the CIS Facility is not anticipated to result in any significant impacts to land use considering that the majority of the Site would remain undeveloped. In general, these lands would likely be used for grazing or other purposes if they were not utilized for the CIS Facility. Currently,

approximately 93 percent of land in Lea County is used as range land for grazing (approximately 2.6 million acres) (NRC 2012b, Section 3.2). The operation of the CIS Facility at full build-out would restrict activities on 330 acres would result in the loss of 0.01 percent of the land available for grazing and other purposes. Due to the abundance of other nearby land for grazing and other purposes, this impact would not be significant.

Although the proposed CIS Facility would change the existing land use of the Site, the CIS Facility would be compatible and consistent with land use activities in the area and would be compatible and consistent with the current land use designation for the Site.

4.1.4 Comparable NRC Land Use Analysis

This analysis is consistent with NRC Regulation (NUREG)-2157 (NRC 2014b, Section 4.1), in which NRC determined that construction and operation of an ISFSI would have minimal impacts on land use. Normal operation and ISFSI construction would not significantly affect land use and would not be inconsistent with agency land use.

4.1.5 Decontamination and Decommissioning

D&D activities are similar in nature to the construction activities, however, the D&D activities would be expected to be completed within a few years compared to the full CIS Facility construction over 20 years. At the end of useful plant life, the CIS Facility would be decommissioned such that the Site and remaining facilities could be released for unrestricted use and for NRC license termination pursuant to 10 Code of Federal Regulations (CFR) §20.1401 and §20.1402. Therefore, land use impacts from the D&D would be minimal. Additional information related to the D&D of the CIS Facility can be found in the Holtec License Application.

4.2 VISUAL AND SCENIC RESOURCES

This section describes the potential impacts to visual and scenic resources associated with the Proposed Action. Construction impacts for Phase 1 are presented in Section 4.2.1; concurrent impacts from operations and construction of Phases 2-20 are presented in Section 4.2.2; full facility operations are presented in Section 4.2.3; NRC analysis related to visual and scenic resources is presented in Section 4.2.4; and D&D impacts are presented in Section 4.2.5. Potential mitigation measures are presented in Chapter 6.

4.2.1 Construction (Phase 1)

Construction activities would result in short-term, less than significant impacts to visual and scenic resources. Equipment used during the proposed construction projects of Phase 1 could create a short-term visual effect; however, the visual environment of the Site does not constitute a unique or sensitive viewshed of public interest. In addition, there are no regionally or locally important or high quality views associated with the Site. The Site is located in a sparsely populated area more inclined to be used for cattle grazing or oil and gas exploration and is not visible from any city, township, borough or identifiable population center. Visibility of the Site is confined to east and west traffic on U.S. Highway 62/180 and is similar from either direction. Following the completion of construction, the CIS Facility would remain as a permanent visual feature within the viewshed.

The Site has been determined to be in the Class IV BLM visual resource inventory class, meaning that the level of change allowable to the characteristic landscape can be high, and that these changes may dominate the view and be the major focus of viewer attention. During construction activities of Phase 1, the visual and aesthetic characteristics of areas undergoing development would be temporarily altered by the use of construction equipment, and the delivery and stockpiling of construction materials. Temporary visual intrusions into the landscape may result from the use of construction cranes at the Site for erecting building structures and installing equipment. Although CIS Facility construction would alter the natural state of the landscape, impacts to scenic views are not considered to be significant, based on the absence of high quality scenic views in the area.

4.2.2 Concurrent Operation and Additional Construction (Phases 2-20)

Construction of Phases 2-20 would result in short-term, less than significant impacts to visual and scenic resources. The viewshed and BLM visual resource inventory class would remain unchanged after completion of Phase 1 construction. Construction of additional phases would occur as operations are occurring at any areas previously constructed. Holtec would have procedures in place to ensure that the construction activities of Phases 2-20 do not adversely affect operations. The construction process for additional phases would be the same as that for Phase 1 CIS Facility. Expanding the ISFSI Pad for Phases 2-20 would not cause any additional impacts to visual and scenic resources.

4.2.3 Operation

The operation of Phase 1 CIS Facility is not anticipated to result in any appreciable effects to visual and scenic resources. Given that the Site is undeveloped, the proposed CIS Facility might be considered “out of character” with current, onsite conditions. However, considering that properties in the general area have been developed for industrial purposes (e.g., numerous oil and gas wells), the proposed CIS Facility would be similar to existing, architectural features on surrounding land. The proposed use of the CIS Facility site does not fall outside of the objectives for Class IV, which provides for management activities that require major modifications of the existing character of the landscape. Security lighting for all ground level facilities and equipment would be down-shielded to keep light within the boundaries of the Site, helping to minimize the potential for impacts.

The most visible structure would be the Cask Transfer Building, which would be constructed during Phase 1, would be approximately 60 feet high. Due to the relative flatness of the Site and the vicinity, the structures may be observable from nearby highways and properties, partially obstructing views of the existing landscape. However, considering that there are no high quality viewing areas and the presence of many existing, man-made structures (pump jacks, high power lines, industrial buildings, and above-ground tanks) near the CIS Facility, the obstruction of existing views due to the proposed structures would be comparable to current conditions. Overall, the visual impact of the CIS Facility would be minimal. The operation of the CIS Facility at full build-out would not alter visual and scenic resources and the viewshed and BLM visual resource inventory class would remain unchanged.

4.2.4 Comparable NRC Visual and Scenic Resources Analysis

This analysis is consistent with NUREG-2157 (NRC 2014b, Section 4.14), in which NRC determined that no changes to the visual profile are likely to occur as a result of the continued operation and maintenance of an ISFSI, and that construction of an ISFSI would have minimal impacts on visual and scenic resources.

4.2.5 Decontamination and Decommissioning

D&D activities of the CIS Facility would involve removal of all materials from storage and decontamination of the used process equipment and materials from building interiors and from outdoor storage areas, and demolition of structures on the Site. After D&D activities are complete, the area previously occupied by the CIS Facility would be covered with topsoil, contoured, and replanted with native vegetation. The visual and scenic resource impacts resulting from the D&D of the facility would be minimal.

4.3 GEOLOGY AND SOILS

This section presents the potential impacts of the construction and operation of the CIS Facility on the existing geologic and soil conditions as well as any existing geologic and soil conditions that may impact the CIS Facility project during construction and operation. Construction impacts for Phase 1 are presented in Section 4.3.1; concurrent impacts from operations and construction of Phases 2-20 are presented in Section 4.3.2; full facility operations are presented in Section 4.3.3; comparable NRC analysis related to geology and soils is presented in Section 4.3.4; and D&D impacts are presented in Section 4.3.5. Chapter 6 describes proposed mitigation measures that would be in place to reduce adverse impacts that could occur during construction, routine, and non-routine operation of the CIS Facility.

Background. The entire Site is underlain by Triassic bedrock consisting of shale, siltstone, and minor amounts of fine-grained, poorly sorted sandstone. Most of the proposed operational area is relatively flat and the shale bedrock is covered by a laterally extensive veneer of 25 feet of Quaternary pediment deposits consisting of well sorted eolian sand and sandy-gravelly materials near the bedrock interface. The Mescalero Caliche unit is near the surface and is about 10 feet thick at the Site. The Site is located in an area of low seismic hazard. Risks from landslides, liquefaction, subsidence, and volcanism are considered to be low. In addition, areas in vicinity of the Site contain potash extraction operations and oil/gas wells. Surface soils consist mostly of Simona fine sandy loam and the Simona-Upton association, which are not prime farmland, but are moderately susceptible to wind erosion.

4.3.1 Construction (Phase 1)

The Site terrain ranges in elevation from 3,520 to 3,540 feet above mean sea level (amsl) sloping downward from south to north. Because the CIS Facility requires an area of flat terrain, cut and fill would likely be required for some portions of the Site. Material from the higher portions of the Site would be utilized for fill at the lower areas of the Site to the extent possible. Soil excavated during construction may be utilized for backfill, site grading, or disposed of at an approved offsite disposal facility. The resulting terrain change for the Site from gently sloping to flat topography is

not expected to cause significant environmental impact. Most of the surrounding area contains naturally flat topography (less than 5 percent slope).

CIS Facility construction would disturb soils to a depth of about 25 feet below grade for excavation and grading of the facility. The surficial geologic profile would be permanently altered during construction. However, due to the relatively shallow depth of excavation, construction activity would not induce seismic activity or affect subsurface faults resulting in the accidental discharge of radiological materials or other contaminants to surrounding soils during the operational phase. Additionally, the groundwater table is located about 90-100 feet deep in the south east corner and 200-300 feet deep in the north east corner, and thus would not likely be impacted by construction (GEI 2017, Section 5.3). Similarly, the excavation for the facility would not impact existing oil and gas or mineral deposits because these resources are located at much greater depths. The facility components do not overlap active oil and gas wells; however, the proposed rail spur does appear to intersect the edge of two potash "drill island" locations identified as Belco Shallow and Belco Deep. Holtec has concluded that the rail spur would not impact potash mining operations (Holtec 2016a).

Construction activities like clearing and grading of soils, may cause short-term increases in soil erosion from wind and water. The bulk of construction would occur in the Simona fine sandy loam and Simona-Upton association, which are slightly susceptible to water erosion, and somewhat susceptible to wind erosion. Additionally, surface storm water during construction could potentially impact nearby waterbodies and drainages by increasing the sediment load to these receptors. Additionally, there would be a long-term loss of the native surficial soil profile, within the disturbed operational footprint of the facility. However, the Lea County Soils Survey describes soils found at the CIS Facility Site as not prime farmland, thus, the construction of the CIS Facility is not anticipated to displace any potential agricultural use (USDA/NRCS 2016).

4.3.2 Concurrent Operation and Additional Construction (Phases 2-20)

The construction impacts described in Section 4.3.1 are representative of the CIS Facility construction for additional phases. The phased construction approach (for Phases 2-20) would have the same types of impacts as Phase 1 construction and Holtec would have procedures in place to ensure that any concurrent construction activities of Phases 2-20 do not adversely affect operations. Additionally, mitigation measures for soil stabilization and sediment control would be applied during all phases of construction, as described in Chapter 6.

4.3.3 Operation

Once facility construction is complete, the exposed soils and excavations would be covered by structures or paved, preventing the creation of new dust sources. Operation of the CIS Facility is not expected to affect the underlying geology because the CIS Facility does not have moving parts to affect the subsurface. Although soils may be affected by spills and leaks of radiological and hazardous materials, the CIS Facility is designed to prevent leakage and licensee employees would conduct routine inspections to verify that the CIS Facility is performing as expected. Leaks could result in spills of oil and hazardous material from operating equipment and stormwater runoff carrying grease. However, these activities are monitored and, in the case of stormwater runoff, regulated under National Pollutant Discharge Elimination System (NPDES) permit requirements.

Mitigation measures for spill prevention and stormwater management would be applied during operations, as described in Chapter 6.

Operation of the CIS Facility would not be expected to be impacted from geologic hazards such as seismic events, subsidence, liquefaction, landslides, or volcanism. The proposed facility is in a flat area of relatively low seismic hazard, thus, earthquakes, liquefaction, and landslides are considered as low risk hazards. Additionally, the CIS Facility would be constructed in accordance with 10 CFR §72.122, *General Design Criteria, Overall Requirements,* which requires that structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lighting, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform safety functions.

The Site is not in a volcanically active area, and volcanic risk hazards are therefore low. The Site is also not near a water body and tsunami and seiche hazards are also therefore low.

The CIS Facility and associated facilities would not be expected to impact existing potash and oil/gas operations in the area. Access to mineral resources directly underneath the footprint of the CIS Facility would be precluded during the operational life of the facility; however, these resources are widely available elsewhere in the region.

4.3.4 Comparable NRC Geology and Soils Analysis

The impacts to geology and soils from interim storage of SNF were previously analyzed in NUREG-2157 (NRC 2014b, Section 5.6). The analysis in NUREG-2157 indicated the following types of geology and soils impacts could occur.

- Construction impacts associated with away-from-reactor storage include earth clearing and foundation laying for the ISFSI, both of which may contribute to soil erosion.
- The environmental impacts on soils would include loss of soils as a result of physical alterations to the existing soil profile. These alterations could lead to a reduced availability to support plant and animal life and could lead to changes in erosion patterns and characteristics that affect how water infiltrates into the soil. However, the NRC concluded that these losses are a small percentage of the similar available soils locally. The NRC also noted that soils used in project construction are recoverable upon facility decommissioning, and that no excess soils would be generated that require shipment or disposal off-site.
- Similarly, economic geologic resources (such as minerals, oil, and gas, if present) that would be unavailable for exploitation during facility construction and operation are widely available elsewhere in the region.
- The amount of land committed to the away-from-reactor ISFSI is relatively small compared, for example, to the land available in a typical county. The methods necessary to control soil erosion are well understood and permits typically require the implementation of erosion controls.
- Because of the relatively small size of the facility, restrictions on access to geologic resources under the ISFSI site would also be minimal.

- In general, while the geological characteristics of the site and vicinity are essential to the safe design and operation of the ISFSI, continued storage of spent fuel does not have a significant environmental impact on geological resources (such as, damage to unstable slopes, adjacent utilities, or nearby structures).

For these reasons, the NRC concluded that the impacts on soils and geologic resources from the building and long-term operation of an away-from-reactor ISFSI would be small. The conclusion in this ER is consistent with the NRC conclusion in NUREG-2157.

4.3.5 Decontamination and Decommissioning

The CIS Facility would be designed and constructed in a manner that would minimize the quantity of radiological-contaminated equipment and facilitate the removal of such materials at the time the CIS Facility is permanently decommissioned pursuant to 10 CFR §72.130. Final radiological and site surveys and removal of any contaminated soils identified during these surveys (from both radiological and non-radiological contamination) are required under 10 CFR Part 20, Subpart E. At the time of license termination, the Site would be released for unrestricted use in accordance with 10 CFR Part 20, Subpart E.

During D&D, some ground disturbance would occur from the use of machinery such as bulldozers to demolish facility buildings. However, ground disturbance would generally be limited to areas previously disturbed during the construction and operation phases. Mitigation measures used during construction would be applied during D&D; therefore, impacts to geology and soils would be similar to or less than during construction, and would be short-term. Because the Project infrastructure would be removed, there would be complete access to mineral resources. After D&D activities are complete, the area previously occupied by the CIS Facility would be covered with topsoil, contoured, and replanted with native vegetation. Therefore, the impacts to geology and soils from D&D would be small.

4.4 ECOLOGICAL RESOURCES

This section describes the potential impacts to ecological resources associated with the CIS Facility. Construction impacts for Phase 1 are presented in Section 4.4.1; concurrent impacts from operations and construction of Phases 2-20 are presented in Section 4.4.2; full facility operations are presented in Section 4.4.3; threatened and endangered species are discussed in Section 4.4.4; consultations with agencies are discussed in Section 4.4.5; comparable NRC analysis related to ecology is presented in Section 4.4.6; and D&D impacts are presented in Section 4.4.7. Potential mitigation measures are presented in Chapter 6.

4.4.1 Construction (Phase 1)

As discussed in Section 4.1.1, Phase 1 construction would disturb approximately 119.4 acres within an approximately 1,040 acre site within BLM Section 13. The ecological impacts of this land disturbance are expected to be small given the CIS Facility area size, especially in relation to the vast amount of uninhabited and undisturbed land found throughout the region. The CIS Facility consists entirely of an upland area with no streams, ponds or other water environments to be cleared.

The proposed CIS Facility consists of one primary vegetation community type. The Apacherian-Chihuahuan mesquite upland scrub vegetation community is identified by the dominant presence of deep-rooted shrubs that are able to access the deep-soil moisture. The Apacherian-Chihuahuan mesquite upland scrub vegetation community is common in the piedmonts of the Chihuahuan Desert. The density of vegetation varies slightly across the proposed Site, due to several low-lying areas that collect water after heavy rain events. Vegetation is intersected by two existing linear features: a telephone line and a water pipeline. Each of these existing right-of-ways are used as two-track roads that are vegetated in between tracks. The non-vegetated area of the tracks themselves represents a small fraction of the total area and is not considered a habitat type. The majority of the proposed Site is suitable for use by wildlife resources. The Apacherian-Chihuahuan mesquite upland scrub provides potential habitat for an assortment of birds, mammals, and reptiles. Because the Apacherian-Chihuahuan mesquite upland scrub is common in this region, the disturbance to the biota due to CIS Facility construction would be insignificant.

Standard land clearing methods, primarily the use of heavy equipment, would be used during the construction phase of the CIS Facility. The additional noise, dust, and other factors associated with the clearing would be short-lived in duration and would represent only a temporary impact to the biota of the CIS Facility. Because there is similar habitat surround the CIS Facility area, biota would have an opportunity to move to undisturbed areas within areas of suitable habitat bordering the Site.

After construction is complete, the Site would be stabilized with native grass species, pavement, and crushed stone to control erosion. Furthermore, any eroded areas that may develop would be repaired and stabilized.

4.4.2 Concurrent Operation and Additional Construction (Phases 2-20)

Figure 2.2.1 depicts a view of the proposed Holtec CIS Facility development. The land to be cleared for the full build-out of the CIS Facility is approximately 330 acres, as detailed in Section 4.1. The construction impacts described in Section 4.4.1 are representative of the CIS Facility construction for additional phases. The phased construction approach (for Phases 2-20) would have the same types of impacts as Phase 1 construction and Holtec would have procedures in place to ensure that any concurrent construction activities of Phases 2-20 do not adversely affect operations.

4.4.3 Operation

Once fully operational, the CIS Facility would have minimal impacts to ecological resources. The CIS Facility would not generate significant noise, would not significantly affect the area available for terrestrial wildlife, and would not adversely impact terrestrial environments or their associated plant and animal species.

Roadway and railway maintenance would be employed during operation of the CIS Facility. However, because road maintenance is currently being employed along the existing roads and railways, this would not represent a substantial new impact to biota. The impacts to biota from maintenance practices during CIS Facility construction, operations, and decommissioning would be small.

Herbicides may be used in limited amounts according to government regulations and manufacturer's instructions to control unwanted noxious vegetation during operation of the facility. However, none of the practices are anticipated to permanently affect biota.

The tallest proposed CIS Facility structure would be approximately 60 feet, which is well under the 200 foot threshold that requires lights for aviation safety. This avoidance of lights, which attract species, and the low above-ground level structure height, also reduces the relative potential for impacts to wildlife. Additionally, security lighting for all ground level facilities and equipment would be down-shielded to keep light within the boundaries of the Site, also helping to minimize the potential for light pollution impacts.

No important habitats (e.g., marshes, natural areas, bogs) have been identified on the CIS Facility area. Therefore, no special maintenance practices are proposed once the CIS Facility is operational, and there would be no direct discharge of water. Consequently, no significant impacts to aquatic systems are expected.

4.4.4 Threatened and Endangered Species

No communities or habitats that have been defined as rare or unique or that support threatened and endangered species have been identified on the CIS Facility. Thus, proposed activities are not expected to impact communities or habitats defined as rare or unique or that support threatened and endangered species within the Site.

4.4.5 Consultations with Agencies

The results of the ecological survey have been provided to the New Mexico Environmental Department (NMED) and United States Fish and Wildlife Service (USFWS) for information. Consultation would be initiated by the Federal agencies, as appropriate, during any subsequent National Environmental Policy Act (NEPA) process.

4.4.6 Comparable NRC Ecological Analysis

This analysis is consistent with the NUREG-2157 (NRC 2014b), in which NRC determined that construction and operation of an ISFSI would have minimal impacts on terrestrial resources. Normal operations and ISFSI construction would not generate significant noise, would not significantly affect the area available for terrestrial wildlife, and would not adversely impact terrestrial environments or their associated plant and animal species (NRC 2014b).

4.4.7 Decontamination and Decommissioning

D&D activities would be similar to construction activities, with the exception that land would be restored rather than disturbed. After D&D activities are complete, the area previously occupied by the CIS Facility would be covered with topsoil, contoured, replanted with native vegetation, and released for unrestricted use in accordance with 10 CFR Part 20, Subpart E.

4.5 WATER RESOURCES

This section describes the potential impacts to water resources associated with the Proposed Action. Construction impacts for Phase 1 are presented in Section 4.5.1; concurrent impacts from

operations and construction of Phases 2-20 are presented in Section 4.5.2; full facility operations are presented in Section 4.5.3; NRC analysis related to land use is presented in 4.5.4; and D&D impacts are presented in Section 4.5.5. Chapter 6 describes proposed mitigation measures that would be in place to reduce adverse impacts that could occur during construction, routine, and non-routine operation of the CIS Facility.

4.5.1 Construction Impacts (Phase 1)

Water resources are essentially nonexistent at the Site. There are no surface water bodies on the Site and groundwater resources are at depths of 93.1 to 100 feet and 253.4 to 263.7 feet at wells B107 and B101, respectively.(GEI 2017, Section 5.3). The region has a semi-arid climate, with low precipitation rates and minimal surface water occurrence. Thus, the potential for negative impacts on water resources is very low due to lack of water presence and formidable natural barriers to any surface or subsurface water occurrences.

Construction activities associated with Phase 1, including grading and clearing would result in ground surface disturbance and could cause soil erosion and subsequent transport of sediment via stormwater. As discussed in Chapter 6, implementing erosion and sediment control best management practices (BMPs) during construction would minimize any adverse effects on water resources. BMPs could include silt fencing, sediment traps, applying water sprays for dust control, and revegetating disturbed areas.

Phase 1 construction would have short-term less than significant effects and long-term effects to water resources. Short-term effects would be due to site-specific temporary changes in surface hydrology, and the potential for soil erosion and transport during construction. Long-term effects would be due to an increase in impervious surfaces. Effects to water resources would not reduce water availability or supply, exceed safe annual yield of water supplies, adversely affect water quality, threaten or damage hydrology, or violate water resources laws or regulations. These effects would be less than significant. Although the effects would be less than significant, BMPs would be incorporated into all construction activities to minimize erosion, runoff, and sedimentation.

Permits related to water must be obtained for pre-licensing and site construction and CIS Facility operation. The purpose of these permits is to address the various potential impacts on water and provide mitigation as needed to maintain state water quality standards and avoid any degradation to water resources at or near the site. These permits include:

- A NPDES General Permit for Industrial Stormwater: This permit is required for point source discharge of stormwater runoff from industrial or commercial facilities to the waters of the State. All new and existing point source industrial stormwater discharges associated with industrial activity require a NPDES Stormwater Permit from the U.S. Environmental Protection Agency (EPA) Region 6 and an oversight review by the New Mexico Water Quality Bureau (NMWQB).
- NPDES General Permit for Construction Stormwater: Because construction of the CIS Facility facility will involve the disturbance of more than one acre of land, an NPDES Construction General Permit from the EPA Region 6 and an oversight review by the NMWQB are required.

- Section 401 Certification: Under Section 401 of the Clean Water Act (CWA), States can review and approve, condition, or deny all Federal permits or licenses that might result in a discharge to State waters, including wetlands. A 401 certification confirms compliance with the State water quality standards. Activities that require a 401 certification include Section 404 permits issued by the U.S. Army Corps of Engineers (USACE). The State of New Mexico has a cooperative agreement and joint application process with the USACE relating to 404 permits and 401 certifications.

Surface Water. There are no surface waters at the Site. The only major natural lakes or ponds within 6 miles of the Site include Laguna Gatuna, Laguna Tonto, Laguna Plata, and Laguna Toston which are ephemeral playas. During construction and operation of the CIS Facility, potable water will be supplied by existing potable water systems. No adverse impacts to surface water are anticipated during construction of the proposed CIS Facility. Surface runoff from the Site would flow into Laguna Gatuna to the east and Laguna Plata to the northwest and would not reach groundwater. Laguna Gatuna and Laguna Plata are large enough to accommodate a 100-year return period precipitation event.

Groundwater. Due to the depth of groundwater, excavation during construction would not reach the groundwater. The near surface water table appears to be 35-50 feet deep, where present, and is likely controlled by the water level in the playa lakes. No groundwater was encountered in the test boring on the west side of the Site in the vicinity where the ISFSI would be located (ELEA 2007, Section 2.4.2). The depth of groundwater was measured at two locations, B101 and B101, see Figure 3.5.4. Groundwater was observed in B101 from a depth range of 253.4 to 263.7 feet, and observed in B107 from a depth range of 93.1 to 100 feet from the ground surface (GEI 2017, Section 5.3).

Wetlands. No USACE jurisdictional wetlands were identified on the Site (ELEA 2007, Section 2.5); therefore, there would be no impacts to wetlands during construction of the proposed CIS Facility.

Floodplains. The proposed CIS Facility site or Lea County has no floodplains identified or mapped for Lea County, New Mexico (FEMA 2008, Section 6.0; FEMA 2016); therefore, there would be no impacts to floodplains during construction of the proposed CIS Facility.

4.5.2 Concurrent Operation and Additional Construction (Phases 2-20)

Construction of Phases 2-20 would occur as operations are occurring at any areas previously constructed. Holtec would have procedures in place to ensure that the construction activities of Phases 2-20 do not adversely affect operations. In terms of water resources, this means ensuring an adequate buffer is maintained between operational and construction areas. The construction process for additional phases would be the same as that for Phase 1 CIS Facility. Water resource impacts during construction activities for Phases 2-20 would be the same as those for Phase 1.

4.5.3 Operation

The operation of the CIS Facility at full build-out is not anticipated to result in any appreciable effects to water resources. Potential impacts could result primarily from runoff contamination. The most significant source for runoff during operations would be the concrete ISFSI Pad.

Contamination is highly unlikely. The VVM storage system design and construction, along with environmental monitoring of the ISFSI Pad combine to make the potential for contaminant release from the CIS Facility extremely low. Impacts to groundwater would not be expected, due to the depth of groundwater and the fact that the CIS Facility would not release pollutants, including radionuclides, during normal operations. Similarly, impacts to the near surface water table would be unlikely.

To estimate the potential effects of rainfall-induced stormwater runoff, Holtec reviewed precipitation data for the area spanning more than 50-years as well as other available data developed for other nuclear facilities in the area. As discussed in Section 3.6.1.7, the highest daily precipitation in the area was 3.6 inches, which occurred in December of 2015. Based on the data reviews, Holtec determined that the maximum flood at the CIS Facility site would be similar to the maximum flood developed by NRC in 2012 for the International Isotopes Fluorine Products (IIFP) facility. located approximately 23 miles northeast of the proposed CIS Facility. Given the proximity of the IIFP facility to the CIS Facility site (approximately 23 miles northeast), the maximum flood at the IIFP facility site reasonably represents the maximum flood that could occur at the CIS Facility site.

In the Safety Evaluation Report for the IIFP facility (NUREG-2116; NRC 2012b), the NRC estimated the 1-hour, 24-hour, and 48-hour all-season precipitation corresponding to a 100,000-year return period by extrapolating the National Oceanic and Atmospheric Administration (NOAA) precipitation data. Considering the 1-hour, 24-hour, and 48-hour all-season precipitation for a 100,000-year return period, the NRC concluded that the estimated maximum flood (standing water) level would be 4.8 inches (NRC 2012b, Section 1.3.3.4.4). The topography of the Site shows a high point located on the southern border of the Site and gentle slopes leading to the two drainages (Laguna Plata and Laguna Gatuna). Both of these drainages would be able to accept a one day severe storm total within the 7.5 inch range with excess free board space. The natural drainage of the CIS Facility site is useful by providing a natural area for impoundment of excess runoff during severe storms (ELEA 2007).

4.5.4 Comparable NRC Infrastructure Analysis

This analysis is consistent with NUREG-2157 (NRC 2014b), in which NRC determined that construction and operation of an ISFSI would have minimal impacts on water resources. Normal operation and ISFSI construction would not significantly affect water resources.

4.5.5 Decontamination and Decommissioning

A Decommissioning Plan would be prepared at the end of CIS Facility facility life and would include decontamination, dismantlement, and clean-up procedures; methodology and general decontamination and cleaning methods; and waste management protocol. These procedures, methods, and protocol would be designed to prevent impacts to groundwater quality; therefore, impacts to groundwater quality during decommissioning would be minimal. Sampling would also be integral to the D&D process to demonstrate that any residual impacts, as compared to the baseline sampling results, meet NRC and EPA guidelines. The overall impact to water resources from D&D activities would be minimal.

4.6 AIR QUALITY AND NOISE

This section describes the air quality (Section 4.6.1) and noise (Section 4.6.2) impacts of the Proposed Action during construction, operations, and decommissioning, and compares those impacts to standards for evaluation. Within the section, the potential impacts associated with Phase 1 construction, concurrent operation and construction (Phases 2-20), and operations at full build-out are presented. Potential mitigation measures are presented in Chapter 6.

4.6.1 Air Quality Impacts

Overall, the impacts on air quality during both construction and operations are expected to be minimal. Although the initial, temporary impacts from construction would be greater than operations, the impacts would be minimal in both cases.

4.6.1.1 Construction (Phases 1-20)

The primary air emissions during construction would be fugitive dust. Fugitive dust is airborne PM that is not emitted from a definable point source, such as a combustion unit stack or a process vent, but rather is emitted from natural and manmade area sources open to the atmosphere (e.g., earthmoving activities, unpaved roadways, and cement plants). Engine exhaust air emissions would be produced by heavy duty, off-road construction equipment, vehicle emissions from workers commuting to the Site, and deliveries of materials to the Site. These emissions are typically products of combustion which includes carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), and the Greenhouse Gas (GHG) compound of carbon dioxide equivalent (CO_2e), with minimal emissions of volatile organic compounds (VOCs), particulate matter less than or equal to 10 microns (PM_{10}), and particulate matter less than or equal to 2.5 microns ($PM_{2.5}$).

Small quantities of VOC emissions would be released from the refueling and on-site maintenance of the off-road construction equipment used for construction. There is the potential for additional VOC emissions from certain painting and other construction-finishing activities, depending on the amounts of organic solvent-based paints and architectural coatings that would be used for the buildings and other structures. All emissions would result in minimal impacts to the air quality.

The fugitive dust emissions would be derived from three main sources: earthmoving activities, unpaved roadways, and cement plants. In order to provide a conservative and bounding analysis of potential air quality impacts, the emissions associated with earthmoving activities were calculated using generally accepted methods for the full 330 acres of land that would be disturbed over the construction period (WRAP 2006, Section 3.2.1). The road emissions were estimated using a mix of vehicles, such as cranes, forklifts, and dump trucks, traveling up to one-half mile trips up to five trips per day with generally accepted emission factors and methods (AP42 2006, Section 13.2.2) and (TCEQ 2001).[1] The cement plant emissions were calculated using generally accepted air emission calculations with an estimate of four hundred thousand tons of cement being used per year (AP42 2006, Section 13.2.4).

[1]New Mexico has not created air emission factors and calculation methodology guidance documents, and generally accepts calculation methodologies from other states like Texas and California which are used here.

Of the combustion sources, vehicle exhaust would be the dominant source. Vehicles that would be operating on the Site during construction would consist of a variety of vehicles and construction equipment. A mix of these vehicles was used to estimate emissions (CARB 2016). Also evaluated were emissions from vehicles for workers traveling to the Site and materials being delivered to the Site. The emissions were estimated based on an annual period using generally accepted emission factors and methods (CARB 2016).

Other VOC emissions from the project would be from the storage and loading of diesel fuel and gasoline for on-site construction equipment and architectural coatings. The emissions for fuel loading were estimated using the TANKS4.09 emissions modeling software that uses generally accepted emission factors and methods based on estimated activities of similar sites over a six month period (AP42 2006, Section 7.1). The emissions for painting were estimated using generally accepted emission factors and methods based on estimated activities of similar sites over a six month period (TCEQ 2011).

Tables 4.6-1 and 4.6-2 present the hourly emissions and annual emission from construction, respectively, of the criteria pollutants CO, NO_x, SO_2, PM, PM_{10}, $PM_{2.5}$, VOCs, and CO_2e based on emission estimates developed for the construction activities. All sources are from temporary activities during construction. Emissions from all criteria pollutants would be less than 10 pounds per hour (PPH) and 10 tons per year (TPY). Emissions from greenhouse gas (GHG) emission would be less than 25,000 TPY. These emission rates are below regulatory standards requiring regulation, which further indicates the minimal impact that emissions would have on the environment. In accordance with New Mexico Air Regulations, sources with emissions less than 10 PPH and 10 TPY of each criteria pollutant in counties that are in attainment of National Ambient Air Quality Standards (NAAQS) are not required to obtain an air permit (NMAC 2016, Section 20.2.73). The proposed CIS Facility Site would be in Lea County, an attainment county for NAAQS; and would have emissions less 10 PPH and 10 TPY. This “no permit required” status is presumed to be protective of the environment and to meet NAAQS and New Mexico Air Quality Standards (NMAAQS). Due to this, no modeling or further impacts evaluation was performed, and the impacts of emissions from the Proposed Action on air quality would be minimal.

GHG compounds are typically evaluated at sites with stationary equipment that emit more than 25,000 TPY of CO_2e (40 CFR 98, Section 98.2). Though emissions from activities at the CIS Facility Site would be from non-stationary sources, the GHG emissions would be well below this minimal standard; thus, impacts of GHG emissions from this project on air quality would be minimal.

4.6.1.2 Operation (Includes Phases 2-20 Construction)

During operations, the primary source of emissions would be from deliveries of materials to be stored onsite. There is expected to be emissions of fugitive dust, which is PM that is not emitted from a definable point source, such as a combustion unit stack or a process vent, but rather is emitted from natural and manmade area sources open to the atmosphere from unpaved roadways. Emissions from engine exhaust would also be produced by vehicles delivering materials to the Site and workers commuting to the Site. These emissions are typically products of combustion that includes CO, NO_x, SO_2, and CO_2e, with minimal emissions of VOC, PM_{10}, and $PM_{2.5}$. No radiological emissions would occur during operations.

Fugitive dust emissions derived from road emissions were estimated using a mix of vehicles, such as cranes, forklifts, and dump trucks, traveling up to one-half mile trips up to five trips per day over a one year month period with generally accepted emission factors and methods (AP42 2006, Section 13.2) and (TCEQ 2001).

Emissions from vehicles for workers traveling to the Site and materials being delivered to the Site were evaluated. The emissions were estimated based on an annual period using generally accepted emission factors and methods (CARB 2016). Until full build-out is achieved, ongoing construction would occur. It is estimated that emissions from ongoing construction would only be a fraction, approximately fifteen percent, of the initial construction. Emission estimates were created based on activities to operate the facility plus fifteen percent of the initial construction emissions for ongoing construction. (Because the air quality impacts for operations are essentially independent of the capacity of SNF stored at the CIS Facility, the analysis which follows provides a bounding air quality analysis because it accounts for both concurrent construction and operation). Tables 4.6.3 and 4.6.4 present the hourly emissions and annual emission from both operations and ongoing construction, respectively, of the criteria pollutants CO, NO_x, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOCs; and the GHG compound of CO_2e.

All sources are activities that would occur once the CIS Facility Site is in operation along with the ongoing construction. Emissions from all criteria pollutants would be less than 10 PPH and 10 TPY. Emissions from GHG emission would be less than 25,000 TPY. These emission rates are below regulatory standards requiring regulation, which further indicates the minimal impact that emissions would have on the environment.

As presented above, air emissions during the operational and ongoing construction phase are expected to be less than 10 PPH and 10 TPY for all criteria pollutants expected to be emitted. In accordance with New Mexico Air Regulations, sources with emissions less than 10 PPH and 10 TPY of each criteria pollutant in counties that are in attainment of NAAQS are not required to obtain an air permit (NMAC 2016, Section 20.2.73). The proposed CIS Facility Site would be in Lea County, an attainment county for NAAQS; and would have emissions less 10 PPH and 10 TPY. This “no permit required” status is presumed to be protective of the environment and to meet NAAQS and NMAAQS. Due to this, no modeling or further impacts evaluation was performed, and the impacts of emissions from the Proposed Action on air quality would be minimal.

GHG compounds are typically evaluated at sites with stationary equipment that emit more than 25,000 TPY of CO_2e (40 CFR 98, Section 98.2). Though emissions from activities at the CIS Facility Site would be from non-stationary sources, the GHG emissions would be well below this minimal standard; thus, impacts of GHG emissions from this project on air quality would be minimal.

4.6.1.3 Comparable NRC Air Quality Analyses

This analysis is consistent with the NUREG-2157 (NRC 2014b), in which NRC determined that the air emission impacts from SNF storage activities would be substantially smaller than air emissions during power generation. The NRC also concluded that construction of an IFSFI, during ongoing operation and maintenance of the storage facilities, would result in minor and temporary

air emissions. Additionally, the NRC concluded that greenhouse gas emissions would be a small fraction of the overall level in the U.S. (NRC 2014b).

4.6.1.4 Decontamination and Decommissioning

Activities required for D&D include the removal of equipment from inside of buildings and demolishing the CIS Facility Site. This activity is not expected to produce any significant levels of fugitive dust or other air emissions. Heavy duty, off-road construction equipment would be required for the demolition of the structures and loading of demolition debris into trucks for off-site disposal. These demolition activities would produce fugitive dust emissions that could be mitigated using water sprays and other dust suppression work practices. Shipping destinations for disposal of the demolition debris removed from the CIS Facility Site would depend on the locations of the land disposal, recycling, or other facilities open and accepting material at the time of facility closure. However; emissions and impacts are expected to be similar or less than those emissions from construction. Thus, the impacts are expected to be minimal from D&D.

4.6.2 Noise

Noise is defined as unwanted sound. High levels of noise can damage hearing, cause sleep deprivation, interfere with communication, and disrupt concentration. Even at low levels, noise can be a source of irritation, annoyance, and disturbance to people and communities when it significantly exceeds normal background sound levels. In the context of protecting the public health and welfare, noise implies adverse effects on people and the environment. This section presents the impacts of noise during construction, operations, and D&D.

4.6.2.1 Construction (Phases 1-20)

Construction activities at the CIS Facility Site would require the use of heavy equipment such as excavators, front loaders, bulldozers, and dump trucks; and materials-handling equipment, such as cement mixers and cranes. Noise generated from this type of equipment would range from 80 to 95 dBA at approximately 50 feet (IIFP 2009, Section 4.7), which would be equivalent of 50 to 66 A-weighted decibels (dBA) at approximately 1,200 feet. Most of the construction activities would occur during weekday, daylight hours; however, construction could occur during nights and weekends, if necessary. Large trucks would produce noise levels around 85 dBA at approximately 50 feet, which is equivalent of 56 dBA at approximately 1,200 feet (see Table 4.6.5).

The CIS Facility Site would be built approximately 1,350 feet from either U.S. 62/180 or NM 243. Considering the sound pressure level from an outdoor noise source decreases 6 decibel units (dB) per doubling of distance, the highest noise level predicted at either road during construction is expected to be within the range of 44 dBA to 59 dBA. In general, the highest noise level is predicted to be less than 44 dBA to 59 dBA from any public area. Further, finishing work within the building structures would create noise levels slightly above normal background levels, but well below the construction levels. Sound levels would be expected to dissipate to near background levels by the time they reach the property boundaries.

No sensitive noise resources are located in the immediate vicinity of the Site. As shown in Table 3.6.8 “Department of Housing and Urban Development (HUD) Noise Assessment Guidelines”, acceptable ranges for residential areas, the lowest acceptability area, is between 60 and 65 decibels

(dB) (HUD 2016). Due to the temporary and episodic nature of construction, the significant distance to the nearest residence being over one mile from the CIS Facility Site, and since construction activities largely would be during weekday daylight hours, actual construction noise at the Site is not expected to have a significant effect on the area, the public, or the closest resident. Vehicle traffic would be the most noticeable cause of construction noise. There are no sensitive receptors (hospitals, schools, residences) located close to the Site. Due to this, minimal impacts from noise from construction are expected. As documented in Sections 3.7 and 4.7, there are no cultural resources that could be affected by noise from the CIS Facility.

4.6.2.2 Concurrent Operation and Construction (Phases 2-20)

As presented in Section 4.6.2.1, construction noise is expected to have a minimal impact on the area. Any construction associated with Phases 2-20 would be similar to that of Phase 1 construction, and, when combined with noise from operations, would not be expected to be significant given the remoteness of the Site. As a result, minimal impacts from concurrent operations and construction are expected.

4.6.2.3 Operation

Noise point sources from the plant during operation would include: coolers, rooftop fans, air conditioners, transformers, and traffic from delivery trucks, employee and Site vehicles. Noise sources for the plant during operation would consist only of Site vehicle traffic entering and leaving the Site. Ambient background noise sources in the area include vehicle traffic along U.S. Highway 62/180 and New Mexico State Road 243, and low flying aircraft traffic from the Hobbs Regional Airport.

Because actual noise estimates are not available for the operation of the CIS Facility Site, measured noise levels around an automobile assembly plant were used to estimate potential noise impacts conservatively high. These noise levels are 55 to 60 dBA at about 200 feet from the plant property. These noise levels would be inaudible at the nearest highway (U.S. Highway 62/180), even with low background noise levels. EPA has identified 55 dBA as a nearly average outdoor noise level that, if not exceeded, would prevent activity interference and annoyance (IIFP 2009, Section 4.7). Further, as shown in Table 3.6.8 “HUD Noise Assessment Guidelines”; acceptable ranges for residential areas, the lowest acceptability area, is between 60 and 65 dB (HUD 2016). Sound levels from CIS Facility Site operations are expected to dissipate to background levels by the time they reach the property boundary. Certain phases of operation, weather, time of day, wind direction, traffic patterns, season, and the location of the receptor would all impact perceived operational noise levels. Although the noise from the plant and the additional traffic would generally be noticeable on the surrounding U.S. Highway 62/180 and New Mexico State Road 243, the operational noise from the plant is not expected to have a significant noise impact on nearby traffic or the surrounding area. Due to this, minimal impacts from noise from operations are expected.

4.6.2.4 Comparable NRC Noise Analyses

This analysis is consistent with the NUREG-2157 (NRC 2014b), in which NRC determined that dry cask storage noise levels, noise duration, and distance between noise sources and receptors would generally not be expected to produce noise impacts noticeable to the surrounding

community. The NRC also concluded that construction of an ISFSI could result in noise levels that exceed EPA-recommended noise levels, but noted that such impacts would be temporary. Because the proposed CIS Facility Site is located in a relatively isolated area, with no sensitive receptors located close to the Site, construction noise would not exceed EPA-recommended noise levels.

4.6.2.5 Decontamination and Decommissioning

D&D of the CIS Facility Site would produce sound levels similar to or lower than those generated during construction activities. The majority of activities would involve D&D facility equipment and hauling the materials off-site. As a result, the majority of the noise impacting the community would relate to the noise of hauling traffic. Because the anticipated noise emissions would be similar to those during construction, the estimated noise impact is expected to be minimal.

Table 4.6.1:

TOTAL CONSTRUCTION EMISSIONS – POUNDS PER HOUR

Source	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	VOC	CO_2e	PM
Construction Equipment	2.70	6.06	0.01	0.21	0.21	0.73	1,056.87	<0.01
Construction Worker Commuting	0.31	0.03	<0.01	<0.01	<0.01	0.03	55.17	<0.01
Material Delivery	0.77	2.12	<0.01	0.10	0.09	0.18	421.11	<0.01
Earthmoving Activities	<0.01	<0.01	<0.01	0.97	0.10	<0.01	<0.01	<0.01
Road Emissions	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.24
Cement Plant	<0.01	<0.01	<0.01	2.63	0.43	<0.01	<0.01	8.82
Other VOC (Paint and Fuel)	<0.01	<0.01	<0.01	<0.01	<0.01	8.30	<0.01	<0.01
Total	**3.78**	**8.21**	**0.01**	**3.95**	**0.83**	**9.24**	**1,533.15**	**9.06**

Sources: CARB 2016; WRAP 2006; Section 3.2.1; AP42 2006; Sections 7.1, 13.2.2, and 13.2.4; TCEQ 2001, and TCEQ 2011.

Table 4.6.2:

TOTAL CONSTRUCTION EMISSIONS – TONS PER YEAR

Source	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	VOC	CO_2e	PM
Construction Equipment	2.53	5.67	0.01	0.20	0.20	0.68	990.71	<0.01
Construction Worker Commuting	3.99	0.39	0.01	0.06	0.04	0.43	717.22	<0.01
Material Delivery	1.40	3.87	0.01	0.19	0.16	0.33	768.53	<0.01
Earthmoving Activities	<0.01	<0.01	<0.01	1.52	0.15	<0.01	<0.01	<0.01
Road Emissions	<0.01	<0.01	<0.01	0.06	0.01	<0.01	<0.01	0.52
Cement Plant	<0.01	<0.01	<0.01	2.63	0.43	<0.01	<0.01	8.82
Other VOC (Paint and Fuel)	<0.01	<0.01	<0.01	<0.01	<0.01	3.41	<0.01	<0.01
Total	**7.92**	**9.94**	**0.02**	**4.66**	**0.99**	**4.85**	**2,476.45**	**9.34**

Sources: CARB 2016; WRAP 2006; Section 3.2.1; AP42 2006; Sections 7.1, 13.2.2, and 13.2.4; TCEQ 2001, and TCEQ 2011.

Table 4.6.3: CONCURRENT OPERATION AND PHASED CONSTRUCTION EMISSIONS – POUNDS PER HOUR								
Source	**CO**	**NO_x**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO_2e**	**PM**
Worker Commuting	0.31	0.03	<0.01	<0.01	<0.01	0.03	55.17	<0.01
Deliveries	0.77	2.12	<0.01	0.10	0.09	0.18	421.11	<0.01
Road Emissions	<0.01	<0.01	<0.01	0.05	0.01	<0.01	<0.01	0.50
Ongoing Construction	0.57	1.23	<0.01	0.59	0.12	1.39	229.97	1.36
Total	**1.64**	**3.38**	**<0.01**	**0.75**	**0.22**	**1.60**	**706.25**	**1.86**

Sources: CARB 2016; WRAP 2006; Section 3.2.1; AP42 2006; Sections 7.1, 13.2.2, and 13.2.4; TCEQ 2001, and TCEQ 2011.

Table 4.6.4:

CONCURRENT OPERATION AND PHASED CONSTRUCTION EMISSIONS – TONS PER YEAR

Source	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	VOC	CO_2e	PM
Worker Commuting	5.60	0.55	0.01	0.08	0.05	0.61	1006.86	<0.01
Deliveries	2.80	7.75	0.01	0.38	0.32	0.65	1537.06	<0.01
Road Emissions	<0.01	<0.01	<0.01	0.12	0.01	<0.01	<0.01	1.09
Ongoing Construction	1.19	1.49	<0.01	0.70	0.15	0.73	371.47	1.40
Total	**9.59**	**9.79**	**0.02**	**1.28**	**0.39**	**1.26**	**2,543.92**	**1.09**

Sources: CARB 2016; WRAP 2006; Section 3.2.1; AP42 2006; Sections 7.1, 13.2.2, and 13.2.4; TCEQ 2001, and TCEQ 2011.

Table 4.6.5:

ATTENUATED NOISE LEVELS (dBA) EXPECTED FOR OPERATION OF CONSTRUCTION EQUIPMENT

Source	Distance from Source					
	50 feet	100 feet	150 feet	200 feet	400 feet	1,200 feet
Heavy Truck	85	79	76	73	68	56
Dump Truck	84	78	75	72	67	55
Concrete Mixer	85	79	76	73	68	56
Jackhammer	85	79	76	73	68	56
Scraper	85	79	76	73	68	56
Dozer	85	79	76	73	68	56
Crane	85	79	76	73	68	56
Loader	80	74	71	68	62	50
Paver	85	79	76	73	68	56
Excavator	85	79	76	73	68	56
Claw Shovel	93	87	73	81	75	66
Pile Driver	95	89	86	83	77	6

Source: IIFP 2009; Section 4.7.

4.7 CULTURAL RESOURCES

This section describes the potential impacts to historic properties associated with the CIS Facility construction, operations, and decommissioning. Potential mitigation measures are presented in Chapter 6.

4.7.1 Construction (All Phases)

Direct Impacts. Direct impacts to historic properties are actions directly associated with the project that can destroy, alter, or isolate historic properties. A records search was conducted of the Archaeological Records Management Section (ARMS) New Mexico Cultural Resources Information System (NMCRIS), maintained by the New Mexico Historic Preservation Division (NMHPD), for previously recorded cultural resources within the APE of direct impacts, or the project footprint. The results of the ARMS NMCRIS records search indicated that two known cultural resources existed within the direct Area of Potential Effects (APE). Subsequently, a cultural resource survey of the direct APE was conducted in December 2016 (see Appendix C). The survey resulted in the identification of 17 isolates, 1 previously recorded archaeological site, 1 newly discovered archaeological site, 1 previously recorded historical-period linear resource, and 1 newly discovered historical-period linear resource. All four cultural resources were evaluated for National Register of Historic Places (NRHP) eligibility. Of these four cultural resources, two are historic properties that could be directly affected by this project.

Indirect Impacts. Indirect impacts to cultural resources result from activities that are not directly associated with project actions but that contribute to the modification of the environmental setting of historic properties. Examples of indirect impacts to cultural resources include visual, audible, or atmospheric effects that are out of character with the setting of historic properties (primarily considered for the built environment), vandalism that results from improved access to areas where historic properties are located (primarily considered for archaeological sites), induced growth in the region from roads and infrastructure, or alteration of the regional landscape that affects water drainage around known and buried archaeological sites. In addition to resources located within the indirect APE, the proposed project could have the potential for unanticipated impacts to the communities from which the stored nuclear-waste items are being acquired, if the development of the project leads to additional development in those communities that would not otherwise occur.

A records search was conducted of the ARMS NMCRIS, maintained by NMHPD, for previously recorded cultural resources within the APE for indirect impacts, or a 1-mile radius around the project footprint. The ARMS NMCRIS records search indicated that 40 cultural resources are documented within the indirect APE (see Table 3.7.2). Of these 40 resources, 14 are eligible for listing in the NRHP and are therefore considered historic properties. It should be noted that another 19 cultural resources have an undetermined or unknown NRHP status.

The historic properties within the APE of indirect impacts are archaeological sites. Because most archaeological sites in this region are surficial, the visual, audible, and atmospheric effects of this project do not impact those sites. Because the CIS Facility site would be fenced and not open to the public, the potential for vandalism is considered to be minimal and would not be considered an indirect impact for this ER. Construction-design strategies could mitigate potential alteration of

the regional landscape that could affect water drainage around known and buried archaeological sites. As an SNF storage facility, the CIS Facility would not have the potential to induce growth.

Potential for Human Remains. There is a low potential for human remains to be present within the APE of direct impacts. Previous work in the region suggests that burials tend to occur in rock shelters and within archaeological sites that have architectural features. Upon the inadvertent discovery of human remains during construction, work would cease immediately in the vicinity of the human remains. Additionally, an area within 100 feet of the remains would be protected from further disturbance. The appropriate agency (New Mexico BLM Field Office or New Mexico State Historic Preservation Officer [SHPO]) would be notified within 24 hours of the unanticipated discovery of human remains. The agency would determine the appropriate measures to identify, evaluate, and treat such a discovery. If excavation of the human remains proves necessary, then excavation would be conducted pursuant to the guidelines appropriate for the land-managing agency. The agency would conduct the appropriate and necessary consultation with descendent communities and other consulting parties. Construction activities could resume only after the appropriate consultations and notifications have occurred and agency requirements have been completed and approved.

4.7.2 Operations (Including Concurrent Operation and Construction)

Operation of the proposed CIS Facility is not expected to result in impacts to any potential archaeological site; therefore, impacts of facility operations are expected to be small for cultural resources. Concurrent construction and operation would not introduce any potential for additional impacts to cultural resources.

4.7.3 Comparable NRC Cultural Analyses

This analysis is consistent with NUREG-2157, in which the NRC determined that the impacts to cultural resources from SNF storage would be small (NRC 2014b, Section ES.16.1.12), For any construction activities, the NRC recognized that there would be uncertainty associated with the degree of prior disturbance and the resources, if any, present in areas where future ground-disturbing activities (i.e., construction of an ISFSI) could occur. The NRC acknowledged the possibility that cultural resources could be affected by construction activities, because the ISFSI could be located in an area with cultural resources in close proximity (NRC 2014b, Section ES.16.1.12).

4.7.4 Decontamination and Decommissioning

D&D activities would take place on land previously disturbed and any potential to encounter cultural resources would be considerably less than during construction activities. Consequently, D&D impacts on cultural resources would be small.

4.7.5 Agency Consultation

Following the pedestrian survey, the draft cultural resource inventory and evaluation report and completed resource records were sent to the New Mexico SHPO and the BLM – Carlsbad Field Officer (CFO) for their review and requested concurrence of eligibility recommendations (see Appendix C). Consultation would be initiated by the Federal agencies, as appropriate, during any

subsequent NEPA process. Subsequent consultation with tribes associated with the area (such as the Apache Tribe of Oklahoma, the Comanche Indian Tribe, the Hopi Tribal Council, the Kiowa Tribe of Oklahoma, the Mescalero Apache Tribe, the Pueblo of Isleta, and the Ysleta del Sur Pueblo) will be required by the NRC or their designee. Through consultation with the aforementioned tribes, Traditional Cultural Properties (TCPs) that could be potentially affected by the project can be identified.

4.8 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

This section describes the potential impacts to socioeconomics and environmental justice associated with the Proposed Action. Socioeconomic impacts from construction are presented in Section 4.8.1; socioeconomic impacts from operations are presented in Section 4.8.2; environmental justice impacts are presented in Section 4.8.3; NRC analysis related to socioeconomics and environmental justice is presented in Section 4.8.4; and D&D impacts are presented in Section 4.8.5. Potential mitigation measures are presented in Chapter 6.

Socioeconomic impacts are not only important in themselves, but also for the secondary environmental or distributional effects they may have. For example, economic growth can sometimes attract enough new people to an area that it places pressure on housing, schools, water supply, and other infrastructure. Environmental effects of any new construction, facility improvements required, or infrastructure overloads that result from such a population increase should also be evaluated as induced effects of the development. The purpose is not to forecast economic activity but to make sure that reasonably foreseeable indirect effects are appropriately identified and considered.

4.8.1 Construction (Phase 1)

Construction of Phase 1 of the CIS Facility would begin in the first quarter of 2020 and take between 1-1.5 years to complete. Construction activities are estimated to require upwards of 80 construction personnel (50 craft, 30 oversight/management) (Holtec 2016a). The 2020 population in the region of influence (ROI) is projected to be 172,829. The addition of 80 construction personnel would increase the population by 0.05 percent.

Construction of Phase 1 CIS Facility would include short-term economic benefits from construction activities; however, such fractional effects would be less than significant on a regional scale. There would be less than significant permanent change in sales volume, income, employment, or population.

Economy. In terms of employment and income, it is estimated that 80 construction personnel would be needed for 1 to 1.5 years during Phase 1 construction. The 2015 labor force within the ROI was 77,433 (BLS 2016a). The addition of 80 workers would result in a 0.1 percent increase to regional employment. The mean annual salary for a construction worker in New Mexico is $28,320 and the mean annual salary for a construction manager is $86,970 (BLS 2016b). One year of construction activities would generate a total increase in income from direct jobs of about $4 million and approximately $409,000 in personal income tax and New Mexico Gross Receipts Tax. In addition, construction activities could result in beneficial impacts from increased local revenue from commercial activities, and sales taxes.

Population. Based on the number of estimated jobs created for Phase 1 and the assumption that all direct and indirect jobs created would be filled by employees in the ROI labor force, no impact on population is anticipated.

Housing. Based on the estimated number of jobs for Phase 1 and the assumption that workers in the existing labor force in the ROI would fill all direct and indirect jobs, there would be no need for additional housing. However, if there was need for temporary housing, the current housing market would be able to meet that need. Therefore, there would be no impact to housing, including sales, foreclosures, and price stability.

Community Services. Based on the number of estimated jobs created for Phase 1 and the assumption that all direct and indirect jobs would be filled by workers from the ROI's existing labor force, no impact to public schools, law enforcement, or firefighting capabilities is anticipated.

4.8.2 Concurrent Operation and Additional Construction (Phases 2-20)

The operation of the CIS Facility would require an estimated work force of less than 40 personnel and less than 15 security force personnel (Holtec 2016a). Construction activities during Phases 2-20 would occur as operations are occurring at any areas previously constructed. Phases 2-20 construction would take place over 20 years, but would require fewer annual construction personnel than Phase 1, as all support structures would be constructed during the Phase 1. There would be an addition of less than 80 workers during each year of construction for Phases 2-20. When combined with the operating workforce, the total number of annual workers at the Site could be as many as 135. The 2015 labor force within the ROI was 77,433 (BLS 2016a). The addition of 135 workers would result in a 0.2 percent increase to regional employment.

The mean annual salary for engineering operations in New Mexico is $85,730 and the mean annual salary for security guards is $29,880 (BLS 2016b). One year of operation activities would generate a total increase in income from direct jobs of nearly $3.9 million and approximately $411,000 in personal income tax and New Mexico Gross Receipts Tax would be recognized. In addition, operation activities could result in beneficial impacts from increased local revenue from commercial activities, and sales taxes. When combined with the annual salaries associated with construction workers for Phases 2-20, one year of concurrent operation and construction would generate a total increase in income from direct jobs of about $7.9 million and approximately $820,000 in personal income tax and New Mexico Gross Receipts Tax. On a regional scale, concurrent operation and Phases 2-20 construction would result in a less than significant impact on population, housing, and community services.

4.8.3 Operation

Operation of the CIS Facility at full build-out would not require any notable difference in the number of operating personnel compared to Phase 1 operations. Consequently, operation of the CIS Facility at full build-out would require an estimated work force of less than 40 personnel and less than 15 security force personnel (Holtec 2016a). The 2015 labor force within the ROI was 77,433 (BLS 2016a). The addition of 55 workers would result in a 0.05 percent increase to regional employment. The mean annual salary for engineering operations in New Mexico is $85,730 and the mean annual salary for security guards is $29,880 (BLS 2016b). One year of operation activities would generate a total increase in income from direct jobs of nearly $3.9 million and

approximately $411,000 in personal income tax and New Mexico Gross Receipts Tax would be recognized. In addition, operation activities could result in beneficial impacts from increased local revenue from commercial activities, and sales taxes.

The number of permanent jobs created would not result in appreciable change in population, and therefore it would not be likely to affect housing availability or community services or have long-term fiscal impacts in the region. Therefore, the socioeconomic impacts would be short-term and beneficial.

4.8.4 Environmental Justice

Section 3.8.5 of this ER discusses environmental justice populations located within the counties encompassing a 50-mile radius around the Site (three counties in New Mexico and six counties in Texas). There were 35 block groups identified to contain minority populations that exceed the site-specific thresholds for minority populations. No minority populations were identified that exceeded the site-specific threshold within a 4-mile or a 25-mile radius of the Site. The closest minority populations that exceeded the site-specific threshold were located in the population centers of Artesia and Carlsbad in Eddy County and Hobbs in Lea County. There were no low-income populations identified that exceeded the site-specific threshold for low-income populations within the same ROI.

As discussed in Sections 4.9, 4.12, and 4.13, no high and adverse human health or environmental impacts are expected from the construction or operation of the CIS Facility. Environmental impacts from most projects tend to be highly concentrated within the project site boundaries and tend to decrease as distance from the site increases. No effects on environmental justice would be expected, and the Proposed Action would not result in disproportionate adverse environmental or health effects on low-income or minority populations.

4.8.5 Comparable NRC Socioeconomics and Environmental Justice Analysis

This analysis is consistent with NUREG-2157 (NRC 2014b, Sections 4.2 and 4.3), in which NRC determined that construction and operation of an ISFSI would have minimal impacts on socioeconomic resources and environmental justice. The NRC concluded that: (1) the workforce for ISFSI construction and operations would be small; (2) tax payments would continue and would remain relatively constant; (3) there would be no increased demand for housing and public services; and (4) maintenance and monitoring of SNF in ISFSIs would have minimal human health and environmental effects on all populations, including minority and low-income populations near these storage facilities.

4.8.6 Decontamination and Decommissioning

D&D of the CIS Facility would consist of decontaminating and removing equipment from the facility, while leaving the building, parking area, and access roads in place. No reliable information could be obtained regarding labor market conditions 120 years in the future; therefore, it is not apparent how employment from D&D activities would specifically impact the labor market.

However, it is anticipated that the annual workforce for D&D activities would not exceed the number of workers needed for construction of the CIS Facility. Assuming the population within

the ROI would continue to grow in the future, it is unlikely that the introduction of a small number of individuals would create appreciable impacts to the population or community services.

Closing the operation of the CIS Facility would have a minimal economic impact to the community, some of which would be offset by the D&D activities and site closure. It is anticipated that the overall economic impacts of D&D would be minimal.

4.9 TRANSPORTATION

This section presents the potential impacts of transportation activities associated with the Proposed Action. Both radiological and non-radiological transportation impacts are addressed. Potential mitigation measures are presented in Chapter 6.

4.9.1 Construction (Phase 1)

Construction of Phase 1 of the CIS Facility would require a new access road from U.S. Highway 62/180 and a new railroad spur from the existing Carlsbad railroad spur that ends at the Intrepid Mining LLC North facility 3.8 miles due west of the Site (see Figure 2.2.1). The environmental impacts of constructing the access road and railroad spur (e.g., impacts to land use, air quality, cultural, etc.) are included in the Phase 1 construction estimates and are presented in the applicable resource sections of this chapter.

Holtec plans to use trucks and common carrier to make shipments during construction. Therefore, the impacts of rail traffic are not evaluated. If rail shipments are needed for construction to bring large items to the CIS Facility, they are not expected to be a significant impact since they would be infrequent and would be managed as routine railroad traffic. Construction of Phase 1 of the CIS Facility is estimated to require up to 80 construction personnel and the delivery of equipment and supplies, most of which would arrive via U.S. Highway 62/180. The mode of transportation for construction would consist of over-the-road trucks, ranging from heavy-duty 18-wheeled delivery trucks, and dump trucks, to box and flatbed type light-duty delivery trucks. The primary transportation mode for the workforce to and from the site will be by car, truck, or van.

U.S. Highway 62/180 would provide access to the Site. Considering that U.S. Highway 62/180 is a divided 4-lane highway and serves as a main east-west trucking thoroughfare for local industry, it would be able to handle the increased heavy-duty traffic adequately since the traffic count is significantly less at the CIS Facility site than in the urban ends of the highway at the Hobbs and Carlsbad areas (see Section 3.9). Approximately 43 percent of vehicles in the vicinity of the proposed Site were associated with commercial trucks

4.9.2 Concurrent Operations and Additional Construction (Phases 2-20)

Once Phase 1 is operational, transportation impacts associated with workers would have minimal environmental impacts. In 2015, the annual average daily traffic (AADT) on U.S. Highway 62/180 was approximately 5,696 vehicles per day in the vicinity of the proposed Site. Given the estimated steady-state work force of less than 40 personnel and the estimated steady-state security force of less than 15 personnel, the additional traffic on U.S. Highway 62/180 and the access road would be insignificant (less than one percent).

Concurrent operations and additional construction (Phases 2-20) would result in a maximum of 135 construction and operating personnel and the delivery of equipment and supplies, most of which would arrive via U.S. Highway 62/180. The concurrent impacts would not be significantly different than the impacts discussed in Section 4.9.1.

SNF is expected to be transported to the CIS Facility via rail. The railroad spur would cross one existing road (New Mexico State Road 243) and would contain appropriate active traffic control devices (i.e., warning lights and automatic gates serving as a barrier across the road when a train is approaching or occupying the crossing). Section 4.9.3 discusses the potential environmental impacts associated with SNF transportation.

4.9.3 Operations

The analysis in this section focuses on transportation of SNF, as worker transportation associated with operations are expected to be minimal, as addressed in Section 4.9.2. For SNF transportation, incident-free impacts (Section 4.9.3.1) and potential accident impacts (Section 4.9.3.2) are presented.

4.9.3.1 Incident Free Impacts

Over the course of the operational life of the CIS Facility, Holtec would receive up to 100,000 MTUs of SNF in approximately 10,000 canisters from decommissioned shutdown sites and operating reactor sites. Except for the potential use of heavy-haul trucks (or barges for certain decommissioned shutdown sites) to move SNF, this analysis assumes SNF would be transported nationally by rail.

The U.S. Department of Energy (DOE) would be responsible for transporting SNF to the CIS Facility in transportation casks licensed by the NRC pursuant to 10 Part CFR 71. The preparation of such shipments would be conducted in accordance with written procedures prepared by the commercial nuclear power plant, DOE, or their contractors. DOE would also be responsible for coordinating with other Federal agencies, such as the U.S. Department of Transportation (DOT), U.S. Department of Homeland Security, EPA, and the Federal Emergency Management Agency (FEMA). The Federal government, through DOE, is responsible for providing emergency training to states, tribes, and local emergency responders along the transportation routes where SNF would be transported to the CIS Facility. Given its proximity to the Waste Isolation Pilot Plant (WIPP), local fire fighters, law enforcement, and emergency medical staff have been trained to respond to any emergency response actions that may be needed to reduce the severity of events related to transportation incidents involving the CIS Facility.

If the option is selected for a reactor licensee to ship the fuel to HI-STORE, the licensee would use transportation casks licensed by the NRC pursuant to 10 CFR Part 71. The licensee would also coordinate shipments with federal agencies, such as the U.S. Department of Transportation (DOT), US Department of Homeland Security, Environmental Protection Agency (EPA), and the Federal Emergency Management Agency (FEMA), and potentially affected states and applicable state agencies. These interactions would ensure that all necessary emergency responders along the route are properly prepared.

The incident-free radiological transportation analysis in this ER tiers from the analysis prepared for the proposed WCS CIS Facility in Andrews County, Texas (WCS 2016). The WCS CIS Facility site is approximately 39 miles from the proposed Holtec CIS Facility Site. This difference in distance for SNF transportation would be insignificant with respect to potential impacts. The most significant difference involves the amount of SNF that would be received at the Holtec CIS Facility compared to the WCS CIS Facility. The WCS CIS Facility transportation analysis was based on the receipt of 40,000 MTUs of SNF in approximately 4,000 canisters from decommissioned shutdown sites and operating reactor sites, which is 2.5 times less than the Holtec proposal to receive 100,000 MTUs of SNF in approximately 10,000 canisters. Consequently, this ER analysis accounts for that greater amount of SNF transportation for the Holtec CIS Facility.

Background. Radiological impacts of transporting SNF were estimated using RADTRAN, which is a computer model developed by Sandia National Laboratories for the NRC to calculate the radiological impacts of transporting radiological materials (NRC 2014a). RADTRAN, which was initially used for NUREG-0170 (NRC 1977), models both the risks of routine, incident-free transportation and transportation accidents. Since publication of NUREG-0170, RADTRAN has been periodically updated and is widely used to estimate the risk of radiological material transportation for environmental impact statements and risk assessments published by NRC, DOE, and other U.S. Federal and state agencies.

RADTRAN assumes the maximum dose rate allowed for exclusive use shipments under NRC regulations (10 CFR 71.47 (b) (3)) and estimates the potential impacts to the populations located within one-half mile along either side of the transportation routes. WebTRAGIS was used to determine the route length and population density (e.g., rural, suburban, and urban) for each route segment. Using the maximum dose rate (10 mrem/hour at a distance of 6.5 feet from the cask) assures that the doses calculated by RADTRAN bound those of the proposed SNF shipments to and from the CIS Facility.

Transportation Routes. The analysis assumed SNF would be along three representative routes: (1) from the east coast to the CIS Facility (assumed to be from Maine Yankee Nuclear Power Plant to the CIS Facility); (2) from the west coast to the CIS Facility (assumed to be from the San Onofre Nuclear Generating Station [SONGS] to the CIS Facility; and (3) from the CIS Facility to the assumed repository at Yucca Mountain in Nye County, Nevada (see Figure 4.9.1).

The analysis also analyzed the transportation routes needed to remove and transport SNF from the decommissioned shutdown sites at twelve locations across the U.S. to the CIS Facility. At these sites, SNF would require to be transported short distances by heavy haul trucks or barge to a rail transfer facility where the SNF could be subsequently transported to the CIS Facility. The mode of transport of SNF from the twelve decommissioned shutdown sites were obtained from "Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites" (DOE 2014).

Impacts. Radiological dose calculations were performed along each of the three transportation routes for a single shipment of SNF by rail. Holtec estimated that approximately 10,000 canisters of SNF would be transported to the CIS Facility over the next 20 years, an average of 500 canisters received annually. The maximum dose for one shipment of SNF along the transportation routes was estimated at 1.79×10^{-3} mrem. For perspective, the average radiation dose from background

radiation is estimated at 311 mrem per year as reported by the National Council of Radiation Protection and Measurements (see Table 3.11.1).

The radiological impacts of transporting 500 canisters of SNF annually from the Maine Yankee Nuclear Power Plant to the CIS Facility were estimated to be 92.5 person-rem. From SONGS to the CIS Facility, the radiological impacts of transporting 500 canisters of SNF annually was estimated to be 22.3 person-rem. The impacts of transporting 500 canisters from the CIS Facility to a geologic repository at Yucca Mountain were estimated at 57.5 person-rem.

An additional radiological dose could result from the need to transport SNF short distances from the twelve decommissioned shutdown sites by heavy haul truck or barge. The effects of these additional doses would be small (generally less than 1 person-rem) when added to the doses estimated for shipment on the three analyzed rail routes. In addition, the NRC previously analyzed the environmental impacts associated with using heavy-haul trucks and barges to transport SNF from reactors to a rail transfer facility to an interim storage facility in NUREG-1714 (NRC 2001). In that study, the NRC concluded that the impacts of rail transport from the representative route conservatively characterize the nationwide incident-free transportation risks of that proposed action, including potential intermodal transfers (NRC 2001, Section 5.7.2.6). That conclusion remains valid for the proposed action evaluated in this ER. Similarly, in the event that spur is not constructed, Holtec would transport the SNF the final 3.8 miles by heavy haul truck. The impacts of transporting SNF short distances by heavy haul truck would be small (generally less than 1 person-rem) when added to the doses estimated for shipment on the three analyzed rail routes.

Results of the incident-free analysis of transporting 500 canisters of SNF annually are presented in Table 4.9.1. As shown, the annual doses to the public along the transportation route would be much small.

With respect to potential impacts to transportation workers, a prior study by DOE for the transport of up to 70,000 metric tons of SNF to the Yucca Mountain repository from nuclear power plants across the U.S. determined that annual doses to workers would be maintained at less than 500 mrem/year (which is considered an administrative dose limit) (DOE 2008, Table 2-3). Transportation impacts of SNF to the CIS Facility would not exceed this estimate.

As discussed in Section 4.11 of this ER, the operation of the CIS Facility could generate a small amount of LLW that would result in infrequent waste shipments to a licensed disposal facility. The small and infrequent number of shipments and compliance with NRC and the DOT packaging and transportation regulations would also limit potential worker and public radiological and non-radiological impacts from these waste shipments. This conclusion is consistent with the NRC's conclusion that public and worker radiological and non-radiological safety from LLW shipments resulting from SNF storage activities would be small (NRC 2014b, Section 4.16).

With the exception of occupational and public health and safety impacts evaluated in this section, because shipments of SNF would comprise only small fractions of total national highway and rail traffic, the environmental impacts of the shipments on land use and ownership; hydrology; biological resources and soils; cultural resources; socioeconomics; climate change; noise and vibration; aesthetics; utilities, energy, and materials; and waste management would be small in comparison with the impacts of other nationwide transportation activities.

4.9.3.2 Accident Impacts

The radiological transportation impacts that could potentially occur during accidents were also analyzed. Type B transportation casks licensed in accordance with 10 CFR Part 71 are constructed to withstand severe accidents so that most transport accidents would not result in damage to the cask body or seals that could result in a radiological release.

The analysis of radiological risks of accidents considered a spectrum of accidents that ranged from high-probability accidents of low severity and consequences to severe accidents with radiological consequences that have a low probability of occurrence. They included accidents in which the functional performance of a cask would not be degraded, accidents in which no radiological material would be released but shielding would be deformed because of lead shield displacement, and accidents that released radiological material. Radiological accident risks are defined as the sum over a complete spectrum of transportation accidents of each accident's probability multiplied by its radiological consequences.

Table 4.9.2 presents the radiological and non-radiological accident risks of rail transport of approximately 100,000 metric tons of SNF over a 20-year period, tiered from the analysis in DOE 2008. The data in Table 4.9.2 provide a reasonable approximation of the accidents risks associated with SNF transportation to the CIS Facility. As shown, the radiological accident risks to the population would be approximately 5.9 person-rem, which is small. The larger impact would be associated with potential traffic fatalities. Statistically, 2.9 fatalities from traffic accidents would be expected over the 20-year transportation period. Because the risks are for the entire population of individuals along the transportation routes, the risk to any single individual would be small.

About 99.99 percent of transportation accidents would not be severe enough to result in a release of radiological material from the transportation cask or degradation in the cask's shielding. The 0.01 percent of accidents that could result in a release of radiological material or degradation of shielding are known as severe transportation accidents (DOE 2008, Section 6.3.3.2).

Table 4.9.3 presents the impacts of the maximum reasonably foreseeable accident associated with SNF transport to the CIS Facility. If the accident occurred in an urban area, the estimated population radiation dose would be about 16,000 person-rem. If the accident occurred in a rural area, the estimated population radiation dose would be about 21 person-rem. Because these risks are for the entire population exposed during the accident, the risk to any single individual would be small. In an urban area or rural area, the radiation dose from the accident for the maximally exposed individual would be 34 rem; this is based on the individual being 1,100 feet downwind from the accident, where the maximum dose would occur (DOE 2008, Section 6.3.3.2).

4.9.4 Comparable NRC Transportation Analyses

The radiological impacts of transporting SNF have been extensively studied for nearly 40 years. Several transportation risk studies have been published by NRC during that time, including:

- Spent Nuclear Fuel Risk Transportation, NUREG-2125 (NRC 2014a);
- Generic Environmental Impact Statement of Continued Storage of Spent Nuclear Fuel, NUREG-2157 (NRC 2014b).

- Reexamination of Spent Fuel Shipment Risk Estimates, NUREG/CR-6672 (NRC 2000);
- Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, NUREG-0170 (NRC 1977).

All of NRC's assessments have concluded that the risk from radiation emitted from a transportation cask during routine, incident-free transportation is a small fraction of the radiation dose received from the natural background.

In the most recent of these analyses (NUREG-2125), the NRC also concluded that:

1 The collective dose risks from routine transportation are very small. These doses are approximately four to five orders of magnitude less than the collective background radiation dose.

2 The routes selected for this study adequately represent the routes for SNF transport, and there was relatively little variation in the risks per mile over these routes.

3 Radioactive material would not be released in an accident if the fuel is contained in an inner welded canister inside the cask.

4 Only rail casks without inner welded canisters would release radioactive material, and only then in exceptionally severe accidents.

5 If there were an accident during a spent fuel shipment, there is only about one-in-a billion chance that the accident would result in a release of radioactive material.

6 If there were a release of radioactive material in a spent fuel shipment accident, the dose to the MEI would be less than 200 rem and would not be expected to result in an acute lethality.

7 The collective dose risks for the two types of extremely severe accidents (accidents involving a release of radioactive material and loss of lead shielding [LOS] accidents) are negligible compared to the risk from a no-release, no-loss of shielding accident.

8 The risk of gamma shielding loss from a fire is negligible.

9 None of the fire accidents investigated in this study resulted in a release of radioactive material (NRC 2014a, Executive Summary).

The NRC has also analyzed the radiological impacts from transporting SNF in several EIS's supporting other licensing actions and found the radiological impacts to be small. In licensing the Private Fuel Storage SNF Storage facility, the NRC analyzed the radiological impacts associated with transporting 40,000 MTUs of SNF from Maine Yankee to Goshute Indian Reservation near Salt Lake City, Utah and found the radiological impacts to be small (NRC 2001, Section 5.1.2).

In addition, in NUREG-2157, the NRC concluded that the radiological impacts from SNF transportation conducted in compliance with NRC regulations are low, and that the regulations for transportation of radiological material are adequate to protect the public against unreasonable risk of exposure to radiation from SNF packages in transport (NRC 2014b, Section 4.16).

In assessing the Yucca Mountain repository, DOE also evaluated the national impacts of transporting SNF from commercial reactors across the U.S. to the repository. DOE determined that transporting up to 70,000 metric tons of SNF would result in a total dose of 1,100-1,200 person-rem to the population along the transportation routes (DOE 2008, Table 6-4). Those results correlate well with the results presented Table 4.9.1 of this ER, when the results in that table (which represent the impacts of transporting 500 canisters) are integrated to account for a similar overall quantity of SNF transport.

4.9.5 Decontamination and Decommissioning

Prior to D&D activities, all canisters of SNF would be removed and transported to a permanent repository. For purposes of this ER, it is assumed that the repository would be at Yucca Mountain in Nye County, Nevada. The impacts associated with transporting the SNF from the CIS Facility to Yucca Mountain are presented in Table 4.9.1. Those impacts represent the annual impacts of transporting 500 canisters. The impacts of transporting the full inventory of the CIS Facility (10,000 canisters) would be 20 times the impacts presented in Table 4.9.1.

Following the removal of the canisters containing SNF, the empty storage system would be surveyed to determine their levels of residual radioactivity. If the contamination levels were found to be below the applicable NRC limits for unrestricted release, then the empty storage casks would be disposed of as non-controlled material. Any contaminated storage casks would be decontaminated to levels below applicable NRC limits for unrestricted use. The fate of these items would be identified as part of the Final Decommissioning Plan.

While some radiological wastes would be generated during D&D that would require transport to an off-site licensed disposal facility, the NRC has previously determined that these wastes would be small and would have a small impact (NRC 2014b, Section 4.15). Consequently, the transportation impacts of these wastes are expected to be small.

Table 4.9.1:

ANNUAL INCIDENT-FREE TRANSPORTATION IMPACTS[a]

Transportation Route	Dose to Public (person-rem/year)
Maine Yankee Nuclear Power Plant to CIS Facility	92.5
SONGS to CIS Facility	22.3
CIS Facility to Yucca Mountain	57.5

a Based on transport of 500 canisters of SNF.

Table 4.9.2:

ACCIDENT RISKS FOR TRANSPORTATION OF 10,000 CANISTERS TO CIS Facility

	Radiological Accident Dose Risk (person-rem)	Traffic Fatalities	Total Fatalities
Rail Transport	5.9	2.9	2.9

Source: derived from DOE 2008.

Table 4.9.3:

RADIOLOGICAL IMPACTS FROM THE MAXIMUM REASONABLY FORESEEABLE TRANSPORTATION ACCIDENT IN URBAN AND RURAL AREAS[a]

Impact	Urban Area[b]	Rural Area[b]
Population dose (person-rem)	16,000	21
Maximally exposed individual (MEI) dose (rem)	34	34
Maximally exposed first responder dose (rem)	0.14-2.0	0.14-2.0

a Analysis assumes the maximum reasonably foreseeable accident occurs (e.g., probabilities that accident would occur is 1).
b Urban areas have a population density greater than 3,326 people per square mile. Rural areas have a population density less than 139 people per square mile.
Source: DOE 2008.

Figure 4.9.1: TRANSPORTATION ROUTES FOR SNF

4.10 INFRASTRUCTURE

This section describes the potential impact from the Proposed Action on infrastructure (water and electricity) associated with construction and operation of the CIS Facility. Construction impacts for Phase 1 are presented in Section 4.10.1; concurrent impacts from operations and construction of Phases 2-20 are presented in Section 4.10.2; full facility operations are presented in Section 4.10.3; comparable NRC analyses related to infrastructure are discussed in Section 4.10.4; and D&D impacts for the CIS Facility are presented in Section 4.10.5. The CIS Facility would be designed to minimize the use of natural resources, including water and electricity. Chapter 6 describes mitigation measures that would minimize infrastructure impacts during construction and operation of the CIS Facility.

4.10.1 Construction (Phase I)

During Phase 1 construction of the CIS Facility all supporting facilities (e.g., Cask Transfer Building, Security Building, and Administrative Building) and supporting infrastructure (e.g., railroad spur and Site access road) would be constructed. Phase 1 would contain space for 500 canisters of SNF in a vertical underground configuration.

Peak potable water requirements for the CIS Facility would be 20 gallons/minute during any construction or operation scenarios. Potable water would be provided by the City of Hobbs Water Department (Holtec 2016a). The City of Hobbs has municipal well fields that withdraw potable water from the Ogallala Aquifer (IIFP 2009, Section 2.4.15). Because there is an existing potable water supply pipe already in-place at the Site, no notable construction would be required to provide water to the CIS Facility. There would be minimal impacts to water resources on the Site as a result of the small demand of potable water during Phase 1 construction.

Average electrical demand for the CIS Facility would be approximately 200 kW-hours during any construction or operation scenarios (Holtec 2016a). There is existing electrical service along the southern border of the Site and no notable construction would be required to provide power to the CIS Facility. Electrical demand for the CIS Facility during both construction and operation is expected to be small and the existing electrical distribution system would be expected to support the energy demands with minimal impacts.

4.10.2 Concurrent Operation and Additional Construction (Phases 2-20)

The construction process for Phases 2-20 would occur as operations are occurring at any areas previously constructed. Holtec would have procedures in place to ensure that the construction activities of Phases 2-20 do not adversely affect operations. The existing potable water system would be expected to support the demands of all support buildings, along with the concrete batch plant that would be utilized during construction. The construction process for additional phases would be the same as that for Phase 1 CIS Facility. There would be slightly higher demand for potable water during concurrent operations and construction of Phases 2-20 compared to Phase 1 construction, but the overall demand would not exceed 20 gallons/minute. There would be minimal impacts to water resources on the Site and in the vicinity as a result of the small demand of potable water during concurrent operation and construction of Phases 2-20.

The construction process for additional phases would be the same as that for Phase 1 CIS Facility. There would be slightly more demand for electricity during Phases 2-20 construction than Phase 1 construction, but the average electrical demand would not exceed 200 kW-hours. Power usage would be minimized by efficient design of lighting systems, selection of high-efficiency motors, use of appropriate building insulation materials, and other good engineering practices. The existing electrical distribution system would be expected to support the standard energy demands of all support facilities, along with the security fencing and lighting and temperature monitoring system. It is expected that the energy provider, would be Xcel Energy, which currently provides service in the area. Due to the necessity to maintain power to security and alarm systems at all times, the CIS Facility would include backup diesel generators.

4.10.3 Operation

Potable water and electricity demands would not exceed the values presented in Section 4.10.1 and no significant impacts are expected to support operation of the CIS Facility once fully operational.

4.10.4 Comparable NRC Infrastructure Analysis

This analysis is consistent with NUREG-2157 (NRC 2014b, Section 4.8), in which NRC determined that water demands for SNF storage would be minimal and not cause water-use conflicts. In addition, limited electrical power would be needed.

4.10.5 Decontamination and Decommissioning

D&D activities are similar in nature to the construction activities, however, the D&D activities would be expected to be completed within a few years compared to the phased CIS Facility construction over 20 years. Because D&D activities would not require significant quantities of water or electricity compared to construction, infrastructure impacts would be minimal.

4.11 WASTE MANAGEMENT

This section describes the potential waste management impacts associated with construction and operation of the CIS Facility. Construction impacts for Phase 1 are presented in Section 4.11.1; concurrent impacts from operations and construction of Phases 2-20 are presented in Section 4.11.2; full facility operations are presented in Section 4.11.3; comparable NRC analyses related to infrastructure are discussed in Section 4.11.4; and D&D impacts for the CIS Facility are presented in Section 4.11.5. Waste management impacts associated with the construction and operations of the CIS Facility are expected to be small. The CIS Facility would be designed to minimize the volumes of radiological waste generated during operations and at the time of license termination. Chapter 6 describes mitigation measures that would minimize impacts during construction and operation of the CIS Facility.

4.11.1 Construction (Phase I)

During Phase 1 construction of the CIS Facility all supporting facilities (e.g., Cask Transfer Building, Security Building, and Administrative Building) and supporting infrastructure (e.g., railroad spur and Site access road) would be constructed. Phase 1 would contain space for 500 canisters of SNF in a vertical underground configuration. As discussed below, a small amount of non-hazardous and sanitary waste will be generated during Phase 1 construction. No radiological wastes would be generated during Phase 1 construction.

Non-radiological waste types generated during Phase 1 construction could include: non-hazardous and sanitary. Non-hazardous waste generation would be commensurate with typical construction activities and would be disposed of at one of the off-site landfills described in Section 3.11 (Holtec 2016a). Sanitary waste would include waste from water closets, lavatories, mop sinks, and other similar fixtures located in the Cask Transfer Building, Security Building, and Administrative Building. The capacity of the system would be able to handle approximately 3,000 gallons per day.

Construction waste estimates for phase 1 are bounding due to the construction of the supporting facilities and infrastructure. These estimates are based off experience on similar construction projects. The following non-hazardous waste products will be produced during the phased construction: concrete truck washout materials from concrete placement activities, miscellaneous construction wastes (dumpsters), and steel bins for disposal/recycling of extraneous steel material. Approximately 3000 tons, 2500 tons, and 95 tons, respectively, of each of these materials are expected per construction phase. The construction phased are outlined in Table 1.3. This would come to a total estimated volume of approximately 5,600 tons of nonhazardous solid waste for Construction Phase 1 (approximately 2,800 tons on an annual basis).

In addition to waste materials generated from construction activities soil spoils will be produced from the excavation activities at the project site. Each phase of construction outlined in Table 1.3 will include the excavation of approximately 140,000 cubic yards of native fill material. This material will be stockpiled on site in accordance with the BMP parameters outlined in section 6.3.

4.11.2 Concurrent Operations and Additional Construction (Phases 2-20)

The construction process for Phases 2-20 would occur as operations are occurring at any areas previously constructed. Holtec would have procedures in place to ensure that the construction activities of Phases 2-20 do not adversely affect operations.

The construction process for additional phases would be the same as that for Phase 1 CIS Facility and would produce similar wastes as described in Section 4.11.1. Construction activities in the vicinity of operations would not change the amounts or types of wastes generated. There would continue to be no low-level radioactive waste generated by construction activities. The annual estimated volume of nonhazardous solid waste would be 5,600 tons in accordance with the information provided in Section 4.11.1. This would come to a total of 106,400 tons of nonhazardous solid waste for construction phases 2-20 (19-year period).

Non-hazardous and sanitary waste generated for Operations activities during Phases 2-20 would be minimal and would be commensurate with typical office/personnel waste generated by the steady-state work force. Based on industry standards for an office environment, 1 pound of waste will be generated per 100 square feet of office space per day. The total area of the building floor plans at the CIS Facility is 55,000 square feet (Cask Transfer Building, Security Building, and Administrative Building). Therefore, the CIS Facility would produce approximately 550 pounds of nonhazardous solid waste per day. This can be extrapolated out to an annual estimate of 200,750 pounds annually and a total of 3,814,250 pounds for Construction Phases 2-20.

Although CIS Facility operations would not be designed to directly produce any hazardous waste, minimal amounts of hazardous waste may be generated from the use of solvents or other chemicals during operations. The small quantities of hazardous wastes that would be generated are expected to be less than 220 pounds/month. Thus, the CIS Facility would qualify as a Conditionally Exempt Small Quantity Generator (CESQG). All hazardous wastes generated would be identified, stored, and disposed of in accordance with state and Federal requirements applicable to CESQGs. Any RCRA wastes would be disposed of at the WCS facility in Andrews County, Texas, approximately 39 miles from the proposed Holtec CIS Facility.

A small amount of low-level radioactive waste (LLRW) may be generated at the CIS Facility during operations, consisting of contamination survey rags, anti-contamination garments, and other health physics materials. This solid LLRW would be packaged and temporarily stored at the Cask Transfer Building until being transported off-site to a licensed disposal facility. Based on dry fuel storage loading campaign experience, a conservative estimate on the volume of this LLRW is 2 pounds per cask. Based on a total of 10,000 casks loaded over a 40-year license, approximately 500 pounds will be generated annually for a total of 20,000 pounds for all phases.

4.11.3 Operations

Nonhazardous, sanitary, and hazardous waste generated during the Operations only timeframe would not be notably different than the values discussed in Section 4.11.2. The CIS Facility would continue to produce an estimate of 200,750 pounds annually and a total of 3,814,250 pounds of nonhazardous solid waste for the remaining 19 years of the CIS Facility license.

LLRW generated at the site is presented in Section 4.11.2. The CIS Facility would generate approximately 500 pounds annually.

Two options for disposal of the LLRW include the WCS LLRW disposal facility in Andrews, Texas, and the Energy*Solutions* LLRW disposal facility in Clive, Utah. These facilities have significant capacities, which exceed those necessary for the HI-STORE LLRW. The potential impacts of LLRW transportation are addressed in Section 4.9. There would be no generation of liquid or gaseous radiological waste. Additionally, no mixed-waste would be generated.

4.11.4 Comparable NRC Waste Management Analyses

This analysis is consistent with the NUREG-2157 (NRC 2014b, Section 4.15), in which NRC determined that the impacts from waste management activities for continued SNF storage would be small. This is mainly because of the small quantities of waste that would be generated and the fact that wastes would be handled and disposed of according to regulatory requirements.

4.11.5 Decontamination and Decommissioning

D&D activities are not likely to occur for many decades and there are many external factors, such as regulatory requirements and technology developments, which could affect the ultimate impacts associated with D&D.

Following the removal of the canisters containing SNF, the empty storage system would be surveyed to determine their levels of residual radioactivity. Based on the evaluation of activity levels presented in HI-STORM 100 FSAR Table 2.4.1 for steel and concrete, it is expected that the contamination levels for all remaining components of the storage system (concrete, rebar, and steel components) will be below the applicable NRC limits for unrestricted release. Any contaminated storage casks would be decontaminated to levels at or below applicable NRC limits for unrestricted use. Based on these assumptions, the empty storage casks would be disposed of as non-controlled material and considered nonhazardous solid waste. An estimate of the total volume of this nonhazardous solid waste is approximately 6.2 million tons (approximately 6.1 million tons coming from the concrete and steel of the storage system). Annual estimates are highly dependent on the schedule for D&D activities. The fate of these items would be identified as part of the Final Decommissioning Plan.

While some radiological wastes would be generated during D&D, the NRC has previously determined that these wastes would be small and would have a small impact (NRC 2014b, Section 4.15). To perform the final radiation survey of the site we can conservatively assume that there may be twice as much LLRW generated for contamination survey activities. This would be a total volume of 40,000 pounds of LLRW for D&D activities. Annual estimates are highly dependent on the schedule for D&D activities.

4.12 PUBLIC AND OCCUPATIONAL HEALTH FROM NORMAL OPERATIONS

This section presents the potential radiological and non-radiological health impacts of construction, operation, and decommissioning activities associated with the CIS Facility on the public and workers; however, transportation-related public and occupational health impacts are

addressed in Section 4.9. This section is organized as follows: (1) Section 4.12.1 discusses non-radiological impacts for construction and operation; and (2) Section 4.12.2 discusses radiological impacts for construction and operation. Within the sections, the potential impacts associated with Phase 1 construction, concurrent operation and construction (Phases 2-20), and operations at full build-out are presented. Chapter 6 describes proposed mitigation measures that would be in place to reduce adverse impacts that could occur during construction, routine, and non-routine operation of the CIS Facility.

4.12.1 Non-Radiological Impacts

The proposed CIS Facility facility would be subject to Occupational Safety and Health Administration (OSHA's) General Industry Standards (29 CFR Part 1910) and Construction Industry Standards (29 CFR Part 1926). Construction and operations risks would be minimized by adherence to the procedures and policies established by OSHA. These standards establish practices, procedures, exposure limits, and equipment specifications to preserve employee health and safety. In addition, OSHA inspections would also be employed in an effort to reduce the frequency of accidents and further ensure worker safety.

4.12.1.1 Estimate for CIS Facility

Even with adherence to OSHA requirements, the potential exists for fatal and non-fatal occupational injuries. Potential health impacts to workers during construction of the CIS Facility would be small and limited to the normal hazards associated with construction (i.e., no unusual situations would be anticipated that would make the proposed construction and operations activities more hazardous than normal for a major industrial construction project). These normal hazards include fatal and nonfatal occupational injuries, which, for the construction industry, typically result from overexertion, falls, or being struck by equipment.

In order to estimate the number of potential fatal and nonfatal occupational injuries due to the initial construction and normal operations of the proposed CIS Facility, data on fatal occupational injuries per 100,000 workers per year and data on nonfatal occupational injuries per 100 full-time workers per year were identified in the National Safety Council Injury Facts 2015 edition (NSC 2015). Data from both the Bureau of Labor Statistics (BLS) and the OSHA are represented therein. Fatal and non-fatal incident rates for the construction industry were used for the construction activities, which are among the highest incident rates listed. There are no unusual situations anticipated to make the construction-related activities at the proposed site more hazardous than normal, so these industry values are applicable.

Fatal and non-fatal incident rates from the trucking and warehousing industry injury rates were used for the operations activities because these activities involve receiving, transferring, storing, and shipping the SNF, which are similar to trucking and warehousing, and because these rates are among the highest reported. Table 4.12.1 presents the expected number of annual fatal and nonfatal occupational fatalities and injuries during the construction and normal operations of the proposed CIS Facility.

The estimates provided in Table 4.12.1 indicate that the non-radiological health impacts from CIS Facility construction and operation would be small.

4.12.1.2 Comparable NRC Non-Radiological Analyses

Several other environmental documents have assessed the non-radiological impacts associated with actions similar to those of the CIS Facility. The following documents were reviewed and results compared to the results presented above.

- Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County Utah, NUREG-1714 (NRC 2001).
- Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, NUREG-2157 (NRC 2014b).

NUREG-1714 addressed a very similar ISFSI activity and also concluded that the non-radiological occupational health impacts would be small. Table 4.12.2 provides a comparison of the results for the CIS Facility and from NUREG-1714. The values are in good agreement, especially considering the following differences:

- The NUREG-1714 values are based on National Safety Council data from the 2000 report while this assessment used data from the 2015 report (NRC 2001, pg. 4-43). Incident rates have generally declined over time (NSC 2015, pg. 60 and 78).
- The NUREG-1714 impacts are based a workforce of 130 construction workers (NRC 2001, pg. 4-44) and 43 operations workers (NRC 2001, pg. 4-45) while the CIS Facility estimates are based on 80 construction workers and 40 operations workers (Holtec 2016a, items 16 and 17).

The NUREG-1714 values are consistent with, and support the reasonableness of, the CIS Facility estimates for fatal and non-fatal occupational injuries during construction and operations.

NUREG-2157 (NRC 2014b, pg. 5-55) concludes that the NUREG-1714 "*results were typical for an industrial facility of this size and would also apply to a similarly sized away-from-reactor ISFSI at any location*." It also concluded that, "*the non-radiological health impacts would be SMALL*." These values support the conclusion that the CIS Facility non-radiological occupational impacts would be small.

4.12.1.3 Decontamination and Decommissioning

D&D activities are similar in nature to the construction activities in that they include the use of heavy equipment, as well as manual labor. CIS Facility D&D activities are expected to require no more personnel than the 80 people estimated for CIS Facility construction activities. However, the D&D activities would be expected to be completed within a few years whereas the construction of the multiple potential phases may occur over 20 years. Since there are no incident data available for D&D activities and construction activities are similar, this assessment uses construction estimates presented above as the estimate for D&D activities. Therefore, the non-radiological impacts for construction presented in Table 4.12.1 and Table 4.12.2 are considered applicable to D&D activities on an annual basis. Because the D&D activities would be completed in a few years,

the cumulative impact of D&D is expected to be significantly smaller than the cumulative construction impacts.

4.12.2 Radiological Impacts from Normal Operations

This section assesses the radiological impacts to the general public and CIS Facility workers from routine operation of the proposed CIS Facility. There have been no previous activities at the Site that would have led to radiological contamination, so Phase 1 construction activities do not pose a radiological risk. However, construction activities are considered during the expansion phases of the CIS Facility because the storage of SNF has potential to impact construction workers.

In evaluating the potential radiation doses to members of the public and workers, it is important to examine (1) the potential pathways of exposure and (2) the potential sources of radiation. Considering each of these two matters assures that all important issues are addressed.

The potential exposure pathways at the CIS Facility Site include: (1) direct exposure to radiation (neutrons and gamma rays) that is emitted from the storage casks, (2) exposure to radioactive material through ingestion of contaminated water or food, including plants and animals in the vicinity of the Site that may be used for subsistence, and (3) exposure to radioactive material through submersion or inhalation of airborne radionuclides. The evaluation of exposures from the first route requires consideration of the radiation source (i.e., the canister contents). Exposures from the second and third routes require that some radioactive material escape from the casks and the proposed CIS Facility. Given the CIS Facility start clean/stay clean philosophy (i.e., CIS Facility plans to reject and return canisters that have unacceptable external contamination), as well as the fact that no canisters would be opened at the proposed CIS Facility, and considering the engineered features of the canister/cask, there appears to be no viable mechanism by which significant radioactive materials would migrate off-site, or even away from the casks. Thus, while the latter two exposure routes are possible, radioactive material is unlikely to be available for ingestion or inhalation via those pathways during normal conditions, and hence, there is no opportunity for impacts from these pathways (NRC 2001, page 4-46).

For this analysis, the casks are assumed to maintain confinement of radioactive material under normal conditions. The lid of the canister is double sealed, and consists of a closure lid to shell weld (lid-to-shell) and a closure ring to shell weld (ring-to-shell). In order for a leak to the environment to occur, both the primary and secondary welds must be leaking. Because the confinement boundary is welded and the temperature and pressure of the canister are within the design limits, no discernible leakage is credible. In view of the above, direct radiation from the casks would be the only source of radiation to members of the public as a result of normal operations. Accordingly, the balance of this discussion considers the doses attributable to the first pathway (i.e., direct radiation). The storage casks would emit direct radiation in the form of gamma rays and neutrons from the SNF sealed inside the canister (NRC 2001, pg. 4-46).

All radiological estimates are based on the bounding capacity of the CIS Facility, which is 100,000 MTUs consisting of 10,000 UMAX storage units. As described in Section 2, the initial phases of the project would involve an inventory of only 500 canisters. Therefore, these analyses provide estimates that are expected to exceed the impacts for the initial phase and cover all potential future CIS Facility expansions.

For the purposes of assessing radiological impacts, consistent with NUREG-2157 (NRC 2014b, Section 4.17), impacts are considered to be "small" if releases and doses do not exceed dose standards in the NRC's regulations. This definition of small applies to occupational doses as well as to doses to individual members of the public.

4.12.2.1 Dose to the General Public

This section addresses the potential direct radiation dose to a hypothetical maximally exposed individual (MEI) located at the boundary of the proposed CIS Facility, as well as to individuals who may actually be present or reside nearby for extended periods of time were considered. The assessment is performed for operation of the CIS Facility at its maximum capacity.

Maximally Exposed Individual. As described in Chapter 2, the proposed Site for the CIS Facility is located in southeastern New Mexico in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico. The locations of key facilities within and outside the CIS Facility boundary are shown in Figures 2.2.1, 2.2.2, and 2.2.3.

The dose to the MEI, an individual located at the controlled area boundary, which is 1312 feet (400 meters) from the storage pads (Table 1.0.1 of the HI-STORE CIS Facility SAR), is below the 10CFR72.104(a) limit of 25 mrem/year whole body dose to any real individual as shown in Table 7.4.3 (HI-STORE CIS Facility SAR). This estimate is based on 2000 hours/year occupancy at this location, because there are no residences or activities located there and none are expected. The 25 mrem/year dose limit corresponds to 8.0 percent of the average natural background radiation dose (i.e., 311 mrem/year) and 4.0 percent of the average annual dose (624.8 mrem/year) in the U.S. (see Table 3.11.1).

Nearest Resident. The residence nearest to the CIS Facility is the Salt Lake Ranch located 1.5 miles north of the Site (see Section 2.2.1). Ignoring the potential shielding effects of hills or vegetation and only accounting for distance, the dose to the nearest resident (dose at the maximum distance below 1.5 miles in Table 7.4.3 with 8760 hours/year occupancy of the HI-STORE CIS Facility SAR) is less than the 10CFR72.104(a) limit of 25 mrem/year for the maximum permissible annual whole body dose to any real individual and would not result in any perceivable increase in health risk.

Population Dose. As discussed in Section 2.2.1, the area surrounding the CIS Facility has a very low population density. The nearest significant population centers are Carlsbad (32 miles away) with a population of about 27,000 people and Hobbs, New Mexico (34 miles away) with a population of about 34,000. Given the very low exposure for the hypothetical MEI and the nearest resident, the exposure and potential increase in health risk at these population centers would not be detectible.

4.12.2.2 Occupational Dose

Workers at the CIS Facility would perform tasks that include: handling (i.e., receiving, transferring, and moving) of the SNF canisters and casks; security, inspection, and maintenance activities; administration and management; and facility construction. Some of these activities involve more exposure to direct radiation (e.g., handling casks) than other activities (e.g., administration and management). It is expected that only about half of the operating staff (i.e., 20

of the 40 operations workers) would be involved in the relatively high-exposure activities such as handling activities and the other half (i.e., 20 workers) would be involved in the relatively low-exposure activities.

Operating experience from the loading of more than 800 storage systems is used here as the basis for estimating CIS Facility occupational doses. This loading experience includes welding the MPC lid and other close-proximity activities that would not be performed at the CIS Facility where MPCs are merely transferred from the cask to the UMAX storage system with no welding or similar close proximity activities. Therefore, this operating experience is expected to overstate the expected dose for CIS Facility high-exposure workers. The loading experience shows that the collective dose for a crew is around 0.2 person-rem (200 person-mrem). It takes about 1 week to load a cask, so this results in an annual crew exposure of about 10 person-rem/year (i.e., 0.2 person-rem/week x 50 week/year). Approximately 20 workers are involved in these loading and unloading activities. Therefore, the typical exposure rate for a high-exposure worker loading a cask is 500 mrem/year (10-person-rem/year ÷ 20 people) (Holtec 2017). This 500 mrem/year worker dose is used as a high estimate for the relatively high-exposure CIS Facility workers.

Half of the CIS Facility operating staff (i.e., 20 of the 40 operations staff) would be involved in relatively low-exposure activities such as management and administration where they would receive very little exposures to direct radiation. Therefore, it is reasonable to assume that the average exposure for all operating personnel would be 250 mrem/year.

The initial construction would be completed before any SNF is received at the Site, so there would be no radiological impact to those workers. However, SNF would be received and be in storage at the Site during the subsequent phases of this project. The approximately 80 construction workers would be exposed to some increased radiation. The construction workers would not be in close proximity to the stored SNF and their exposure is expected to be approximately the same as the average exposure for the operations work force, which is 250 mrem/year.

The average exposure for the construction and operations workforces is 0.25 rem/year and the exposure for the high-exposure workers is estimated to be less than 0.5 rem/year. This maximum dose of 0.5 rem/year is a factor of ten below the 5 rem/year total effective dose regulatory limit specified in 10 CFR §20.1201(a) for occupational exposure. Therefore, the radiological impact to workers is considered small.

4.12.2.3 Comparable NRC Radiological Analyses

Several other environmental documents have assessed the radiological impacts associated with actions similar to those of the CIS Facility. The following document was reviewed and its results compared to the results presented above.

- Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County Utah, NUREG-1714 (NRC 2001).
- Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, NUREG-2157 (NRC 2014b).

NUREG-1714 addressed a similar ISFSI activity and also concluded that the radiological occupational and public health impacts would be small. Table 4.12.3 provides a comparison of the results for the CIS Facility and from NUREG-1714. It should be noted that the NUREG-1714 MEI was located 2,220 feet from the above-grade storage pads for 2,000 hours per year while the CIS Facility MEI is located only 1312 feet (400 meters) from the below-grade storage pads for the entire year.

The NUREG-1714 values are reasonably consistent with and support the reasonableness of the CIS Facility estimates for radiological occupational impacts given the differences in the storage system shielding designs and the distances to the receptors. NUREG-2157 relied heavily on NUREG-1714 as its basis and concluded that the analysis:

> *"provide[s] evidence that public and occupational doses would have been maintained significantly below the dose limits established by 10 CFR Part 72 and 10 CFR Part 20. The NRC assumes that any away-from-reactor ISFSI at any site has the same spent fuel capacity and a similar physical size; therefore, doses to workers and to the public would be similar to those calculated for the PFSF. The NRC concludes that public and occupational health impacts would be SMALL*" (NRC 2014b, Section 5.17.1).

These values in Table 4.12.3 support the conclusion that the CIS Facility non-radiological occupational impacts would also be small.

4.12.3 Summary of Environmental Monitoring Program

The CIS Facility would conduct a comprehensive environmental sampling and analysis program, commonly referred to as the consolidated radiological environmental monitoring program (REMP). Routine monitoring of work areas gives an early indication of any potential environmental concerns. The REMP serves as a primary confirmation of the adequacy of the active operational controls and the passive engineering controls for preventing releases beyond the design basis for the facilities. This program also provides environmental data to demonstrate compliance with radiological effluent release standards contained in 10 CFR Part 20 Appendix B. The CIS Facility REMP encompasses procedures and planning documents addressing the types, frequency, and methodologies employed to acquire the requisite data.

The REMP will be initiated at least one year prior to CISF operations. The early initiation of the REMP will provide assurance that a sufficient environmental baseline has been established for the CISF before the arrival of the first cask shipment. The baseline will be established as follows:

- Soil samples will be collected and analyzed for the presence of radiological constituents in areas where radiological operations will occur (e.g, rail cask transfer station, rail spur, Cask Transfer Building, and the HI-STORM UMAX storage pad and the immediate surrounding area around the pad.

- Surface water samples will be collected and analyzed for the presence of radiological constituents in Laguna Gatuna and Laguna Plata.

- Groundwater samples will be collected and analyzed for the presence of radiological constituents near the Cask Transfer Building, and the HI-STORM UMAX storage pad and the immediate surrounding area around the pad.

- Vegetation will be collected and analyzed for the presence of radiological constituents in areas where radiological operations will occur (e.g, Cask Transfer Building, and the HI-STORM UMAX storage pad).

- Background radiation measurements would be taken at various locations near the Holtec site, including the Cask Transfer Building and the HI-STORM UMAX storage pad and fence line.

As part of the REMP, samples of media and effluents, including gases and vapor, air particulates, soil, sediment, fauna, vegetation, surface water, waste waters, and groundwater, are collected and analyzed. A monitoring network of thermoluminescent dosimeters (TLDs) and optically stimulated luminescence (OSL) are also used to measure ambient gamma radiation. The sampling media and sampling locations included in the REMP would provide a measure of the routine operations within and around the facility and monitor the potential impact of the facility operations on the off-site environment, including the general public. The REMP system is expected to include the following:

- Continuous radiation monitoring at boundary fence (via TLDs);
- Continuous monitoring (via TLDs) on the outside of all buildings;
- Continuous monitoring (via TLDs) at strategic work locations, as backup for personnel radiation exposure monitoring;
- Each TLD locations would have a backup (i.e. two TLDs) with quarterly retrieval and processing;
- Local radiation monitors with audible alarms to be placed in the Cask Transfer Building; and

Actual doses would be compared with estimated doses, as well as the dose limits in 10 CFR §20.1201(a), for both specific procedures and individuals. Administrative guidelines would be used to determine when corrective action should be taken to reduce doses for either specific individuals or for specific tasks.

4.12.4 Decontamination and Decommissioning

Prior to D&D activities, all canisters of SNF would be removed and transported to a permanent repository. For purposes of this ER, it is assumed that the repository would be at Yucca Mountain in Nye County, Nevada. The potential impacts of handling the SNF canisters for transfer to the repository would be expected to be similar to the occupational doses presented in Section 4.12.2.2.

D&D activities for the facility would then be limited to radiological surveys and any necessary decontamination of storage systems, storage pads, or building structures. It is not anticipated that the storage casks or pads would have residual radioactive contamination because (a) the SNF

canisters would remain sealed while in the CIS Facility, (b) the canisters would be surveyed at the originating reactor and again once they arrive at the proposed CIS Facility to ensure that there is no radiological contamination, and (c) the neutron flux levels generated by the SNF would be sufficiently low that activation of the storage casks and pads would produce negligibly small levels of radioactivity, if any.

If the contamination levels were found to be below the applicable NRC limits for unrestricted release, then the empty storage casks would be disposed of as non-controlled material. Any contaminated storage casks would be decontaminated to levels at or below applicable NRC limits for unrestricted use. The fate of these items would be identified as part of the Final Decommissioning Plan.

The radiological impacts of D&D are expected to be below the impacts associated with normal operations. Therefore, the values presented in Table 4.12.3 for relatively high-exposure workers is an upper bound on what might reasonably be expected for D&D activities. The number of workers exposed during D&D is expected to be smaller than the 40 operations workers.

Table 4.12.1:

ANNUAL FATAL AND NONFATAL OCCUPATIONAL INJURIES FOR THE CONSTRUCTION AND OPERATION OF THE PROPOSED CIS Facility

Activity	Workers	Rate[a]	Incidents/year
Fatal incidents			
Construction	80	0.000091	0.007
Operations	40	0.000119	0.005
Non-fatal incidents			
Construction	80	0.022	1.8
Operations	40	0.033	1.3

a Source: NSC 2015, pg. 57 for fatal and pg. 79 for non-fatal. The rate for fatal incidents is per 100,000 full-time equivalent workers and the rate for non-fatal incidents is per 100 full-time equivalent workers.

Table 4.12.2:

ANNUAL FATAL AND NONFATAL OCCUPATIONAL INJURIES FOR THE CONSTRUCTION AND OPERATION OF THE PROPOSED CIS Facility – COMPARED TO NUREG-1714

Activity	CIS Facility (incidents/year)	NUREG-1714 (incidents/year)[a]
Fatal incidents		
Construction	0.007	0.02
Operations	0.005	0.005
Non-fatal incidents		
Construction	1.8	4.3
Operations	1.3	1.6

a NRC 2001, Table 4.6.

Table 4.12.3: ESTIMATED ANNUAL OCCUPATIONAL AND PUBLIC RADIOLOGICAL IMPACTS FOR THE PROPOSED CIS Facility – COMPARED TO NUREG-1714		
Activity	**CIS Facility (mrem/year)**	**NUREG-1714 (mrem/year)[a]**
MEI exposure	Table 7.4.3 at 400 meters (HI-STORE CIS FACILITY SAR)	5.85
Nearest resident	Table 7.4.3 at maximum distance less than 1.5 miles (HI-STORE CIS Facility SAR)	0.0356
Relatively high-exposure workers	500	4,300

a Source: NRC 2001, pg. 4-47 and 4-48.

4.13 OFF-NORMAL OPERATIONS AND ACCIDENTS

This section is focused on the safety evaluation of all off-normal and accident events germane to the HI-STORM UMAX VVM containing a loaded canister of SNF. This section is a summary of the discussion in the HI-STORM UMAX Final Safety Analysis Report (FSAR) (Holtec 2017, Chapter 12), which provides additional details. The accidents considered in the HI-STORM UMAX FSAR follow the guidance in NUREG-1536 (NRC 2010, Chapter 11). For each postulated event, the cause, means of detection, consequences, and corrective actions, as applicable, are discussed and evaluated in the HI-STORM UMAX FSAR. As applicable, the evaluation of consequences includes the impact on the structural, thermal, shielding, criticality, confinement, and radiation protection performance of the system due to each postulated event. Chapter 6 describes proposed mitigation measures that would be in place to reduce adverse impacts that could occur during construction, routine, and non-routine operation of the CIS Facility.

4.13.1 Estimated Doses from Off-Normal Operations

Off-normal conditions, as defined in accordance with ANSI/ANS-57.9 (pg. 2-3), are those conditions which, although not occurring regularly, are expected to occur with moderate frequency or on the order of once a year. In this section, design events pertaining to off-normal operation for expected operational occurrences are considered.

The following off-normal events are applicable to the HI-STORM UMAX system and are described in greater detail in Section 12 of the HI-STORM UMAX FSAR (Holtec 2017, Section 12.1):

- Off-Normal Pressure
- Off-Normal Environmental Temperature
- Leakage of One Seal
- Partial Blockage of the Air Inlet Plenum
- Hypothetical Non-Quiescent Wind

The results of the evaluations presented herein demonstrate that the HI-STORM UMAX system can withstand the effects of off-normal events and remain in compliance with the applicable acceptance criteria. None of the off-normal events would affect the safe operation of the HI-STORM UMAX system or result in any release of radioactive material. As a result, there are no impacts from off-normal operations to CIS Facility workers or the public. Therefore, the impacts associated with off-normal events are considered small.

4.13.2 Estimated Doses from Accidents

Accidents, in accordance with ANSI/ANS-57.9, are either infrequent events that could reasonably be expected to occur during the lifetime of the HI-STORM UMAX system or events postulated because their consequences may affect the public health and safety. These design basis accident events have been evaluated in Section 12 of the HI-STORM UMAX FSAR (Holtec 2017) to

quantify the safety margins in the storage system. The following accident events are germane to the safety evaluation of HI-STORM UMAX system:

- Fire Accident
- Partial Blockage of MPC Basket Vent Holes in long- term storage
- Tornado
- Flood
- Earthquake
- 100 percent Fuel Rod Rupture
- Confinement Boundary Leakage
- Explosion
- Lightning
- 100 percent Blockage of Air Inlets
- Burial Under Debris
- Extreme Environmental Temperature
- HI-TRAC VW Transfer Cask Handling Accident

The results of the evaluations performed in the FSAR demonstrate that the HI-STORM UMAX storage system can withstand the effects of all credible and hypothetical accident conditions and natural phenomena without affecting its safety function. While none of these events would result in release of any radioactive material, some corrective action may be associated with the Design Basis Earthquake (potential reposition), 100 percent Blockage of Air Inlets (potential removal of blockage), and Burial Under Debris events (potential removal of debris). The FSAR analyses demonstrate that the requirements of 10 CFR §72.122 and of 10 CFR §72.106(b) and 10 CFR Part 20 would be met. Therefore, the impact of potential and hypothetical accidents is considered small.

4.13.3 Comparable Analyses

Several other environmental documents have assessed the radiological impacts associated with actions similar to those of the CIS Facility. The following document was reviewed and its results compared to the results presented above.

- Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County Utah, NUREG-1714 (NRC 2001).
- Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, NUREG-2157 (NRC 2014b).
- A Pilot Probabilistic Risk Assessment Of a Dry Cask Storage System At a Nuclear Power Plant, NUREG-1864 (NRC 2007)

In NUREG-1714, the NRC addressed a very similar ISFSI activity and also concluded that the radiological occupational and public health impacts would be small. In NUREG-1714, the NRC concluded: "there are no credible mechanisms (either from off-normal operations or from hypothetical accidents) that would result in the release of radioactive SNF contents, including airborne radioactive material, into the environment. The only credible exposure scenarios are associated with worker exposures to direct radiation during cleaning of the storage cask vents or replacing a cask damaged by windborne debris. Such exposures would be small and would be administratively controlled to further reduce the exposure levels; hence, the potential impacts would be small" (NRC 2001, Section 4.7.2.3).

In NUREG-2157, the NRC concluded: "these results are representative of the impacts for an away-from-reactor ISFSI at a different location. Therefore, the NRC concludes that the impacts of postulated accidents would be SMALL during the three storage timeframes" (NRC 2014b, Section 5.18).

The conclusions of NUREG-1714 and NUREG-2157 are consistent with the analyses for the CIS Facility and confirm that the impacts would be small.

The NRC also performed a probabilistic risk assessment (PRA) of a HI-STORM 100 system at a specific reactor site as a pilot project, NUREG-1864 (NRC 2007). The PRA scope included loading fuel from the spent fuel pool (an activity that is not part of the CIS Facility scope), preparing the cask for storage and transferring it outside the reactor building, moving the cask from the reactor building to the storage pad, and storing the cask for 20 years on the storage pad. The PRA considered a broad spectrum of initiating events, including hypothetical events such as meteorite strikes, Tsunamis, and volcanic activity. In NUREG-1864, the NRC concluded that the human health risk from accidents is extremely small. The results of the CIS Facility assessment are consistent with that conclusion.

4.13.4 Decontamination and Decommissioning

Because none of the off-normal or accident conditions would result in the release of radiological material, D&D activities would not result in any off-normal and accident impacts.

4.14 NO ACTION ALTERNATIVE IMPACTS

This section presents the potential impacts of the No Action Alternative. As described in Section 2.1, under the No Action Alternative, Holtec would not construct and operate the CIS Facility and SNF would continue to be stored at commercial reactor sites in accordance with current management objectives. The No Action Alternative impacts are summarized from NUREG-2157 (NRC 2014b). In that document, NRC evaluated the continued storage of SNF for: (1) a short-term period (e.g., 60 years after the end of a reactor's licensed life for operation); (2) a long-term period, which NRC defined as "an additional 100 years after the short-term timeframe for a total of 160 years after the end of a reactor's licensed life for operation"; and (3) indefinite storage. For purposes of this ER, the short-term and long-term storage impacts would best match the 120 years storage period for the proposed Holtec CIS Facility. Consequently, the impacts of short-term and long-term storage are included in the discussion below.

Land Use. Short-term continued at-reactor storage in a SNF or ISFSI would not require disturbance of any new land or result in operational or maintenance activities that would change land use. Any construction required for long-term storage would impact a small fraction of the land committed for a nuclear power plant.

Visual and Scenic Resources. No changes to the visual profile are likely to occur as a result of the continued operation and maintenance of the existing SNF pool and at-reactor ISFSI. In the long-term, periodic construction, replacement, and operation activities would not significantly alter the landscape of an ISFSI.

Geology and Soils. Impacts to soil from small spills and leaks during operation and maintenance of ISFSIs would be minor because of monitoring and environmental protection regulations. No new land would be disturbed for continued operation of SNF pools and ISFSIs. Any construction required for long-term storage would have minimal impacts to soils on the small fraction of land committed for the facilities.

Ecological Resources. Normal operations and replacement of ISFSI facilities would not significantly affect the area available for terrestrial wildlife, and would not adversely impact terrestrial environments or their associated plant and animal species.

Water Resources. Potential impacts to surface water quality and consumptive use from the continued operation of SNF pools and ISFSIs would be less than for normal plant operations. Continued storage of SNF could result in non-radiological and radiological impacts to groundwater quality. Potential consumptive-use and water quality impacts from construction and operation of an ISFSI would be less intense than assumed for initial construction of these facilities.

Meteorology, Climatology, Air Quality, and Noise. Air emission impacts from SNF activities from spent fuel pools and ISFSIs during short-term storage would be substantially smaller than air emissions during power generation. Any construction required for long-term storage would result in minor and temporary air emissions. Normal operations and replacement of ISFSI facilities would not generate significant noise.

Cultural Resources. Because no ground-disturbing activities are anticipated during the short-term storage timeframe, impacts to cultural resources associated with continued operations and maintenance would be small. If construction of a replacement of the ISFSI occurs in an area with no cultural resource present or construction occurs in a previously disturbed area that allows avoidance of cultural resources then impacts would be small. By contrast, a moderate or large impact could result if cultural resources are present at a site and, because they cannot be avoided, are impacted by ground-disturbing activities during the long-term timeframe.

Socioeconomics and Environmental Justice. A small number of workers would be required to maintain and monitor spent fuel pools and an at-reactor ISFSI, tax payments to local jurisdictions would continue, and there would be no increased demand for housing and public services. Any construction required for long-term storage would be small and there would be no increased demand for housing and public services. Minority and low-income populations are not expected to experience disproportionately high and adverse human health and environmental effects from the continued storage of SNF.

Transportation (Non-radiological). A low volume of traffic and shipping activities is expected with the continued storage of SNF in pools and at-reactor ISFSIs. There would be small workforce requirements for continued storage and aging management activities (relative to the power plant workforce).

Transportation (Radiological). A low volume of traffic and shipping activities is expected with the continued storage of SNF in pools and at-reactor ISFSIs. There would be small workforce requirements for continued storage and aging management activities (relative to the power plant workforce) and a low frequency of supply shipments and shipments of LLRW from activities, continued dry cask storage operations, and ISFSI replacement activities.

Infrastructure. Continued SNF storage is not expected to result in any additional infrastructure demands.

Waste Management. Continued at-reactor storage of SNF would generate much less LLRW, mixed, and non-radiological waste than an operating facility, and licensees would continue to implement Federal and State regulations and requirements regarding proper management and disposal of wastes. The construction and operation of an ISFSI would generate a fraction of the LLRW generated during reactor operations.

Human Health, Normal Operations (Non-radiological). Continued SNF storage is not expected to result in any additional non-radiological impacts to health. Any construction required for long-term storage would be expected to have similar non-radiological health impacts as those presented for the Holtec CIS Facility.

Human Health, Normal Operations (Radiological). Annual public and occupational doses would be maintained below the annual dose limits established by 10 CFR Part 72 for the public and 10 CFR Part 20 for occupational personnel. Licensed facilities would also be required by these regulations to maintain an as low as reasonably achievable (ALARA) program to ensure radiation doses are maintained as low as is reasonably achievable.

Off-Normal Operations and Accidents. The postulated design basis accidents include hazards from natural phenomena, such as earthquakes, floods, tornadoes, and hurricanes; hazards from activities in the nearby facilities; and fuel handling-related accidents. The environmental impacts of these postulated accidents involving continued storage of SNF are small because all important safety structures, systems, and components involved with the SNF storage are designed to withstand these design basis accidents without compromising the safety functions. The probability-weighted environmental impact of severe accidents is also small because of the low probability that such events would occur.

CHAPTER 5: CUMULATIVE IMPACTS

5.0 INTRODUCTION

Cumulative impacts are generally defined as the "impact on the environment which results from the incremental impact of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 Code of Federal Regulations [CFR] §1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Holtec based the cumulative impact analysis for this Environmental Report (ER) on the Proposed Action and other activities in the surrounding region with the potential to contribute to cumulative environmental impacts.

Based on the analysis in Chapter 4 of this ER, the cumulative impact analysis focused on the resources with the greatest potential to be meaningfully affected by potential environmental impacts resulting from the Proposed Action in combination with other sources of ongoing or potential impact. The cumulative impact analysis examined potential impacts for approximately 40 years into the future (through approximately 2060), which is the timeframe associated with the initial operating license for the Consolidated Interim Storage (CIS) Facility. Consistent with other Nuclear Regulatory Commission (NRC) documents for nuclear facility operations, Holtec examined a 50-mile radius around the proposed CIS Facility sites as the potential region of influence (ROI) for cumulative impact analysis.

5.1 CURRENT AND REASONABLY FORESEEABLE ACTIONS

In addition to the proposed action of this ER, actions that can contribute to cumulative impacts include Federal, State of New Mexico, local government, private sector, and individual projects in the regions of influence. This section identifies current and reasonably foreseeable actions to which the impacts from the CIS Facility construction and operation could contribute. Holtec categorized the current and reasonably foreseeable actions into two categories: (1) Nuclear activities; and (2) Non-nuclear activities. The analysis considers reasonably foreseeable actions that could occur during the next 40 years.

5.1.1 Nuclear Activities in the Project Area

As discussed in Section 2.4 of this ER, the general Project area contains several other nuclear projects, including Waste Isolation Pilot Plant (WIPP), the National Enrichment Facility (NEF), and the International Isotopes Incorporated Fluorine Extraction Process and Depleted Uranium De-conversion Plant (FEP/DUP). In addition, Waste Control Specialists (WCS) has proposed to construct and operate a CIS Facility in Andrews County, Texas, approximately 39 miles from Holtec's proposed CIS Facility in Lea County, New Mexico. Figure 5.1.1 shows the CIS Facility along with these other existing or proposed nuclear facilities. As shown on that figure, all of these facilities would be within 50-miles of Holtec's proposed CIS Facility. A brief description of these other nuclear facilities follows:

WIPP. Located approximately 16 miles southwest of the proposed CIS Facility, WIPP is the nation's first underground repository permitted to safely and permanently dispose of transuranic (TRU) radioactive and mixed waste generated through defense activities and programs. WIPP, which has been operational since March 1999, stores TRU in underground salt caverns approximately 2,150 feet deep. From the first receipt of waste in March 1999 through the end of 2014, 90,983 cubic meters of TRU waste has been disposed of at the WIPP facility. The environmental impacts of the WIPP are described in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE/EIS-0026-S2) (DOE 1997), as well as the *Waste Isolation Pilot Plant Annual Site Environmental Report for 2014* (DOE 2015).

NEF. Located approximately 38 miles southeast of the proposed CIS Facility, the NEF is used to enrich uranium for use in manufacturing nuclear fuel for commercial nuclear power reactors. NEF enriches uranium using a gas centrifuge process. The environmental impacts of the NEF are documented in NUREG-1790 (NRC 2005).

FEP/DUP. Located approximately 23 miles northeast of the proposed CIS Facility, the FEP/DUP will de-convert depleted uranium hexafluoride (DUF6) into fluoride products for commercial resale and uranium oxides for disposal. Construction of that facility is expected to begin before the end of 2016. The environmental impacts of the FEP/DUP are documented in NUREG-2113 (NRC 2012b).

WCS CIS Facility. In May 2016, WCS submitted a license application to the NRC to construct and operate a CIS Facility in Andrews County, Texas, approximately 39 miles east of the Holtec proposed CIS Facility. The WCS CIS Facility would be similar to the Holtec CIS Facility, but would utilize AREVA and NAC systems to store SNF at the CIS Facility. The environmental impacts of the WCS CIS Facility are documented in an ER which WCS submitted to the NRC in May 2016 (WCS 2016). In addition, the NRC is expected to prepare an EIS for the WCS CIS Facility.

5.1.2 Non-Nuclear Activity in the Project Area

As described in Section 3.1 of this ER, activities in the area are limited to oil and gas exploration and production, oil and gas related services industries, mineral extraction, livestock grazing, and agriculture. A larger transient population exists in the form of potash mine workers, oil field workers, employees of an oil field waste treatment facility, agriculture workers, and workers at an industrial landfill. The nearest population center is the village of Loving, New Mexico, 30 miles to the southwest of the proposed CIS Facility. There is a population density of less than 5 residents per square mile. There are no known significant new non-nuclear projects in the project area, and for purposes of this cumulative impact assessment, the existing non-nuclear activities are assumed to continue at current levels.

5.2 POTENTIAL CUMULATIVE IMPACTS

The analysis in Chapter 4 of this ER indicates that the Proposed Action would not cause any notable impacts for the following areas: visual and scenic resources; geology and soils; ecological resources; water resources; noise; cultural resources; socioeconomics and environmental justice; non-radiological transportation; infrastructure; and waste management. As a result, there is no

need to analyze potential cumulative impacts for these resources. The following resource areas have the potential for cumulative impacts: land resources, air quality, transportation of nuclear materials, and health and safety (normal operations). Cumulative impacts for these resources areas are presented below.

Land Use. Table 5.21.1 presents the cumulative impacts associated with land use. As shown in Table 5.2.1, approximately 1,802 acres would be disturbed and/or set-aside to support the nuclear-related activities within the ROI. In general, these lands would likely be used for grazing or other purposes if they were not utilized for these nuclear-related activities. Currently, approximately 93 percent of land in Lea County is used as range land for grazing (approximately 2.6 million acres) (NRC 2012b). Restricting activities on 1,802 acres would result in the loss of 0.07 percent of the land available for grazing and other purposes. Due to the abundance of other nearby land for grazing and other purposes, this cumulative impact would not be significant.

Air Quality. As discussed in Section 4.6.1.1, emissions from all criteria pollutants would be less than 10 TPY during construction of the CIS Facility. The primary air emissions would be fugitive dust. All of the other projects considered in this cumulative impact analysis have either been constructed, or would be constructed before the CIS Facility construction begins. Consequently, there is no potential for cumulative impacts to occur with respect to fugitive dust.

Transportation of Nuclear Materials. Table 5.2.2 presents the cumulative impacts associated with radiological transportation. As shown in Table 5.2.2, the total annual dose to the public from the transportation activities would be 676 person-rem. This cumulative impact would not be statistically significant.

Health and Safety (Normal Operations). Table 5.2.3 presents the doses to an MEI from each facility. Because the MEI dose from each facility is assumed to occur at the fence boundary for each facility, the MEI doses are not cumulative, as it would not be possible for the same MEI to reside at the fence boundary of each facility. Nonetheless, for conservative purposes, this cumulative analysis assumes that a single MEI would receive a maximum dose from each of the facilities considered in this cumulative analysis. As shown in Table 5.2.3, based on that conservative assumption, the total MEI dose would be 2.8 mrem/year. Compared to the dose that an average individual receives from natural sources (624.8 mrem/year, per Table 3.12.1), a dose of 2.8 mrem/year would be inconsequential.

Table 5.2.1:

CUMULATIVE LAND USE IMPACTS

	Land Use (acres)
Proposed Action	330
WIPP	300
NEF	200
FEP/DUP	640
WCS CIS Facility	332
Total	**1,802**

Source: DOE 2007, NRC 2005, NRC 2012b, WCS 2016.

Table 5.2.2:

CUMULATIVE TRANSPORTATION IMPACTS

	Annual Dose to Public (person-rem)
Proposed Action	172
WIPP	250
NEF	167
FEP/DUP	18[a]
WCS CIS Facility	69
Total	**676**

Source: DOE 2007, NRC 2005, NRC 2012b, WCS 2016.

a NRC 2012b estimated the maximum annual dose from radiological transportation to be 18 person-rem. For conservative purposes, this dose is assumed to be public dose.

Table 5.2.3:

CUMULATIVE RADIOLOGICAL DOSES

	MEI Dose (mrem/year)
Proposed Action	2.5
WIPP	0.24
NEF	1.3×10^{-3}
FEP/DUP	1.4×10^{-2}
WCS CIS Facility	4.3×10^{-2}
Total	**2.8**

Source: DOE 2015, NRC 2005, NRC 2012b, WCS 2016.

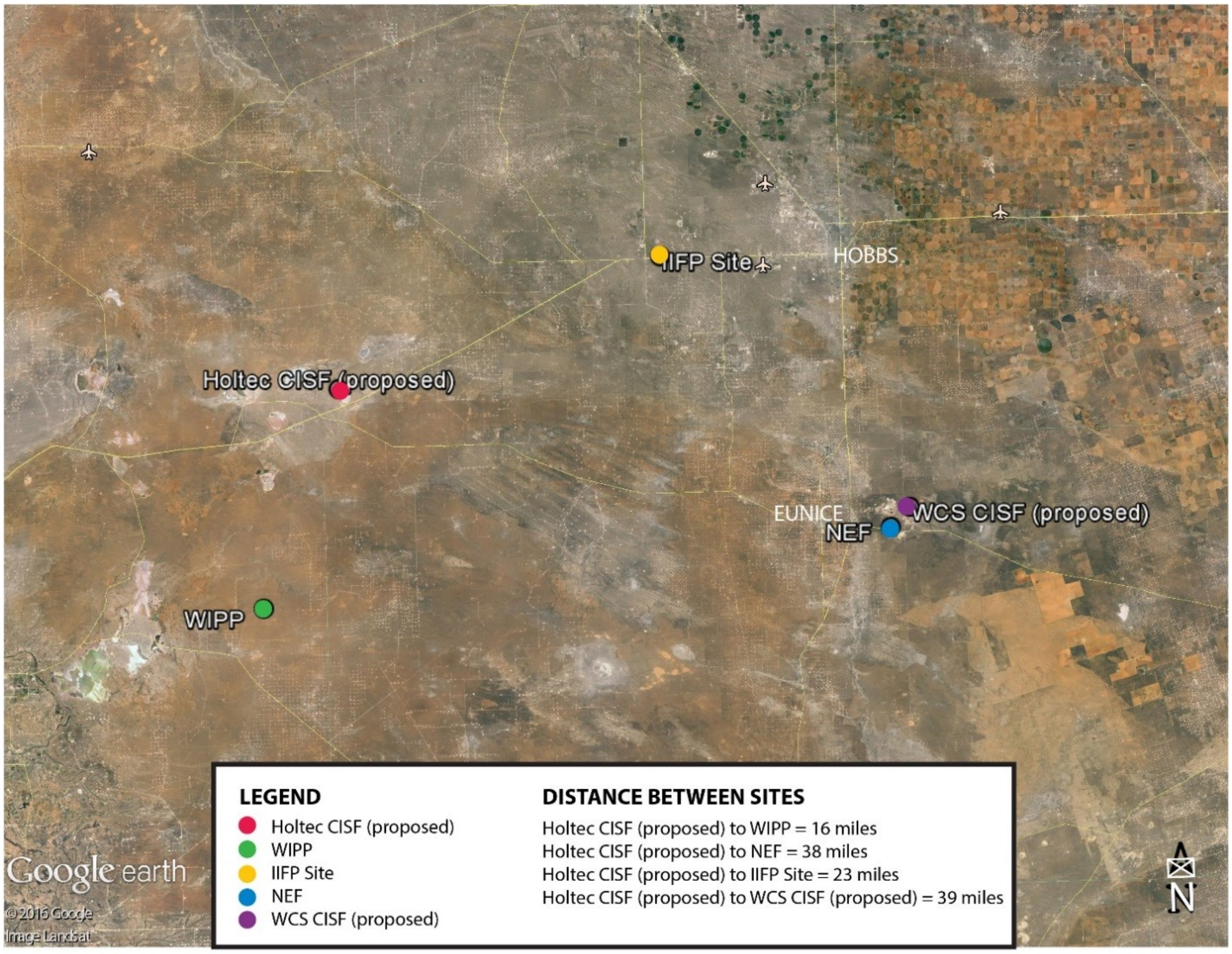


Figure 5.1.1: LOCATIONS OF FACILITIES CONSIDERED IN CUMULATIVE IMPACT ANALYSIS

CHAPTER 6: MITIGATION MEASURES

6.0 INTRODUCTION

This chapter summarizes proposed mitigation measures that could potentially be implemented to reduce adverse impacts that could occur during construction, routine, and non-routine operation of the Consolidated Interim Storage Facility (CISF). In the process of preparing this chapter, the environmental impacts that may result from the construction and operation of the CISF are summarized to put mitigation measures into context. Complete details of the potential impacts are provided in Chapter 4 of this Environmental Report (ER). Additional 'voluntary' mitigation measures are listed; however, these measures may not necessarily be implemented for the CISF.

6.1 LAND USE

Land use impacts are presented in Section 4.1. With the exception of land disturbance and the loss of grazing area, no notable land use impacts would occur. Once operational, the land use at the Site would not be inconsistent with other surrounding land uses. After construction is complete, the CISF would be stabilized with natural and low-water maintenance landscaping. Mitigation measures to minimize any anticipated impacts from the construction and operation of the CISF are as follows:

- Minimizing the construction footprint to the extent practicable.
- Protecting undisturbed areas with silt fencing and straw bales as appropriate.

6.2 VISUAL AND SCENIC RESOURCES

The potential impacts to visual and scenic resources are presented in Section 4.2. The proposed CISF construction would be visible only from fairly close vantage points and would result in an insignificant impact to visual and scenic resources. The most visible structure would be the Cask Transfer Building, which would be approximately 60 feet high.

Facilities in the Project area geared towards resources extraction (e.g., oil well pump jacks) have an equal or higher impact on the visual and scenic landscape compared to the proposed CISF facility and activities.

Mitigation measures to minimize any potential impacts to visual and scenic resources would be as follows:

- Use of accepted natural, low-water consumption landscaping techniques to limit any potential visual impacts. These techniques would incorporate, but not be limited to, the use of landscape plantings. As for aesthetically pleasing screening measures, planned landscape plantings would include indigenous vegetation.
- Prompt natural re-vegetation or covering of bare areas would be used to mitigate visual impacts due to construction activities.
- Minimization of any removal of natural barriers, screens, or buffers.

6.3 GEOLOGY AND SOILS

The potential impacts to the geology and soils are presented in Section 4.3. Impacts to geology and soils would be minimal and would be limited to soil disturbance and temporary increases in soil erosion at the CISF.

Mitigation measures to minimize any potential impact on geology and soils include:

- Mitigating erosional impacts due to site clearing and grading with construction and erosion control best management practices (BMPs) (some of which are further described below).
- Using acceptable methods to stabilize disturbed soils during construction.
- Using earthen berms, dikes, and sediment fences as necessary during all phases of construction to limit suspended solids in runoff.
- Stabilizing cleared areas not covered by structures or pavement by acceptable means as soon as practical.
- Reusing excavated materials whenever possible.

The following measures are considered voluntary:

- Stabilizing drainage culverts and ditches by lining them with rock aggregate/rip-rap or creating berms with silt fencing/straw bales to reduce flow velocity and prohibit scouring.
- Stockpiling soil generated during construction in a manner that reduces erosion, such as placing crushed stone on top of disturbed soil in areas of concentrated runoff.

6.4 ECOLOGICAL RESOURCES

The potential impacts to ecological resources are presented in Section 4.4. Based on database searches and site inventories conducted by qualified ecologists, impacts to ecological resources would be minimal and would include a loss of grazing area and open area for wildlife. There are no habitats for threatened and endangered species on the land proposed for the CISF. Mitigation measures to minimize any potential impacts on ecological resources include:

- Minimizing the construction footprint to the extent practicable.
- Managing unused open areas, including areas of native grasses and shrubs, for the benefit of wildlife (i.e. leave undisturbed).
- Using native plant and grass species (i.e., low-water consuming plants and grasses) to re-vegetate disturbed areas to enhance wildlife habitat.

The following measures are considered voluntary:

- Using animal-friendly fencing around the CISF so that wildlife cannot be injured or entangled in the CISF security fence.

- In addition to the proposed wildlife management practices above, Holtec would consider all recommendations of appropriate Federal and State agencies, including the United States Fish and Wildlife Service (USFWS) and New Mexico Department of Game and Fish.

6.5 WATER RESOURCES

The potential impacts to water resources are presented in Section 4.5. No substantial impacts are anticipated to the following:

- Surface water and groundwater quality.
- Consumptive water uses (e.g., groundwater depletion) on other water users and adverse impacts on surface-oriented water users resulting from facility activities. Site groundwater would not be utilized for any reason, and therefore, should not be impacted by routine CISF operations. The CISF water supply would be obtained from the City of Hobbs Water Department.
- Hydrological system alterations or impacts.
- Withdrawals and returns of ground and surface water.
- There are no floodplains or jurisdictional wetlands on the Site.

As discussed above, even though there is little potential to impact any groundwater or surface water resources, the following measures could be implemented:

- Maintenance of construction equipment in good repair without visible leaks of oil, greases, or hydraulic fluids.
- Use of BMPs to ensure that stormwater runoff related to these activities would not be released into nearby areas.
- Use of silt fencing and/or sediment traps.
- Control of impacts to water quality during construction through compliance with the Construction General Permit requirements and by applying BMPs as detailed in the CISF Storm Water Pollution Prevention Plan (SWPPP).
- Berming all above ground diesel storage tanks.
- Requiring control of surface water runoff for activities covered by the Construction General Permit.

6.6 METEOROLOGY, CLIMATOLOGY, AIR QUALITY, AND NOISE

The potential impacts to air quality and noise are presented in Section 4.6. Construction and operational activities would result in temporary increases in hydrocarbons, particulate matter, and fugitive dust due to vehicle emissions, concrete batch plant operations, and ground disturbance. During construction activities, best practices would be employed to reduce and control dust emissions. No substantial impacts from emissions would occur and visibility would not be impacted. Impacts to air quality would be minimal. Mitigation of the operational noise sources will occur primarily from the plant design, equipment and physical structures. The buildings

themselves will absorb the majority of the noise located within. Natural land contours, vegetation (such as scrub brush), and site buildings and structures will mitigate the impact of other equipment located outside of structures that contribute to Site noise levels

With regard to noise, there are no sensitive receptors (e.g., hospitals, churches, and schools) within 10 miles of the Site. Noise levels would increase during construction and during operation of the CISF, but not to a level that would cause significant impact to nearby residents. The nearest residence to the Site is located at the Salt Lake Ranch, 1.5 miles north of the Site.

Mitigation measures to minimize any potential impact on air quality include:

- Construction phase BMPs (such as watering) would be used to minimize fugitive dusts. Air concentrations of the Criteria Pollutants for vehicle emissions and fugitive dust would be below the National Ambient Air Quality Standards (NAAQS) and thus would not require further mitigation measures.

The following measures are considered voluntary:

- Heavy truck and earth moving equipment usage will be restricted after twilight and during early morning hours.

- Noise suppression systems on construction vehicles will be kept in proper operation.

6.7 CULTURAL RESOURCES

The potential impacts to cultural resources are presented in Section 4.6. As described in that section, the potential to impact cultural resources is considered low. To minimize any potential impact on cultural resources, accidental discovery procedures would be in place. In the event that any inadvertent discovery of human remains or other item of archeological significance is made during construction, the facility would immediately cease construction activities in the area around the discovery and notify the State Historic Preservation Officer (SHPO) to make the determination of appropriate measures to identify, evaluate, and treat these discoveries.

6.8 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The potential socioeconomic and environmental justice impacts are presented in Section 4.8. As described in that section, construction and operation of the CISF would result in direct and indirect economic benefits within the region of influence (ROI). There would be no adverse direct impacts to the nearby communities. There would be minimal demands on local social resources and infrastructure to meet housing and other social infrastructure needs, based on the anticipated increases in employment for the CISF. With regard to environmental justice, no significant disproportionate impacts to low-income or minority persons are anticipated to result from the proposed project.

Socioeconomic impacts from the project would largely be positive, and no displacements would be required by the proposed project. Therefore, no socioeconomic mitigation measures are required. Given the lack of environmental justice impacts, no environmental justice mitigation

measures are required. However, public involvement activities conducted for the CISF licensing would include wide outreach efforts to ensure full and fair participation by low-income and/or minority communities in the study area.

6.9 TRANSPORTATION

Transportation impacts are presented in Section 4.9. With respect to non-radiological transportation, no substantial impacts would occur. The increase in traffic from heavy haul vehicles and construction workers would not change traffic patterns. Once operational, the estimated steady-state work force of less than 40 personnel and the estimated steady-state security force of less than 15 personnel would not result in any notable change in traffic on United States (U.S.) Highway 62/180.

Impacts related to the transport of radioactive materials are addressed in Section 4.9. As discussed in that section, transportation activities would result in an annual dose of 172 person-rem. With regard to potential impacts from accidents, the radiological accident risks to the population would be approximately 5.9 person-rem, which is small. The larger impact would be associated with potential traffic fatalities. Statistically, 2.9 fatalities from traffic accidents would be expected over the 20-year transportation period. Because the risks are for the entire population of individuals along the transportation routes, the risk to any single individual would be small.

All mitigation measures to minimize potential impacts of transportation activities are considered voluntary, these include:

- Scheduling short-duration activities that may impact traffic (e.g., major equipment deliveries) to minimize traffic impacts, if such activities are required during the course of construction.
- Encouraging car-pooling to minimize impacts to traffic in the CISF vicinity.

6.10 INFRASTRUCTURE

The potential infrastructure impacts are presented in Section 4.10. As described in that section, construction and operation of the CISF would not notably impact infrastructure resources and the existing infrastructure providers of potable water and electricity have adequate capacity to support the CISF. Although no mitigation measures are proposed, the CISF would be designed, constructed and operated in a manner to minimize water and electricity demands.

6.11 WASTE MANAGEMENT

The potential impacts of waste generation and waste management are presented in Section 4.11. As documented in that section, the CISF would generate only minimal amounts of hazardous waste and a small amount of low-level radioactive waste (LLRW) from contamination survey rags, anti-contamination garments, and other health physics materials. With regard to non-hazardous waste, waste generated would be commensurate with typical office/personnel waste generated by the estimated steady-state work force of 40 plus 15 security personnel.

Mitigation measures can be implemented to minimize the generation and potential impact of facility wastes. Solid and liquid wastes would be controlled in accordance with regulatory limits.

These mitigation measures include:

- Prohibition against onsite disposal of waste at the CISF.
- Storage of waste in designated areas of the facility until an administrative limit is reached. When the administrative limit is reached, waste would be shipped offsite to the appropriate, licensed treatment, storage and/or disposal facility.
- Handling sanitary wastes generated during CISF construction with portable systems until such time that plant sanitary facilities are available for site use. An adequate number of these portables systems would be provided.
- Implementation of administrative procedures and practices that provide for the collection, temporary storage, processing, and disposal of categorized solid waste in accordance with regulatory requirements.
- Recycling of debris to the extent possible.

6.12 PUBLIC AND OCCUPATIONAL HEALTH-NORMAL OPERATIONS

The potential impacts to public and occupational health are presented in Section 4.12. There would be no chemical substances, airborne particulates, or gases or liquid effluents that could contribute to offsite exposures. Worker impacts were estimated to be: 0.007 fatalities annually during construction and 0.005 fatalities annually during operations. Approximately 1.8 non-fatal injuries were estimated annually during construction, and 1.3 non-fatal injuries were estimated annually during operations.

Potential impacts to the public and workers would be small. The dose to the maximally exposed individual (MEI) would be 2.5 millirem (mrem)/year. The average exposure for the construction and operations workforces would be 0.25 rem/year and the exposure for the high-exposure workers is estimated to be less than 0.5 rem/year.

Mitigation measures to minimize radiological exposure are listed below. Radiological practices and procedures are in place to ensure compliance with Holtec's Radiation Protection Program. This program is designed to achieve and maintain radiological exposure to levels that are as low as reasonably achievable (ALARA). These measures include:

- Conducting routine facility radiation surveys to characterize potential radiological exposure.
- Monitoring of all radiation workers via the use of dosimeters to ensure that radiological doses remain within regulatory limits and are ALARA.
- Monitoring radiological dose rates at the fence line boundary to measure potential exposure to any member of the general public.

6.13 OFF-NORMAL EVENTS AND ACCIDENTS

The potential impacts of accidents are presented in Section 4.13. The postulated design basis accidents include hazards from natural phenomena, such as earthquakes, floods, tornadoes, and hurricanes; and fuel handling-related accidents. The results demonstrate that the HI-STORM UMAX storage system can withstand the effects of all credible and hypothetical accident conditions and natural phenomena without affecting its safety function. There are no credible mechanisms (either from off-normal operations or from hypothetical accidents) that would result in the release of radioactive spent nuclear fuel (SNF) contents, including airborne radioactive material, into the environment. Consequently, no mitigation measures are needed.

CHAPTER 7: MONITORING

7.0 INTRODUCTION

This chapter summarizes proposed monitoring that would be in place to demonstrate that the Consolidated Interim Storage (CIS) Facility operations would be in compliance with applicable regulatory requirements.

7.1 REGULATORY BASIS FOR RADIOLOGICAL MONITORING

The Nuclear Regulatory Commission (NRC) requires, pursuant to 10 Code of Federal Regulations (CFR) 20, that licensees conduct surveys necessary to demonstrate compliance with these regulations and to demonstrate that the amount of radioactive material present in effluent from the facility has been kept as low as low as reasonably achievable (ALARA). In addition, pursuant to 10 CFR 72, the NRC requires that licensees submit annual reports specifying the quantities of the principal radionuclides released to unrestricted areas and other information needed to estimate the annual radiation dose to the public from facility operations. The NRC has also issued Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment that reiterates that concentrations of hazardous materials in effluent must be controlled and that licensees must adhere to the ALARA principal such that there is no undue risk to the public health and safety at or beyond the proposed CIS Facility boundary (NRC 2006).

Moreover, the NRC, in 10 CFR §20.1301, requires each licensee to conduct operations so that the total effective dose equivalent (TEDE) to individual members of the public from the licensed operation does not exceed 0.1 rem in a year, exclusive of the dose contributions from background radiation. The dose in any unrestricted area from external sources may not exceed 0.002 rem in any one hour.

7.2 ENVIRONMENTAL PATHWAYS

The only pathway for public exposure to radiation from routine operations at the CIS Facility is external exposure at the uncontrolled boundary from the spent fuel casks stored on the pad. There is no air pathway because the casks are sealed by being welded shut. There is no potential for a liquid pathway because the spent fuel contains no liquid component and the casks are sealed to prevent any liquids from contacting the spent fuel assemblies. There is a water pipeline in the vicinity that provides water to Hobbs, New Mexico. The CIS Facility may be connected to the pipeline; however, there is not pathway for CIS Facility operations to contaminate this water supply. Any surface contamination on the stored casks is well below regulatory limits.

Though no pathways exist for exposures due to liquid effluents, administrative investigation and action levels are established for monitoring surface water runoff as an additional step in the radiation control process. Because the surface water drainage paths are normally dry, it is not possible to monitor runoff in a continuous or batch mode basis. Even if surface water were sampled, the radionuclide levels would likely be so low as to be statistically insignificant. Instead,

quarterly soil sampling coupled with weekly/monthly radiological surveys on the casks and storage pad would be conducted.

There are no connections to municipal sewer systems. Onsite sewage would be routed to holding tanks, which are periodically pumped; the sewage would then be sent offsite for disposal in a publically owned treatment works. Each holding tank would be periodically sampled (prior to pumping) and analyzed for relevant radionuclides.

7.3 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The radiological environmental monitoring program (REMP) includes the collection of data during preoperational years in order to establish baseline radiological information that would be used in determining and evaluating potential impacts from CIS Facility operations on the local environment. The REMP would be initiated at least one year prior to CIS Facility operations. The early initiation of the REMP provides assurance that a sufficient environmental baseline has been established for the CIS Facility before the arrival of the first cask shipment. Radionuclides in environmental media would be identified using technically appropriate, accurate, and sensitive analytical instruments (e.g., liquid scintillation or gamma/alpha spectrometry). Data collected during the operational years would be statistically compared to the baseline generated by the pre-operational data. Such comparisons provide a means of assessing the magnitude of potential radiological impacts on members of the public and in demonstrating compliance with applicable radiation protection standards.

Direct radiation in offsite areas emanating from fuel stored on the dry cask storage pad or resulting from cask handling operations is expected to be minimal, see Section 4.12 of this Environmental Report (ER). However, thermoluminescent dosimeters (TLDs) or optically stimulated luminescence (OSLs) dosimeters would be placed strategically around the CIS Facility perimeter to measure these potential exposures and demonstrate regulatory compliance. Monitoring is expected to include the following:

- Continuous radiation monitoring at boundary fence (via TLDs)
- Continuous monitoring (via TLDs) on the outside of all buildings
- Continuous monitoring (via TLDs) at strategic work locations, as backup for personnel radiation exposure monitoring
- Each TLD locations will have a backup (i.e. two TLDs) with quarterly retrieval and processing
- Local radiation monitors with audible alarms to be places in canister transfer building
- Continuous airborne radioactivity monitoring of the transfer building ventilation exhaust

Detection of radionuclide impacts to surface water runoff would be conducted in a two-step process. First, all casks would be checked for surface contamination during weekly surveys and all storage pads would be checked for surface contamination during monthly surveys. Second, soil samples would be collected on a quarterly basis at the culverts leading to the CIS Facility outfalls. Monitored radioactive contaminants exceeding the action levels, as established in written

procedures, would cause an immediate investigation and would require corrective action to protect human health and prevent future recurrences.

During the course of facility operations, revisions to the REMP may be necessary and appropriate to assure reliable sampling and collection of environmental data. The rationale and actions behind such revisions to the program would be documented and reported to the NRC and other appropriate regulatory agency, as required. Sampling focuses on locations proximate to the facility, but may also include distant locations as control sites. Potential sample locations have been identified, but are subject to change based on NRC guidance, meteorological information and current land use.

7.4 COMPLIANCE WITH REGULATORY REQUIREMENTS

Compliance with 10 CFR §20.1301 is demonstrated using a calculation of the TEDE to the individual who is likely to receive the highest dose in accordance with 10 CFR 20.1302(b)(1). Appropriate models, codes, and assumptions that accurately represent the facility, the site and the surrounding area support the determination of the TEDE by pathway analysis. Compliance with 10 CFR 72.104 and 10 CFR 72.106 is demonstrated by the annual reporting required by 10 CFR 72. .44(d)(3).

Compliance is demonstrated through boundary monitoring and environmental sampling data. If a potential release should occur, then routine operational environmental data would be used to assess the extent of the release.

The offsite impact from the CIS Facility storage has been evaluated and is discussed in Section 4.12 of this ER. The conservative evaluation shows (see Section 4.12.2.1.1) that an annual dose equivalent of 2.5 mrem/year is expected at the highest impacted area at the facility perimeter fence. Because the offsite dose equivalent rate from stored casks is expected to be very low and difficult to distinguish from the variance in normal background radiation beyond the CIS Facility boundary, demonstration of compliance would rely on a system that combines direct dose equivalent measurements and computer modeling to extrapolate the measurements. The direct dose equivalent at offsite locations would be measured using TLD/OSL data from the highest impacted offsite areas.

Appropriate investigation and action levels are specified for CIS Facility surface water runoff. Data analysis methods and criteria used in evaluating and reporting environmental sample results are appropriate and would indicate when an action level is being approached in time to take corrective actions.

7.5 QUALITY ASSURANCE

The REMP is included in the facility's quality assurance (QA) program. Key parts of the program are the written procedures that ensure representative sampling; proper use of appropriate sampling methods and equipment; proper locations for sampling points; and proper handling, storage, transport, and analyses of environmental samples. In addition, written procedures ensure that sampling and measuring equipment are properly maintained and calibrated at regular intervals. Moreover, the REMP implementing procedures include functional testing and routine checks to demonstrate that monitoring and measuring instruments are in working condition. The instrument

maintenance and calibration program is tailored to the given instrumentation, in accordance with manufacturers' recommendations.

A qualified independent laboratory would analyze environmental samples. Monitoring and sampling activities, laboratory analyses, and reporting of facility-related radioactivity in the environment would be conducted in accordance with industry-accepted and the NRC approved methodologies. Monitoring procedures would employ well-known analytical methods and instrumentation.

The quality control (QC) procedures used by the laboratories performing the facility's REMP would be adequate to validate the analytical results and would conform to the guidance in Regulatory Guide 4.15 (NRC 2006). These QC procedures include the use of established standards such as those provided by the National Institute of Standards and Technology, as well as standard analytical procedures such as those established by the National Environmental Laboratory Accreditation Conference.

Holtec would ensure that any contractor laboratory used to analyze CIS Facility samples participates in third-party laboratory intercomparison programs appropriate to the media and analytes being measured. Examples of these third-party programs include but are not limited to: (1) Mixed Analyte Performance Evaluation Program; and (2) Analytics Inc., Environmental Radiochemistry Cross-Check Program. Holtec would require that all radiological and non-radiological laboratory vendors be certified by the National Environmental Laboratory Accreditation Program or an equivalent state laboratory accreditation agency for the analytes being tested.

Holtec would ensure that only individuals trained in accordance with written procedures will be permitted to calibrate analytical sampling equipment. Sampling equipment would be inspected for defects, obstructions, and cleanliness. Calibration intervals and methods would be developed based on applicable industry standards and in accordance with procedures.

The radiation monitoring program falls under the oversight of the Holtec Radiation Safety Program. Therefore, it is subject to periodic audits conducted by facility QA personnel. Written procedures would be in place to ensure the collection of representative samples; use of appropriate sampling methods and equipment; proper locations for sampling points; and proper handling, storage, transport, and analyses of environmental samples. In addition, the facility's written procedures also ensure that sampling and measuring equipment, including ancillary equipment, are properly maintained and calibrated at regular intervals, if required. Employees involved in implementation of this program will be trained in the program procedures.

7.6 REPORTING PROCEDURES

Reporting procedures would comply with the requirements of 10 CFR 72.44(d)(3) and the guidance specified in Regulatory Guide 4.16. Reports of the concentrations of any radionuclides released to unrestricted areas would be provided and would include the Minimum Detectable Concentration (MDC) for the analysis and the error for each data point.

Each year, Holtec would submit a summary report of the environmental sampling program to the NRC, including all associated data as required by 10 CFR 72.44(d)(3). The report would include

the types, numbers, and frequencies of environmental measurements and the identities and activity concentrations of facility-related nuclides found in environmental samples. The report would also include the MDC for the analyses and the error associated with each data point. Significant positive trends in activities, if any, would also be noted in the report, along with any adjustment to the program, unavailable samples, and deviation to the sampling program.

7.7 PHYSIOCHEMICAL MONITORING

Chemicals are not anticipated to be stored at the CIS Facility and therefore, no physicochemical monitoring would be required.

7.8 ECOLOGICAL MONITORING

Ecological monitoring would not be required given that threatened or endangered species would not be impacted during construction, operation, and decommissioning of the CIS Facility as discussed in Section 4.4.

CHAPTER 8: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

8.0 INTRODUCTION

This chapter discusses the: (1) unavoidable adverse environmental impacts of the Proposed Action (Section 8.1); (2) irreversible and irretrievable commitments of resources of the Proposed Action (Section 8.2); and (3) relationship between the short-term use of the environment and enhancement of long-term productivity.

8.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Section 102(2)(C)(ii) of National Environmental Policy Act (NEPA) requires that an environmental impact statement (EIS) include information about any adverse environmental effects that cannot be avoided if the proposal is implemented. Because the Nuclear Regulatory Commission (NRC) will utilize this Environmental Report (ER) to prepare a project-specific EIS for the Proposed Action, this section provides input to that EIS analysis.

8.1.1 Land Use

Phase 1 construction of the Consolidated Interim Storage (CIS) Facility would disturb approximately 119.4 acres of land. At full build-out, approximately 330 acres would be disturbed. Although construction of the CIS Facility would change the existing land use of the Site, the proposed CIS Facility would be compatible and consistent with land use activities in the area and would be compatible and consistent with the current land use designation for the Site. Once the CIS Facility reaches its end of life, land could be returned to open space uses if the buildings, access road, and rail spur were removed, areas cleaned up, and the land re-vegetated.

8.1.2 Visual and Scenic Resources

The proposed CIS Facility would be visible only from fairly close vantage points and would have no notable visual and scenic impacts compared to other activities in the area. Consequently, there would be no adverse environmental impacts to visual and scenic resources.

8.1.3 Geology and Soils

Disturbing the existing soil profile and using aggregate in construction would be unavoidable adverse impacts of the Proposed Action. However, only a very small amount of soil would be permanently lost in Project construction, and aggregate materials could be recovered after decommissioning. Economic mineral resources located beneath the CIS Facility would be unavailable for exploitation during the life of the project.

8.1.4 Ecological Resources

The CIS Facility would eventually require the commitment of approximately 330 acres for the assumed 120 year life of the facility. The loss of wildlife habitat in these areas would be unavoidable. Currently, this land is sparsely vegetated and supports a low amount of wildlife.

Small areas of animal habitat would be unavoidably lost in the disturbed areas during construction activities. It is likely that individual animals of less mobile species would be lost during construction. The impacts to vegetation and wildlife are expected to be small, especially considering the other available land areas in southeastern New Mexico that are comparable to the potentially affected area.

8.1.5 Water Resources

Unavoidable impacts to surface water are not a concern since there are no surface waters near the facility; however, there may be increased stormwater runoff from the CIS Facility due to the presence of impervious surfaces (e.g., buildings, asphalt, concrete, etc.). Such runoff would be directed to natural drainage networks and controlled under the appropriate permits. No unavoidable adverse impacts on groundwater are expected.

8.1.6 Meteorology, Climatology, Air Quality, and Noise

Unavoidable impacts to air quality from construction and operation of the CIS Facility would be associated with earth-moving activities that create airborne dust. Through the use of adequate control measures, such as treating disturbed areas with dust suppressants, the potential impacts to air quality due to suspended particulate matter would be minimal, although not unavoidable. Increased noise will accompany construction and operation of the CIS Facility; however, the increased noise levels will not create adverse impacts given the lack of noise receptors around the facility.

8.1.7 Historic and Cultural Resources

Based on available data, construction and operation of the CIS Facility would have no adverse impacts on historic properties. In the unlikely event that buried cultural resource sites or artifacts are encountered during construction activities, the significance and potential for adverse impacts would be evaluated at that time.

8.1.8 Socioeconomics and Environmental Justice

Socioeconomic impacts from the project would be positive. With regard to environmental justice, no significant disproportionate impacts to low-income or minority persons are anticipated to result from the proposed project.

8.1.9 Transportation

The increase in traffic from heavy haul vehicles and workers would not significantly change traffic patterns or traffic on area roads. Transportation of spent nuclear fuel (SNF) would have minimal adverse impacts.

8.1.10 Infrastructure

The construction and operation of the CIS Facility would include the consumption of fossil fuels used to generate electricity. Energy would also be expended in the form of diesel fuel, gasoline, and oil for construction equipment and transportation vehicles. Water would also be required during construction and operation. The amounts of unavoidable energy and water required to construct and operate the CIS Facility would be minimal.

8.1.11 Wastes

Operations at the CIS Facility would generate a variety of wastes (including potentially radioactive, hazardous, and sanitary) as an unavoidable impact of normal operations. Although Holtec would use pollution prevention and waste avoidance measures, and would dispose of wastes in accordance with all applicable requirements, generation of wastes would result in an adverse impact.

8.1.12 Human Health

Impacts of radiation doses from the SNF transportation and storage at the CIS Facility cannot be avoided. However, the radiation doses that would occur would be well below regulatory limits and would represent a small fraction of the existing background levels of radiation. Thus, the radiological health risk is considered to be small.

8.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Section 102(2)(C)(v) of NEPA requires that an EIS include information about irreversible and irretrievable commitments of resources that would occur if the proposed actions were implemented. The NRC guidance in United States NRC Regulation (NUREG)−1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs, defines an irreversible commitment as the commitment of environmental resources that cannot be restored (NRC 2003, Section 5.8). In addition, an irretrievable commitment refers to the commitment of material resources that once used cannot be recycled or restored for other uses by practical means.

For an away-from-reactor Independent Spent Fuel Storage Installation (ISFSI), the NRC concluded in its Generic EIS that there would be no irreversible and irretrievable commitments of resources during continued storage for most resources (NRC 2014b, Chapter 8). For the CIS Facility, land and visual resources allocated for SNF storage would be committed for up to 120 years as continued operations would preempt other productive land uses and permanently affect the viewshed. Waste management activities involving waste treatment, storage, and disposal would result in the irreversible commitment of capacity for waste disposal. Transportation activities would involve the irreversible and irretrievable commitment of resources, including vehicle fuel for commuting workers and shipping activities.

The irretrievable commitment of resources during construction and operation of the CIS Facility would include the consumption of fossil fuels used to generate electricity. Energy would also be expended in the form of diesel fuel, gasoline, and oil for construction equipment and transportation vehicles. Water would also be required during construction and operation. The amounts of irretrievable energy and water required to construct and operate the CIS Facility would be minimal.

The irreversible and irretrievable commitment of material resources during the entire lifecycle of the CIS Facility includes construction materials that cannot be recovered or recycled, materials that are rendered radioactive but cannot be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Construction and operational materials required include wood, concrete, sand, gravel, plastics, steel, aluminum, and other metals. At this time, no unusual material

requirements have been identified either as to type or quantity. The resources, except for those that can be recovered and recycled with present technology, would be irretrievably lost. However, none of these identified construction resources is in short supply and all are readily available in the vicinity of the locations being considered for the CIS Facility.

8.3 SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Section 102(2)(C)(iv) of NEPA requires that an EIS include information about the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. The NRC guidance in NUREG−1748 further clarifies that short-term represents the period from start of construction to end of the Proposed Action, including prompt decommissioning, and long-term represents the period extending beyond the end of the Proposed Action (NRC 2003, Section 5.8).

The proposed initial operating period for the CIS Facility is 40 years with possible license extensions of 80 years for an extended operating lifetime of 120 years. Assuming the facility is closed and decommissioned at the end of the 120-year license period, the impacts from the facility would be short-term (i.e., no more than approximately 120 years). Impacts during the short-term would be limited to the impacts presented in Section 8.1. Long-term impacts could result if the CIS Facility lifetime were extended indefinitely or if the facility were not decommissioned at the end of its life as is planned.

The proposed CIS Facility would occupy land that is presently undeveloped rangeland. A limited amount of grazing currently occurs on this land and there are potential mineral and hydrocarbon resources that could be extracted. The use of this land for the proposed Project would reduce the amount of such land available, but the reduction would not be a significant amount. The proposed CIS Facility would replace this land with an industrial development which has its own infrastructure. The addition of such infrastructure to the area would increase the productivity and usefulness of the land above its current use and could potentially increase the opportunities for further economic development in the area.

In NUREG-2157, NRC examined the relationship of short-term uses and long-term productivity and concluded that the maximum impact on long-term productivity of the land occupied by an ISFSI would result if the CIS Facility is not dismantled after the short-term storage period ends (NRC 2014b, Section 8.4). Under such a scenario, the loss of productivity in the location would be indefinite and other productive uses of the site would be foregone. Long-term productivity of those lands needed for waste disposal would also be impacted.

Once storage ends and decontamination and decommissioning (D&D) is complete, the NRC license may be terminated and the site would be available for other uses. Other potential long-term impacts on productivity would include the commitment of land and consumption of disposal capacity necessary to meet waste disposal needs. This commitment of land for disposal would remove land from other productive use. A small contribution to greenhouse gas emissions would add to the atmospheric burden of emissions that could contribute to potential long-term impacts.

Impacts to long-term productivity can be eliminated under the short-term storage scenario once the ISFSI operations cease and the associated facilities undergo D&D. Though greenhouse gas emissions of the CIS Facility proposal would be very small, those emissions could contribute to long-term impacts associated with climate change (NRC 2014b, Section 8.4).

CHAPTER 9: COST BENEFIT ANALYSIS

9.0 INTRODUCTION

The successful construction and operation of the Holtec Consolidated Interim Storage (CIS) Facility has the potential to greatly reduce United States (U.S.) government expenditures for the storage and management of spent nuclear fuel (SNF) prior to the development of a permanent disposal site. The Nuclear Waste Policy Act of 1982 (NWPA) obligated the Federal government to dispose of SNF from the nation's nuclear power plants and created a "polluter pays" funding mechanism to ensure that the full costs of disposing of commercial SNF would be paid by utilities (and their ratepayers), with no impact on taxpayers or the Federal budget. Nuclear utilities are assessed a fee on every kilowatt-hour of nuclear-generated electricity as a quid pro quo payment in exchange for the Federal government's contractual commitment to begin accepting commercial spent fuel by January 31, 1998. Fee revenues go to the government's Nuclear Waste Fund (NWF), which was established for the sole purpose of covering the cost of disposing of civilian nuclear waste and ensuring that the waste program would not have to compete with other funding priorities.

The NWPA also authorized the Department of Energy (DOE) to enter into Standard Contracts with commercial reactor licensees for the disposal of SNF. During the 1980s, DOE entered into 76 such contracts. Beginning in 1983, monies were collected from electricity consumers, as part of their monthly bill, and deposited into the NWF. The fee has generated approximately $750 million in annual revenues.

The NWPA also created a process for establishing a permanent, underground repository by the mid-1990s. Congress assigned responsibility to the DOE to site, construct, operate, and close a repository for the disposal of SNF. In December 1987, Congress amended the NWPA to designate Yucca Mountain, Nevada as the permanent repository site for the nation's nuclear waste. In 2010, the Obama Administration stopped the Yucca Mountain license review and empaneled a study commission to recommend a new policy for the long-term management of SNF and high-level radioactive waste. In January 2012, the Blue Ribbon Commission on America's Nuclear Future published its final recommendations to the Secretary of Energy (DOE 2012). In January 2013, the DOE issued its used fuel management strategy to implement the Blue Ribbon Commission's recommendations (DOE 2013).

As a consequence of Federal actions (and inaction), there is presently no licensed disposal site for tens of thousands of metric tons of SNF, no proposed alternate site to Yucca Mountain, and a continued obligation for the disposal of SNF by the Federal government. The unfulfilled Federal obligation to dispose of SNF has become an increasingly expensive liability for nuclear power plant operators. Because there is not, nor has there ever been, an operational disposal site for SNF, operators of nuclear plants have had to retain, store, and manage SNF on-site.

As the expense of ongoing storage of SNF has compounded for nuclear power plant operators, it has become common practice for them to either file lawsuits against the Federal government or to negotiate for reimbursement of their storage costs. The reimbursements come from the U.S. Department of Treasury's Judgment Fund, which is used to pay for judgments against the U.S. The Judgment Fund is permanent, has an indefinite appropriation, and is exempt from annual

congressional approval. The payments are made to the plant operators because of the DOE's partial breach of contract, stemming from its failure to take possession of SNF (starting January 31, 1998), as required by the NWPA and the Standard Contract it signed with utilities.

On November 19, 2013, a Federal court ruled that the DOE must stop collecting fees for SNF disposal until it again complies with the NWPA (as it is currently written) or until Congress enacts an alternate waste management plan (National Association of Regulatory Utility Commissioners v. United States Department of Energy 2013). Substantial concerns also exist regarding the future of the NWF, given the entanglement of budget rules and reimbursement issues facing the fund.

According to an article in The National Law Journal, in 2015 alone, the Federal government paid approximately $650 million to utility companies for expenses related to storing SNF. The same article estimates that the total expenditure over the past five years has been $4 billion (Greene 2016). Similarly, the Congressional Budget Office (CBO) reported in their December 2015 testimony before the U.S. House Subcommittee on Environment and the Economy (part of the Committee on Energy and Commerce), that $4.3 billion in damages have been paid out of the taxpayer-funded U.S. Judgment Fund to date, and that remaining liabilities will total $23.7 billion, even if legislation and sufficient appropriations are enacted that will enable the DOE to begin accepting waste within the next 10 years (CBO 2015). Further delays in implementing an interim storage site beyond 2025 will increase this liability, which will ultimately be borne by the nation's taxpayers.

A recent CBO estimate of the Federal government's liability for the SNF disposal costs was $23.7 billion assuming "legislation and sufficient appropriations are enacted that will allow the government to begin to accept waste within the next 10 years" (CBO 2015, page 1). This figure was an increase from a 2006 estimate of $6.9 billion, which assumed that the permanent storage of SNF would be complete in 2055 (Government Accountability Office [GAO] 2014). As of the end of fiscal year 2015, the NWF was credited with a total of $41.9 billion, which includes $21.6 billion in fees paid by the nuclear industry as well as $20.3 billion from intra-governmental transfers of interest credit. Expenditures from the fund totaled about $7.6 billion, mostly for work on the Yucca Mountain facility, leaving the 2015 balance at $34.3 billion.

9.1 SCOPE OF THIS COST-BENEFIT ANALYSIS

In accordance with NUREG-1748, Section 6.7 (NRC 2003), this cost-benefit analysis includes the following items:

- Qualitative discussion of environmental degradation (including air, water, soil, biotic, as well as socioeconomic factors such as noise, traffic congestion, overuse of public works and facilities, and land access restrictions): addressed in Chapter 4 of this ER;
- Decreased public health and safety: addressed in Chapter 4 of this ER;
- Capital costs of the proposed action and alternatives, including land and facilities: addressed in Section 9.2 of this chapter;
- Operating and maintenance costs: addressed in Section 9.2 of this chapter;

- Post-operation restoration: environmental impacts addressed in Chapter 4 of this ER, with costs addressed in Section 9.2 of this chapter;
- Post-operation monitoring requirements: addressed in Chapter 7 of this ER;
- Other costs of the alternative (e.g., lost tax revenue, decreased recreational value, degradations in transportation corridors, as appropriate): addressed in Section 9.2 of this chapter;
- Qualitative discussion of the environmental benefits: addressed in Chapter 4 of this ER;
- Increased public health and safety: addressed in Chapter 4 of this ER;
- Capital benefits of the alternative: addressed in Section 9.2 of this chapter;
- Tax revenues received by local, State, and Federal governments: addressed in Section 9.2 of this chapter;
- Incremental increases in regional productivity: addressed in Section 9.2 of this chapter;
- Enhancement of recreational values: addressed in Chapter 4 of this ER;
- Creation and improvement of transportation corridors and facilities: addressed in Chapter 4 of this ER; and
- Other benefits: addressed throughout this ER.

The results of the cost-benefit analysis presented in Section 9.2 considers only quantifiable benefits and costs and is based on the storage of SNF at the proposed CIS Facility for two scenarios: (1) Phase 1 (5,000 metric tons of SNF), and (2) Phases 1-20 (full implementation: 100,000 metric tons of SNF) over an initial 40-year license.[1] "Benefits" are estimated as the costs to society that can be avoided by use of the proposed CIS Facility. These "avoided costs" are estimated by subtracting the costs of storing SNF at the proposed CIS Facility from the costs of continuing to store SNF at reactor sites until it can be sent to a permanent repository (i.e., the costs associated with the No-Action Alternative). The cost-benefit analysis does not address penalties that could arise as a result of contractual breaches.

There are approximately 100 commercial nuclear power reactors operating in the United States today; together they supply approximately 20 percent of the nation's electricity needs. Given that each reactor uses about 20 metric tons of uranium fuel per year, the industry as a whole generates approximately 2,000 metric tons of SNF on an annual basis (NRC 2014b, Section 2.1.2). At present, nearly all of the nation's existing inventory of SNF is being stored at the reactor sites where it was generated— about three-quarters of it in shielded concrete pools and the remainder in dry casks aboveground. As of the end of 2011, the amount of commercial SNF in storage at commercial nuclear power plants was approximately 68,000 metric tons (NRC 2014b, Section 2.1.2). Based on an annual generation rate of 2,000 metric tons of SNF, the inventory at the end of 2016 is estimated to be approximately 78,000 metric tons of SNF. This inventory includes

[1] Given that the earliest estimated time by which a permanent geologic repository could be licensed and operational is 2048 (DOE 2013, pg. 7), an analysis of SNF storage for a nominal 40 year period (i.e., 2022-2062) provides ample time by which a permanent geologic repository could be operational.

approximately 3,000 metric tons of SNF in storage at commercial reactors that have been shut down and are no longer operating (DOE 2012).

With regard to shutdown commercial nuclear power plant sites in the U.S., the SNF is often referred to as “stranded SNF” and is stored on site. Direct cost considerations alone provide a compelling reason to move stranded SNF as quickly as possible to a consolidated storage facility like the CIS Facility. This is because the cost attributable to storing SNF at plant sites increases dramatically once the reactor is shut down. Because the cost of loading SNF into dry storage casks has generally already been incurred at this point, continued storage involves little activity other than site security and monitoring. At an operating nuclear plant, security is already in place and only incremental effort is required to include the independent spent fuel storage installation (ISFSI) within the plant’s security umbrella. The same is true for the personnel needed to monitor the status of the fuel and perform any routine maintenance. When the rest of the site is shut down, however, these structures, systems, equipment and people are still needed to tend the SNF, and the cost is substantial (DOE 2012). For purposes of this cost-benefit analysis, Holtec has assumed that the CIS Facility would prioritize the storage of stranded SNF as part of Phase 1 operations.

The detailed basis for Holtec’s cost assumptions and calculations is described in Holtec’s Cost-Benefit Analysis Data Call (Holtec 2017a). Holtec has calculated net benefits by finding the cost avoided by the U.S./reactor licensees due to operation of the proposed CIS Facility, and then subtracting the costs of building and operating the proposed CIS Facility. The cost of the No-Action Alternative (i.e., the case in which the proposed CIS Facility is not constructed) is calculated in order to establish the baseline cost without the availability of the proposed CIS Facility. This cost is then compared to the total costs assuming that the proposed CIS Facility would be available. The calculation for determining the net benefits of the proposed CIS Facility is to subtract the cost of the proposed CIS Facility from the cost of the No-Action Alternative for both Phase 1 and Phases 1-20 (full implementation).

The cost-benefit analysis assumes that SNF is shipped to the CISF starting in 2023, with 500 canisters shipped annually until 2042. The analysis also assumes that transportation of fuel from the CISF to a final repository would begin in 2060, and then construction of three new reactor site ISFSIs would occur in 2022.

Discounting. Costs (and benefits) were determined and “discounted” to a present value to be comparable at a single point in time. Discounting reduces future values in order to reflect the time value of money. This means that benefits and costs have more value if they are experienced sooner. The higher the discount rate, the lower the corresponding present value of future cash flows. The discount rate is an extremely important variable in this analysis because the proposed CIS Facility represents a near-term investment that reduces future costs.

Holtec has calculated the present values using two rates: (1) a 7 percent discount rate, which is mandated by OMB Circular A-94 (OMB 2015, page 9) for public investment and regulatory analyses (note: the OMB rate is intended to approximate the marginal pre-tax rate of return on an average investment in the private sector in recent years); and (2) a 3 percent discount rate, consistent with the cost-benefit analysis provided in NUREG-2157 (NRC 2014b, page 7-2). Both of these rates (i.e., 7 percent and 3 percent) are used to calculate the present value of costs and benefits for Phase 1 and Phases 1-20 (full implementation).

9.2 RESULTS

9.2.1 No-Action Alternative Costs

Under the No-Action Alternative, storage of SNF would continue as provided in current NRC licenses issued to reactor operators. Key assumptions regarding the No-Action Alternative are as follows:

- Commercial SNF will be stored at ISFSIs at reactor sites, which includes operating reactor sites and decommissioned shutdown sites through 2060. A repository is assumed to be available for SNF disposal by at least 2060.[2]
- As of October 2016, all but three reactor sites had existing ISFSIs or planned to build an ISFSI (NRC 2017). The analysis assumes that the three reactor sites without an ISFSI will construct an ISFSI in order to maintain a desired capacity in their storage pools. These ISFSIs could cost about $30 million each, but this cost would vary widely by site (GAO 2014, page 30).
- For every year after 2020 that DOE fails to take custody of the SNF in accordance with its contracts with the reactor operators, DOE estimates that the government will continue to accumulate up to $500 million per year beyond the estimated $12 billion in liabilities that will have accrued up to that point; however, the outcome of pending litigation could substantially affect the government's total liability (GAO 2014, page 37).

Based on these assumptions, Holtec developed cost data for the No-Action Alternative, as described below.

Shutdown Sites: Operation and maintenance costs for SNF storage at shutdown sites (which currently accounts for approximately 3,000 metric tons of SNF) range from $4.5 million to $8 million per year, compared to an incremental $1 million per year or less when the reactor is still in operation (BRC 2012, Section 5.2.1). For the shutdown sites identified in Table 2.1.1 of this ER, the cumulative operation and maintenance costs for SNF storage would range from $54 million to $96 million per year at today's costs, based upon the above values. Using the mid-point of this estimate, this cost-benefit assumes that the cumulative operation and maintenance costs for storing the stranded SNF (3,000 metric tons) would be $75 million per year at today's costs.

Operating Sites: The operation and maintenance costs for SNF storage at each of the operating reactor sites (which currently accounts for approximately 75,000 metric tons of SNF) is approximately $1 million per year or less (BRC 2012, Section 5.2.1). For the current operating reactor sites, the cumulative operation and maintenance costs for SNF storage is approximately $60 million per year at today's costs.

Future SNF Storage: As commercial reactor operations continue, SNF would continue to be generated. Assuming such generation continues at the current rate of 2,000 metric tons per year (NRC 2014b, Section 2.1.2), approximately 22,000 additional metric tons of SNF would be

[2] The earliest estimated time by which a permanent geologic repository could be licensed and operational is 2048 (DOE 2013, page 7). As such, the 2060 date is considered to be achievable.

accumulated by 2027, bringing the total SNF requiring storage to 100,000 metric tons.3 As of June 2014, there were operational ISFSIs at all but three reactor sites across the U.S. and nearly all reactor sites operate an ISFSI or have plans to construct an ISFSI (see Appendix G of NUREG-2157; NRC 2014b, and NRC 2017). Consequently, this cost-benefit analysis assumes that existing and future ISFSIs would be capable of storing the additional 22,000 metric tons of SNF that would be generated by approximately 2027. Moreover, per the analysis in NUREG-2157 (NRC 2014b, page 2-17), construction of a replacement at-reactor ISFSI is considered to be "a continued storage activity in the long-term and indefinite timeframes," both of which would occur beyond the planning basis of this ER.

Reactor Operations: It is not reasonable to assume that all of the existing reactors would continue to operate for the next 40 years, as many of these reactors would be expected to reach their end-of-life, even with license extensions.4 Although it is unknown whether the SNF at these sites would become stranded, this cost-benefit analysis provides a bounding range: (1) Scenario 1-- all SNF becomes stranded by 2040, at which time the annual operation and maintenance costs for SNF storage would rise from $60 million to approximately $375 million at today's costs; and (2) Scenario 2-- no additional SNF becomes stranded, and annual operation and maintenance costs for SNF storage would remain at $60 million at today's costs. In addition to analyzing Scenarios 1 and 2, this cost-benefit analysis also considers a third scenario, which is based on DOE's estimate that the Federal government's future liabilities related to SNF will average up to $500 million per year (GAO 2014, Page 37).

Based on the discussion above, the total annual costs for storing SNF under the No-Action Alternative would be as shown in Table 9.2.1 (Scenario 1), Table 9.2.2 (Scenario 2), and Table 9.2.3 (Scenario 3). Given these scenarios, the costs associated with the No-Action Alternative for the storage of 5,000 metric tons of SNF are estimated as follows:

- Non-discounted cost: $3.2 billion
- Discounted cost (3%): $1.9 billion
- Discounted cost (7%): $1.1 billion

The range of costs associated with the No-Action Alternative for the storage of 100,000 metric tons of SNF are estimated as follows:

- Non-discounted cost: $8.1 billion - $22.6 billion
- Discounted cost (3%): $5.8 billion - $14.2 billion
- Discounted cost (7%): $4.5 billion - $9.3 billion

9.2.2 Proposed Action Costs

Holtec developed cost data for both construction and operation of the CIS Facility for both Phase 1 and Phases 1-20 (full implementation). This information is presented in Tables 9.2.4 and 9.2.5.

3 The cost-benefit analysis analyzes the storage of 100,000 tons of SNF for full implementation of the CIS Facility.
4 Per Table G-1 of NUREG-2157 (NRC 2014b), most of the existing reactors in the U.S. began operations in the 1970s and 1980s. Many of these reactor sites could cease operations by 2040 and any SNF at those sites could become "stranded".

The labor and operation values illustrated in these tables are based off scaled costs at currently decommissioned nuclear power plants, which can be found in Appendix G of this report. Table 9.2.6 includes the total project costs (construction plus operations and maintenance) for both Phase 1 and Phases 1-20, including discounted costs.

9.2.3 Discussion of Results

Under either Phase 1 or Phases 1-20 (full implementation), Holtec has determined that the Proposed Action would result in substantial net benefits compared to costs. Under Phase 1, the non-discounted total costs of the Proposed Action would be $1.575 billion versus a No-Action Alternative cost of $3.2 billion, which results in a net benefit of $1.625 billion over 40 years. When discounting is applied, the net benefit is $2.086 billion (for a 3 percent discount), and $2.3527 billion (for a 7 percent discount).

If full implementation occurs, the non-discounted total costs of the Proposed Action would be $8.4 billion versus a No-Action Alternative cost range of $8.1 billion to $22.6 billion, which results in a net benefit of -$0.3 billion to $14.2 billion over 40 years. When discounting is applied, the net benefit is $0.6 billion to $15.1 billion (for a 3 percent discount), and $1.3 billion to $15.8 billion (for a 7 percent discount).

These results are based on uncertainties regarding both assumptions and data estimates. For example, the analysis assumes that a permanent repository is available in 2060, thereby reducing the quantity and duration of SNF at stranded sites. If a permanent repository is delayed beyond 2060, or opens sooner, the benefits of the Proposed Action could increase or decrease accordingly.

9.2.4 Tax Revenues

Construction and operation of the CIS Facility will generate tax revenues on three levels: (1) local, through real estate taxes and sales taxes; (2) state, through personal income taxes and New Mexico Gross Receipts Tax; and (3) national, through personal income taxes.

During construction, approximately 80 workers would be employed annually over the 20-year construction period for full build-out of the CIS Facility. The mean annual salary for a construction worker in New Mexico is $28,320 and the mean annual salary for a construction manager is $86,970 (BLS 2016b). One year of construction activities would generate a total increase in income from direct jobs of about $4 million and approximately $409,000 in personal income tax and New Mexico Gross Receipts Tax. In addition, construction activities could result in beneficial impacts from increased local revenue from commercial activities and sales taxes. Nationally, a total increase in income from direct jobs of about $4 million would generate approximately $600,000 in personal income tax based on a nominal 15 percent effective tax rate.

During operations, approximately 40 personnel and 15 security force personnel would be employed at the CIS Facility. The mean annual salary for engineering operations in New Mexico is $85,730 and the mean annual salary for security guards is $29,880 (BLS 2016b). One year of operation activities would generate a total increase in income from direct jobs of nearly $3.9 million and approximately $411,000 in personal income tax and New Mexico Gross Receipts Tax would be recognized. In addition, operation activities could result in beneficial impacts from increased local revenue from commercial activities, and sales taxes. Nationally, a total increase in

income from direct jobs of about $3.9 million would generate approximately $585,000 in personal income tax based on a nominal 15 percent effective tax rate.

Real estate taxes on the CIS Facility would be determined based on the assessed value of the property, but at this time it would be premature to speculate as to that value.

The No-Action Alternative also generates tax revenues on the same three levels as the CIS Facility. However, site-specific data does not exist to permit quantifiable estimates of these tax revenues. Nonetheless, given the much higher costs of operating multiple ISFSIs at multiple reactor sites, it is clear that tax revenues for the No-Action Alternative are much greater than for the CIS Facility.

9.2.5 Other Costs

The CIS Facility would not result in any lost tax revenue, decreased recreational value, degradations in transportation corridors, or incremental increases in regional productivity.

9.2.6 Comparison with Other Analyses

NRC published an analysis of the benefit and cost of a similar ISFSI at Skull Valley (NRC 2001). There are many differences between the Skull Valley ISFSI and the CIS Facility, so a direct comparison is not possible. For example, the Skull Valley ISFSI was evaluated for a capacity of 21,000 metric tons and 38,000 metric tons of SNF, while the proposed Holtec CIS Facility is evaluated for capacities of 5,000 metric tons and 100,000 metric tons. The Skull Valley EIS included a repository opening of 2015 while the analysis in this ER assumes a repository opening in 2060. Also, the Skull Valley EIS was performed in 2001 and costs may be different as a result of inflation. While a direct comparison is not valid, the general conclusions of the Skull Valley EIS do provide insights into the validity of the conclusions presented here.

NUREG-1714 (NRC 2001, Table 8.2) reports a net benefit of $255 million for a 21,000 metric ton facility and a $921 million net benefit for a 38,000 metric ton facility with a repository opening date of 2015, both based on a 7% discount rate. This corresponds to a $600 million benefit for a 5,000 metric ton CIS Facility and -$2.0 billion to $2.8 billion benefit for a 100,000 metric ton CIS Facility, also both based on a 7% discount rate.

Table 9.2.1:

NO-ACTION ALTERNATIVE COSTS – SCENARIO 1

	Phase 1 Quantity (5,000 metric tons)	**Phase 1-20 Quantity (100,000 metric tons)**
	Stranded SNF (3,000 metric tons) + Non-stranded SNF (2,000 metric tons)	**Stranded SNF (3,000 metric tons initially; assumed to be 100,000 metric tons by 2040) + Non-stranded SNF (97,000 metric tons initially; assumed to be 0 metric tons by 2040)**
Annual Storage	$77 million	$135 million from 2020-2040 $375 million from 2041-2060
New ISFSI Construction	$0 (None required)	$90 million (3 new ISFSIs)
SNF Transportation[1]	$130 million	$2.6 billion
Non-discounted Cumulative Costs	$3.2 billion	$12.9 billion
Discounted Costs (3%)	$1.9 billion	$10.3 billion
Discounted Costs (7%)	$1.1 billion	$8.0 billion

Note 1: Transportation of SNF to an eventual repository; costs based on estimate of $26,000 per metric ton of SNF transported (see GAO 2014).

Table 9.2.2:

NO-ACTION ALTERNATIVE COSTS – SCENARIO 2

	Phase 1 Quantity (5,000 metric tons)	**Phase 1-20 Quantity (100,000 metric tons)**
	Stranded SNF (3,000 metric tons) + Non-stranded SNF (2,000 metric tons)	**Stranded SNF (assumed to be constant at 3,000 metric tons) + Non-stranded SNF (assumed to be constant at 97,000 metric tons)**
Annual Storage	$77 million	$135 million
New ISFSI Construction	$0 (None required)	$90 million (3 new ISFSIs)
SNF Transportation[1]	$130 million	$2.6 billion
Non-discounted Cumulative Costs	$3.2 billion	$8.1 billion
Discounted Cost (3%)	$1.9 billion	$5.8 billion
Discounted Cost (7%)	$1.1 billion	$4.5 billion

Note 1: Transportation of SNF to an eventual repository; costs based on estimate of $26,000 per metric ton of SNF transported (see GAO 2014).

Table 9.2.3:

NO-ACTION ALTERNATIVE COSTS – SCENARIO 3

	Phase 1-20 Quantity (100,000 metric tons)[1]
SNF Transportation[2]	$2.6 billion
Non-discounted Cumulative Costs	$22.6 billion
Discounted Cost (3%)	$14.2 billion
Discounted Cost (7%)	$9.3 billion

Note 1: The DOE estimate of annual liabilities for SNF disposal does not break down costs according to the amount of SNF requiring disposal. As such, an estimate for only Phase 1 (i.e., 500 canisters of SNF) cannot be made. Scenario 3 is applicable to 100,000 metric tons of SNF storage.

Note 2: Transportation of SNF to an eventual repository; costs based on estimate of $26,000 per metric ton of SNF transported (see GAO 2014).

Table 9.2.4:

PROPOSED ACTION CONSTRUCTION COSTS

	Phase 1 Quantity (5,000 metric tons)	Phase 1-20 Quantity (100,000 metric tons)
Land Acquisition	$1 million	$1 million
Security Building	$35.41 million	$35.41 million
Administrative Building	$4.09 million	$4.09 million
Storage Building	$2.51 million	$2.51 million
Cask Transfer Building	$25.9 million	$25.9 million
Concrete Batch Plant	$1.01 million	$1.01 million
Rail Line Construction	$12.78 million	$12.78 million
Site Work	$51.2 million	$238.5 million
UMAX construction	$89.4 million	$1.79 billion
TOTAL	**$223.3 million**	**$2.1 billion**

Source: Holtec 2017a.

Table 9.2.5:

PROPOSED ACTION OPERATION AND MAINTENANCE COSTS

	Phase 1 Quantity (5,000 metric tons)	Phase 1-20 Quantity (100,000 metric tons)
(8) Radiation Protection Techs ($60/hr)	$998,400	$998,400
(2) Administrators ($50/hr)	$208,000	$208,000
(2) Chemists ($60/hr)	$249,000	$249,000
(6) Operators ($60/hr)	$748,800	$748,800
(12) Riggers ($60/hr)	$1,497,600	$1,497,600
(2) Maintenance Techs ($60/hr)	$249,600	$249,600
(1) Facility Manager ($60/hr)	$124,800	$124,800
(40) Security Personnel ($40/hr)	$3,328,000	$3,328,000
(1) Accountant ($60/hr)	$124,800	$124,800
(1) Administrative Assistant ($30/hr)	$62,400	$62,400
(2) Project Managers ($70/hr)	$291,200	$291,200
Plant Operation Costs (minus labor)	$19,404,800	$19,404,800
Annual Cost	**$27.3 million**	**$27.3 million**

Source: Holtec 2017a.

Table 9.2.6:

PROPOSED ACTION COSTS (TOTAL)

	Phase 1 Quantity (5,000 metric tons)	Phase 1-20 Quantity (100,000 metric tons)
SNF Transportation[1]	\$260 million	\$5.2 billion
Non-discounted Cumulative Costs[2]	\$1.575 billion	\$8.4 billion
Discounted Cost (3%)[3]	\$1.114 billion	\$7.5 billion
Discounted Cost (7%)[3]	\$847.3 million	\$6.8 billion

Source: Holtec 2017a.

Note 1: Transportation costs are double for Proposed Action compared to No-Action Alternative, to account for transportation as follows: (1) from reactors to the CIS Facility, and (2) from the CIS Facility to a permanent repository. Costs are based on an estimate of \$26,000 per metric ton of SNF transported and are independent of transportation distance (see GAO 2014).

Note 2: Construction costs for Phase 1 are not discounted, as these activities would be conducted in the 2020 timeframe. For Phase 1, only operation and maintenance costs are discounted.

Note 3: Construction costs (site work and UMAX construction) for Phase 2-20 are discounted over a 20 year period to account for construction of these phases after Phase 1. Operation and maintenance costs for Phases 1-20 are discounted.

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CHAPTER 11: GLOSSARY

100-year flood
Refers to a flood elevation (for a given area) that has a 1% chance of being equaled or exceeded each year. The term 100-year flood is synonymous with the 1% annual chance flood.

500-year flood
Refers to the flood elevation for a given area that has a 0.2% chance of being equaled or exceeded each year. This term is synonymous with the 0.2% annual chance flood.

Air pollutant
Any substance in air which could, if in high enough concentration, harm humans, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne.

Air quality
A measure of the quantity of pollutants, measured individually, in the air. These levels are often compared to regulatory standards.

Air quality standards
The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

Adverse environmental impacts
Impacts that are determined to be harmful to the environment.

Aesthetics (visual resources)
The natural and cultural features of the landscape that can be seen and that contribute to the public's appreciative enjoyment of the environment. Visual resource or aesthetic impacts are generally defined in terms of a project's physical characteristics and potential visibility and the extent to which the project's presence would change the perceived visual character and quality of the environment in which it would be located.

Air quality
Assessment of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances. Air quality standards are the prescribed levels of substances in the outside air that cannot be exceeded during a specific time in a specified area.

Alluvium
Clay, silt, sand, and/or gravel deposits found in a stream channel or in low parts of a stream valley that is subject to flooding. Ancient alluvium deposits frequently occur above the elevation of present-day streams.

Alpha particle
A positively charged particle emitted in the radioactive decay of certain nuclides. Made up of two protons and two neutrons bound together, it is identical to the nucleus of a helium atom.

Alternative
Reasonable means, other than the proposed action, by which to achieve the same purpose and satisfy the same need as the proposed action.

Ambient Temperature
The 24 hour average of the local temperature as forecast by the National Weather Service.

Ambient air
The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. It is not the air in immediate proximity to emission sources.

Ambient Air Quality Standards
Standards established on a State or Federal level, that define the limits for airborne concentrations of designated "criteria" pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, total suspended particulates, ozone, and lead), to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).

Ancillary or Ancillary Equipment
Generic name of a device used to carry out "short term" operations.

Aquatic biota
An organism that lives in, on, or near the water, including fish, macro-invertebrates, zooplankton, phytoplankton, macrophytes, and aquatic vegetation.

Aquifer
An underground layer of permeable, unconsolidated sediments or porous or fractured bedrock that yields usable quantities of water to a well or spring.

Area of potential effects
The geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking

Archaeological
The study of the buildings, graves, tools and other objects which belonged to people who lived in the past, in order to learn about their culture and society.

Archaeological Resources Protection Act of 1979
A statute which requires Federal permitting for excavation or removal of archaeological resources from public or Native American lands.

As low as (is) reasonably achievable (ALARA)
Making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest (see 10 CFR 20.1003).

Atmosphere
The layer of air surrounding the earth.

Atom
Smallest unit of an element that is capable of entering into a chemical reaction and displays the other properties of the element.

Attainment area
A region that meets the U.S. Environmental Protection Agency (EPA) National Ambient Air Quality Standards (NAAQS) for a criteria pollutant under the Clean Air Act.

Backfill
Materials, such as salt or a mixture of salt and other materials, used to reduce void volumes in storage panels or drifts.

Background radiation
Radiation from: (1) naturally occurring radioactive materials, as they exist in nature prior to removal, transport, or enhancement or processing by man; (2) cosmic and natural terrestrial radiation; (3) global fallout as it exists in the environment; (4) consumer products containing nominal amounts of radioactive material or emitting nominal levels of radiation; and (5) radon and its progeny in concentrations or levels existing in buildings or the environment that have not been elevated as a result of current or past human activities.

Baseline
A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement during the performance of an effort; the established plan against which the status of resources and the progress of a project can be measured.

Basin
A topographic or structurally low area compared to the immediately adjacent areas.

Berm
An earthen embankment; a long artificial mound of stone or earth similar to a dike or levee.

Best Management Practices (BMP)
Structural, nonstructural, and managerial techniques recognized to be the most effective and practical means to reduce surface water and groundwater contamination while still allowing the productive use of resources.

Biota
The flora and fauna of an area.

Biotic community
A group of organisms living and interacting within the same habitat.

Bounding
That which represents the maximum reasonably foreseeable event or impact. All other reasonably foreseeable events or impacts would have fewer and/or less severe environmental consequences.

Caliche
Calcium carbonate ($CaCO_3$) deposited in the soils of arid or semiarid regions.

Cancer
Any malignant new growth of abnormal cells or tissue.

Canister
All-welded vessel containing used fuel that has been qualified to serve as a confinement boundary under the rules of 10 CFR 72.

Carbon monoxide
An odorless, colorless, poisonous gas produced by incomplete burning of carbon in fuels. Exposure to carbon monoxide reduces the delivery of oxygen to the body's organs and tissues. Elevated levels can cause impairment of visual perception, manual dexterity, learning ability, and performance of complex tasks.

Carcinogen
An agent capable of producing or inducing cancer.

Cask
A heavily shielded container used for the dry storage or shipment (or both) of radioactive materials such as spent nuclear fuel (spent fuel) or other high-level radioactive waste. Casks are often made

from lead, concrete, or steel. Casks must meet regulatory requirements and are not intended for long-term disposal in a repository.

Cavity Enclosure re Container (CEC)
A thick walled cylindrical steel weldment that defines the storage cavity for the MPCs.

Cenozoic
An era of geologic time, from the beginning of the Tertiary period to the present; considered to have begun about 65 million years ago.

Census tract
An area usually containing between 2,500 and 8,000 persons that is used for organizing and monitoring census data. The geographic dimensions of census tracts vary widely, depending on population density. Census tracts do not cross county borders.

CISF
The consolidated interim storage facility envisaged to be built and operated by Holtec in Southeastern New Mexico.

Clean Air Act
A Federal law that requires the EPA to set and enforce air pollutant emissions standards for stationary sources and motor vehicles.

Climatology
The science devoted to the study of the conditions of the natural environment (rainfall, daylight, temperature, humidity, air movement) prevailing in specific regions of the earth.

Climate change (Global climate change)
Changes in the Earth's surface temperature thought to be caused by the greenhouse effect and responsible for changes in global climate patterns. The greenhouse effect is the trapping and buildup of heat in the atmosphere (troposphere) near the Earth's surface. Some of the heat flowing back toward space from the Earth's surface is absorbed by water vapor, carbon dioxide, ozone, and certain other gases in the atmosphere and then reradiated back toward the Earth's surface.

Closure Lid
The METCON lid that is installed on the MPC storage cavity to provide physical and shielding protection to the stored MPC.

Code of Federal Regulations (CFR)
The codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the Federal government. It is divided into 50 titles that represent broad areas subject to Federal regulation. Each volume of the CFR is updated once each calendar year and is issued on a quarterly basis.

Committed dose equivalent
The predicted dose equivalent to a tissue or organ over a 50-year period after an intake of a radionuclide into the body. It does not include dose contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

Committed effective dose equivalent
The sum of the committed dose equivalents to various organs or tissues in the body from radioactive material taken into the body, each multiplied by the tissue-specific weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

Concentration
The amount of a substance contained in a unit quantity (mass or volume) of a sample.

Confined aquifer
An aquifer bounded above and below by impermeable beds, or by beds of distinctively lower permeability than that of the aquifer itself, allowing the groundwater to be under pressure; an aquifer containing confined water.

Confinement
The ability of a storage system to retain radioactive material, including gases and particulates, within the system.

Confinement Boundary
The outline formed by the sealed, cylindrical enclosure of the Multi-Purpose Canister (MPC) shell welded to a solid baseplate, a lid welded around the top circumference of the shell wall, the port cover plates welded to the lid, and the closure ring welded to the lid and MPC shell providing the redundant sealing.

Consolidated storage
A spent fuel storage facility designed to store spent fuel produced from multiple nuclear power plants.

Controlled Area
Area immediately surrounding an ISFSI for which the owner/user exercises authority over its use and within which operations are performed.

Continued storage
The time period during which spent fuel is stored after the end of the licensed life for operations of a nuclear reactor and prior to disposal in a permanent repository.

Corrective action
Measures taken to rectify conditions adverse to quality, safety, or compliance with NRC requirements.

Conservative
When used with predictions or estimates, leaning on the side of pessimism. A conservative estimate is one in which the uncertain inputs are used in the way that provides a reasonable upper limit of the estimate of an impact.

Consumptive use
Water use where the water is withdrawn from the source and not returned.

Containment
Retention of a material or substance within prescribed boundaries.

Contamination
The presence of excess radioactive material from an activity in or on a material or property.

Cooling water
Water circulated through a nuclear reactor or processing plant to remove heat.

Cosmogenic
Produced by the action of rays that come from outer space.

Cost-benefit analysis
A formal quantitative procedure comparing costs and benefits of a proposed project.

Council on Environmental Quality (CEQ)
Established by the National Environmental Policy Act (NEPA). Council on Environmental Quality regulations (40 CFR Parts 1500-1508) describe the process of implementing NEPA, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation. As an independent regulatory body, the NRC's policy is to take account of the regulations of the Council on Environmental Quality published November 29, 1978 (43 FR 55978-56007) voluntary, to the extent applicable.

Criteria pollutants
Six pollutants (ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide) known to be hazardous to human health and for which the U.S. Environmental Protection Agency sets National Ambient Air Quality Standards under the Clean Air Act.

Critical habitat
Specific geographic areas, whether occupied by a listed species or not, that are essential for its conservation and that have been formally designated by rule published in the *Federal Register*.

Criticality
The normal operating condition of a reactor, in which nuclear fuel sustains a fission chain reaction. A reactor achieves criticality when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions. Nuclear fuel that is in storage or being handled is required to avoid criticality, or remain "subcritical."

Cultural resource (historic resource)
The remains of past human activity and include prehistoric era and historic era archaeological sites, historic districts, buildings, or objects with an associated historical, cultural, archaeological, architectural, community, or aesthetic value. Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture.

Cumulative impacts
Cumulative impacts are those impacts on the environment that result 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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Day-night Average Sound Level (LDN)
A sound level that represents the average sound level during daytime hours and nighttime hours, with the nighttime hours having a 10 dB increase to represent the higher sensitivity of humans at those hours.

Decibel (dB)
A standard unit for measuring sound-pressure levels based on a reference sound pressure of 0.0002 dyne per square centimeter. This is the smallest sound a human can hear. In general, a sound doubles in loudness with every increase of slightly more than 3 decibels.

Decibel, A-weighted (dBA)
A number representing the sound level which is frequency weighted according to a prescribed frequency response established by the American National Standards Institute and accounts for the response of the human ear.

Decommissioning
The process of safely closing a nuclear power plant (or other facility where nuclear materials are handled) to retire it from service after its useful life has ended. This process primarily involves decontaminating the facility to reduce residual radioactivity and then releasing the property for unrestricted use (see 10 CFR 20.1003) or (under certain conditions) restricted use. This often includes dismantling the facility or dedicating it to other purposes. Decommissioning begins after the nuclear fuel, coolant, and radioactive waste are removed from the reactor.

Decontamination
The reduction or removal of contaminating radioactive material from a structure, area, object, or person. Decontamination may be accomplished by (1) treating the surface to remove or decrease the contamination, (2) letting the material stand so that the radioactivity is decreased as a result of natural radioactive decay, or (3) covering the contamination to shield or attenuate the radiation emitted

Delaware Basin
An area in southeastern New Mexico and the adjacent parts of Texas where the Permian sea deposited a large thickness of evaporites some 220 to 280 million years ago. It is partially surrounded by the Capitan Reef.

Department of Energy (DOE)
The DOE is a cabinet-level agency that has both important energy- and national security-related missions. The DOE carries out policies ranging from nuclear power to fossil fuels to alternative energy sources.

Depleted uranium
Uranium having a percentage of uranium-235 smaller than the 0.7 percent found in natural uranium. It is obtained from spent (used) fuel elements or as byproduct tails, or residues, from uranium isotope separation.

Deposition
Material that is deposited; a deposit or sediment. The laying, placing, or throwing down of any material.

Design life
The design life of components or systems generally refers to the estimated minimum period of time that the component or system is expected to perform within specifications before the effects of aging result in performance deterioration or a requirement to replace the component or system.

Design basis events
Conditions of normal operation, design basis accidents, external events, and natural phenomena, for which the plant must be designed to ensure the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures.

Design basis accident
A postulated accident that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.

Direct jobs
The number of workers required at a site to implement an alternative.

Disposal
The act of placing unwanted materials in an area with the intent of not recovering in the future.

Dose
A general term which may be used to refer to the amount of energy absorbed by an object or person per unit mass. Known as the "absorbed dose," this reflects the amount of energy that ionizing radiation sources deposit in materials through which they pass, and is measured in units of radiation-absorbed dose (rad). The related international system unit is the gray (Gy), where 1 Gy is equivalent to 100 rad. See also, **total effective dose equivalent (TEDE)**, **committed effective dose equivalent (CEDE)**, and **deep dose equivalent**.

Dose conversion factor
A numerical factor used in converting radionuclide intake (curies) in the body to the resultant dose equivalence (rem or person-rem).

Dose equivalent
The product of the absorbed dose in tissue, quality factor, and all other modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert (Sv).

Dosimetry
The theory and application of the principles and techniques involved in the measurement and recording of radiation doses. Its practical aspect is concerned with the use of various types of radiation instruments with which measurements are made (i.e., film badge, thermoluminescent dosimeter, and Geiger counter).

Dry cask storage
A method for storing spent fuel in special containers known as casks. After fuel has been cooled in a spent fuel pool for at least 1 year, dry cask storage allows approximately one to six dozen spent fuel assemblies to be sealed in casks and surrounded by inert gas.

Ecology
The science dealing with the relationship of all living things with each other and with the environment.

Ecological
Of or pertaining to the environment as it relates to living organisms.

Economic
A distinctive part of the economy of a geographic region defined by a sector standard industrial classification scheme. One such scheme defines "major" sectors and divides them intosubsectors; for example, the major sector "trade" contains the subsectors "wholesale trade" and "retail trade." Another classification scheme specifies "primary" and "secondary" sectors; the criterion for including a sector in the primary classification is that its level of activity is generally not controlled

by the level of economic activity in the region; a primary industry, in other words, produces goods and services for export from the region.

Effects
Include: (i) direct effect, which are caused by the action and occur at the same time and place; (ii) indirect effects caused by the action and are later in time or farther removed in distance, but still reasonably foreseeable; and (iii) cumulative effects caused by the aggregate effects of past, present, and reasonably foreseeable future actions. Effects and impacts as used in thi document are synonymous.

Effective dose equivalent
The sum of the products of the dose equivalent received by specified organs or tissues of the body and a tissue-specific weighting factor. The effective dose equivalent is expressed in units of rem (or sievert).

Effluent
A discharge of gas or liquid into the environment, partially or completely treated or in its natural state. This term typically refers to wastes discharged into surface waters.

Element
One of the known chemical substances that cannot be divided into simpler substances by chemical means.

Emission
Gases, particles, or liquids released into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities.

Emission standards
Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

Endangered species
Animal or plant species in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act of 1973 (ESA)
Requires consultation with the FWS and/or the NMFS to determine whether endangered or threatened species or their habitats will be affected by a proposed activity and what, if any, mitigation measures are needed to address the impacts.

Energy
The capacity for doing work.

Environment
The sum of all external conditions and influences affecting the life development and, ultimately, the survival of an organism.

Environmental impact statement (EIS)
A document required of Federal agencies by NEPA for major proposals or legislation that will or could significantly affect the environment. The primary purpose of an EIS is to serve as an action-forcing device to ensure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal government. An EIS provides full and fair discussions of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. The EIS should be used by Federal officials in conjunction with other relevant material to plan actions and make decisions.

Environmental justice
The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

Environmental monitoring
The act of measuring, either continuously or periodically, some quantity of interest, such as radioactive material in the air.

Environmental Protection Agency (EPA)
A Federal agency, created for the purpose of promoting human health by protecting the nation's air, water, and soil from harmful pollution by enforcing environmental regulations based on laws passed by Congress. The agency performs environmental assessments, conducts research, and provides education. It has the responsibility of maintaining and enforcing national standards under a variety of environmental laws (e.g., Clean Air Act), in consultation with State, Tribal, and local governments. It delegates some permitting, monitoring, and enforcement responsibility to States and Native American Tribes. EPA enforcement powers include fines, sanctions, and other measures. The agency also works with industries and all levels of government in a wide variety of voluntary pollution prevention programs and energy conservation efforts.

EPA Air Quality Designations
- **Attainment**: An EPA air quality designation for any area that meets the national primary or secondary ambient air quality standard for the pollutant.
- **Nonattainment**: An EPA air quality designation for any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.

- **Unclassifiable**: Any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

Environmental Report (ER)
Environmental Report required as part of an environmental assessment, which identifies, describes and evaluates the likely significant effects on the environment of implementing a plan or program.

Erosion
Removal and transport of materials by wind, ice, or water on the earth's surface.

Exposure
Measure of the ionization produced in air by X or gamma radiation. It is the sum of the electrical charges on all ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in air, divided by the mass of the air in the volume element.

Exposure limit
The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur:

Exposure pathways
A route or sequence of processes by which a radioactive or hazardous material may move through the environment to humans or other organisms. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route.

Fault
A fracture or a zone of fractures along which there has been displacement parallel to the fracture.

Fish and Wildlife Service (FWS)
A Federal agency within the U.S. Department of the Interior responsible for the management of fish, wildlife, and natural habitats. The FWS's major responsibilities are for migratory birds, endangered species, certain marine mammals, and freshwater and anadromous fish.

Flood
An event in which a river, lake, ocean, or other water feature to rise above normal limits.

Floodplain
The lowland and relatively flat areas adjoining creeks, rivers, lakes, and coastal waters. This includes, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year. The base floodplain shall be used to designate the 100-yr floodplain (1-percent chance floodplain).

Fuel cycle
The series of steps involved in supplying fuel for nuclear power reactors. It can include mining, milling, isotopic enrichment, fabrication of fuel elements, use in a reactor, chemical reprocessing

to recover the fissionable material remaining in the spent fuel, re-enrichment of the fuel material, refabrication into new fuel elements, and waste disposal.

Fugitive dust
Particulate air pollution released to the ambient air from ground-disturbing activities related to construction, manufacturing, or transportation (i.e., the discharges are not released through a confined stream such as a stack, chimney, vent, or other functionally equivalent opening). Specific activities that generate fugitive dust include, but are not limited to, land-clearing operations, travel of vehicles on disturbed land or unpaved access roads, or onsite roads.

Gamma
Short-wavelength electromagnetic radiation (high-energy photons) emitted In the radioactive decay of certain nuclides. Gammas are the same as gamma rays or gamma waves.

Geologic
Of or related to a natural process acting as a dynamic physical force on the Earth (faulting, erosion, mountain building resulting in rock formations, etc.).

Geologic repository
An excavated, underground facility that is designed, constructed, and operated for safe and secure permanent disposal of high-level radioactive waste. A geologic repository uses an engineered barrier system and a portion of the site's natural geology, hydrology, and geochemical systems to isolate the radioactivity of the waste.

Geology
The science that deals with the earth; the materials, processes, environments, and history of the planet, especially the lithosphere, including the rocks, their formation, and structure.

Greater-than-class-C waste (GTCC)
GTCC waste means low-level radioactive waste that exceeds the concentration limits of radionuclides established for Class C wastes in 10 CFR 61.55.

Greenhouse gases
Gases that trap heat in the atmosphere. The most common greenhouse gases are carbon dioxide, methane, nitrous oxide, and fluorinated gases. Greenhouse gases contribute to global climate change.

Groundwater
The water found beneath the Earth’s surface, usually in porous rock formations (aquifers) or in a zone of saturation, which may supply wells and springs, as well as base flow to major streams and rivers. Generally, it refers to all water contained in the ground.

Habitat
Area in which a plant or animal lives and reproduces.

Hazardous material
A substance or material in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce.

Hazardous waste
According to the *Resource Conservation and Recovery Act*, a waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness, or (2) pose a substantial hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes possess at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. Hazardous waste is nonradioactive.

Herbaceous
Non-woody vegetation.

Herbicide
A chemical agent (often synthetic) capable of killing or causing damage to certain plants (usually weeds) without significant disruption of other plants.

HI-STAR System
A Holtec-designed transportation and storage system consisting of an MPC sealed within the HI-STAR storage/transportation Overpack.

Historic Resources
The sites, districts, structures, and objects associated with historic events, persons, or social or historic movements.

Historic property
Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an American Indian tribe or Native Hawaiian organization and that meet the National Register criteria [36 CFR 800.16(l)].

HI-STORM VVM
The module that receives and contains the sealed multi-purpose canisters containing spent nuclear fuel for long term storage. It provides the gamma and neutron shielding, ventilation passages, missile protection, and protection against natural phenomena and accidents for the loaded MPC.

HI-STORM UMAX
The system **c**onsisting of loaded canisters (MPCs) stored in VVMs.

HI-TRAC
A generic term for the transfer cask used to house the MPC during loading, unloading, and onsite transfer operations to a HI-STAR storage/transportation overpack. The HI-TRAC transfer cask is required for shielding and protection of the SNF during loading and closure of the MPC.

High-level radioactive waste (HLW)
The highly radioactive materials produced as byproducts of fuel reprocessing or of the reactions that occur inside nuclear reactors. HLW includes the following:

- irradiated spent fuel discharged from commercial nuclear power reactors,
- the highly radioactive liquid and solid materials resulting from the reprocessing of spent fuel, which contain fission products in concentration (this includes some reprocessed HLW from defense activities and a small quantity of reprocessed commercial HLW), and
- other highly radioactive materials that the Commission may determine require permanent isolation.

Hydrology
The study of water that considers its occurrence, properties distribution, circulation, and transport and includes groundwater, surface water, and rainfall.

Impacts
An assessment of the meaning of changes in all attributes being studies for a given resource. An aggregation of all of the adverse effects, usually measured using a qualitative and nominally subjective technique.

Independent Spent Fuel Storage Installation (ISFSI) is a facility for the interim storage of SNF in accordance with 10 CFR 72. The CISF would constitute an ISFSI.

Indirect effects
Those effects that would not directly destroy the physical integrity of a significant cultural resource, but would either adversely affect an element or elements that contribute to the significance of the resource or would increase the risk of destruction by outside action.

Indirect jobs
Jobs generated or lost in related industries within a regional economic area as a result of a change in direct employment.

Ingestion
To take in by mouth. Material that is ingested enters the digestive system.

Inhalation
To take in by breathing. Material that is inhaled enters the lungs.

Ionizing radiation
Radiation capable of displacing electrons from atoms or molecules to produce ions.

Interim Storage
An autonomous monitored canister storage facility from which the stored canister can be retrieved, if necessary.

ISFSI Pad means the reinforced concrete pad that provides the support surface for the cask handling device.

Isotope
Two or more forms (or atomic configurations) of a given element that have identical atomic numbers (the same number of protons in their nuclei) and the same or very similar chemical properties but different atomic masses (different numbers of neutrons in their nuclei) and distinct physical properties. Thus, carbon-12, carbon-13, and carbon-14 are isotopes of the element carbon, and the numbers denote the approximate atomic masses. Among their distinct physical properties, some isotopes (known as radioisotopes) are radioactive because their nuclei emit radiation as they strive toward a more stable nuclear configuration. For example, carbon-12 and carbon-13 are stable, but carbon-14 is unstable and radioactive.

Karst
A topography characterized by sinkholes, caves, and disappearing streams formed by dissolution in limestone, dolomite, and evaporite bedrock.

Land Use
The way land is developed and used in terms ofthe kinds of anthropogenic activities that occur (e.g., agriculture, residential areas, industrial areas).

Licensee
A company, organization, institution, or other entity to which the NRC or an Agreement State has granted a general license or specific license to construct or operate a nuclear facility, or to receive, possess, use, transfer, or dispose of source material, byproduct material, or special nuclear material.

License Life
The duration for which the system is authorized by virtue of its certification by the U.S. NRC.

Loam
A rich, friable soil containing a relatively equal mixture of sand and silt and a somewhat smaller proportion of clay.

Low-income population
A population where 25 percent or more of the population is identified as living in poverty.

Low-level mixed waste
Low-level waste that also contains hazardous chemical components regulated under the *Resource Conservation and Recovery Act*.

Low-level waste (LLW)
A general term for a wide range of items that have become contaminated with radioactive material or have become radioactive through exposure to neutron radiation. The radioactivity in these wastes can range from just above natural background levels to much higher levels, such as seen in parts from inside the reactor vessel in a nuclear power reactor.

Magnitude (earthquake)
A measure of the total energy released by an earthquake. It is commonly measured in numerical units on the Richter scale. Each unit, e.g. 7, is different from an adjacent unit by a factor of 30.

Maximally exposed individual (MEI)
A hypothetical person who—because of proximity, activities, or living habits—could receive the highest possible dose of radiation or of a hazardous chemical from a given event or process.

Meteorology
The science dealing with the atmosphere and its phenomena, especially as relating to weather.

Minority
The term minority is defined by the U.S. Census Bureau to include the five racial categories of black/African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, some other race, and two or more races. NUREG-1748 defines minority populations to include individual of Hispanic or Latino origin.

Mitigation
A series of actions implemented to ensure that projected impacts will result in no net loss of habitat value or wildlife populations. The purpose of mitigative actions is to avoid, minimize, rectify, or compensate for any adverse environmental impact.

Mixed oxide fuel (MOX)
A type of nuclear reactor fuel (often called "MOX") that contains plutonium oxide mixed with either natural or depleted uranium oxide, in ceramic pellet form. Using plutonium reduces the amount of highly enriched uranium needed to produce a controlled reaction in commercial lightwater reactors.

Mixed waste
A type of waste that contains both hazardous and radioactive source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954.

Mixing height
The height above the earth's surface through which relatively strong vertical mixing of the atmosphere occurs.

Model
A simplified representation of an object or natural phenomenon. The model can be in many possible forms: a set of equations or a physical, miniature version of an object or system constructed to allow estimates of the behavior of the actual object or phenomenon when the values of certain variables are changed. Important environmental models include those estimating the transport, dispersion, and fate of chemicals in the environment.

Monitoring
Periodic or continuous processes and activities necessary to assess the status of the environment that is typically part of a structured program required or approved by a regulatory agency responsible for protection of human health and safety and the environment.

Multi-Purpose Canister (MPC)
The sealed canister consisting of a fuel basket for SNF storage.

Municipal solid waste
Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.

National Ambient Air Quality Standards (NAAQS)
Air quality standards established by the Clean Air Act, as amended. The primary NAAQS specify maximum outdoor air concentrations of criteria pollutants that would protect the public health within an adequate margin of safety. The secondary NAAQS specify maximum concentrations that would protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Environmental Policy Act (NEPA) of 1969
A federal law constituting the basic national charter for protection of the environment. The act calls for the preparation of an environmental impact statement (EIS) for every major federal action that may significantly affect the quality of the human or natural environment. The main purpose is to ensure that environmental information is provided to decision makers so that their actions are based on an understanding of the potential environmental and socioeconomic consequences of a proposed action and the reasonable alternatives.

National Historical Preservation Act of 1966 (NHPA)
Section 106 of the NHPA addresses the impacts of Federal undertakings on historic properties. Undertakings are defined in the NHPA as any project or activity that is funded or under the direct jurisdiction of a Federal agency, or any project or activity that requires a Federal permit, license, or approval.

National Pollutant Discharge Elimination System (NPDES)
Federal permitting system required for any discharges to waters of the United States regulated through the *Clean Water Act,* as amended.

National Register of Historic Places
A list maintained by the National Park Service of architectural, historic, archaeological, and cultural sites of local, state, or national importance.

Natural phenomena
Events that occur in nature such as earthquakes, tornadoes, hurricanes, floods, and tsunamis.

Natural Resources Conservation Service
An organization within the U.S. Department of Agriculture aimed at helping America's private land owners and managers conserve their soil, water, and other natural resources.

No-Action alternative
In general, the No-Action Alternative of an EIS assumes that the proposed action would not take place; the resulting environmental impacts from taking no action would be compared with the impacts of permitting the proposed action or an alternative action.

Nonradioactive nonhazardous waste
Waste that is neither radioactive nor hazardous and typically deposited in a landfill.

Normal operations
Conditions during which facilities and processes operate as expected or designed. In general, normal operations include the occurrence of some infrequent events that, although not considered routine, are not classified as accidents

NOx
Oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced primarily by combustion of fossil fuels, and can constitute an air pollution problem.

Nuclear fuel
Fissionable material that has been enriched to a composition that will support a self-sustaining fission chain reaction when used to fuel a nuclear reactor, thereby producing energy (usually in the form of heat or useful radiation) for use in other processes.

Nuclear power plant
A facility that uses a nuclear reactor to generate electricity.

Nuclear reactor
A device in which nuclear fission may be sustained and controlled in a self-supporting nuclear reaction. There are many types of reactors, but all incorporate certain features, including fissionable material or fuel, a moderating material (unless the reactor is operated on fast neutrons),

a reflector to conserve escaping neutrons, provisions of removal of heat, measuring and controlling instruments, and protective devices. The reactor is the principal component of a nuclear power plant.

Nuclear Regulatory Commission (NRC)
The NRC is an independent agency of the United States government tasked with protecting public health and safety related to nuclear energy.

Nuclear waste
A subset of radioactive waste that includes unusable byproducts produced during the various stages of the nuclear fuel cycle, including recovery (or extraction), conversion, and enrichment of uranium; fuel fabrication; and use of the fuel in nuclear reactors. Specifically, these stages produce a variety of nuclear waste materials, including uranium mill tailings, depleted uranium, and spent (depleted) fuel, all of which are regulated by the NRC. By contrast, "radioactive waste" is a broader term, which includes all wastes that contain radioactivity, regardless of how they are produced.

Nuclide
A species of atom, characterized by its number of protons, number of neutrons, and energy state.

Occupational dose
The dose received by an individual in the course of employment in which the individual's assigned duties involves exposure to radiation or to radioactive material. Occupational dose is restricted by NRC regulations under 10 CFR Part 20, Subpart C.

Occupational Safety and Health Administration (OSHA)
A Federal agency in the Department of Labor whose mission is to prevent work-related injuries, illnesses, and deaths. Congress created OSHA under the Occupational Safety and Health Act on December 29, 1970.

Off-site
Area outside the property boundary (or outside the fence line) of a facility.

Onsite
Area inside the property boundary (or inside the fence line) of a facility.

Outfall
The place where effluent is discharged into receiving waters.

Oxide
A compound consisting of an element combined with oxygen.

Ozone
A molecule of oxygen in which three oxygen atoms are chemically attached to each other.

Package
In the regulations governing the transportation of radioactive materials, the packaging together with its radioactive contents as presented for transport.

Packaging
A shipping container without its contents.

Paleocene
Noting or pertaining to an epoch of the Tertiary period, from 65 to 55 million years ago, and characterized by a proliferation of mammals.

Particulate matter
Materials such as dust, dirt, soot, smoke, and liquid droplets that are emitted into the air by sources such as factories, power plants, cars, construction activity, fires, and natural windblown dust. Exposure to high concentrations of particulate matter can affect breathing, aggravate existing respiratory and cardiovascular disease, alter the body's defense systems against foreign materials, damage lung tissue, and cause premature death.

Peak ground acceleration
The maximum acceleration experienced by the particle on the ground during the course of the earthquake motion.

Permeability
The capability of a soil or rock to transmit a fluid.

Perennial
A feature that contains water year round during a year of normal rainfall, with the aquatic bed located below the water table for most of the year. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

Person-rem
A measure of the radiation dose to a given population; the sum of the individual radiation doses received by that population.

Physiochemical
Being physical and chemical. Of or relating to chemistry that deals with the physiochemical properties of substances.

Physiographic
Geographic regions based on geologic setting.

Pleistocene
Noting or pertaining to the epoch forming the earlier half of the Quaternary period, beginning about 1.75 million years ago and ending 11,500 years ago, characterized by widespread glacial ice and the advent of modern humans.

Plume
The elongated pattern of contaminated air or water originating at a point source, such as a smokestack or a hazardous waste disposal site.

PM_{10}
Particulate matter with a 10-micron or less aerodynamic diameter. PM_{10} includes $PM_{2.5}$.

$PM_{2.5}$
Particulate matter with aerodynamic diameter of 2.5 µm or less. Since it is very small, PM2.5 is important because it can be inhaled deep into the lungs.

Point source
A source of effluents that is small enough in dimensions that it can be treated as if it were a point. The converse is a diffuse source. A point source can be either a continuous source or a source that emits effluents only in puffs or for a short time.

Pollutant
Any material entering the environment that has undesired effects.

Pollution
The addition of an undesirable agent to the environment in excess of the rate at which natural processes can degrade, assimilate, or disperse it.

Pollution prevention
The use of any process, practice, or product that reduces or eliminates the generation and release of pollutants, hazardous substances, contaminants, and wastes, including those that protect natural resources through conservation or more efficient utilization.

Population dose
The sum of the radiation doses received by the individual members of a population.

Porosity
Percentage of void space in a material.

Potable water
Water that is safe for human consumption.

Precambrian
All geologic time and its corresponding rocks before the beginning of the Paleozoic era, equal to about 90% of geologic time. The Precambrian ended 570 million years ago, during which the Earth's crust formed and life first appeared in the seas.

Prehistoric
Predating written history, in North America, also predating contact with Europeans.

Private Fuel Storage Facility (PFSF)
A previous proposed away-from-reactor ISFSI on the Reservation of the Skull Valley Band of Goshute Indians in Tooele County, Utah. The NRC analyzed the environmental impacts of constructing and operating the PFSF in NUREG-1714.

Probability weighted consequence
A measure of the severity of an environmental impact or accident that accounts for both the likelihood that the event occurs and the consequences if the event does occur. Where both the likelihood and consequences (e.g., cumulative dose, cost to the local economy, or area of land contamination) can be quantified, it is the product of these two factors.

Proposed action
Action under consideration.

Quaternary
Noting or pertaining to the present period of Earth's history, forming the latter part of the Cenozoic era, originating about 2 million years ago and including the Recent and Pleistocene epochs.

Rad
The special unit for radiation absorbed dose, which is the amount of energy from any type of ionizing radiation air). A dose of one rad means the absorption of 100 ergs (a small but measurable amount of energy) per gram of absorbing tissue (100 rad = 1 gray).

Radiation
Ionizing radiation; e.g., alpha particles, beta particles, gamma rays, X-rays, neutrons, protons, and other particles capable of producing ion pairs in matter. As used in this document, radiation does not include nonionizing radiation.

Radiation standards
Exposure standards, permissible concentrations, rules for safe handling, regulations for transportation, regulations for industrial control of radiation, and control of radioactive material by legislative means.

Radioactivity
The property possessed by some elements (e.g., uranium) of spontaneously emitting energy in the form of radiation as a result of the decay (or disintegration) of an unstable atom. Radioactivity is

also the term used to describe the rate at which radioactive material emits radiation. Radioactivity is measured in curies (Ci) and becquerels (Bq).

Radioactive waste
Materials from nuclear operations that are radioactive or are contaminated with radioactive materials and for which there is no practical use or for which recovery is impractical.

Radionuclide
A radioactive atomic nuclide, which is an atomic nucleus specified by atomic weight, atomic number, and energy state.

Rare
Species listed as threatened, endangered, or other special concern by the state or federal government.

Recharge
The downward vertical flow of groundwater to an aquifer. Recharge may be from seepage through the unsaturated zone (for unconfined aquifers) or downward flow from overlying layers (for confined aquifers).

Region (socioeconomic)
The relevant region is limited to that area necessary to include social and economic base data for: (i) the county in which the proposed facility would be located; and (ii) those specific portions of surrounding counties and urbanized areas from which the construction/refurbishment work force would be principally drawn, or that would receive stresses to community services by a change of residence of construction/refurbishment/decommissioning workers. Other social and economic impacts can generally be presumed to fall within the same area covered by this definition of the region.

Region of influence (ROI)
The physical area that bounds the environmental, sociological, economic, or cultural features of interest for the purpose of analysis. A site-specific geographic area that includes the counties where approximately 90 percent of the site's current employees reside.

Relief
A term used loosely for the physical shape, configuration, or general unevenness of a part of the Earth's surface, considered with reference to variations of height and slope or to irregularities of the land surface; the elevations or differences in elevation, considered collectively, of a land surface.

Rem
A common (or special) unit of dose equivalent, effective dose equivalent, or committed dose equivalent.

Remediation
The restoration of a site by removal of pollution or contamination from the site environment, consistent with regulatory standards, for the protection of public health and safety and the environment.

Repackaging
Replacement of the canister and/o cask which houses spent fuel assemblies.

Repository
See **Geologic repository**.

Reasonable alternatives
Those alternatives that are practical or feasible from the technical and economic standpoint and using common sense.

Reservoir
A natural or artificial lake used for the storage of water for industrial and domestic purposes and for the regulation of inland waterway levels. Service reservoirs store water for domestic supply purposes under cover and regulate diurnal fluctuations in demand. Impounding reservoirs provide storage to cover seasonal or year-to-year variations in inflow. Such reservoirs (feeder reservoirs) may supply water for domestic or industrial use or for regulating water levels in rivers and canals.

Resource Conservation and Recovery Act (RCRA)
This Act was designed to provide "cradle to grave" control of hazardous chemical wastes.

Restricted area
Any area to which access is controlled for the protection of individuals from exposure to radiation and radioactive materials.

Riparian
The land adjacent to the banks or the banks of any river or stream.

Risk
The likelihood of suffering a detrimental effect as a result of exposure to a hazard. In accident analysis, the probability weighted consequence of an accident, defined as the accident frequency per year multiplied by the consequence.

Risk assessment (chemical or radiological)
The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

Rulemaking
The process by which NRC formulates, amends, or repeals regulations.

Runoff
The portion of rainfall that is not absorbed by soil, evaporated, or transpired by plants, but finds its way into streams directly or as overland surface flows.

Safeguards
The use of material control and accounting programs to verify that all special nuclear material is properly controlled and accounted for, as well as the physical protection (or physical security) equipment and security forces. Requirements for physical protection of plants and materials are found in 10 CFR Parts 37 and 73.

Safety-related
Systems, structures, components, procedures, and controls (of a facility or process) that are relied upon to remain functional during and following design basis events. Their functionality ensures that key regulatory criteria, such as levels of radioactivity released, are met.

Sanitary/industrial waste
Nonhazardous, nonradioactive liquid and solid waste generated by normal housekeeping activities.

Scenario
A set of conditions presumed for the purpose of estimating doses by analysis.

Saturated zone
The portion of the ground wholly saturated with water.

Sediment
Eroded soil particles that are deposited downhill or downstream by surface runoff.

Seismic
Pertaining to any earth vibration, especially an earthquake.

Seismicity
A seismic event or activity such as an earthquake or earth tremor; seismic action.

Severe accident (beyond-design-basis accident)
Accidents that may challenge safety systems at a level much higher than expected. See also **Design basis accident**.

Shielding
Any material or obstruction that absorbs radiation and thus tends to protect personnel or materials from the effects of ionizing radiation. Shielding also refers to the resulting ability of a system to limit the dose rate at designated locations to acceptable regulatory limits.

Silt
A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Sievert (Sv)
The SI unit of radiation dose equivalent, equal to 1 joule of energy per kilogram of absorbing tissue. The sievert replaces the *rem* (1 Sv = 100 rem).

Site
The area of land owned or controlled by the applicant for the principal purpose of constructing and operating a facility. As a general rule, the applicant's "site boundary" should be accepted as defining the site.

Site characterization
An onsite investigation at a known or suspected contaminated waste or release site to determine the extent and type(s) of contamination.

Socioeconomic
Social and economic characteristics of a human population. Includes both the social impacts of economic activity and the economic impacts of social activity.

Source material
Uranium or thorium ores containing 0.05 percent Uranium or Thorium regulated under the *Atomic Energy Act*. In general, this includes all materials containing radioactive isotopes in concentrations greater than natural and the by-product (tailings) from the formation of these concentrated materials

Spent fuel (spent nuclear fuel)
Nuclear reactor fuel that has been removed from a nuclear reactor because it can no longer sustain power production for economic or other reasons.

Stability
A property of the atmosphere that suppresses mixing. The main parameter determining stability is the vertical temperature profile of the atmosphere.

State Historic Preservation Officer (SHPO)
The state officer charged with the identification and protection of prehistoric and historic resources in accordance with the *National Historic Preservation Act*.

Storage
Temporary placement of waste in a facility. Storage usually implies the need for continued surveillance.

Stormwater
The flow of water that results from precipitation and that occurs immediately following rainfall or as a result of snowmelt.

Strata
Layers of rock.

Stratigraphy
The study of layered sequences of rocks.

Subgrade
The lateral space between each CEC, the SFP and the ISFSI Pad.

Subsidence
The process of sinking or settling of a land surface due to natural or artificial causes.

Support Foundation Pad (SFP)
The reinforced concrete pad located underground on which the CECs are situated.

Surface water
A creek, stream, river, pond, lake, bay, sea, or other waterway that is directly exposed to the atmosphere.

Terrestrial
Belonging to or living on land.

Tertiary
The first period of the Cenozoic era (after the Cretaceous period of the Mesozoic era and before the Quaternary period), thought to have covered the span of time between 65 million years and 3 to 2 million years ago. The Tertiary period is divided into five epochs: the Paleocene, Eocene, Oligocene, Miocene, and Pliocene.

Threatened Species
Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Requirements for declaring a species threatened are contained in the *Endangered Species Act*.

Topography
The shape of Earth's surface or the geometry of landforms in a geographic area.

Topsoil
The fertile, surface portion of a soil; usually dark colored and rich in organic material.

Total effective dose equivalent (TEDE)
Sum of the effective dose equivalent (for external exposure) and the CEDE (for internal exposure).

Transmission line
A set of conductors, insulators, supporting structures, and associated equipment used to move large quantities of power at high voltage, usually over long distances between a generating or receiving point and major substations or delivery points.

Travel corridor
Pathways that animals use to travel from one location to another to acquire resources.

Uplift (geologic)
A structurally high area in the crust, produced by positive movements that raise or upthrust the rocks, as in a dome or arch.

Uranium
A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are uranium-235 (0.7 percent of natural uranium), which is fissile, and uranium-238 (99.3 percent of natural uranium), which is fissionable by fast neutrons and is fertile. Natural uranium also includes a minute amount of uranium-234.

Vertical Cask Transporter or VCT
The generic name for a device that has the ability to raise or lower a cask or a canister with the built-in safety of a redundant drop protection system. A VCT may be designed to be limited in its operation space to the ISFSI pad area and/or it may have the capability to translocate the cask over a suitably engineered haul path.

Viewshed
The area on the ground that is visible from a specified location.

Visual Resource Management (VRM)
A process devised by the Bureau of Land Management to assess the aesthetic quality of a landscape and to design proposed activities in a way that would minimize their visual impact on that landscape. The process consists of a rating of site visual quality followed by a measurement of the degree of contrast between the proposed development activities and the existing landscape.

Visual and Scenic Resources
Natural or developed landscapes that provide information for an individual to develop their perceptions of the area. The size, type, gradient, scale, and continuity of landforms, structures, land use patterns, and vegetation are all contributing factors to an area's visual character and how it is perceived.

Volatile organic compound
Any compound containing carbon and hydrogen in combination with any other element that has a vapor pressure of 77.6 millimeters of mercury (1.5 pounds per square inch) absolute or greater under actual storage conditions.

Vertical Ventilated Module (VVM)
The vertical ventilated module wherein the canister (MPC) is stored in the upright orientation.

Waste classification (classes of waste)
Classification of LLW according to its radiological hazard. The classes include Class A, B, and C, with Class A being the least hazardous and accounting for 96 percent of LLW. As the waste class and hazard increase, the regulations established by the NRC require progressively greater controls to protect the health and safety of the public and the environment.

Waste Confidence
Historically, Waste Confidence has been the NRC's generic determination regarding the safety and environmental impacts of storing spent fuel beyond the licensed life for operations of a nuclear power plant. As part of this rulemaking, the name used for the rule will be changed from "Waste Confidence" to "Continued Storage."

Waste management
The planning, coordination, and direction of functions related to generation, handling, treatment, storage, transportation, and disposal of waste. It also includes associated pollution prevention and surveillance and maintenance activities.

Waste minimization
An action that economically avoids or reduces the generation of waste by source reduction and recycling; or reduces the toxicity of hazardous waste, improving energy usage.

Water resources
This term includes both freshwater and marine systems, wetlands, floodplains, and ground water.

Water table
The top of an unconfined aquifer, below which the aquifer is saturated.

Water quality
(i) The fitness of water for use; and (ii) the physical, chemical, and biological characteristics of water

Wetland
The U.S. Army Corps of Engineers and the EPA define wetlands as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wind rose
A graphic display of the distribution of the wind direction at a location during a defined period. It is a set of wind statistics that describes the frequency, direction, force, and speed. The characteristics patterns can be presented in either tabular or graphic forms.

Wind Speed
The speed of air movement measured for a set height above ground level (agl) at a meteorological observing site. This height may vary depending on the location. Typically, anemometers at National Weather Service stations are placed at 32 feet 10 inches (10 meters) agl; however, some are still found at 20 feet (6 meters) agl

Yucca Mountain
Yucca Mountain, Nevada, was the DOE's proposed location for a geologic repository for spent fuel and HLW. After the DOE requested to withdraw the application for the Yucca Mountain site in 2010 and the NRC's Atomic Safety and Licensing Board dismissed the proceeding, the U.S. Court of Appeals in 2013 ordered the NRC resume its license review and the Commission complied. Site selection remains an ongoing process.

CHAPTER 12: LIST OF PREPARERS

12.0 LIST OF PREPARERS

The organizations and individuals listed below are the principal contributors to the preparation of this ER.

12.1 TETRA TECH, INC.

Jay Rose
Project Manager
B.S. Ocean Engineering, U.S. Naval Academy, 1983
J.D., Catholic University Columbus School of Law, 1996

Brandon Hawkins
Deputy Project Manager
M.S., University of Texas of the Permian Basin, 2011
B.S., University of Texas of the Permian Basin, 2009

Maher Itani
Project Engineer, Infrastructure, Waste Management
M.E.A., Engineering Administration, George Washington University, 1987
B.S., Civil Engineering, George Washington University, 1985

Kenneth Bulmahn
Nuclear Resources Manager, Health and Safety, Accidents
B.S., Mechanical Engineering, Purdue University, 1974
Steve Compton
Non-Nuclear Resources Manager
M.S., Utah State University, 1992
B.S., Cornell University, 1986

Delight Buenaflor
Document Integrator, Land Use, Visual Resources, Water Resources, Socioeconomics
B.A., Biology, McDaniel College (Formerly Western Maryland College), 1996

Henry Garson
QA Manager
B.S., Finance, State University of New York at Buffalo, 1964
J.D., State University of New York at Buffalo School of Law, 1967

Kim Hould
Ecological Resources

M.S., New Mexico State University, 2006
B.S., University of Minnesota, 2001

Malcolm Richards
Air Quality and Noise
J.D., Texas Southern University, 2006
B.S., Environmental Management, University of Houston – Clear Lake, 1992

David Wertz
Geology and Soils
M.S., Geophysics, Boston College, 2001
B.S., Environmental Science, University of Rochester, 1998

12.2 STATISTICAL RESEARCH, INC.

Bradley J. Vierra
Cultural Resources
Ph.D., University of New Mexico, 1992
M.A., University of New Mexico, 1985
B.A., California State University, 1975

APPENDIX A: DATA SOURCES

A.1 GENERAL DATA SOURCES

This Appendix discusses the data sources used in this Environmental Report (ER), focusing on the data used to support the environmental analyses. The analyses in the ER were prepared based on the most relevant and most current data sources available. In general, data sources supporting the ER analyses are less than four years old. In cases where older data sources are used, those sources were considered to be the best available. Justifications and discussions for any data sources more than four years old follows, arranged by the environmental resources in Chapters 3 and 4 where the data source first appears in the ER. The full reference citations for the references discussed below are included in Chapter 10 of this ER.

LAND USE

International Isotopes Fluorine Products (IIFP) 2009. Data from this ER, which was prepared in 2009 for a nuclear facility approximately 23 miles northeast of the proposed Consolidated Interim Storage Facility (CISF), provided background data to characterize the affected environment. IIFP 2009 contains information that could not be found in any other more current reference.

Eddy-Lea Energy Alliance (ELEA) 2007. This siting study for the Global Nuclear Energy Partnership (GNEP) involved the same 1,040 acre site that is proposed for the CISF. ELEA 2007 contains data based on site-investigations (such as soil borings and groundwater wells) specifically relevant to the CISF Site. As such, this data source provided unique site-specific information that does not exist in any other source.

Bureau of Land Management (BLM) 1986. The BLM Resource Management Plan Environmental Impact Statement contains the most current information regarding visual resource management classification of the area.

GEOLOGY AND SOILS

Powers et al., 1978. This document provides the most comprehensive characterization of the regional geology for the CISF Site. This document is referenced in numerous environmental reports for nearby facilities because of its comprehensive description of the regional geology, seismicity, and seismic risk. It contains information that could not be found in any other more current reference.

Sanford A., Balch, R., and Delap S., 1993. This reference supports the technical conclusions of Powers 1978, with respect to the design basis earthquake (DBE) for the region; the DBE is again confirmed in reference DOE 2016.

United States Geological Survey (USGS) 2009. The website was designed to display earthquake probabilities that are computed from the source model of the 2008 USGS-National Seismic Hazard Mapping Project (NSHMP) update. There is no more current version for this website application.

ECOLOGICAL RESOURCES

NatureServe 2009. This document provides the Ecological Classification Standard used to describe the Chihuahuan desert. This is the most current document describing the desert.

Dick-Peddie et al. 1993. This reference is used to describe the New Mexico vegetation communities. Nothing as comprehensive has been written since.

NatureServe 2013. This document provides the Ecological classification Standard used to describe the Apaherian-Chihuahuan ecology. This is the most current document describing this resource.

Bureau of Land Management (BLM) 2008. The BLM Resource Management Plan amendment contains the most current information regarding BLM resources in the area.

New Mexico Rare Plant Technical Council (NMRPTC) 1999. This reference provides information regarding rare plants in New Mexico and includes the most recent data available.

AIR QUALITY AND NOISE

New Mexico Environmental Department (NMED) 2010. This document is specific regulatory guidance document and is the current version of this guidance; therefore, this reference is the most current reference with this information.

Holzworth 1972. This is the current leading document on this subject matter. To date, no additional studies have been published to the general public on this subject. Further, more recent documents regarding this subject refer to this document as the authoritative source.

U.S. Environmental Protection Agency (EPA) 1973. This is the current regulatory agency guidance document on this subject matter. To date, no additional standards regarding noise and its effect on the environment has been published to the general public. Also, other documents refer to this document as the authoritative source in regards to a standard of noise level and its effect on the environment. Therefore, this reference is proper.

Geer 1996. This is a reference document of terms. This is the currently, generally accepted reference document in regards to meteorological terms and definitions. Most meteorological studies and publications use document as the authoritative source for meteorological terms and definitions. A new version has of this reference document has not yet been published.

AP42 2006. This document is a regulatory guidance document from the EPA in regards to accepted calculation methodologies and emission factors and is the current version of this guidance.

Texas Commission on Environmental Quality (TCEQ) 2001. This document is a regulatory guidance document from the agency in regards to accepted calculation methodologies and emission factors and is the current version of this guidance.

TCEQ 2011. This document is a regulatory guidance document from the agency in regards to accepted calculation methodologies and emission factors and is the current version of this guidance.

SOCIOECONOMICS

U.S. Census Bureau (USCB) 2010. The 2010 Census is the latest Census for the U.S., and provides the most current source of data related to may socioeconomic factors, such as housing units, addressed in the ER.

TRANSPORTATION

U.S. Department of Energy (DOE) 2008. The *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (*DOE/EIS-0250F-S-1) contains the most recent analysis of the environmental impacts of transporting spent nuclear fuel (SNF) from the nation's nuclear power sites to a geological repository.

PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

ANSI/ANS-57.9. This reference merely provides a description of the events that fall into the various off-normal/accident conditions. This categorization scheme is not time sensitive and is widely used.

NRC 2001. This reference is the most recent and only EIS addressing a site-specific independent spent fuel storage installations (ISFSI), so there are no other sources to consider. This is a key reference for the Generic EIS (NRC 2014b), which shows it is the most recent.

NRC 2007. This is the newest and only detailed probabilistic risk assessment (PRA) addressing ISFSIs and, therefore, it is the only available reference.

A.2 METEOROLOGICAL DATA

This ER uses meteorological data from the Western Region Climate Center (WRCC), which is located at the Lea County Regional Airport approximately 23 miles from the proposed CISF Site. Meteorological data from the Waste Isolation Pilot Plant (WIPP), which is located approximately 16 miles away from the proposed CISF Site was also considered in the ER. However, for the

reasons explained below, the data from the WRCC was considered to be better and more representative.

1. The WRCC is a governmental department closely associated with the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS). The data from the WRCC is generally considered to be the authoritative source of meteorological data. The WIPP meteorological data is not generally considered an authoritative source of meteorological data. Due to this, the WRCC would be considered the better data.
2. WIPP meteorological data only dates back approximately 20 years, whereas WRCC has more than 60 years of data (back to 1948). Due to this, the representation of weather patterns, average temperatures, average wind speeds and wind directions, and average precipitation from the WRCC is the better data. This is because the amount of both annual and monthly average data better represents the variations that occur over years of weather patterns.
3. WRCC has detailed data and averages such as distinctions between rainfall precipitation and snowfall precipitation; single day high and low temperatures; and single day rainfall and snowfall rates since 1948. The WIPP data only has averages over approximately the past 20 years.
4. Perhaps most importantly, the WRCC and WIPP meteorological averages are substantially similar. Examples of this are the temperature and wind data. In 2014, the annual average temperatures were within two degrees (WIPP = 62.7 degrees Fahrenheit and WRCC = 61.2 degrees Fahrenheit). In addition, the WIPP and WRCC wind data all show the majority of wind from the south to east sector with over 80 percent of the wind speeds being between zero and nineteen miles per hour.

APPENDIX B: ECOLOGICAL SURVEY RESULTS

Survey results are in attached pages.

TETRA TECH

October 19, 2016

Ed Mayer
Program Director
Holtec International
Holtec International Technology Center
One Holtec Drive
Marlton, NJ 08053

Re: Holtec International
Holtec Underground Consolidated Interim Storage Facility
Lea County, New Mexico
Ecological Survey

Dear Mr. Mayer:

Tetra Tech, Inc. (Tetra Tech) conducted an in-field ecological survey of the Holtec Underground Consolidated Interim Storage Facility project (Project) in Lea County, New Mexico. The purpose of this survey was to confirm previous findings (ELEA 2007), and document a baseline characterization of the ecology at the project area prior to disturbances associated with construction and operation of the Project.

Project Purpose and Description

Holtec International is proposing to construct and operate a Consolidated Interim Storage Facility (CISF) in Lea County, New Mexico, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico. The CISF would be constructed and operated on an approximately 330 acre footprint.

The proposed CISF would store canisters containing Spent Nuclear Fuel (SNF) and Reactor-Related Greater than Class C Low-Level Radioactive Waste (LLRW) entirely below-ground to serve as a “security-friendly” storage facility. The CISF would not have any aboveground structures for the transfer of loaded canisters. Nor would it require any utilities (water, compressed air, or electric power) for its operation.

Survey Methods

Tetra Tech conducted a survey of the project area on October 14, 2016. The survey consisted of six vegetation sample points along eight transect lines in order to collect a biological representation of the Project area. Visual observations of any wildlife were also documented within the Project area. In addition, noxious weeds and any other notable features were taken into consideration during field surveys. Results of the field survey are listed below.

Survey Results

Vegetation

Major characteristics

The area of interest is currently composed entirely of mesquite upland scrubland habitat, although historically a desert grassland. Due to evident overgrazing, the vegetation has changed from a desert grassland to mesquite scrubland. **Table 1** depicts the dominant species that were found during the surveys.

Table 1. Dominant Plant Species

Common Name	Scientific Name
Broom snakeweed	*Gutierrezia sarothrae*
Honey mesquite	*Prosopis glandulosa*
Prairie verbena	*Glandularia bipinnatifida*
Prickly pear	*Opuntia engelmannii*
Scarlet globemallow	*Sphaeralcea coccinea*
Silverleaf nightshade	*Solanum elaeagnifolium*
Tobosa grass	*Pleuraphis mutica*
Western peppergrass	*Lepidium montanum*
Woolly croton	*Croton capitatus*

Condition

The area of interest is at the climax stage of plant successional stages. Due to heavy presence of honey mesquite and broom snakeweed, it is determined that the plant community is well established and will not change over time. The majority of the plant species listed in **Table 1** are indicative of heavy long-term grazing practices. There were no signs of present grazing or plant species desirable to livestock found within the immediate Project area. Silverleaf nightshade was the only discovered invasive species listed for Lea County, New Mexico in the Project area. Silverleaf nightshade is commonly found on disturbed sites.

Several low-lying areas were found within the Project area that show evidence of water catchment after heavy rain events. The presence of thick vegetation suggests consistent ephemeral flooding.

Important Habitat

The surveyed area primarily consists of short shrubs with honey mesquite reaching heights of up to 12-feet. There were no trees and a fairly small population of grass species. During surveys, only one listed species was observed; the loggerhead shrike (*Lanius ludovicianus*), which is listed as a Sensitive Taxa with Full Protection by the state of New Mexico. The loggerhead shrike was observed perched on top of a honey mesquite shrub that measured approximately 10-feet in height.

Noxious Weeds

There are four plant species within the BLM CFO that are identified in the New Mexico Noxious Weed List Noxious Weed Management Act of 1998. These species are African rue (*Peganum harmala)*, Malta starthistle (*Centaurea melitensis)*, Russian olive (Elaeagnus

angustifoia), and salt cedar (*Tamarix spp.*). During field surveys, none of the noxious weeds were observed.

<u>*Wildlife*</u>

Species observations

During field surveys, three mammals and eight birds were observed. There were no amphibians or reptiles observed. Observed species are provided below in **Table 2**.

Table 2. Observed Wildlife

Common Name	Scientific Name
Mammals	
Black-tailed jackrabbit	*Lepus californicus*
Desert cottontail	*Sylvilagus audubonii*
Mearn's grasshopper mouse	*Onychomys arenicola*
Birds	
Lark sparrow	*Chondestes grammacus*
Loggerhead shrike	*Lanius ludovicianus*
Mourning dove	*Zenaida macroura*
Northern harrier	*Circus cyaneus*
Red-tailed hawk	*Buteo jamaicensis*
Scaled quail	*Callipepla squamata*
Western meadowlark	*Sturnella neglecta*
White-winged dove	*Zenaida asiatica*

Threatened, Endangered and Sensitive Wildlife Species Sightings

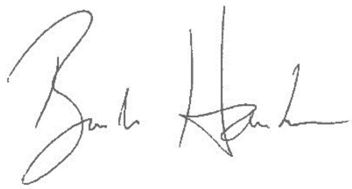
No federally-listed species were observed during field surveys. However, a loggerhead shrike, a state-listed Sensitive Taxa with Full Protection species, was observed. The loggerhead shrike is found across a broad range of habitat, including forested, non-forested, agricultural, and semi-arid habitats which include grasslands with scattered shrubs.

<u>*Water Resources*</u>

During field surveys, there were no water sources observed. An area in the northeast corner of the Project area showed evidence of flooding due to an old culvert that was installed under a private ranch road. Several low-lying areas and a canyon-like feature approximately 300 feet north of the Project area were found. Both mentioned features showed evidence of collecting water during heavy rain events due to thick communities of upland vegetation. However, this drainage does not exhibit suitable bed and bank morphology and is within a topographically closed basin, and not a tributary to a Water of the United States (WUS).

If you have any questions or require additional information, please contact me by e-mail at brandon.hawkins@tetratech.com or by phone at 432-687-8125.

Sincerely,



Brandon Hawkins
Senior Project Manager

Reference

ELEA 2007 Eddy Lea Energy Alliance (ELEA). Eddy Lea Siting Study. April 28, 2007.

APPENDIX C: CULTRURAL RESOURCES COMMUNICATIONS AND SURVEY RESULTS

Survey results are in attached pages.

NMCRIS No.: 137254

NMCRIS INVESTIGATION ABSTRACT FORM (NIAF)

1. NMCRIS Activity No.:	2a. Lead Agency:	2b. Other Agency(ies):	3. Lead Agency Report No.:
137254	U.S. Nuclear Regulatory Commission	U.S. Department of the Interior Bureau of Land Management–Carlsbad Field Office	

4. Title of Report:

A Cultural Resource Inventory of the Holtec International Proposed Consolidated Interim Storage Facility (CISF) Project Area, Lea County, New Mexico

Author(s)

Monica L. Murrell and Tim M. Mills

5. Type of Report

- [ ] Negative
- [x] Positive

6. Investigation Type

- [ ] Research Design
- [x] Archaeological Survey/Inventory
- [ ] Architectural Survey/Inventory
- [ ] Test Excavation
- [ ] Excavation
- [ ] Collections/Non-Field Study
- [ ] Compliance Decision Based on Previous Inventory
- [ ] Overview/Lit Review
- [ ] Monitoring
- [ ] Ethnographic Study
- [ ] Site/Property Specific Visit
- [ ] Historic Structures Report
- [ ] Other

7. Description of Undertaking (what does the project entail?):

This document presents the results of the cultural resource inventory by Statistical Research, Inc. (SRI), of the Holtec International (Holtec) proposed Consolidated Interim Storage Facility (CISF) Project area. Phase I of the proposed CISF would be constructed and operated on an approximately 27.25-acre initial footprint within an approximately 119.4-acre parcel. That acreage does not include appurtenant infrastructure, such as support buildings, a parking lot, an access road, and a rail spur. The Project area is located in southeastern New Mexico, in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico. The block parcel that would contain the CISF, support buildings, and parking lot is confined to lands owned by Holtec, and the linear access segments are on a mixture of lands managed by the U.S. Department of the Interior Bureau of Land Management– (BLM-) Carlsbad Field Office (CFO) and owned by private individuals. This cultural resource inventory was performed under contract with Tetra Tech, Inc., in support of an Environmental Report that will be submitted to the U.S. Nuclear Regulatory Commission (NRC).

[x] **Continuation**

8. Dates of Investigation: from: 06-Dec-2016 to: 09-Dec-2016

9. Report Date: 30-Dec-2016

10. Performing Agency/Consultant: Statistical Research, Inc.

Principal Investigator: Monica Murrell

Field Supervisor: Tim Mills

Field Personnel Names: Amanda Hernandez, Harlan McCaffrey, Ted Etsitty

Historian / Other: Karen Swope

11. Performing Agency/Consultant Report No.:

16-135

12. Applicable Cultural Resource Permit No(s):

U.S. Department of the Interior Bureau of Land Management Permit No. 159-2920-16-O

NMCRIS No.: 137254

13. Client/Customer (project proponent):

Tetra Tech

Contact: Brandon Hawkins

Address: 4000 N. Big Spring, Ste. 401, Midland, TX 79705 **Phone:** 432-687-8125

14. Client/Customer Project No.:

15. Land Ownership Status (must be indicated on project map):

Land Owner (By Agency)	Acres Surveyed	Acres in APE
Private individual (see records for name)	262.45	262.45
BLM-CFO	27.66	27.66
TOTALS	290.11	290.11

16. Records Search(es):

Date(s) of HPD/ARMS File Review: 30 Nov 2016	Name of Reviewer(s): Phillip O. Leckman	
Date(s) of Other Agency File Review: 1 Dec 2016	Name of Reviewer(s): Timothy M. Mills	Agency: BLM-CFO

17. Survey Data:

a. Source Graphics [ ] **NAD 27** [x] **NAD 83** **Note: NAD 83 is the NMCRIS standard.**

☐ **USGS 7.5' (1:24,000) topo map** ☐ **Other topo map, Scale:**

☑ **GPS Unit** **Accuracy** ☑ **<1.0m** ☐ **1-10m** ☐ **10-100m** ☐ **>100m** ☐ **Aerial Photo(s)**

Other Source Graphic(s):

b. USGS 7.5' Topographic Map Name	**USGS Quad Code**
Williams Sink, NM	32103-E7
Laguna Gatuna, NM	32103-E6

c. County(ies): LEA

d. Nearest City or Town: Carlsbad, NM

e. Legal Description:

Township (N/S)	Range (E/W)	Section
20S	32E	12
20S	33E	18
20S	32E	13
20S	32E	14
20S	32E	15
20S	32E	16
20S	33E	19

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20S	32E	23
20S	32E	24
20S	32E	22
20S	32E	20
20S	32E	21
20S	32E	19

Projected legal description? [ ] **Yes** [x] **No** [ ] **Unplatted**

f. Other Description (e.g. well pad footages, mile markers, plats, land grant name, etc.):

[ ] **Continuation**

18. Survey Field Methods:

Intensity: [x] 100% coverage [ ] <100% coverage

Configuration: [x] block survey units [x] linear survey units (l x w): 9.14 miles long x various widths

[ ] other survey units (specify):

Scope: [x] non-selective (all sites/properties recorded) [ ] selective/thematic (selected sites/properties recorded)

Coverage Method: [x] systematic pedestrian coverage

[ ] other method (describe):

Survey Interval (m): 15 **Crew Size:** 4 **Fieldwork Dates:** from: 06-Dec-2016 to: 09-Dec-2016

Survey Person Hours: 60.00 **Recording Person Hours:** 60.00 **Total Hours:** 120.00

Additional Narrative:

The project area contains one block survey area and several linear corridors.

[ ] **Continuation**

19. Environmental Setting (NRCS soil designation; vegetative community; elevation; etc.):

The pipeline is contained within the Mescalero Plain physiographic subregion, within the Permian Basin of southeastern New Mexico. This major landform is characterized by the environmental setting of the Chihuahuan Desert. The Mescalero Plain, though considered part of the Pecos Valley Section, is distinguished by the westward-sloping pediment surface extending from the base of the Mescalero Ridge to the Pecos River. The Mescalero sand sheet covers approximately 80 percent of this landform. Dunes, drainages, sinks, and rock outcrops provide some local relief across what is predominantly level terrain. The project area occurs within a predominantly flat plain with minimal dune formation and falls within an elevation range of 3,470–3,540 feet above mean sea level (AMSL), although most of survey area is between a narrower range of 3,510–3,520 feet AMSL. The sediments are alluvial with caliche nodules. The eastern edge of the project area, however, slopes down into a floodplain that leads to Laguna Gatuna, where sediments are more clayey and compact. The vegetation consists of mesquite, snakeweed, and various small forbs and grasses.

[ ] **Continuation**

20.a. Percent Ground Visibility: 76-99% **b. Condition of Survey Area (grazed, bladed, undistributed, etc.):**

At least 75 percent of the survey area is characterized by stable, undisturbed sediments with good geomorphic integrity. A heavily used modern road runs adjacent to a 5-mile stretch of the linear survey portion but has little impact on the project area. The majority of surface disturbance comes from bioturbation as a result of cattle trampling and rodent burrows. Particularly in the block-survey area, large rabbit warrens and pack-rat dens are common and can reach up to 1 m in height. With the exception of a 25-foot-wide two-track road and two pipeline corridors on the eastern side of the survey corridor, there appears to be little mechanical disturbance overall.

[ ] **Continuation**

21. CULTURAL RESOURCE FINDINGS [x] **Yes, see next report section** [ ] **No, discuss why:**

[ ] **Continuation**

NMCRIS No.: 137254

22. Attachments (check all appropriate boxes):

[x] USGS 7.5 Topographic Map with sites, isolates, and survey area clearly drawn (required)

[x] Copy of NMCRIS Map Check (required)

[x] LA Site Forms - new sites (with sketch map & topographic map) if applicable

[x] LA Site Forms (update) - previously recorded & un-relocated sites (first 2 pages minimum)

[x] Historic Cultural Property Inventory Forms, if applicable

[x] List and Description of Isolates, if applicable

[ ] List and Description of Collections, if applicable

23. Other Attachments:

[ ] Photographs and Log

[x] Other Attachments **(Describe):** BLM map check

24. I certify the information provided above is correct and accurate and meets all applicable agency standards.

Principal Investigator/Qualified Supervisor: **Printed Name:** Monica Murrell

Signature: [signature] **Date:** 30 Dec 2016 **Title:** Principal Investigator

25. Reviewing Agency

Reviewer's Name/Date:

Accepted [ ] **Rejected** [ ]

26. SHPO

Reviewer's Name/Date:

HPD Log #:

Date sent to ARMS:

CULTURAL RESOURCE FINDINGS

[fill in appropriate section(s)]

SURVEY RESULTS:

Archaeological Sites discovered and registered: 1

Archaeological Sites discovered and NOT registered: 0

Previously recorded archaeological sites revisited (site update form required): 1

Previously recorded archaeological sites not relocated (site update form required): 0

TOTAL ARCHAEOLOGICAL SITES (visited & recorded): 2

☐ **Non-selective isolate recording?**

Total isolates recorded: 16

HCPI properties discovered and registered: 2

HCPI properties discovered and NOT registered: 0

Previously recorded HCPI properties revisited: 0

Previously recorded HCPI properties not relocated: 0

TOTAL HCPI PROPERTIES (visited & recorded, including acequias): 2

NMCRIS No.: 137254

MANAGEMENT SUMMARY:

This document presents the results of the cultural resource inventory by SRI of the Holtec proposed CISF Project area. Phase I of the proposed CISF would be constructed and operated on an approximately 27.25-acre initial footprint within an approximately 119.4-acre parcel. That acreage does not include appurtenant infrastructure, such as support buildings, a parking lot, an access road, and a rail spur. The Project area is located in southeastern New Mexico, in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico. The block parcel that would contain the CISF, support buildings, and parking lot is confined to lands owned by Holtec, and the linear access segments are on a mixture of lands managed by the BLM-CFO and owned by private individuals. This cultural resource inventory was performed under contract with Tetra Tech, Inc., in support of an Environmental Report that will be submitted to the NRC. SRI's cultural resource inventory for the Project covered a cumulative area of 290.11 acres within Lea County, in southeastern New Mexico.

[x] **Continuation**

IF REPORT IS NEGATIVE, YOU ARE DONE AT THIS POINT.

SURVEY LA/HCPI NUMBER LOG

Sites/Properties Discovered:

LA/HCPI No.	Field/Agency No.	Eligible? (Y/N/U, applicable criteria)
HCPI 42195	SRI-1018	N
LA 187010	SRI-1031	Y, criterion d

Previously recorded revisited sites/HCPI properties:

LA/HCPI No.	Field/Agency No.	Eligible? (Y/N/U, applicable criteria)
LA 89676	SRI-1045	Y, criterion d
HCPI 42196	SRI-1057/LA 149299	N

MONITORING LA NUMBER LOG (site form required)

Sites Discovered (site form required):

LA No. **Field/Agency No.**

Previously recorded sites (site update form required):

LA No. **Field/Agency No.**

Areas outside known nearby site boundaries monitored? [ ] **Yes** [ ] **No, Explain why:**

TESTING & EXCAVATION LA NUMBER LOG (site form required)

Tested LA number(s)

Excavated LA number(s)

NMCRIS No.: 135954

Continuation Sheet

7. Description of Undertaking (what does the project entail?):

The CISF would be constructed for storage of Spent Nuclear Fuel and Reactor-Related Greater than Class C Low-Level Radioactive Waste (SNF). Holtec intends to request authorization to possess and store 500 canisters and anticipates subsequently requesting authorization to possess and store an additional 500 canisters of SNF for each of nineteen subsequent expansion phases to be completed over the course of 20 years. Ultimately, Holtec anticipates that 100,000 MTUs of SNF would be stored at the CISF upon completion of all eight phases.

CULTURAL RESOURCE FINDINGS

MANAGEMENT SUMMARY:

Survey was conducted by a crew of four persons from December 6 through 8, 2016. The survey area consisted of one block parcel and several linear corridors that represent the potential paths of future rail lines and/or service roads. Corridor widths were 30 feet for existing or planned access roads and 50 feet for planned rail corridors. The survey resulted in the documentation of 1 previously recorded prehistoric archaeological site, 1 newly recorded prehistoric archaeological site, 1 previously documented historical-period site (henceforth considered a historic cultural property), 1 newly documented historic cultural property, and 16 isolated occurrences. Both of the recorded prehistoric sites are recommended *eligible* for listing in the National Register of Historic Places, and the linear resources related to the historical-period built environment are recommended *not eligible*.

Authorization # (BLM Use):

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FIELDWORK AUTHORIZATION REQUEST

To Conduct Specific Cultural Resource Work Under the Authority of a Cultural Resource Use Permit Issued by the Bureau of Land Management Pursuant to Sec. 302(b) of P.L. 94-579, October 21, 1976, 43 U.S.C. 1732 and Sec. 4 of P.L. 96-95, October 31, 1979, 16 U.S.C. 470cc

1. Name of Permittee and Company
Brad Vierra, SRI

2. Date Permit Issued

3. Contact Telephone Number
505 323 9300

4. Project Name and Client Name

5. Location of Work or Legal Description (Include map)
   a. Description of Public Lands Involved
T20S R33E Sections 13 & 18
T20S R32E Section 14

6. Nature of Cultural Resource Work (Survey, APE, etc.)
   a. Identification of Previous Surveys and Sites (if applicable)
Feasibility Survey for EIS

7. Name of Individual(s) Responsible for Planning & Supervising Field Work, & Approving Reports, Evaluations, & Recommendations
Monica Murrell

8. Signature of Individual Conducting Pre-Field Consultation
[signature]

9. Date
Dec 1, 2016

· The individual named in item 7 above shall be present during the conduct of field work authorized herein, or shall notify the authorized officer of the need for any extended absence, and shall make provision that the work will be carried out under supervision of equal quality, by an individual approved by the authorized officer.

· All terms and conditions of the permit continue to apply; any special conditions attached hereto have the same force and effect as conditions of the permit.

· Permittee shall immediately notify the authorized officer of any change in items 3 through 7 above.

Fieldwork Authorization Request approved by: [signature]
(Signature of BLM Authorized Officer)

Date: 12/1/16

State	Township	Direction	Range	Direction	Township/Range Label	Section

Contains information protected under 10 CFR 2.390(a)(3) and Section 304 of the National Historic Preservation Act

Isolated Occurrences Documented in the Project Area

PD No.	Description	UTM Coordinates (NAD 83)	
		Easting	Northing

Contains information protected under 10 CFR 2.390(a)(3) and Section 304 of the National Historic Preservation Act

Contains information protected under 10 CFR 2.390(a)(3) and Section 304 of the National Historic Preservation Act

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A Cultural Resource Inventory of the Holtec International Proposed Consolidated Interim Storage Facility (CISF) Project Area, Lea County, New Mexico

Edited by Monica L. Murrell and Timothy M. Mills

with contributions by Carrie J. Gregory and David T. Unruh

Submitted to
Tetra Tech, Inc.
4000 N. Big Spring, Ste. 401
Midland, TX 79705

Technical Report 16-135
Statistical Research, Inc.
Albuquerque, New Mexico

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LIST OF ACRONYMS AND ABBREVIATIONS

AMSL	above mean sea level
BLM	U.S. Department of the Interior Bureau of Land Management
CFO	Carlsbad Field Office
CISF	Consolidated Interim Storage Facility
cmbs	centimeters below surface
FCR	fire-cracked rock
GPS	Global Positioning System
HCPI	Historic Cultural Property Inventory
Holtec	Holtec International
IO	isolated occurrence
LA	Laboratory of Anthropology
MTUs	Metric Tons of Uranium
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
SNF	Spent Nuclear Fuel and Reactor-Related Greater Than Class C Low-Level Radioactive Waste
SRI	Statistical Research, Inc.
ST	Shovel Test

CHAPTER 1

Introduction

Carrie Gregory and Tim M. Mills

This document presents the results of the cultural resource inventory by Statistical Research, Inc. (SRI), of the Holtec International (Holtec) proposed Consolidated Interim Storage Facility (CISF) Project area. Phase I of the proposed CISF would be constructed and operated on an approximately 27.25-acre initial footprint within an approximately 119.4-acre parcel. That acreage does not include appurtenant infrastructure, such as support buildings, a parking lot, an access road, and a rail spur. The Project area is located in southeastern New Mexico, in Lea County, 32 miles east of Carlsbad, New Mexico, and 34 miles west of Hobbs, New Mexico (Figures 1.1 and 1.2). The block parcel that would contain the CISF, support buildings, and parking lot is confined to lands owned by Holtec, and the linear access segments are on a mixture of lands managed by the U.S. Department of the Interior Bureau of Land Management– (BLM-) Carlsbad Field Office (CFO) and owned by private individuals. This cultural resource inventory was performed under contract with Tetra Tech, Inc., in support of an Environmental Report that will be submitted to the U.S. Nuclear Regulatory Commission (NRC).

The CISF would be constructed for storage of Spent Nuclear Fuel and Reactor-Related Greater Than Class C Low-Level Radioactive Waste (hereinafter referred to collectively as "SNF"). Holtec intends to request authorization to possess and store 500 canisters and anticipates subsequently requesting authorization to possess and store an additional 500 canisters of SNF for each of nineteen subsequent expansion phases to be completed over the course of 20 years. Ultimately, Holtec anticipates that 100,000 MTUs of SNF would be stored at the CISF upon completion of all eight phases.

A permit has not yet been sought for this Project, and no undertaking has been established. Once a permit is acquired and an undertaking initiated, the NRC will be required to conduct an assessment of cultural properties that could potentially be affected by the Project, in compliance with Section 106 (*U.S. Code*, Title 54, Section 306108) of the National Historic Preservation Act of 1966, as amended, and its implementing legislation, *Code of Federal Regulations*, Title 36, Part 800, To accomplish this, the NRC must first identify cultural resources that may be affected by the proposed undertaking and then evaluate those resources to determine whether they are historic properties, which are prehistoric and historical-period sites, buildings, structures, districts, and objects listed in, or eligible for listing in, the National Register of Historic Places (NRHP).

In anticipation of subsequent federal and/or state permitting, all fieldwork and reporting have conformed to the regulations for performing cultural resource survey provided in New Mexico Administrative Code, Title 4: Cultural Resources; BLM Manual Supplement H-8100-1, *Procedures for Performing Cultural Resource Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities* (BLM 2005); and *Standards for Survey Site Evaluation and Reporting for the CFO* (BLM-CFO 2012).

The intent of the cultural resource inventory was to locate and document cultural resources that intersect with the proposed Project area. The objectives of the inventory were to identify and evaluate the potential eligibility of any cultural resources for listing in the NRHP. Pedestrian cultural resource survey was conducted across the Project area in 15-m-wide transects. The survey area ultimately comprised a cumulative area of 290.11 acres, including a 242.88-acre block parcel and a series of linear access corridors extending a distance of 14.72 km (9.14 miles). The linear corridors include a 50-foot-wide rail spur measuring 12 km (7.45 miles) in length and a 30-foot-wide access road measuring 2.7 km (1.6 miles) in length. Survey was conducted by a crew of four people from December 6 through 8, 2016.

Contains information protected under 10 CFR 2.390(a)(3) and Section 304 of the National Historic Preservation Act

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The survey resulted in the documentation of 1 previously recorded archaeological site, 1 newly recorded archaeological site, 2 linear resources associated with the historical-period built environment, and 16 isolated occurrences (IOs). The 2 archaeological sites are both recommended *eligible* for listing in the NRHP, and the 2 historical-period linear properties are recommended *not eligible*.

This chapter provides an overview of the Project. Chapters 2 and 3, respectively, describe the Project environmental setting and cultural background. Chapter 4 outlines the survey methods, and Chapter 5 describes the cultural resources recorded within the proposed Project area. A summary is presented in Chapter 6. Appendix A contains the Project corridor maps, showing the locations of IOs, which are listed in Appendix B. Appendixes C and D contain detailed data from Project shovel tests and features, and artifact data are presented in Appendix E. New Mexico Laboratory of Anthropology (LA) site forms and Historic Cultural Property Inventory (HCPI) forms related to the historical-period built environment are provided in Appendix F.

CHAPTER 2

Environmental Context

Monica L. Murrell

Introduction

This chapter presents an overview of the environmental context of the Project area. The pipeline is contained within the Mescalero Plain physiographic subregion, within the Permian Basin of southeastern New Mexico. This major landform is characterized by the environmental setting of the Chihuahuan Desert. In this chapter, the historical development of the natural environment in the vicinity of the Project area is discussed within the context of the Chihuahuan Desert region.

Regional Overview of the Chihuahuan Desert

The Chihuahuan Desert is one of the largest deserts in North America. Straddling the U.S.-Mexico border, it occupies portions of northern Mexico, central and southern New Mexico, and Texas west of the Pecos River. The Chihuahuan Desert formed over the last 8,000 years and is characterized by shrubby desert scrub species, such as creosote bush, mesquite, and ocotillo (Table 2.1), which are situated along large expanses of outwash plains, low hills, and valleys (Brown 1994). Upslope of the shrubby plains, bedrock outcrops and arroyo, *bajada*, and piedmont habitats give way to increasingly rich succulent-scrub communities of leaf-and-stem succulents, including agave, yucca, and sotol (see Table 2.1), that grade into semidesert grasslands at their upper limits (Brown 1994). Chihuahuan Desert desert scrub vegetation has replaced much of the semidesert grasslands that once covered large portions of southeastern New Mexico, largely as a result of the overgrazing that has occurred during the past 150 years. Adjacent vegetation communities situated to the north and east of the Project area retain characteristics of the semidesert- and plains-grassland plant communities, such as the short- and midgrass prairie characteristic of the Southern High Plains (Brown 1994).

Major watercourses near the Project area include the Pecos and Delaware Rivers, which coalesce near the New Mexico–Texas border in Eddy County. A number of smaller, ephemeral washes, such as Tucker Draw, Brush Draw, Wood Draw, Dog Town Draw, and Pickett Draw, serve as tributaries for these major rivers. Most of the drainage within the Chihuahuan Desert is internal, characterized by bolsons and barren playas that once were pluvial lakes. Dune fields have developed across many of these lowland areas as a result of the transportation of dry lakebed deposits by the wind. Aeolian dune and sand-sheet deposits are composed predominantly of quartz or gypsum originating from the calcareous soils that cover much of the region. Playas served as important resources to prehistoric populations, and several archaeological sites surround these areas or are situated very close by. A number of sizable playa depressions situated near the Project vicinity include Laguna Plata, Laguna Gatuna, and Laguna Tonto. Playa settings exhibit a notable diversity of plant species similar to those of wetland communities, such as cattail (*Typha* spp.) and bulrush (*Scirpus* spp.), and provide an important resource patch of seed-bearing annuals that, in turn, also attract a diversity of faunal species, including big game and waterfowl (Haukos 1997). Water availability is the most critical resource that has impacted the nature of both prehistoric and historical-period land use across the Project area. Agricultural pursuits conducted across the area during the historical period relied heavily on irrigation systems developed off major watercourses, including both the Delaware and the Pecos River. Ranching activities were also greatly influenced by available water resources.

Table 2.1. Plants Commonly Identified in the Project Area

Family	Genus	Species	Subspecies/ Variety	Common Name
Acanthaceae (acanthus)	*Stenandrium*	*barbatum*		early shaggytuft, shaggy stenandrium
Agavaceae (agave)	*Agave*	*parryi*	ssp. *neomexicana*	New Mexico agave, Parry's agave
	Yucca	*baccata*		banana yucca, datil yucca
	Yucca	*elata*		soaptree yucca
	Yucca	*torreyi*		Torrey's yucca
Amaranthaceae (amaranth)	*Amaranthus*	*acanthochiton*		greenstripe
	Amaranthus	*albus*		pigweed amaranth, prostrate pigweed, tumble pigweed
	Amaranthus	*palmeri*		Palmer's amaranth, carelessweed
	Atriplex	*hymenelytra*		desert holly
	Froelichia	*floridana*		cottonweed, field snakecotton
	Tidestromia	*lanuginosa*		woolly honeysweet, woolly tidestromia
Anacardiaceae (cashew)	*Rhus*	*virens*	var. *choriophylla*	evergreen sumac, Mearns's sumac
Asteraceae (sunflower)	*Artemisia*	*dracunculus*		dragon wormwood, false tarragon, green sagewort
	Artemisia	*ludoviciana*		white sagebrush, gray sagewort, prairie sage
	Baccharis	*salicina*		Great Plains falsewillow, willow baccharis
	Bahia	*dissecta*		ragleaf bahia
	Baileya	*multiradiata*		desert marigold
	Berlandiera	*lyrata*		lyreleaf greeneyes
	Brickellia	*laciniata*		splitleaf brickellbush
	Chrysactinia	*mexicana*		damianita
	Dyssodia	*papposa*		prairie dogweed
	Ericameria	*nauseosa*		goldenbush, rubber rabbitbrush
	Erigeron	*divergens*		spreading daisy, spreading fleabane
	Erigeron	*modestus*		plains fleabane
	Flourensia	*cernua*		tarbush
	Grindelia	*squarrosa*		curlycup gumweed
	Gutierrezia	*microcephala*		threadleaf snakeweed
	Gutierrezia	*sarothrae*		broom snakeweed
	Gutierrezia	*sphaerocephala*		roundleaf snakeweed
	Gutierrezia	*wrightii*		Wright's snakeweed
	Helianthus	*annuus*		annual sunflower
	Lactuca	*serriola*		prickly lettuce
	Machaeranthera	*tanacetifolia*		Tahoka daisy
	Melampodium	*leucanthum*		Plains Blackfoot daisy
	Parthenium	*confertum*	var. *lyratum*	Gray's feverfew
	Parthenium	*incanum*		mariola
	Ratibida	*columnifera*		prairie coneflower, Mexican hat

Family	Genus	Species	Subspecies/ Variety	Common Name
	Sartwellia	*flaveriae*		creeping zinnia, threadleaf glowwort
	Senecio	*flaccidus*		Douglas senecio, threadleaf groundsel
	Sonchus	*asper*		perennial sowthistle, prickly sowthistle
	Taraxacum	*officinale*		common dandelion
	Verbesina	*encelioides*		golden crownbeard
	Viguiera	*dentata*		sunflower goldeneye, toothleaf goldeneye
	Viguiera	*stenoloba*		resinbush, skeletonleaf
	Viguiera	*tenuifolia*		leafy goldeneye
	Xanthium	*strumarium*		common cocklebur
	Zinnia	*acerosa*		desert zinnia, spinyleaf zinnia
	Zinnia	*grandiflora*		Plains zinnia, Rocky Mountain zinnia
Berberidaceae (barberry)	*Mahonia*	*haematocarpa*		red barberry
	Mahonia	*trifoliolata*		agarito, algerita
Bignoniaceae (catalpa)	*Chilopsis*	*linearis*		desert willow
Boraginaceae (borage)	*Tiquilia*	*canescens*		rat-ear coldenia, woody crinklemat
	Tiquilia	*greggii*		Gregg’s coldenia, plumed crinklemat
	Tiquilia	*hispidissima*		hairy coldenia, hairy crinklemat
Brassicaceae (mustard)	*Descurainia*	*pinnata*		green tansymustard, western tansymustard
	Lepidium	*lasiocarpum*		hairypod pepperweed, shaggyfruit pepperweed
	Lesquerella	*fendleri*		Fendler bladderpod
	Lesquerella	*gordonii*		Gordon’s bladderpod
	Nerisyrenia	*camporum*		bicolor fanmustard
	Thlaspi	*arvense*		fanweed, field pennycress
Cactaceae (cactus)	*Echinocactus*	*horizonthalonius*		devilshead cactus
	Echinocactus	*texensis*		horse crippler
	Echinocereus	*pectinatus*		rainbow cactus
	Echinocereus	*triglochidiatus*		claretcup cactus
	Echinocereus	*viridiflorus*		brown-spine hedgehog cactus, green pitaya
	Mammillaria	*heyderi*		Heyder’s pincushion, little nipple cactus
	Opuntia	*engelmannii*	var. *lindheimeri*	Texas pricklypear
	Opuntia	*imbricata*		cane cholla, walkingstick cholla
	Opuntia	*leptocaulis*		Christmas cholla, tasajillo
	Opuntia	*phaeacantha*		brownspine pricklypear, tulip pricklypear
Capparaceae (caper)	*Koeberlinia*	*spinosa*		allthorn, crown of thorns, spiny allthorn
Caryophyllaceae (pink)	*Cerastium*	*nutans*		common chickweed, nodding chickweed
Chenopodiaceae (goosefoot)	*Atriplex*	*canescens*		fourwing saltbush
	Kochia	*scoparia*		kochia weed
	Krascheninnikovia	*lanata*		winterfat
	Salsola	*kali*		Russian thistle, tumbleweed

continued on next page

Family	Genus	Species	Subspecies/ Variety	Common Name
	Salsola	*tragus*		prickly Russian
Commelinaceae (spiderwort)	*Commelina*	*erecta*		erect dayflower
	Tradescantia	*wrightii*		Wright's spiderwort
Convolvulaceae (morning glory)	*Convolvulus*	*arvensis*		European bindweed, field bindweed
	Ipomoea	*lindheimeri*		blue morning glory, Lindheimer's morning glory
Cucurbitaceae (gourd)	*Cucurbita*	*foetidissima*		coyote melon, buffalo gourd
Cupressaceae (cypress)	*Juniperus*	*deppeana*		alligator juniper
	Juniperus	*monosperma*		one-seed juniper
	Juniperus	*pinchotii*		Pinchot's juniper
Elaeagnaceae (oleaster)	*Elaeagnus*	*angustifolia*		Russian olive
Ephedraceae (jointfir)	*Ephedra*	*torreyana*		Torrey's ephedra, Mormon tea
	Ephedra	*trifurca*		longleaf jointfir
Euphorbiaceae (spurge)	*Croton*	*dioicus*		grassland croton
	Croton	*fruticulosus*		bush croton, shrubby croton
	Croton	*pottsii*	var. *pottsii*	leather croton, Potts's leatherweed
Fabaceae (pea)	*Acacia*	*berlandieri*		Berlandier's acacia, guajillo
	Acacia	*constricta*		whitethorn acacia
	Acacia	*greggii*		catclaw acacia, Gregg's catclaw
	Acacia	*greggii*	var. *greggii*	catclaw acacia
	Astragalus	*mollissimus*		purple locoweed, woolly milkvetch
	Astragalus	*nuttallianus*		turkey peas, smallflowered milkvetch
	Dalea	*formosa*		feather dalea, featherplume
	Dalea	*frutescens*		black prairie clover
	Hoffmannseggia	*glauca*		hog potato
	Melilotus	*officinalis*		yellow sweetclover
	Prosopis	*glandulosa*		honey mesquite
	Robinia	*neomexicana*		New Mexico locust
	Senna	*lindheimeriana*		showy senna, velvet-leaf senna
	Senna	*roemeriana*		Roemer's senna, twoleaf senna
Fagaceae (beech)	*Quercus*	*havardii*		shinnery oak, Havard's oak
Fouquieriaceae (ocotillo)	*Fouquieria*	*splendens*		ocotillo
Fumariaceae (fumitory)	*Corydalis*	*aurea*		butter and eggs, golden corydalis
Garryaceae (silktassel)	*Garrya*	*wrightii*		Wright's silktassel
Juglandaceae (walnut)	*Juglans*	*microcarpa*		little walnut
Liliaceae (lily)	*Allium*	*drummondii*		Drummond's onion
	Dasylirion	*leiophyllum*		green sotol
	Nolina	*micrantha*		chaparral beargrass
	Nolina	*microcarpa*		small-seed sacahuista

Family	Genus	Species	Subspecies/ Variety	Common Name
	Nothoscordum	*texanum*		Texas false garlic
	Zephyranthes	*longifolia*		copper zephyrlily, rainlily
Linaceae (flax)	*Linum*	*pratense*		meadow flax
Loasaceae (stockleaf)	*Mentzelia*	*albicaulis*		white blazingstar, whitestem stickleaf
	Mentzelia	*humilis*		gypsum blazingstar
	Mentzelia	*texana*		Texas blazingstar
Malvaceae (mallow)	*Sphaeralcea*	*incana*		gray globemallow, soft globemallow
	Sphaeralcea	*leptophylla*		scaly globemallow
Moraceae (mulberry)	*Morus*			mulberry (nonnative)
	Morus	*microphylla*		Texas mulberry
Nytaginaceae (four o'clock)	*Allionia*	*incarnata*		trailing allionia, trailing four o'clock
	Boerhavia	*linearifolia*		narrowleaf spiderling
	Mirabilis	*hirsuta*		hairy four o'clock
	Selinocarpus	*lanceolatus*		gypsum moonpod
Onagraceae (evening primrose)	*Calylophus*	*hartwegii*		Hartweg's sundrops
	Gaura	*mollis*		velvetweed
	Oenothera	*albicaulis*		white-stem evening primrose
Papaveraceae (poppy)	*Argemone*	*polyanthemos*		annual prickly poppy, white prickly poppy
Poaceae (grass)	*Andropogon*	*gerardii*		big bluestem
	Aristida	*purpurea*		purple threeawn
	Bouteloua	*barbata*		sixweeks grama
	Bouteloua	*breviseta*		chino grama, gypsum grama
	Bouteloua	*eriopoda*		black grama
	Bouteloua	*gracilis*		blue grama
	Bouteloua	*hirsuta*		hairy grama
	Cenchrus	*spinifex*		sandbur
	Chloris	*cucullata*		hooded windmill grass
	Cynodon	*dactylon*		bermudagrass
	Dasyochloa	*pulchella*		fluffgrass
	Digitaria	*californica*		Arizona cottontop
	Eleusine	*indica*		goosegrass, wiregrass
	Muhlenbergia	*porteri*		bush muhly
	Muhlenbergia	*reverchonii*		seep muhly
	Muhlenbergia	*torreyi*		ring muhly
	Panicum	*bulbosum*		bulb panicgrass
	Panicum	*obtusum*		blunt panicgrass, vine mesquite
	Pleuraphis	*mutica*		tobosagrass
	Schizachyrium	*scoparium*		little bluestem

continued on next page

Family	Genus	Species	Subspecies/ Variety	Common Name
	Scleropogon	*brevifolius*		burrograss
	Sorghum	*halepense*		Johnsongrass
	Sporobolus	*airoides*		alkali sacaton, Wright's dropseed
	Sporobolus	*contractus*		spike dropseed
	Sporobolus	*flexuosus*		mesa dropseed
	Sporobolus	*wrightii*		big alkali sacaton, giant sacaton
Polygonaceae (buckwheat)	*Rumex*	*crispus*		curly dock, narrowleaf dock, sour dock
	Rumex	*hymenosepalus*		sand dock
Portulacaceae (purslane)	*Portulaca*	*oleracea*		common purslane, duckweed, wild portulaca
	Portulaca	*pilosa*		kiss-me-quick
	Portulaca	*suffrutescens*		shrubby purslane
	Talinopsis	*frutescens*		arroyo fameflower
	Talinum	*aurantiacum*		orange fameflower, talinum
	Talinum	*parviflorum*		prairie fameflower
	Talinum	*pulchellum*		showy fameflower
Ranunculaceae (crowfoot)	*Clematis*	*drummondii*		old man's beard, Texas virgin's bower
Rhamnaceae (buckthorn)	*Condalia*	*ericoides*		javelina bush
	Ziziphus	*obtusifolia*	var. *obtusifolia*	graythorn, lotebush
Rosaceae (rose)	*Fallugia*	*paradoxa*		Apache plume
Scrophulariaceae (figwort)	*Leucophyllum*	*minus*		Big Bend barometerbush, Big Bend cenizo
	Verbascum	*thapsus*		woolly mullein
Solanaceae (potato)	*Chamaesaracha*	*sordida*		hairy five eyes
	Datura	*inoxia*		desert thornapple, sacred datura
	Lycium			wolfberry
	Physalis	*angulata*		cutleaf groundcherry, lanceleaf groundcherry
	Solanum	*elaeagnifolium*		silverleaf nightshade
	Solanum	*rostratum*		buffalobur nightshade
Sterculiaceae (cacao)	*Ayenia*	*microphylla*		dense ayenia, shrubby ayenia
Tamaricaceae (tamarisk)	*Tamarix*			tamarisk, saltcedar
Ulmaceae (elm)	*Celtis*	*laevigata*	var. *reticulata*	netleaf hackberry
	Ulmus	*pumila*		Siberian elm
Vitaceae (grape)	*Vitis*	*arizonica*		canyon grape
Zygophyllaceae (creosote bush)	*Kallstroemia*	*californica*		California caltrop
	Kallstroemia	*parviflora*		small-flowered carpetweed
	Larrea	*tridentata*		creosote bush
	Peganum	*harmala*		African rue
	Tribulus	*terrestris*		goathead, puncturevine

Note: Scientific names are those used by Brown (1994).

Elevations in the Chihuahuan Desert range from 1,312 feet above mean sea level (AMSL) near Langtry, Texas, to as much as 4,900 feet AMSL near the Rio Grande. The Chihuahuan Desert climate is characterized by temperatures that range from lows reaching –22°F to highs in excess of 104°F. Precipitation typically falls during summer rainstorms, influenced by humid air masses originating from the Gulf of Mexico. These localized storms are often of high intensity and short duration, occurring as the result of the intermingling of convection off rocky and sandy surfaces with the moist gulf air (Scurlock 1998; Tuan et al. 1973). Low-intensity fall and winter precipitation usually originates from Pacific frontal storms. The climate of the area is generally described as warm temperate, and the growing season consists of approximately 200–250 frost-free days. Annual precipitation recorded over a period of more than 70 years at the Carlsbad, New Mexico, weather station (Western Regional Climate Center database, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm1469, accessed January 28, 2016) included a low of 2.95 inches and a high of 33.94 inches.

Local Physiography

The Permian Basin of southeastern New Mexico can be classified into at least three distinct physiographic units: the Sacramento Section, the Pecos Valley Section, and the Llano Estacado Section. The Pecos Valley Section is further divided into six subsections: the Northern Pecos Slopes, the Pecos Floodplain/Terrace, the Southwest Pecos Slope, the Mescalero Plain, the Canadian River drainage, and the Portales Valley (Hogan 2006). The Canadian River drainage and the Portales Valley are situated to the north of the Project area. These different physiographic units can be used to examine adaptive strategies and to isolate differing components of prehistoric settlement-subsistence systems that may have occurred within distinct environmental zones (Hogan 2006; Katz and Katz 2001).

Sacramento Section

Situated to the west of the Pecos River are the Sacramento and Guadalupe Mountains, characterized by high tablelands with broad, rolling summit plains and west-facing escarpments; the summit plains are separated by broad, structural basins typical of the Basin and Range Province (Hawley 1986:26). The highlands of the Sacramento and Guadalupe Mountains are composed of a sedimentary sequence of Permian limestone and sandstone interbedded with gypsum. Extensive areas of karst depressions are contained among the summit plains of tablelands and cuestas, where the dissolution of calcium sulfate and carbonate has resulted in the formation of extensive limestone cave systems.

Pecos Valley Section and Physiographic Subregions

The Pecos Valley Section is bordered on the west by the upland plains and tablelands of the Sacramento Section and on the east by the escarpment of the Mescalero Ridge and the caliche caprock of the Llano Estacado. This physiographic section incorporates most of the study area and has been traditionally divided into upper and lower subsections, based on differential drainage basins (Hawley 1986). A stepped sequence of terraced valleys bordering the Pecos and Canadian Rivers reflects alternating intervals of valley incision and stability during Pleistocene glacial-interglacial cycles. Late Tertiary and Quaternary alluvial fills are located in the broader central-valley areas along the Pecos River, south of Santa Rosa, and in the Portales Valley. Quaternary aeolian deposits blanket older surfaces of the valley border east of the Pecos River (Hawley 1986:27). The valleys of the Pecos and the Canadian Rivers range from broad, flat reaches occupied by floodplains and low terraces to relatively shallow canyons. Bedrock substrates within the Pecos Valley Section include Permian units composed of gypsiferous and saline evaporites, limestone and dolomite,

mudstone and shale, and sandstone. Solution-subsidence depressions of varying sizes are common landscape features across this section, because of the dissolution of evaporite and carbonate units (Hawley 1986:27).

Pecos Floodplain/Terrace, Southwest Pecos Slope, and Northern Pecos Slopes

A narrow band mostly conforming to the course of the Pecos River, which comprises the inner valleys, canyons, and inset terraces of Quaternary age as well as the broad Blackdom Terrace along the western side of the river, near Roswell-Artesia, is designated the Pecos Floodplain/Terrace subsection (Hogan 2006). The Southwest Pecos Slope subsection includes a small area of gentle slopes situated between the Guadalupe Ridge and Reef Escarpment and the Pecos River (Hogan 2006). The Northern Pecos Slopes subsection encompasses erosional remnants of Pliocene and lower Pleistocene alluvial deposits and higher piedmont erosion surfaces transitional to the Sacramento Section highlands, as well as a nearly level plain dipping from the Portales Valley and the Llano Estacado eastward, toward the Pecos River (Hogan 2006).

Mescalero Plain

The Mescalero Plain, though considered part of the Pecos Valley Section, is distinguished by the westward-sloping pediment surface extending from the base of the Mescalero Ridge to the Pecos River. It extends southward from the Portales Valley all the way to the New Mexico–Texas border. The Mescalero sand sheet covers approximately 80 percent of this landform. Dunes, drainages, sinks, and rock outcrops provide some local relief across what is predominantly level terrain (Reeves 1972).

Canadian River Drainage and Portales Valley

The easternmost extensions of the Pecos Valley Section are defined by the Canadian River drainage and the Portales Valley (Hawley 1986:27). The Canadian River borders the northern margin of the Llano Estacado and is bounded by two prominent escarpments. To the north, the Canadian Escarpment divides the Pecos Valley from the high piedmont plains of the Raton Section, and to the south, the escarpment delineates the boundary of the Llano Estacado Section. At the northern edge of the Mescalero Plain lies the Portales Valley, which divides the westernmost edge of the Llano Estacado into northern and southern lobes. The Portales Valley is an ancestral channel of the Upper Pecos–Brazos River formed during the middle Pleistocene (Hawley 1986:26).

Llano Estacado Section

A high, isolated pediment surface covering much of the Texas Panhandle and the eastern third of southeastern New Mexico is designated the Llano Estacado Section, or the Southern High Plains (Reeves 1972:112–113). The Llano Estacado is bounded on the north by the Canadian Escarpment and on the west by the sand-dune-mantled hillsides, high sandstone cliffs, and caliche caprock of the Mescalero Ridge. The Llano Estacado, or Staked Plains, is a nearly flat to undulating, broad mesa with a slight, southeastward gradient that ranges in elevation from 5,000 to 3,000 feet AMSL. The resistant caliche-caprock surface of this landform is underlain by Ogallala Formation alluvial and aeolian deposits. The caprock zone of secondary carbonate accumulation rests near or at the surface, along the margins of the plateau, as well as in areas south of the Portales Valley (Hawley 1986:27). Elsewhere, the caprock is concealed under sandy and clayey deposits. Surface drainage is accommodated by broadly spaced, shallow stream valleys. Thousands of shallow depressions are situated across the Llano Estacado, many of which contain playas bordered by dune ridges along their eastern margins. These depressions were formed predominantly by deflation, but dissolution may also have been related to the formation and enlargement of these features (Hawley 1986:27).

Paleoenvironment

A paleoclimatic model for the Permian Basin recently developed by Cummings and Kováčik (2013) included a detailed reconstruction of precipitation and temperature fluctuations over the past 16,000 years. These data provide a means of interpreting characteristics of the environmental setting, through time, that may have influenced aspects of human occupation across this landscape.

Pleistocene-Holocene Transitions

The Pleistocene-Holocene boundary marks the transition into a much warmer climate and decreased moisture availability. During the late Pleistocene, the climate was characterized by wetter and cooler conditions linked to cyclical glacial and interglacial periods. Vegetation zones were displaced 3,000–4,000 feet lower in elevation ca. 18,000 B.P., when montane coniferous forest and woodland covered southeastern New Mexico (Dick-Peddie 1993). Pluvial lakes were scattered across much of the Mescalero Plain and the adjacent Llano Estacado during the late Pleistocene and early Holocene. Mollusk-bearing spring and *cienega* deposits also developed along the Mescalero Ridge escarpment during that interval (Hall 2002). The high water table in the Ogallala Aquifer during that time fed numerous playas along the Llano Estacado and promoted springs at the foot of the caprock escarpment (Hall 2002).

Temperatures shifted toward hotter and drier summers during the onset of the Holocene, when forest and woodland vegetation retreated to higher elevations. The initial development of the Mescalero sand sheet also coincided with the shift toward xeric conditions (Hall 2002). During that time, the water table also dropped; the result was the disappearance of playa lakes and springs. Sagebrush also retreated from the grasslands. Desert scrub- and semidesert-grassland vegetation similar to that in the modern environment was established in the Permian Basin by 8000 B.P.

Middle Holocene

A warming trend that began ca. 6500 B.P. resulted in increasingly xeric conditions characterized by rising temperatures and decreased annual precipitation, persisting until ca. 5800 B.P. Temperatures consistently rose throughout that time span, until the termination of the Medieval Warm Period. Winter precipitation also declined ca. 5900 B.P.; a slight rise ca. 5400 B.P. was followed by another drop between 4800 and 4000 B.P. An upward trend in summer precipitation occurred until ca. 5500 B.P. and was sustained until 4400 B.P., and precipitation declined until ca. 3300 B.P. Precipitation ca. 6400 B.P. typically occurred during the later summer, peaking in September and showing a smaller spike during midsummer, in June. Those patterns shifted to dominant August-through-September rainfall between 5400 and 4000 B.P. After that, rainfall patterns exhibited an annual peak in August over the next 500 years, until another shift to August-through-September-dominant rainfall. Overall climatic trends during the middle Holocene revealed two major periods of environmental stress: 6500–5400 B.P. and ca. 4000–3000 B.P. (Cummings and Kováčik 2013). Vegetation during that time probably consisted of desert-shrub grassland. The Mescelaro sand sheet continued to form a thick mantle over the Berino paleosol (Hall 2002).

Late Holocene

Temperature fluctuations over the last 2,000 years exhibited less seasonal variability than 5,000 years ago, reflecting modern conditions in the Permian Basin. Annual precipitation over the last 800 years was slightly higher than during the middle Holocene, averaging approximately 12 inches. Winter precipitation has been historically low in this area, and climate regimes have been dominated by the summer-monsoon pattern.

Summer precipitation has exhibited variable fluctuations persisting into the modern era. Around 2100 B.P., rainfall shifted from a dominant August-through-September pattern to peaks occurring in May and July. That shift toward late-spring-through-summer-dominant rainfall patterns diminished after 500 years. For the past 400 years, the seasonality of rainfall has decreased in intensity during the late spring, entirely disappearing for extended periods, and has included a return to a July-through-August-dominant rainfall pattern. That shift in precipitation patterns corresponded to the Little Ice Age cooling period (Cummings and Kováčik 2013).

Environmental stresses were less severe than during the middle Holocene but persisted from 2000 to 1600 B.P. and over the past 200 years. The modern environment of the study region was less hospitable during the historical period than it was during prehistoric occupation of the area (Cummings and Kováčik 2013). A period of landscape stability between 500 and 100 B.P. resulted in the formation of a weak A soil horizon, the Loco Hills soils, along the Mescalero sand sheet. The deflation and concurrent accumulation of coppice and parabolic dunes are the most recent and rapid geologic changes along the Mescalero sand sheet. The erosion has presumably been related to changes in historical-period land use, most notably the increased use of the area for grazing livestock, which dramatically impacted the vegetation cover that had developed along the sand sheet during the previous phase of landscape stability (Hall 2002).

Holocene Vegetation Patterns and Prehistoric Land Use

The past 8,000 years have witnessed some dramatic shifts in local vegetation patterns across the study area. Desert scrub- and semidesert-grassland communities developed across the Permian Basin after the retreat of the coniferous forest and woodland to higher elevations. Although grasslands originally covered much of southeastern New Mexico, the grasses have been replaced with scrubland vegetation as a result of overgrazing during the past 150 years. Table 2.1 presents a list of plant species currently identified across the study area.

Macrobotanical remains, phytoliths, and starches recovered from 500 thermal features sampled across the study area reflected an emphasis on the use of wild-plant species endemic to the Chihuahuan Desert (Cummings and Kováčik 2013). An examination of the macrobotanical remains recovered from features spanning the Middle Archaic period to the Formative period and the later historical period indicated a limited variety of wild-plant resources, such as honey mesquite, sumac, barrel cactus (*Ferocactus*, *Echinocactus*), pricklypear, cheno-am (*Chenopodium-Amaranthus*) spp., fourwing saltbush, copperleaf or three-seeded mercury (*Acalypha rhomboidea*), sandmat (*Chamaesyce*), acacia, acorns (*Quercus*), carpetweed, dropseed, goosefoot, juniper, hedgehog cactus, and sunflower. Only scant evidence of domesticated food resources (i.e., maize [*Zea mays*]) was identified within the sampled features, and Cummings and Kováčik (2013) suggested that the presence of maize within those limited contexts reflected the transport of domesticated resources across the study area, rather than local cultivation. The recognition of the frequent occurrence of both sedge (Cyperaceae) and dayflower phytoliths within a large number of the sampled thermal features was interpreted to reflect human-induced changes to the environment. It was speculated that the presence of those weedy species reflected the formation of microhabitat resource patches that resulted from disturbances to the landscape as an unintended consequence of human occupation. Cummings and Kováčik (2013) also suggested that the proliferation of those species may have indirectly enhanced the habitat for quail (Phasianidae). Dayflower is a known winter seed resource eaten by quail, and human-induced disturbances to the landscape may have unintentionally promoted the presence of those wild-animal resources within the area.

CHAPTER 3

Archaeological Background

Monica L. Murrell

The Paleoindian Period

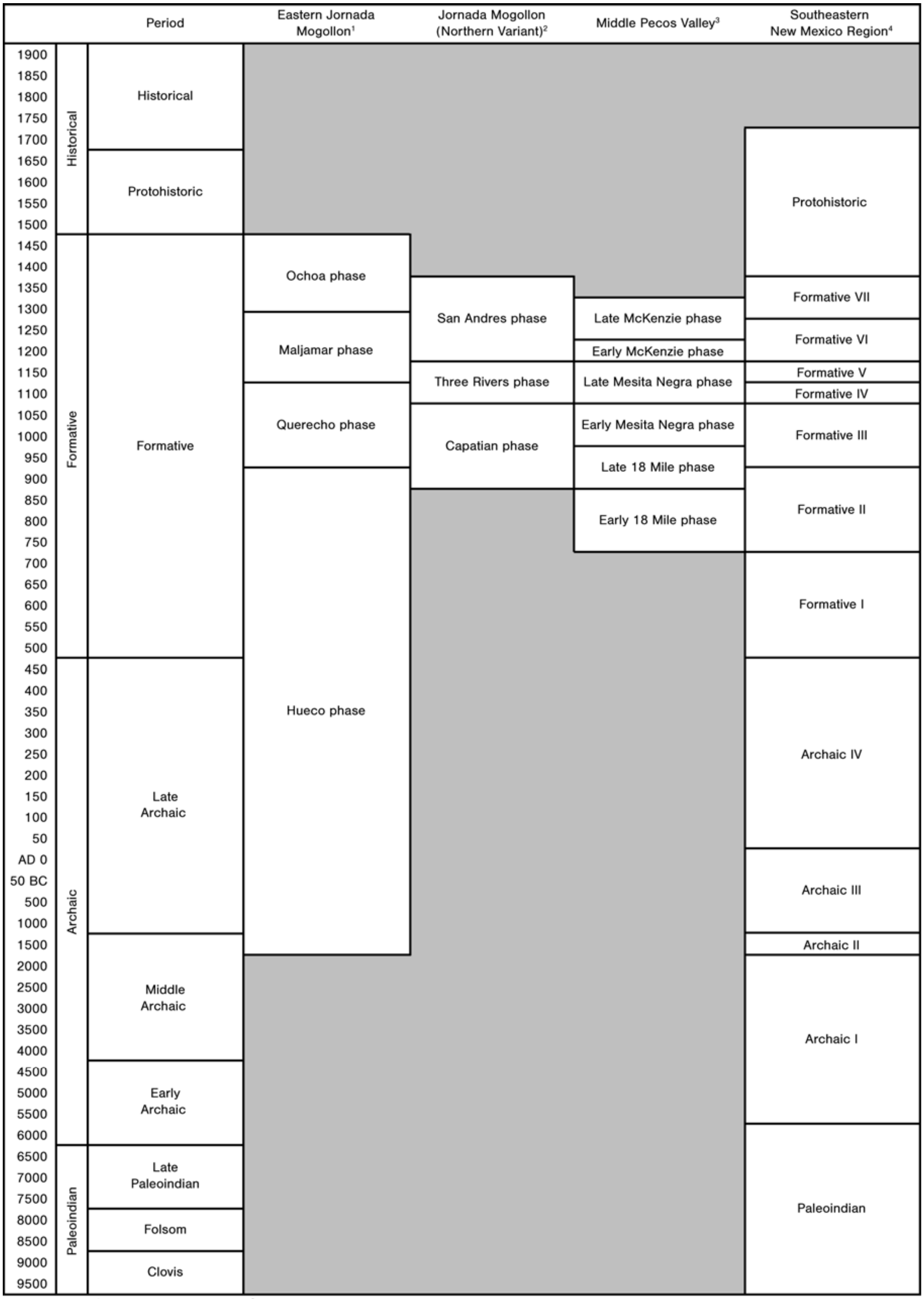
The earliest evidence of human occupation in the Mescalero Plain and adjacent portions of the Llano Estacado date to the Paleoindian period (ca. 10,000–6000 B.C.). Paleoindian period populations are traditionally characterized as highly mobile groups that hunted and scavenged extinct megafauna, such as mammoth (*Mammuthus*) and a robust form of bison (*Bison antiquus*). The Paleoindian period is typically divided into three main complexes or subphases, based on variability in tool kits and projectile point forms.

Clovis Complex

The Clovis complex (ca. 10,000–9000 B.C.), characterized by lanceolate, fluted spear points, represents the first definitive evidence of human occupation in North America (Figure 3.1). An additional distinctive characteristic of the Clovis complex lithic tradition is a core-and-blade technology that resulted in the production of large, prismatic blades (Collins 1999; Green 1963; Hester 1972; Stanford 1991). Raw materials identified in Clovis complex assemblages typically consist of high-quality cryptocrystalline silicates originating from distant nonlocal sources consistent with a high degree of residential mobility. However, locally available raw materials were also used by these populations as sources of toolstone (Condon 2006).

Folsom Complex

The Folsom complex (ca. 9000–8000 B.C.) immediately followed, and has sometimes been interpreted to overlap, the Clovis complex. This period in time was host to major environmental changes coinciding with the late Pleistocene–early Holocene transition and the extinction of large megafauna. Folsom adaptations have been invariably linked to a reliance on bison hunting, and numerous mass-kill sites have been documented in the archaeological record of the Southern High Plains (e.g., Lubbock Lake, Blackwater Draw Locality No. 1, Plainview, and Milnesand) (Holliday 1997). Folsom groups were confined largely to the Great Plains and its peripheries. Similar to Clovis points, Folsom points are also characterized by the lanceolate spear point with a concave base and a wide and shallow flute that extends almost the entire length of the point. Raw-material selection among Folsom assemblages continued to exhibit high-quality nonlocal toolstone as well as locally available materials (Condon 2006). Various researchers have suggested both temporal and technological overlap between Folsom and Midland components (e.g., Amick 1995; Holliday 1997; Sebastian and Larralde 1989). Midland points exhibit a lanceolate form similar to that of Folsom points but are unfluted.



Notes: [1]Leslie 1979 [2]Lehmer 1948 [3]Jelinek 1967 [4]Katz and Katz 1993, 2001

Figure 3.1. Regional cultural-historical schematic for southeastern New Mexico.

Late Paleoindian Period

Late Paleoindian period complexes (ca. 8000–6000 B.C.) are generally more varied and less understood than the preceding Folsom complex. Common projectile point styles assigned Late Paleoindian period temporal affiliations include a series of unfluted, lanceolate forms, such as Plainview, Plano, Firstview, Hell Gap, Eden, and Cody (Turner and Hester 1993). Subsistence patterns during this time are traditionally defined as a continuation of specialized bison hunting but are presumed to reflect a gradual shift toward a more generalized subsistence strategy.

The Archaic Period

Researchers typically view the Paleoindian period–Archaic period transition as a shift to a broad-spectrum hunter-gatherer settlement configuration that included patterns of seasonal mobility influenced by the availability of specific plant resources (Beckett and MacNeish 1994; Irwin-Williams 1973; MacNeish 1993; Vierra 2005). The Archaic period (ca. 6000 B.C.–A.D. 500) encompasses a wide time depth and is traditionally divided into Early, Middle, and Late periods, based on variations in projectile point typology and paleoenvironmental conditions. Katz and Katz (1993) provided a regionally specific cultural sequence for the Archaic period in southeastern New Mexico that was divided into four generalized phases, as discussed below.

Early Archaic Period

The Early Archaic period (ca. 6000–4000 B.C.) is the first Archaic period phase, and it is typically defined by a morphologically unique lanceolate projectile point style commonly referred to as the Jay complex style, which is characterized by weak shoulders and a long, tapering stem (Irwin-Williams 1973). Although technological aspects of the Jay complex have been identified in southeastern New Mexico, these manifestations have not been associated with a dated context in the region (Katz and Katz 1993, 2001). An additional point style potentially dating to the Early Archaic period is that of the slender, bipointed Lerma point (Turner and Hester 1993). The Archaic I temporal subdivision (ca. 5500–1700 B.C.) identified by Katz and Katz (1993) temporally overlaps with the Early Archaic period but encompasses a broad time depth that is too ambiguous for precise interpretations and lacks supporting chronological data.

Vierra et al. (2012) suggested that this period may correspond to the transition from early Holocene warming to middle Holocene xeric conditions and the concomitant movement of Early Archaic period groups into adjacent regions. Bajada phase (4800–3200 B.C.) manifestations, distinguished from Jay complex points by the presence of basal indentation and thinning, well-defined shoulders, and decreasing length, appeared during the terminal Early Archaic period and persisted until the early portion of the Middle Archaic period (Irwin-Williams 1973). That period in time has been interpreted to reflect a mixed spectrum of subsistence activities adapted to the seasonal exploitation of local resources. The presence of Jay and Bajada point types found within the region could reflect limited resource-procurement excursions into desert areas of southeastern New Mexico from the uplands to the north (Vierra et al. 2012).

Middle Archaic Period

The Middle Archaic period (ca. 4000–1200 B.C.) roughly corresponds to the Archaic II sequence (1700–1000 B.C.) identified by Katz and Katz (1993). However, the Archaic II temporal subdivision is based on the dated context of isolated fire-cracked-rock (FCR) features devoid of an associated diagnostic typological assemblage (Hogan 2006). A variety of diagnostic artifacts associated with the Middle Archaic period

found in the region have included San Jose–style, contracting-stem (e.g., Langtry), and large side-notched projectile points that have been interpreted to reflect the movement of groups between the southern desert lowlands and the northern uplands as well as between the desert regions to the west and east and the southern borderlands (Carpenter et al. 2005; Miller and Shackley 1998). San Jose–style projectile points are characterized by basal grinding, serrated blades, and relatively smaller stem-to-blade ratios than those seen in earlier Bajada points, and there was a later development toward increasingly expanded stems and marked serrations (Irwin-Williams 1973). A notable addition to the lithic assemblage during this time was the appearance of milling stones and shallow basin metates, which reflect the intensification of plant-processing activities.

Paleoenvironmental conditions following the middle Holocene dry period improved and use of the southern-borderland deserts by Middle Archaic period groups appears to have intensified, as evidenced by the increasing number of sites dating to that interval (Amick and Lukowski 2006; Anderson 1993; Carmichael 1986; O'Laughlin 1980). Aspects of subsistence, settlement, and technological adaptations appear to reflect a greater emphasis on hunting smaller game and wild-plant foraging, which also may have involved an increasing use of upland resources, such as piñon (*Pinus edulis*) nuts (Vierra 2007). Evidence of ephemeral brush structures during this interval has been found, and large FCR earth ovens and larger groupings of hearths may suggest an increase in the size of specialized-activity groups (Irwin-Williams 1973).

Late Archaic Period

The Late Archaic period (ca. 1200 B.C.–A.D. 500) broadly correlates to the Archaic III and IV temporal subdivisions defined by Katz and Katz (1993). This period heralded the appearance of the earliest-dated maize remains (ca. 1200 B.C.), which were recovered from Tornillo Rockshelter, Fresnal Cave, and Cerro Juanaqueña (Hard and Roney 2005; Tagg 1996; Upham et al. 1987). Projectile points (e.g., Ensor, Palmillas, Maljamar, Marcos, and San Pedro) correlating to the Late Archaic period exhibit a pronounced degree of stylistic variability but are typically characterized by corner-notched and stemmed dart points with large, triangular blades and no basal grinding (Shelley 1994; Turner and Hester 1993).

This interval in time was witness to the use of domesticated-plant resources (i.e., maize), accompanied by a shift toward the use of more-formalized milling technology, although Hard et al. (1996) suggested that there was a low reliance on the use of domesticated food resources by Jornada Archaic period groups. Models of cyclical transhumance have been based on the seasonal availability of plant resources and macrobotanical remains recovered from rockshelter contexts (Anderson 1993). Anderson's (1993) model projected the use of lower-basin settings during the late spring, summer, and early fall to exploit grasses, mesquite, and rabbits (*Sylvilagus*) and the use of upland alluvial-fan settings for agricultural pursuits. Upland occupations within rockshelters provided resources such as piñon, oak, and deer (*Odocoileus*), which were exploited during summer and fall occupations, and maize probably was cultivated in those areas (Bohrer 2007; MacNeish 1993). Overall patterns of decreased residential mobility, increased complexity in the use of specific environmental zones, and increasing reliance on maize cultivation typify the Late Archaic period (Anderson 1993).

Formative Period

The Formative period is marked by the introduction of ceramic technology, the appearance of the bow and arrow, the intensification of maize agriculture, and the adoption of a more sedentary way of life, although these developments did not simultaneously occur across all areas of southeastern New Mexico. The earliest reported instance of Jornada Brown wares ca. A.D. 200 was based on radiocarbon dates obtained from Deadman's Shelter (Hogan 2006; Hughes and Willey 1978). Evidence of agricultural intensification and sedentary settlement within the study area has been extremely limited, and there is a traditionally accepted

view that there was a continuation of the hunter-gatherer subsistence economy within this region throughout the Formative period.

Several local phase sequences have been developed for southeastern New Mexico, most of which have limited applicability to this study, because of the nature of archaeological manifestations situated in the dynamic aeolian setting of the Mescalero Plain. Lehmer (1948) was the first researcher to recognize the Jornada branch of the Mogollon, as a result of his seminal field investigations conducted in south-central New Mexico. Katz and Katz (1993, 2001) constructed a regional cultural sequence for southeastern New Mexico that was subdivided into seven Formative period phases encompassing generalized date ranges common to multiple local phases. That provisional framework was designed to accommodate broad regional comparisons, but the approach did not include associated developmental changes in artifact types, architectural forms, settlement locations, and subsistence patterns specific to a particular area (Hogan 2006). Another problem with the temporal approach adopted by Katz and Katz (1993, 2001) was the near impossibility of assigning Ceramic period sites to particular phases based on the presence of temporally diagnostic artifacts (Hogan 2006). Among the various locally specific phase sequences pertaining to southeastern New Mexico, the cultural sequence developed by Leslie (1979) for the eastern extension of the Jornada Mogollon is the most applicable to cultural resources in the Permian Basin. That sequence followed the work of Lehmer (1948) and Corley (1965), which also broadly paralleled general developments associated with the pit-house-to-pueblo transition identified in other major culture areas of New Mexico.

Late Hueco Phase

The earliest phase associated with the local introduction of ceramic technology is referred to as the Hueco phase (pre–A.D. 500–950). This phase overlaps both the Late Archaic and Early Formative periods and is presumed to represent the precursor of Formative period developments (Leslie 1979). It also roughly corresponds to the Formative I temporal subdivision and the early portion of the Formative II temporal subdivision identified by Katz and Katz (1993). Only scant evidence of brown-ware ceramics and informal ground stone have been associated with late Hueco phase sites. Additional grinding implements added to the Early Formative period milling inventory were bedrock mortars and pestles. Manifestations have consisted mostly of ephemeral campsites with no evidence of structural remains (Leslie 1979). Projectile points associated with this interval in time consist of Leslie's (1978) Types 5 and 6 as well as regional types, such as Scallorn-style arrow points, and are generally characterized by expanding-base, side- and corner-notched points with triangular blades. A synthesis of radiocarbon dates obtained from various excavations conducted in the Permian Basin revealed a dramatic increase in the occupational intensity of this area beginning in the Late Archaic period and peaking during the Early Formative period (Railey et al. 2009).

Querecho Phase

The Querecho phase (A.D. 950–1100/1150) is considered the first ceramic phase associated with Eastern Jornada Mogollon manifestations. Jornada Brown has dominated ceramic assemblages, sometimes accompanied by Cebolleta and Mimbres Black-on-white trade wares. This period in time also represents the introduction of the bow and arrow, noted by the appearance of corner-notched arrow points that correspond to Leslie's (1978) Types 3A–3F. Grinding implements added to the ground stone assemblage included oval basin metates and convex-faced manos. Most of the known sites from the early part of this phase were nonstructural; however, small, rectangular pit rooms and possible surface-room floors configured into loosely aggregated villages have been identified at a handful of late Querecho phase sites (Leslie 1979). A large increase in the presence of logistical gathering sites also appeared within the large parabolic-dune fields during the Querecho phase. Manifestations assigned to the Querecho phase correspond to the latter half of the Formative II temporal subdivision and the Formative III temporal subdivision identified by Katz and Katz (1993).

Maljamar Phase

The Maljamar phase (ca. A.D. 1100/1150–1300) has been suggested to represent a transition into a more sedentary lifeway that was characterized by the appearance of pit-house villages with up to 20–30 rectangular structures (Leslie 1979). Small logistical sites were still established during this phase but were present in smaller numbers. Jornada Brown remained the dominant local ceramic type, and some corrugated wares appeared near the end of the phase. Chupadero Black-on-white, accompanied by small quantities of El Paso Polychrome and Three Rivers Red-on-terracotta, also appeared during this time. Additional nonlocal types present during the terminal Maljamar phase included Glaze A, Gila Polychrome, Ramos Polychrome, and Lincoln Black-on-red. Projectile points transitioned from corner-notched to side-notched styles, such as Leslie's (1978) Types 2A and 2B, ca. A.D. 1200. Leslie (1979) suggested that a large portion of the Eastern Jornada area may have been temporarily abandoned during the latter half of the phase. The Maljamar phase corresponds to the Formative IV, V, and VI temporal subdivisions described by Katz and Katz (1993). There has been increased evidence of agriculturally based subsistence strategies from the Formative VI temporal subdivision, and bison remains have been identified in association with Formative VI sites.

Ochoa Phase

The Ochoa phase (ca. 1350–1450/1500) is the latest phase associated with Eastern Jornada manifestations. Village sites including 15–30 surface rooms arranged as units or small room blocks and large, shallow pit structures correspond to this phase. Chupadero Black-on-white constituted the dominant decorated ware, accompanied by Ochoa Corrugated brown wares (Leslie 1979). Additions to the lithic assemblage included shaft straighteners, scrapers, and an increase in the presence of obsidian. Projectile points are characterized by the appearance of small, corner- and basal-notched arrow points corresponding to Leslie's (1978) Types 2C–2F. The Ochoa phase parallels the Formative VII temporal subdivision identified by Katz and Katz (1993) and potentially corresponds to the Little Ice Age cooling period.

Protohistoric Period

Early Spanish explorers traveled through portions of southeastern New Mexico during expeditions conducted around the mid-sixteenth century. The southernmost portion of southeastern New Mexico may have been passed through ca. 1535 by Cabeza de Vaca, along with other survivors of a Spanish shipwreck on the Texas coast on their way back to Mexico (Pratt et al. 1989). Later *entradas*, including one by Francisco Vásquez de Coronado in 1541, may have entered the area en route to the Southern Plains, in search of the riches of "Quivira" (Pratt et al. 1989). Antonio de Espejo and Castaño de Sosa also led expeditions that followed the Pecos River valley in the late sixteenth century (Williams 1986). The period from 1650 to 1800 was host to several Spanish military expeditions that entered southeastern New Mexico to commercially engage with the Jumanos, as well as for slave raiding (Katz and Katz 1985; Pratt et al. 1989). Recorders of those expeditions described encounters with Apache groups (referred to as the Querechos, Vaqueros, and Faraones) and the Jumanos, and historical documents mentioned the Siete Rios Apache that inhabited an area near Carlsbad in 1659 (Pratt et al. 1989). Those groups became part of the Mescalero Apaches during the late nineteenth century (Pratt et al. 1989).

Historical Period

Euroamerican settlers attracted by available grazing land migrated into southeastern New Mexico and had established livestock ranches in the area by the mid-nineteenth century. Under the Homestead Act of 1862, a quarter section of land was guaranteed to citizens if it was settled and improved. By the 1880s, the Eddy brothers, along with Joseph S. Stevens, had established the Pecos Irrigation and Investment Company to irrigate the Pecos River valley, to supply much-needed water for farming in the area. In 1891, the Pecos Valley Railroad, running from Eddy to Pecos, was established under the financial backing of James John Hagerman. The residents of Eddy voted to change the name of their town to Carlsbad in 1899, with the hopes of attracting tourists to local hot springs. Potash mining became a prominent industry in the area during the 1920s and continues into the present day. The Carlsbad area became the focus of oil and gas development with the establishment of the El Paso Natural Gas Company in 1928, and an emphasis on mining activities has remained a mainstay of the local economy for almost a century.

CHAPTER 4

Survey Methods

David T. Unruh and Tim M. Mills

The primary goal of the Class III intensive survey was to identify and document all cultural manifestations within the specified areas. A Class III inventory results in full coverage and a total inventory of the cultural resources observed within a defined area (BLM 2005:1-9). A database search for previously documented cultural resources was conducted on November 30, 2016, before the survey, using the New Mexico Cultural Resources Information System of the Archaeological Records Management Section. Two previously recorded sites were identified within the survey corridor. Another review was completed at the BLM-CFO on December 12, 2016, and the results indicated the same.

Transects were spaced 15 m apart. The crew's positions were monitored by means of a mapping-grade Trimble Geo XH Global Positioning System (GPS) unit that contained the locations of the survey parcels. All cultural manifestations that qualified as IOs observed in the Project area were recorded as they were encountered during the pedestrian survey and were point-provenienced and fully documented, in terms of the range of items present, including characteristics that were temporally diagnostic. Specific attributes recorded during the in-field analysis are described in the following sections. Archaeological sites discovered during the survey were plotted by means of a Trimble GPS unit and were marked with pin flags and flagging tape. A permanent datum consisting of a capped length of rebar including the LA site number (for previously recorded sites) or SRI field site number (for newly discovered sites) and recording date was set at each archaeological site recorded in the Project area. All archaeological fieldwork and subsequent reporting entirely conformed to the New Mexico Standards for Survey and Inventory (*New Mexico Administrative Code*, Title 4, Chapter 10, Part 15 [4.10.15 NMAC]). Methods derived from BLM Manual Supplement H-8100-1 (BLM 2005) and BLM-CFO standards were applied to the entire Project area, for consistency.

Artifacts

SRI followed the in-field-analysis standards for flaked stone, ground stone, ceramic, and historical-period artifacts defined in the BLM-CFO manual (BLM-CFO 2012:3–4).

Artifact Collections

No artifacts were collected during this inventory, because the majority of the survey area was contained on privately owned lands. No projectile points or ceramics were encountered.

Artifact Recording

Information was also recorded for artifacts as detailed below.

Prehistoric Artifacts

Flaked Stone Artifacts

- Artifact type: e.g., core flake, biface flake, biface, uniface, cobble biface, cobble uniface, hammerstone, tested material, core, projectile point, retouched flake, scraper, tabular knife
- Material type: e.g., andesite, chert, chalcedony, basalt, limestone, obsidian, quartz, silicified wood, quartzite, rhyolite, sandstone, opalized caliche, purple quartzite, mustard quartzite, San Andres chert, fossiliferous chert
- Counts

Projectile points, ornaments, and artifacts made of obsidian were collected and point-plotted with a mapping-grade Trimble Geo XH GPS unit.

Ceramic Artifacts

- Ware: undifferentiated brown ware, Chupadero Black-on-white, El Paso Polychrome, Ochoa Corrugated, Playas Red, Three Rivers Red-on-terracotta, Mimbres Black-on-white, Chihuahuan wares (such as Ramos Polychrome, Babicora, and Dublan), or other (used when the ware was not identifiable)
- Counts

Rim sherds were collected and point-plotted with the mapping-grade Trimble Geo XH GPS unit. Pot drops were recorded and documented as features.

Ground Stone Artifacts

- Artifact type: cobble mano, tabular mano, pestle, metate (basin, trough, and slab), metate fragment, milling stone, mano fragment, or indeterminate ground stone
- Material type: e.g., sandstone, limestone, granite, vesicular basalt, basalt, quartzite, rhyolite
- Counts

FCR
Though not considered an artifact class, all feature- and non-feature-related FCR was documented with the mobile app for SRI's relational database, including approximate counts and material types.

Bone and Shell
Bone type was recorded as large or small (game). Shell was noted. Counts were recorded.

Historical-Period Artifacts

Glass

- Artifact type: e.g., jar, bottle, window
- Artifact portion: e.g., whole, bottle base, or shard
- Color: e.g., solarized amethyst, cobalt blue, milk glass, clear, amber, green

Identifying marks, manufacturing techniques, stamps, labels, and lettering were noted if present. Counts were recorded.

Metal

- Artifact type: e.g., building material, cans, containers, automobiles, projectile points, cartridge cases, barrel bands

Identifying marks, manufacturing techniques, labels, lettering, stamps, headstamps on cartridges, make and model of automobile, and so on were noted if present. Counts were recorded.

Wood

- Artifact type: e.g., board, fence post, wagon

Identifying marks and manufacturing techniques were noted if present. Dimensions and counts were recorded.

Isolated Occurrences

According to the BLM (2005:1-10), isolated manifestations are

- defined by the presence of fewer than 10 artifacts or a single undatable feature,
- frequently found to be redeposited materials that lack significant locational context, and
- not related to other nearby, isolated manifestations or sites.

IOs were recorded and plotted on Project maps. Pertinent information was recorded, including the GPS location, and each IO was assigned a unique identifier (provenience-designation number). Photographs were taken of IOs that were determined to be temporally or functionally diagnostic.

Sites

According to the BLM (2005:1-10), a site

- contains more than 10 artifacts in total and/or a single datable feature,
- contains multiple features, or
- consists of a surface scatter with associated features.

Site Recording

Per the BLM guidelines noted in Manual Supplement H-8100-1 (BLM 2005:1-15–1-16) and BLM-CFO (2012) standards, SRI included the following when recording each site:

- a detailed, scaled plan map, which contained the site number (LA, BLM, or SRI field number), a north arrow (true or magnetic), a scale and scale bar, a key, the site boundary, the Project boundary, prominent natural or cultural landmarks, the site datum, photograph points, natural features (rock outcrops and vegetation), topography, cultural/site features, artifact locations/distribution, the name of the map maker, and the date of the map, and
- photographs.

Arbitrary excavation units were used to aid in the identification of cultural materials potentially concealed at investigated sites. Trowel tests were used to test for the presence of subsurface deposits within the confines of defined features. Shovel tests were used to identify buried features and as control units to produce representative profiles of the site stratigraphy and to assess the geomorphic context. As advocated by the BLM-CFO (2012) standards, shovel testing was used only to determine the presence or absence of buried cultural deposits deeper than 10 cm below surface (cmbs) or deeper than depths normally accessible through trowel testing. At least three shovel tests were excavated at each documented site, resulting in a reasonable level of confidence that the depositional potential of the site was accurately assessed. Shovel tests measured 50 by 50 cm and were excavated in natural or arbitrary levels. Detailed stratigraphic profiles were generated for at least one of the shovel tests excavated at each individual site.

Per recent updates to the BLM-CFO guidelines and State of New Mexico standards, historical-period linear resources, such as railways and roads, were formally designated as parts of the historical-period built environment. These historic properties were documented using Historic Cultural Property Inventory (HCPI) forms and supplied HCPI designations rather than recorded as archaeological sites.

Site Boundaries

According to BLM (2005) guidelines, site boundaries were drawn when no artifacts could be found within 20 m in any direction from the last artifact on the site periphery.

Site Types

Definitions of prehistoric site types adhered to the final site types advanced by Hogan (2006): artifact scatters, campsites with domestic features, single residences, multiple residences, residential complexes, quarry/lithic-procurement areas, possible structures, ring middens, bedrock mortars/metates, domestic features (hearths), rockshelters, caves, and miscellaneous features.

Features

Feature Types

Definitions of prehistoric feature types used the BLM-CFO (2012) classification scheme and adhered to the definitions provided therein. Feature types included the following: large stain, small stain, FCR concentration, FCR concentration with carbon staining, ring midden, rock alignment, and bedrock mortar.

Feature Recording

The dimensions of features were recorded in metric units. Length was measured along the north–south axis of a feature, and width was measured along the east–west axis. Depth was determined by trowel test, and the presence or absence of charcoal, ash, buried artifacts, and FCR was recorded. The number and type(s) of associated artifacts and/or FCR were also recorded, and additional information on feature integrity was noted. Features at historical-period properties were photographed and sketched.

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CHAPTER 6

Inventory Summary

Tim M. Mills and Monica L. Murrell

SRI's cultural resource inventory for the Project covered a cumulative area of 290.11 acres within Lea County, in southeastern New Mexico. The survey area consisted of one block parcel and several linear corridors that represent the potential paths of future rail lines and/or service roads. Corridor widths were 30 feet for existing or planned access roads and 50 feet for planned rail corridors. The survey resulted in the documentation of 1 previously recorded prehistoric archaeological site, 1 newly recorded prehistoric archaeological site, 1 previously documented historical-period site (henceforth considered a historic cultural property), 1 newly documented historic cultural property, and 16 IOs (see Table 5.1; Appendix B). Both of the recorded prehistoric sites are recommended *eligible* for listing in the NRHP, and the linear resources related to the historical-period built environment are recommended *not eligible*.

Treatment of Recorded Sites

The two prehistoric sites are recommended *eligible* for listing in the NRHP; thus, avoidance measures are recommended. Neither of the historical-period properties that were identified is considered particularly significant or eligible for listing in the NRHP. Thus, treatment recommendations are not provided for those properties. Plans for construction designs and any realignments in the immediate area of Laguna Gatuna should consider that there is a high likelihood of surface and buried archaeological remains beyond what has been currently plotted within the survey corridor.

Cultural Resource Summary

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APPENDIX A

Project Corridor Maps

Contains information protected under 10 CFR 2.390(a)(3) and Section 304 of the National Historic Preservation Act

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APPENDIX D: ADDITIONAL SOIL DATA

Additional soil data is in attached pages.

Eddy Lea Siting Study
Contract No: DE-FG07-07ID14799

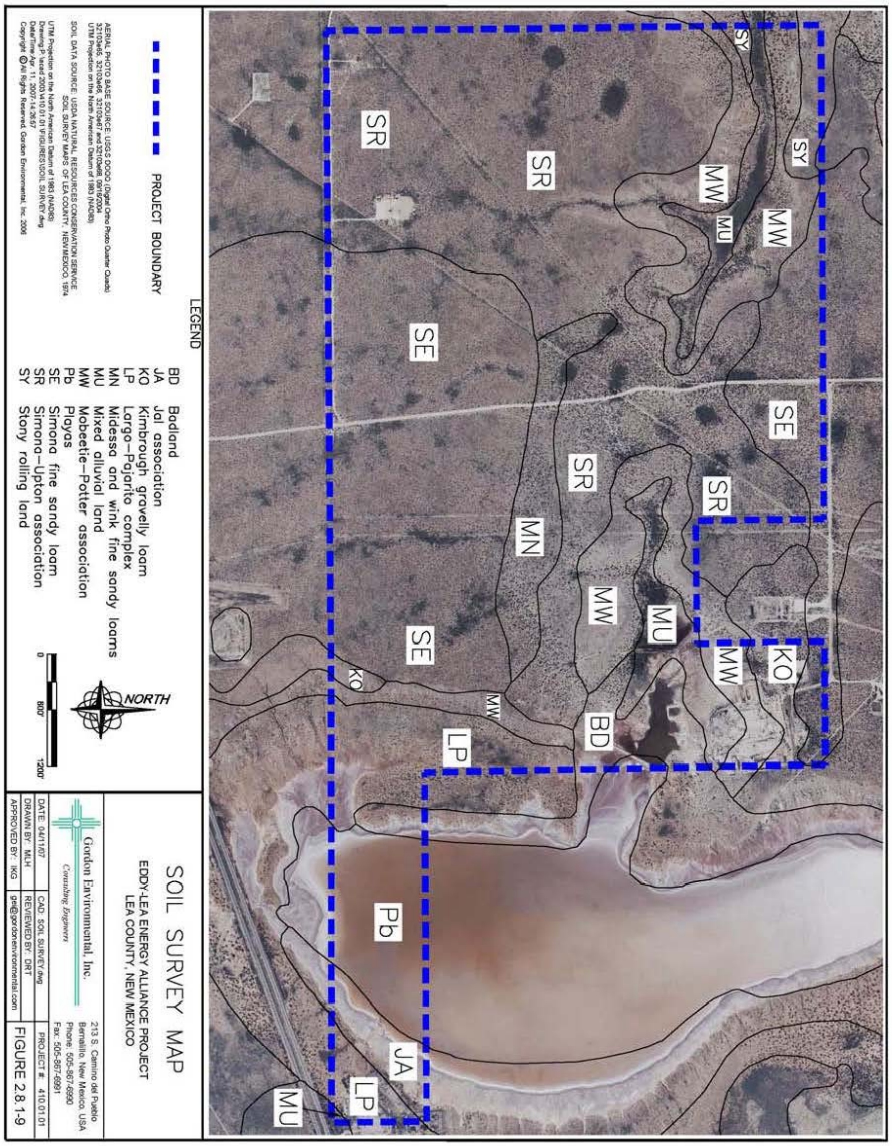


TABLE 1

Map Unit Description

Lea County, New Mexico

BD Badland

Setting

Landscape: Badlands
Elevation: 3000 to 4400 feet
Mean annual precipitation: 10 to 16 inches
Mean annual air temperature: 58 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Badland: 85 percent

Description of Badland

Setting
Landform: Erosion remnants
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 15 to 30 percent
Depth to restrictive feature: 0 to 3 inches to Paralithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.20 to 1.98 in/hr)
Frequency of flooding: None
Frequency of ponding: None

Interpretive Groups
Land capability (non irrigated): 8e

Typical Profile
0 to 60 inches: bedrock

TABLE 1

Map Unit Description

Lea County, New Mexico

JA Jal association

Setting

Landscape: Tablelands
Elevation: 3000 to 4000 feet
Mean annual precipitation: 10 to 16 inches
Mean annual air temperature: 58 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Jal and similar soils: 55 percent
Drake and similar soils: 30 percent

Description of Jal

Setting
Landform: Playa rims
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Concave
Parent material: Calcareous alluvium and/or calcareous lacustrine deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 50 percent
Gypsum maximum: 1 percent
Salinity maximum: Non saline or very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio maximum: 2.0
Available water capacity: Moderate (about 7.2 inches)

Interpretive Groups
Land capability classification (irrigated): 4e
Land capability (non irrigated): 7c
Ecological site: Limy (R042XC030NM)

Typical Profile
0 to 12 inches: sandy loam
12 to 60 inches: loam

Description of Drake

Setting
Landform: Playa dunes
Landform position (two-dimensional): Backslope, footslope
Down-slope shape: Concave, linear
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 50 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Moderate (about 6.1 inches)

Interpretive Groups
Land capability classification (irrigated): 4e
Land capability (non irrigated): 7c
Ecological site: Sandy (R042XC004NM)

TABLE 1

Map Unit Description

Lea County, New Mexico

Typical Profile
0 to 9 inches: loamy fine sand
9 to 30 inches: fine sandy loam
30 to 60 inches: sandy clay loam

KO Kimbrough gravelly loam, 0 to 3 percent slopes

Setting

Landscape: Tablelands
Elevation: 3600 to 4200 feet
Mean annual precipitation: 12 to 15 inches
Mean annual air temperature: 58 to 60 degrees F
Frost-free period: 195 to 205 days

Composition

Kimbrough and similar soils: 85 percent

Description of Kimbrough

Setting
Landform: Plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Depth to restrictive feature: 4 to 20 inches to Petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately low (0.00 to 0.06 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 25 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 0.8 inches)

Interpretive Groups
Land capability (non irrigated): 7e
Ecological site: Very Shallow (R077XD074NM)

Typical Profile
0 to 6 inches: gravelly loam
6 to 16 inches: cemented material

TABLE 1

Map Unit Description

Lea County, New Mexico

LP Largo-Pajarito complex

Setting

Landscape: Uplands
Elevation: 3200 to 3700 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 200 days

Composition

Largo and similar soils: 45 percent
Pajarito and similar soils: 40 percent

Description of Largo

Setting

Landform: Plains, alluvial fans
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy alluvium derived from sedimentary rock

Properties and Qualities

Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate maximum: 50 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: High (about 10.6 inches)

Interpretive Groups

Land capability (non irrigated): 7c
Ecological site: Loamy (R042XC007NM)

Typical Profile

0 to 13 inches: loam
13 to 30 inches: silty clay loam
30 to 60 inches: silty clay loam

Description of Pajarito

Setting

Landform: Alluvial fans, plains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous sandy alluvium and/or mixed sandy eolian deposits derived from sedimentary rock

Properties and Qualities

Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 45 percent
Gypsum maximum: 0 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Moderate (about 7.7 inches)

Interpretive Groups

Land capability classification (irrigated): 2e
Land capability (non irrigated): 7c
Ecological site: Loamy Sand (R042XC003NM)

TABLE 1

Map Unit Description

Lea County, New Mexico

Typical Profile
0 to 16 inches: loamy fine sand
16 to 48 inches: fine sandy loam
48 to 60 inches: fine sandy loam

TABLE 1

Map Unit Description

Lea County, New Mexico

MN Midessa and wink fine sandy loams

Setting

Landscape: Uplands
Elevation: 3100 to 3400 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Midessa (ratliff) and similar soils: 45 percent
Wink and similar soils: 40 percent

Description of Midessa (ratliff)

Setting
Landform: Plains
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 50 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Moderate (about 8.1 inches)

Interpretive Groups
Land capability classification (irrigated): 4e
Land capability (non irrigated): 6c
Ecological site: Loamy (R042XC007NM)

Typical Profile
0 to 4 inches: fine sandy loam
4 to 22 inches: clay loam
22 to 60 inches: clay loam

Description of Wink

Setting
Landform: Plains
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous sandy alluvium and/or calcareous sandy eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 30 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 2.9 inches)

Interpretive Groups
Land capability (non irrigated): 7e
Ecological site: Sandy (R042XC004NM)

Typical Profile

TABLE 1

Map Unit Description

Lea County, New Mexico

0 to 12 inches: fine sandy loam
12 to 23 inches: sandy loam
23 to 60 inches: sandy loam

MU Mixed alluvial land

Setting

Landscape: Uplands
Elevation: 3600 to 4000 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Ustifluvents and similar soils: 85 percent

Description of Ustifluvents

Setting
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Mixed alluvium derived from sedimentary rock

Properties and Qualities
Slope: 0 to 7 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low or very high (0.06 to 20.00 in/hr)
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate maximum: 20 percent
Gypsum maximum: 5 percent
Available water capacity: Moderate (about 7.8 inches)

Interpretive Groups
Land capability (non irrigated): 6e

Typical Profile
0 to 60 inches: stratified sand to loamy fine sand to loam to sandy clay loam to clay loam to clay

TABLE 1

Map Unit Description

Lea County, New Mexico

MW Mobeetie-Potter association, 1 to 15 percent slopes

Setting

Landscape: Uplands
Elevation: 3700 to 4000 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Mobeetie and similar soils: 70 percent
Potter and similar soils: 24 percent

Description of Mobeetie

Setting
Landform: Draws, escarpments
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous sandy alluvium derived from sedimentary rock

Properties and Qualities
Slope: 1 to 10 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 15 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Moderate (about 7.2 inches)

Interpretive Groups
Land capability (non irrigated): 6e
Ecological site: Sandy (R077XD075NM)

Typical Profile
0 to 4 inches: fine sandy loam
4 to 24 inches: fine sandy loam
24 to 60 inches: fine sandy loam

Description of Potter

Setting
Landform: Draws, escarpments
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 5 to 15 percent
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high or high (0.60 to 2.00 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 70 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 0.9 inches)

Interpretive Groups
Land capability (non irrigated): 7s
Ecological site: Very Shallow (R077XD074NM)

Typical Profile

TABLE 1

Map Unit Description

Lea County, New Mexico

0 to 4 inches: gravelly fine sandy loam
4 to 14 inches: extremely cobbly loam

Pb Playas

Setting

Landscape: Tablelands
Elevation: 3000 to 4000 feet
Mean annual precipitation: 10 to 16 inches
Mean annual air temperature: 58 to 62 degrees F
Frost-free period: 195 to 205 days

Composition

Playas, saline: 85 percent

Description of Playas, saline

Setting
Landform: Playa floors
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Mixed alluvium and/or mixed lacustrine deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 1 percent
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 0 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Calcium carbonate maximum: 50 percent
Gypsum maximum: 4 percent
Salinity maximum: Slightly saline or moderately saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio maximum: 8.0
Available water capacity: Very low (about 1.8 inches)

Interpretive Groups
Land capability (non irrigated): 8w

Typical Profile
0 to 6 inches: silty clay loam
6 to 60 inches: clay

TABLE 1

Map Unit Description

Lea County, New Mexico

SE Simona fine sandy loam, 0 to 3 percent slopes

Setting

Landscape: Tablelands
Elevation: 3000 to 4000 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 59 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Simona and similar soils: 85 percent

Description of Simona

Setting
Landform: Plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to Petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately low (0.00 to 0.06 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 35 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 2.0 inches)

Interpretive Groups
Land capability classification (irrigated): 6s
Land capability (non irrigated): 7s
Ecological site: Shallow Sandy (R042XC002NM)

Typical Profile
0 to 8 inches: fine sandy loam
8 to 16 inches: gravelly fine sandy loam
16 to 26 inches: cemented material

TABLE 1

Map Unit Description

Lea County, New Mexico

SR Simona-Upton association

Setting

Landscape: Tablelands
Elevation: 3000 to 4000 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 59 to 62 degrees F
Frost-free period: 190 to 205 days

Composition

Simona and similar soils: 50 percent
Upton and similar soils: 35 percent

Description of Simona

Setting
Landform: Ridges
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to Petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately low (0.00 to 0.06 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 50 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 1.9 inches)

Interpretive Groups
Land capability (non irrigated): 7s
Ecological site: Shallow Sandy (R042XC002NM)

Typical Profile
0 to 8 inches: gravelly fine sandy loam
8 to 16 inches: fine sandy loam
16 to 26 inches: cemented material

Description of Upton

Setting
Landform: Ridges
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and Qualities
Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to Petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low or moderately high (0.01 to 0.60 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 75 percent
Gypsum maximum: 1 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 0.9 inches)

Interpretive Groups
Land capability classification (irrigated): 6e
Land capability (non irrigated): 7s

TABLE 1

Map Unit Description

Lea County, New Mexico

Ecological site: Shallow (R042XC025NM)

Typical Profile

0 to 8 inches: gravelly loam
8 to 18 inches: cemented material
18 to 60 inches: very gravelly loam

SY Stony rolling land

Setting

Landscape: Uplands
Elevation: 3200 to 3700 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 195 to 205 days

Composition

Torriorthents and similar soils: 85 percent

Description of Torriorthents

Setting

Landform: Escarpments
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous residuum weathered from sandstone and shale

Properties and Qualities

Slope: 5 to 95 percent
Depth to restrictive feature: 10 to 60 inches to Lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low or high (0.06 to 1.98 in/hr)
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate maximum: 25 percent
Gypsum maximum: 2 percent
Sodium adsorption ratio maximum: 2.0
Available water capacity: Very low (about 1.0 inches)

Interpretive Groups

Land capability (non irrigated): 7e
Ecological site: Shallow (R042XC025NM)

Typical Profile

0 to 20 inches: extremely gravelly sandy loam
20 to 60 inches: bedrock

TABLE 1

Map Unit Description

Detailed Soil Map Units

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The contrasting components are mentioned in the map unit descriptions. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description indicates the composition of the map unit and selected properties of the components of the unit.

Soils that have profiles that are almost alike make up a "soil series." Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into "soil phases." Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A "complex" consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An "association" is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An "undifferentiated group" is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include "miscellaneous areas." Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

TABLE 2
Soil Features

Lea County, New Mexico

Map symbol and soil name	Restrictive layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	In		In	In			
BD:									
Badland	Paralithic bedrock	0-3	---	Moderately cemented	---	---	---	---	---
JA:									
Jal	---	---	---	---	---	---	---	High	Low
Drake	---	---	---	---	---	---	---	Moderate	Low
KO:									
Kimbrough	Petrocalcic	4-20	4-17	Indurated	---	---	---	High	Low
LP:									
Largo	---	---	---	---	---	---	---	High	Low
Pajarito	---	---	---	---	---	---	---	High	Low
MN:									
Midessa (ratliff)	---	---	---	---	---	---	---	Moderate	Low
Wink	Strongly contrasting textural stratification	---	---	Moderately cemented	---	---	---	High	Low
MU:									
Ustifluvents	---	---	---	---	---	---	---	---	---
MW:									
Mobeetie	---	---	---	---	---	---	---	Low	Low
Potter	---	---	---	---	---	---	---	Moderate	Low

TABLE 2
Soil Features

Lea County, New Mexico

Map symbol and soil name	Restrictive layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	In		In	In			
Pb:									
Playas, saline	---	---	---	---	---	---	---	High	High
SE:									
Simona	Petrocalcic	7-20	4-17	Indurated	---	---	---	High	Low
SR:									
Simona	Petrocalcic	7-20	4-17	Indurated	---	---	---	High	Low
Upton	Petrocalcic	7-20	4-10	Indurated	---	---	---	High	Low
SY:									
Torriorthents	Lithic bedrock	10-60	---	Indurated	---	---	---	High	Low

TABLE 2
Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. "Depth to top" is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

"Subsidence" is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

"Potential for frost action" is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as "low," "moderate," or "high," is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as "low," "moderate," or "high." It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

TABLE 3
Physical Soil Properties

Lea County, New Mexico

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
BD:														
Badland	0-60	---	---	---	---	1.40-14.00	---	---	---	---	---	---	---	---
JA:														
Jal	0-12	---	---	4-12	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.6	.24	.24	5	3	86
	12-60	---	---	18-27	1.40-1.50	4.23-14.11	0.10-0.14	0.0-2.9	0.0-0.1	.37	.37			
Drake	0-9	75-90	0-15	4-12	1.40-1.60	14.11-42.34	0.06-0.10	0.0-2.9	0.5-1.0	.17	.17	4	2	134
	9-30	35-70	15-50	10-18	1.35-1.55	14.11-42.34	0.10-0.15	0.0-2.9	0.1-0.5	.24	.24			
	30-60	55-85	5-25	20-30	1.45-1.65	14.11-42.34	0.06-0.12	0.0-2.9	0.0-0.2	.24	.24			
KO:														
Kimbrough	0-6	35-50	35-50	15-20	1.35-1.45	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.20	.37	1	5	56
	6-16	---	---	---	---	0.00-0.42	---	---	---	---	---			
LP:														
Largo	0-13	30-50	30-50	15-25	1.40-1.50	4.23-14.11	0.13-0.21	0.0-2.9	0.6-0.8	.43	.43	5	4L	86
	13-30	2-20	50-70	27-35	1.40-1.50	4.23-14.11	0.14-0.18	0.0-2.9	0.1-0.8	.32	.32			
	30-60	0-20	40-75	18-35	1.40-1.50	1.41-4.23	0.16-0.21	3.0-5.9	0.0-0.2	.43	.43			
Pajarito	0-16	75-90	0-20	5-12	1.40-1.50	14.11-42.34	0.09-0.11	0.0-2.9	0.4-0.7	.17	.17	5	2	134
	16-48	40-80	5-30	10-18	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.1-0.5	.24	.24			
	48-60	35-75	5-45	10-18	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.0-0.3	.24	.24			
MN:														
Midessa (ratliff)	0-4	55-75	10-30	12-20	1.35-1.55	14.11-42.34	0.10-0.15	0.0-2.9	0.7-2.0	.24	.24	5	3	86
	4-22	30-70	20-45	20-35	1.35-1.55	4.23-14.11	0.12-0.18	0.0-2.9	0.5-1.0	.32	.32			
	22-60	25-70	10-45	20-35	1.35-1.55	4.23-14.11	0.10-0.16	0.0-2.9	0.5-1.0	.32	.32			

This report shows only the major soils in each map unit. Others may exist.

USDA Natural Resources Conservation Service

Tabular Data Version: 7
Tabular Data Version Date: 01/13/2007

TABLE 3
Physical Soil Properties

Lea County, New Mexico

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
MN:														
Wink	0-12	---	5-30	8-18	1.35-1.55	14.11-42.34	0.10-0.14	0.0-2.9	0.0-0.5	.24	.24	5	3	86
	12-23	---	5-30	8-18	1.35-1.55	14.11-42.34	0.10-0.15	0.0-2.9	0.0-0.5	.20	.28			
	23-60	---	---	8-18	1.55-1.70	14.11-42.34	0.02-0.08	0.0-2.9	0.0-0.5	.10	.15			
MU:														
Ustifluvents	0-60	20-90	---	5-50	1.35-1.55	0.42-141.14	0.10-0.17	0.0-20.0	0.0-4.0	---	---	5	4L	86
MW:														
Mobeetie	0-4	55-75	5-30	10-18	1.35-1.50	14.11-42.34	0.10-0.14	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	4-24	35-75	5-40	10-18	1.35-1.50	14.11-42.34	0.10-0.14	0.0-2.9	0.5-1.0	.24	.24			
	24-60	35-75	5-40	10-18	1.40-1.55	14.11-42.34	0.10-0.14	0.0-2.9	0.5-1.0	.24	.24			
Potter	0-4	55-75	10-35	18-35	1.35-1.60	4.23-14.11	0.10-0.13	0.0-2.9	0.5-1.0	.15	.28	1	8	0
	4-14	30-50	30-45	15-27	1.40-1.65	4.23-42.34	0.01-0.06	0.0-2.9	0.1-0.5	.10	.32			
Pb:														
Playas, saline	0-6	---	---	35-70	1.30-1.70	0.00-0.42	0.02-0.04	6.0-8.9	0.0-0.1	.37	.37	5	4	86
	6-60	---	---	35-70	1.35-1.65	0.00-0.42	0.02-0.04	6.0-8.9	0.0-0.1	.37	.37			
SE:														
Simona	0-8	55-75	5-30	15-20	1.45-1.55	14.11-42.34	0.11-0.15	0.0-2.9	0.4-0.7	.28	.28	1	3	86
	8-16	55-80	5-25	15-20	1.45-1.55	14.11-42.34	0.09-0.15	0.0-2.9	0.1-0.4	.24	.24			
	16-26	---	---	---	---	0.00-0.42	---	---	---	---	---			

TABLE 3
Physical Soil Properties

Lea County, New Mexico

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
SR:														
Simona	0-8	55-80	5-30	15-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.4-0.7	.15	.28	1	4	86
	8-16	55-80	5-30	15-20	1.45-1.55	14.11-42.34	0.09-0.15	0.0-2.9	0.1-0.4	.24	.24			
	16-26	---	---	---	---	0.00-0.42	---	---	---	---	---			
Upton	0-8	30-50	30-50	15-30	1.30-1.50	4.23-14.11	0.08-0.14	0.0-2.9	0.5-1.0	.15	.28	1	6	48
	8-18	---	---	---	---	0.07-4.23	---	---	---	---	---			
	18-60	---	---	15-30	1.35-1.55	4.23-14.11	0.08-0.14	0.0-2.9	0.5-1.0	.15	.32			
SY:														
Torriorthents	0-20	---	---	15-20	1.30-1.60	14.11-42.34	0.04-0.05	0.0-2.9	1.0-2.0	.10	.32	2	7	38
	20-60	---	---	---	---	0.42-14.00	---	---	---	---	---			

TABLE 3
Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

"Depth" to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

"Sand" as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

"Silt" as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

"Clay" as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

"Moist bulk density" is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

"Saturated hydraulic conductivity (Ksat)" refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

"Available water capacity" refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

"Linear extensibility" refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

"Organic matter" is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained by returning crop residue to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

TABLE 4
Chemical Soil Properties

Lea County, New Mexico

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
BD:								
Badland	0-60	---	---	---	---	---	---	---
JA:								
Jal	0-12	3.0-8.0	---	7.9-8.4	10-40	0-1	0.0-2.0	0-2
	12-60	12-20	---	8.5-9.0	25-50	0-1	2.0-4.0	0-2
Drake	0-9	3.0-9.0	---	7.9-8.4	5-25	0	0.0-2.0	0-2
	9-30	6.0-12	---	7.9-8.4	20-40	0	0.0-2.0	0-2
	30-60	8.0-16	---	7.9-8.4	25-50	0	0.0-2.0	0-2
KO:								
Kimbrough	0-6	10-15	---	7.4-8.4	5-25	0-1	0.0-2.0	0-2
	6-16	---	---	---	---	---	---	---
LP:								
Largo	0-13	10-16	---	7.4-8.4	0-5	0	0.0-2.0	0-2
	13-30	10-20	---	7.4-8.4	10-30	0	0.0-2.0	0-2
	30-60	12-23	---	7.4-8.4	20-50	0	0.0-2.0	0-2
Pajarito	0-16	3.0-9.0	---	7.4-8.4	1-6	0	0.0-2.0	0-2
	16-48	10-13	---	7.9-8.4	2-14	0	0.0-2.0	0-2
	48-60	10-16	---	7.9-8.4	20-45	0	0.0-2.0	0-2
MN:								
Midessa (ratliff)	0-4	10-20	---	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	4-22	15-30	---	7.9-8.4	2-10	0-1	0.0-2.0	0-2
	22-60	15-30	---	7.9-8.4	20-50	0-1	0.0-2.0	0-2
Wink	0-12	5.0-12	---	7.9-8.4	2-5	0-1	0.0-2.0	0-2
	12-23	5.0-12	---	7.9-8.4	5-10	0-1	0.0-2.0	0-2
	23-60	5.0-12	---	7.9-8.4	15-30	0-1	0.0-2.0	0-2
MU:								
Ustifluvents	0-60	4.1-40	---	6.6-9.0	0-20	0-5	0.0-8.0	0
MW:								
Mobeetie	0-4	6.0-15	---	7.9-8.4	0-10	0-1	0.0-2.0	0-2
	4-24	6.0-15	---	7.9-8.4	5-15	0-1	0.0-2.0	0-2
	24-60	6.0-15	---	7.9-8.4	5-15	0-1	0.0-2.0	0-2
Potter	0-4	12-25	---	7.9-8.4	20-40	0-1	0.0-2.0	0-2
	4-14	10-18	---	7.9-8.4	30-70	0-1	0.0-2.0	0-2

TABLE 4
Chemical Soil Properties

Lea County, New Mexico

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
Pb:								
Playas, saline	0-6	23-46	---	8.4-9.6	0-15	0-4	8.0-16.0	0-8
	6-60	23-46	---	8.4-9.6	15-50	0-4	8.0-16.0	0-8
SE:								
Simona	0-8	10-15	---	7.4-8.4	10-25	0-1	0.0-2.0	0-2
	8-16	10-13	---	7.4-8.4	15-35	0-1	0.0-2.0	0-2
	16-26	---	---	---	---	---	---	---
SR:								
Simona	0-8	10-15	---	7.4-8.4	10-25	0-1	0.0-2.0	0-2
	8-16	10-13	---	7.4-8.4	20-50	0-1	0.0-2.0	0-2
	16-26	---	---	---	---	---	---	---
Upton	0-8	10-20	---	7.9-8.4	40-60	0-1	0.0-2.0	0-2
	8-18	---	---	---	---	---	---	---
	18-60	10-20	---	7.9-8.4	40-75	0-1	0.0-2.0	0-2
SY:								
Torriorthents	0-20	10-15	---	7.4-7.8	0-25	0-2	0.0-2.0	0-2
	20-60	---	---	---	---	---	---	---

TABLE 4

Chemical Soil Properties

This table shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

"Depth" to the upper and lower boundaries of each layer is indicated.

"Cation-exchange capacity" is the total amount of extractable bases that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

"Effective cation-exchange capacity" refers to the sum of extractable bases plus aluminum expressed in terms of milliequivalents per 100 grams of soil. It is determined for soils that have pH of less than 5.5.

"Soil reaction" is a measure of acidity or alkalinity. It is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

"Calcium carbonate" equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

"Gypsum" is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

"Salinity" is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity and aeration, and a general degradation of soil structure.

TABLE 5
Engineering Properties

Lea County, New Mexico

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
	In				Pct	Pct					Pct	
BD:												
Badland	0-60	Bedrock	---	---	0	0	---	---	---	---	---	---
JA:												
Jal	0-12	Sandy loam	SM	A-2, A-4	0	0	100	100	70-80	30-40	10-20	NP-5
	12-60	Loam	CL, ML	A-4, A-6	0	0	100	100	70-95	50-75	30-40	5-15
Drake	0-9	Loamy fine sand	SM	A-2	0	0	100	100	80-100	15-35	15-24	NP-3
	9-30	Fine sandy loam	SC, SC-SM	A-2, A-4, A-6	0	0	100	100	80-100	30-50	18-35	4-16
	30-60	Sandy clay loam	SC, SC-SM, SM	A-2, A-4, A-6	0	0	100	100	75-100	20-45	17-30	2-12
KO:												
Kimbrough	0-6	Gravelly loam	CL, CL-ML	A-4	0	5-10	65-80	60-75	55-70	50-60	20-25	5-10
	6-16	Cemented material	---	---	---	---	---	---	---	---	---	---
LP:												
Largo	0-13	Loam	CL, CL-ML	A-4	0	0	100	100	90-100	60-80	25-30	5-10
	13-30	Silty clay loam	CL, CL-ML	A-4	0	0	100	100	90-100	85-95	25-30	5-10
	30-60	Silty clay loam, Silt loam	CL	A-6	0	0	100	100	95-100	85-95	30-40	10-20

TABLE 5
Engineering Properties

Lea County, New Mexico

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
	In				Pct	Pct					Pct	
LP:												
Pajarito	0-16	Loamy fine sand	SC-SM, SM	A-2	0	0	100	100	85-100	25-35	15-21	3-6
	16-48	Fine sandy loam, Sandy loam	SM	A-2, A-4	0	0	100	100	60-100	25-45	15-20	NP-5
	48-60	Fine sandy loam, Sandy loam	ML, SM	A-2, A-4	0	0	100	100	60-95	20-55	20-30	NP-5
MN:												
Midessa (ratliff)	0-4	Fine sandy loam	CL, CL-ML, SC, SC-SM	A-4	0	0	95-100	95-100	75-98	35-55	17-27	4-9
	4-22	Clay loam, Loam, Sandy clay loam	CL, SC	A-4, A-6	0	0	95-100	95-100	85-100	45-80	25-40	8-20
	22-60	Clay loam, Loam, Sandy clay loam	CL, SC	A-4, A-6	0	0	95-100	95-100	80-100	45-80	25-40	8-20
Wink	0-12	Fine sandy loam	SC-SM, SM	A-2-4, A-4	0	0-5	90-100	85-100	80-100	25-45	17-25	3-7
	12-23	Fine sandy loam, Loam, Sandy loam	SC-SM, SM	A-2-4, A-4	0	0-5	90-100	85-100	80-100	25-45	17-25	3-7
	23-60	Sandy loam	CL-ML, GC, SC, SC-SM	A-4	0	0-5	70-100	50-100	45-90	35-65	15-22	NP-10
MU:												
Ustifluvents	0-60	Stratified sand to loamy fine sand to loam to sandy clay loam to clay loam to clay	SC	A-7	0	0	95-100	90-100	60-95	10-80	16-74	2-37

TABLE 5
Engineering Properties

Lea County, New Mexico

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
	In				Pct	Pct					Pct	
MW:												
Mobeetie	0-4	Fine sandy loam	CL, CL-ML, SC, SC-SM	A-2-4, A-4	0	0-5	95-100	90-100	75-95	25-55	20-27	4-10
	4-24	Fine sandy loam, Loam	CL, CL-ML, SC, SC-SM	A-2-4, A-4	0	0-5	95-100	90-100	75-95	25-55	20-27	4-10
	24-60	Fine sandy loam, Loam	CL, CL-ML, SC, SC-SM	A-2-4, A-4	0	0-5	90-100	85-100	70-95	25-55	20-27	4-10
Potter	0-4	Gravelly fine sandy loam	CL, CL-ML	A-4, A-6	0	0-5	70-95	70-85	60-80	51-70	20-40	5-20
	4-14	Very cobbly loam, Extremely cobbly loam, Extremely gravelly loam	GC, GC-GM, SC, SC-SM	A-2-4, A-2-6, A-4, A-6	0	5-50	30-80	25-75	20-60	13-50	20-40	5-20
Pb:												
Playas, saline	0-6	Silty clay loam	CH, CL, MH	A-7	0	0	100	100	100	90-100	45-75	20-40
	6-60	Clay, Silty clay, Silty clay loam	CH, CL, MH	A-7	0	0	100	100	100	90-100	45-75	20-40

TABLE 5

Engineering Properties

Lea County, New Mexico

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
	In				Pct	Pct					Pct	
SE:												
Simona	0-8	Fine sandy loam	SM	A-4	0	0	100	100	70-100	35-50	20-25	NP-5
	8-16	Fine sandy loam, Gravelly fine sandy loam, Sandy loam	GM, ML, SM	A-2, A-4	0	0-10	60-95	55-90	50-75	30-55	20-25	NP-5
	16-26	Cemented material	---	---	---	---	---	---	---	---	---	---
SR:												
Simona	0-8	Gravelly fine sandy loam	GM, SM	A-2, A-4	0	0-10	60-80	55-75	50-70	30-50	20-25	NP-5
	8-16	Fine sandy loam, Gravelly fine sandy loam, Sandy loam	GM, ML, SM	A-2, A-4	0	0-10	60-95	55-90	50-75	30-55	20-25	NP-5
	16-26	Cemented material	---	---	---	---	---	---	---	---	---	---
Upton	0-8	Gravelly loam	CL, GC, SC	A-4, A-6	0-10	0-2	65-85	60-75	51-70	36-55	25-40	8-20
	8-18	Cemented material	---	---	---	---	---	---	---	---	---	---
	18-60	Gravelly loam, Very gravelly loam, Extremely gravelly loam	GC, GP-GC, SC, SP-SC	A-2, A-4, A-6	0-10	0-20	31-85	20-75	10-70	5-45	25-40	8-20
SY:												
Torriorthents	0-20	Extremely gravelly sandy loam	GC-GM, GM	A-1	0	0	25-40	20-35	10-25	5-15	20-25	NP-5
	20-60	Bedrock	---	---	---	---	---	---	---	---	---	---

TABLE 5
Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

"Depth" to the upper and lower boundaries of each layer is indicated.

"Texture" is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

"Classification" of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

"Rock fragments" larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

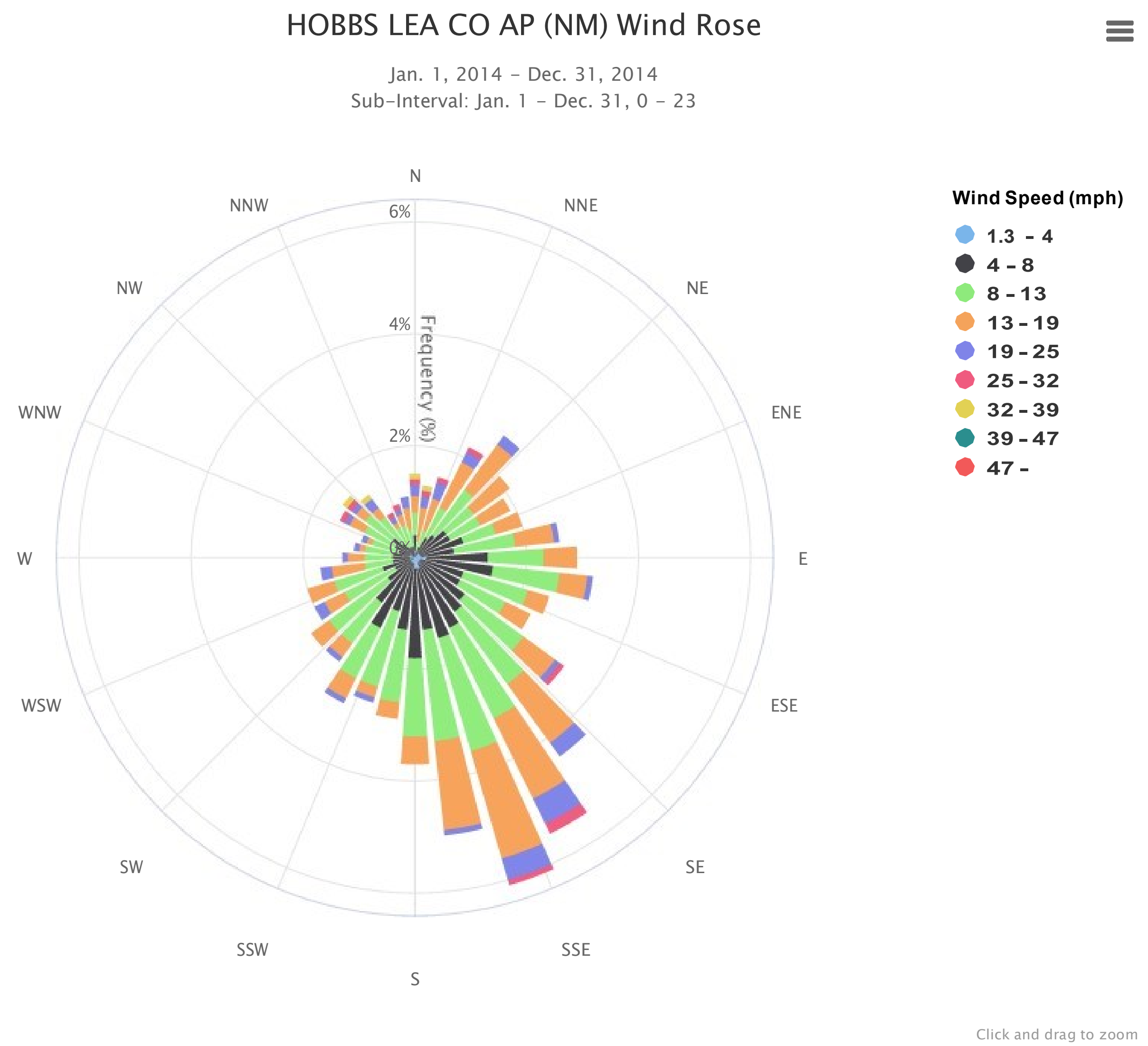
"Percentage (of soil particles) passing designated sieves" is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

"Liquid limit" and "plasticity index" (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

References:
American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

APPENDIX E: ANNUAL WIND ROSE DATA

Annual data results on following pages.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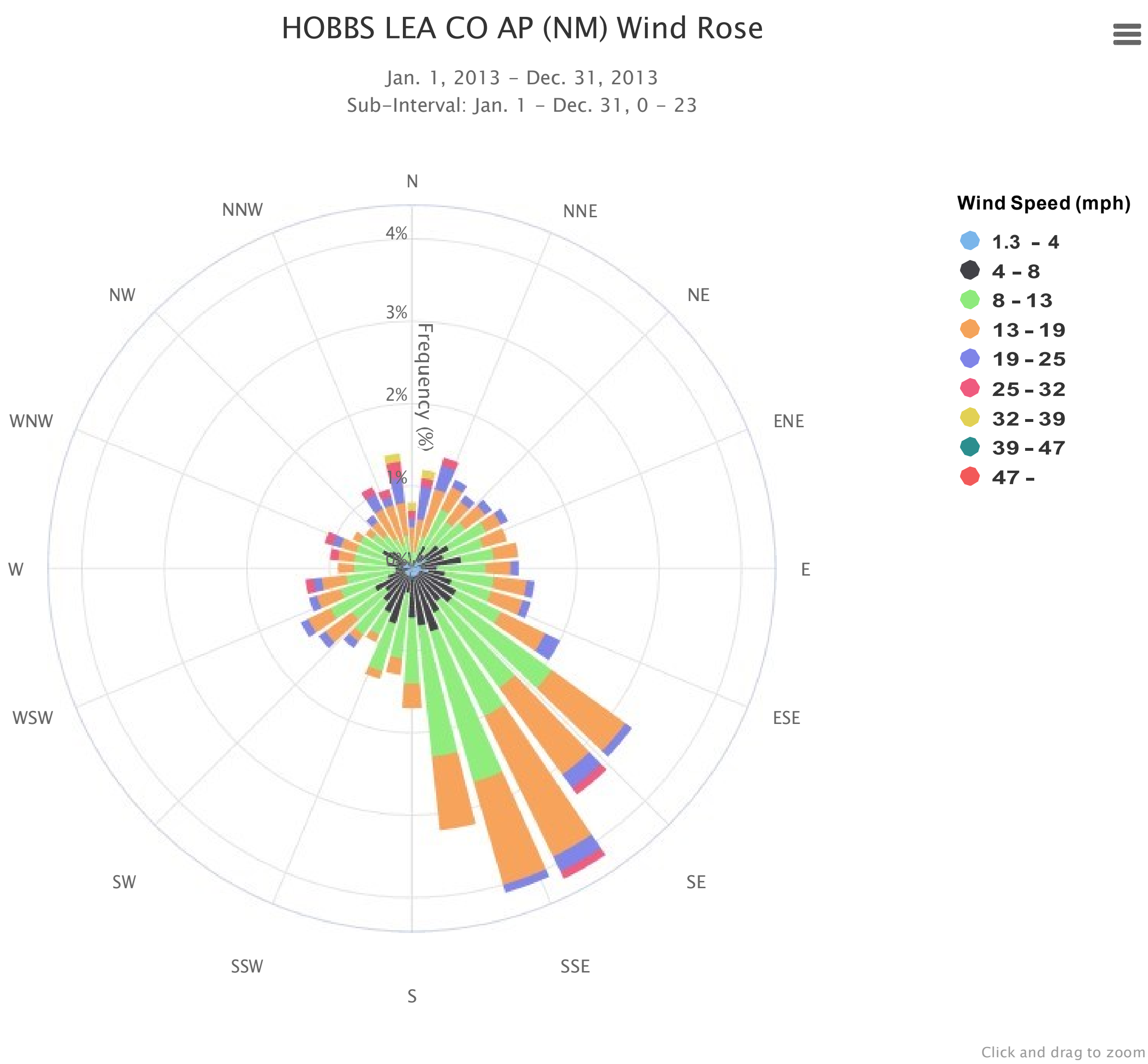
Jan. 1, 2014 – Dec. 31, 2014
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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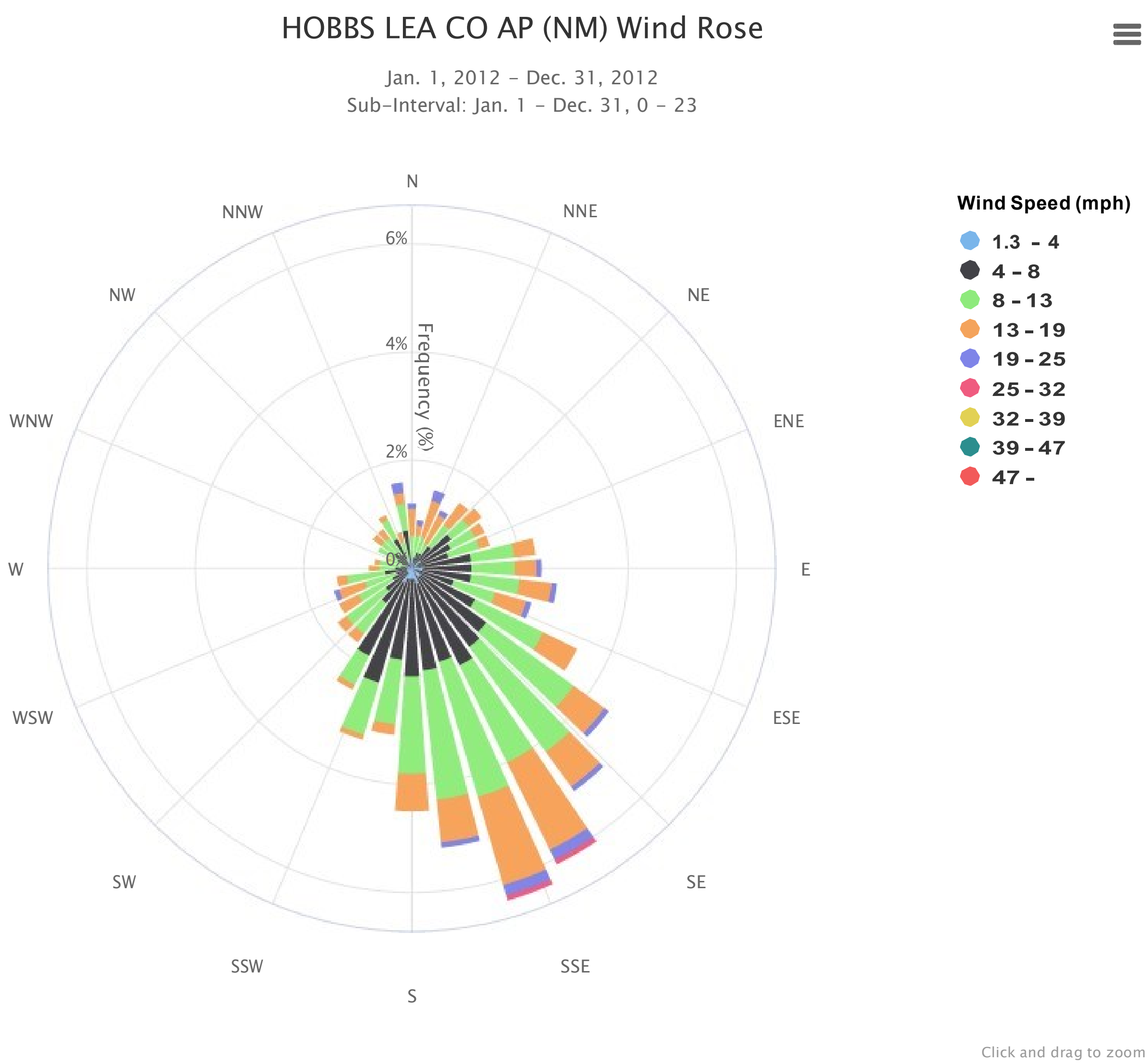
Jan. 1, 2013 - Dec. 31, 2013
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
4%
3%
2%
1%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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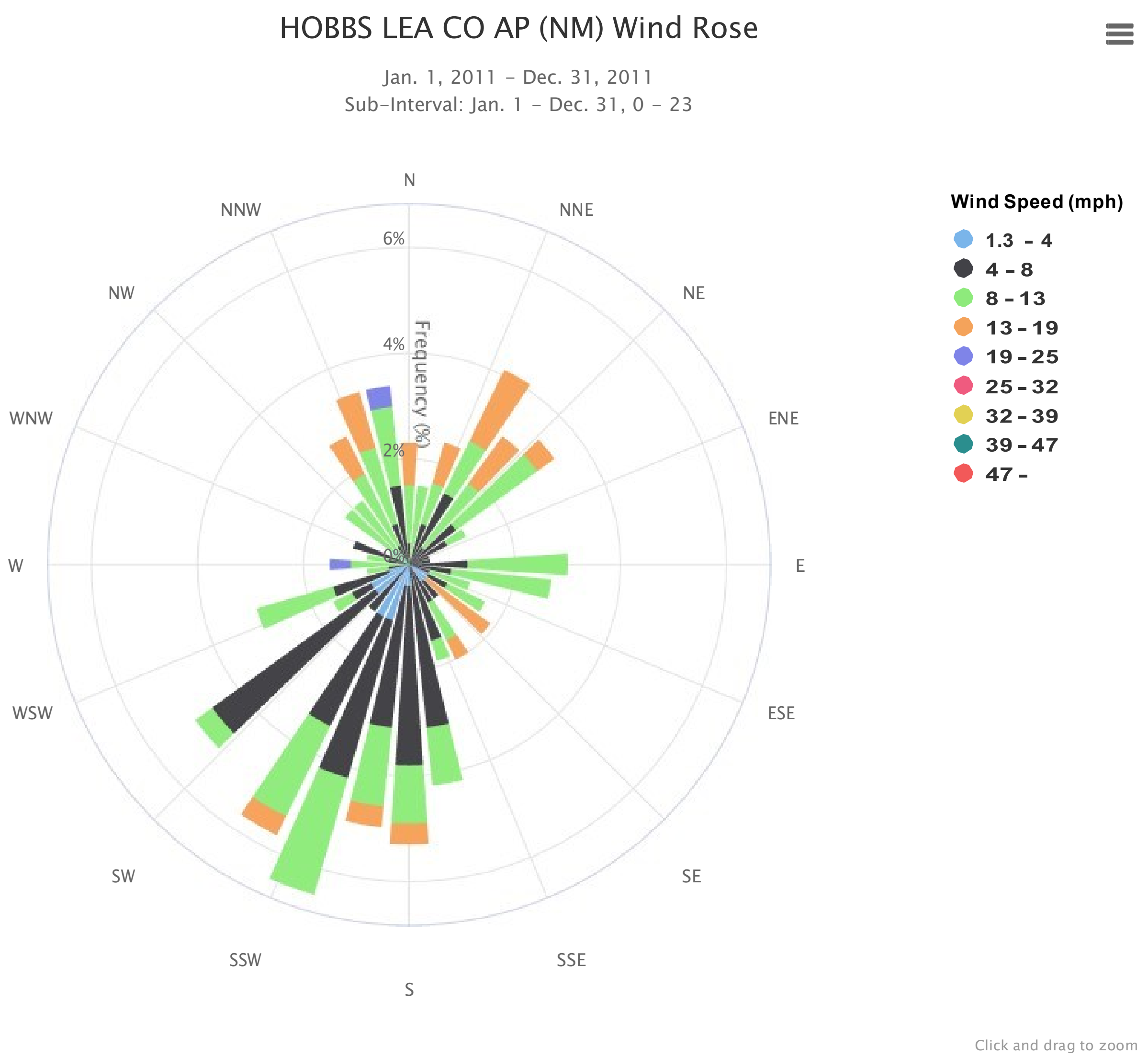
Jan. 1, 2012 - Dec. 31, 2012
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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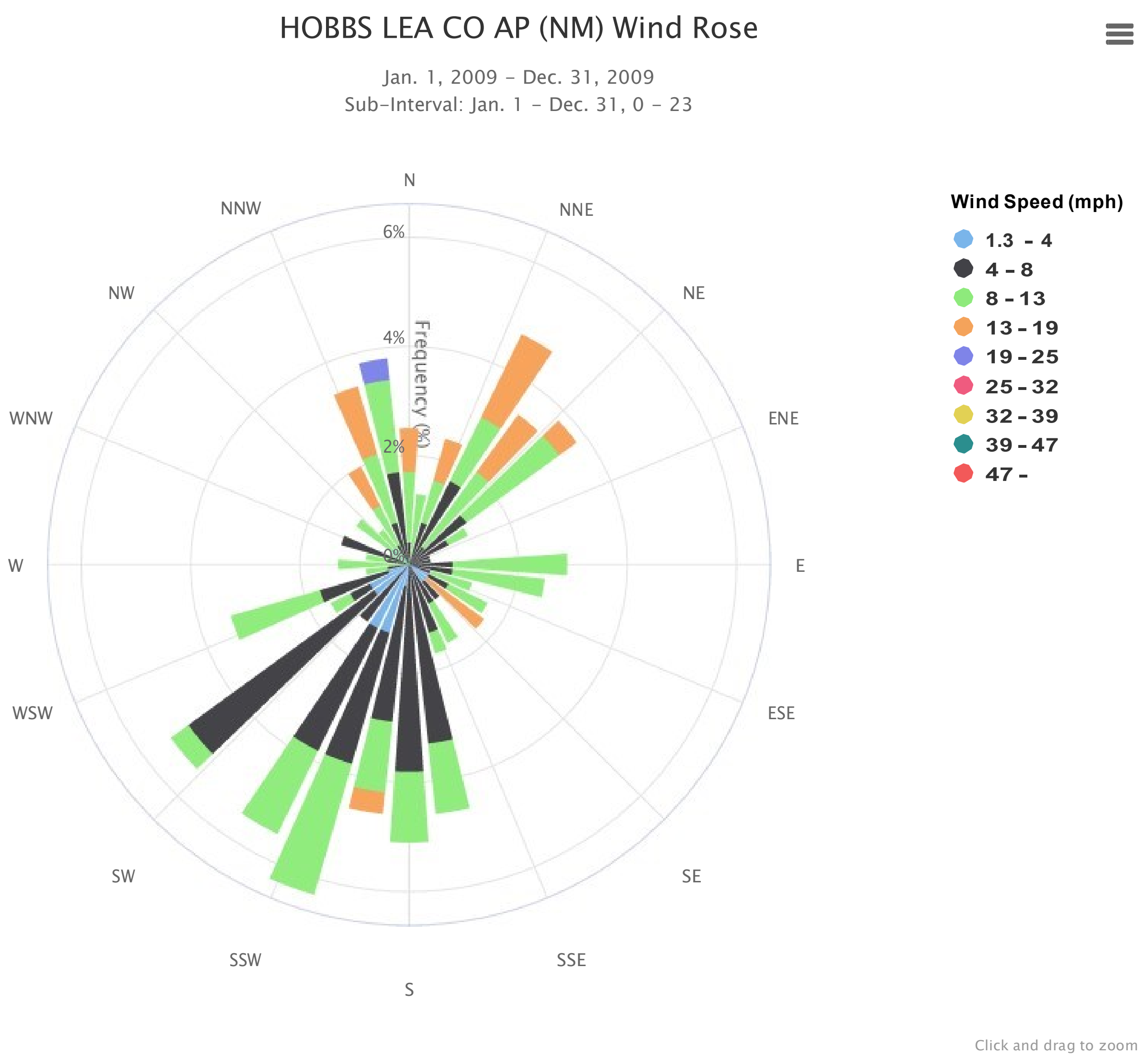
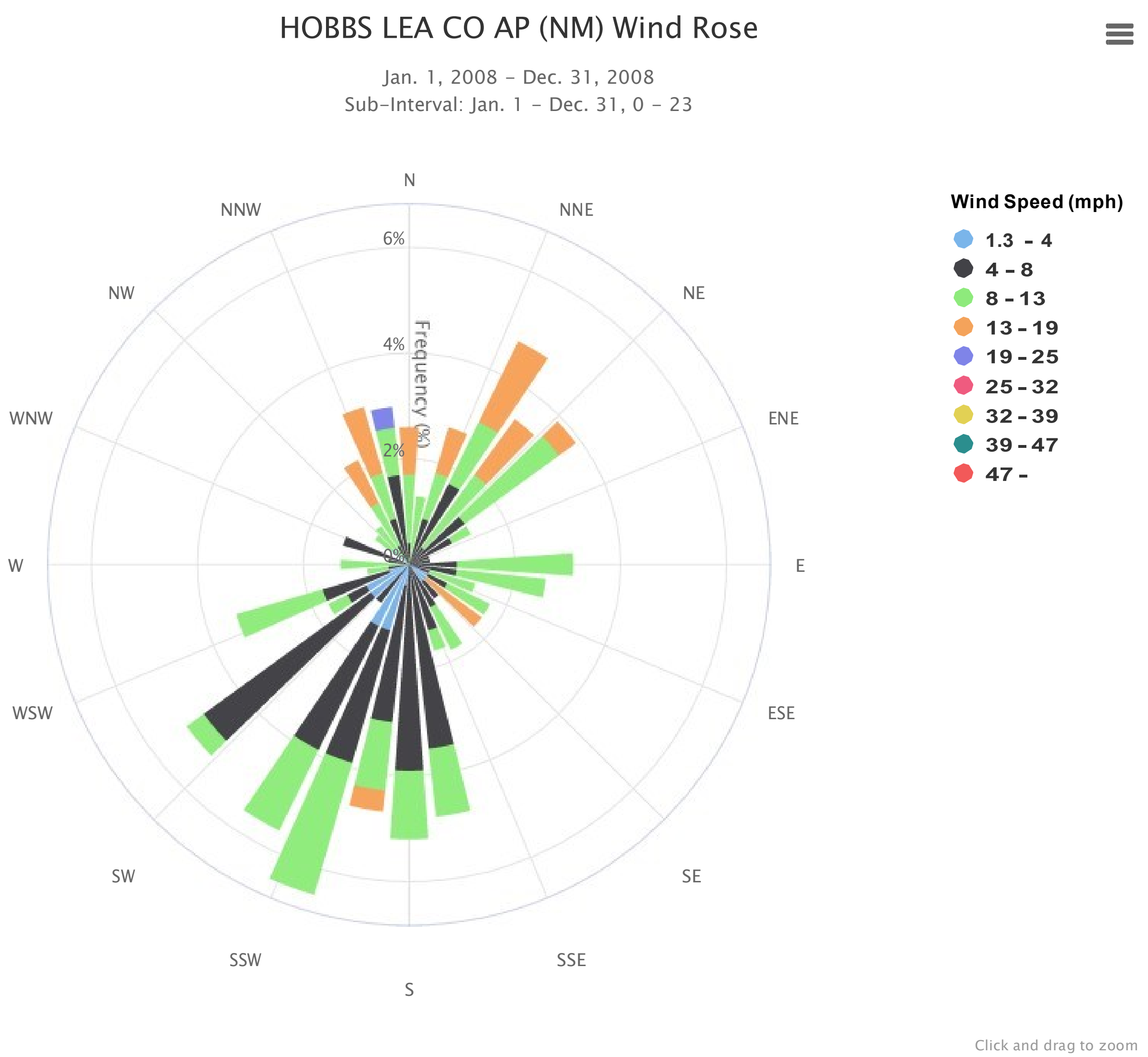
Jan. 1, 2011 – Dec. 31, 2011
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 2009 - Dec. 31, 2009
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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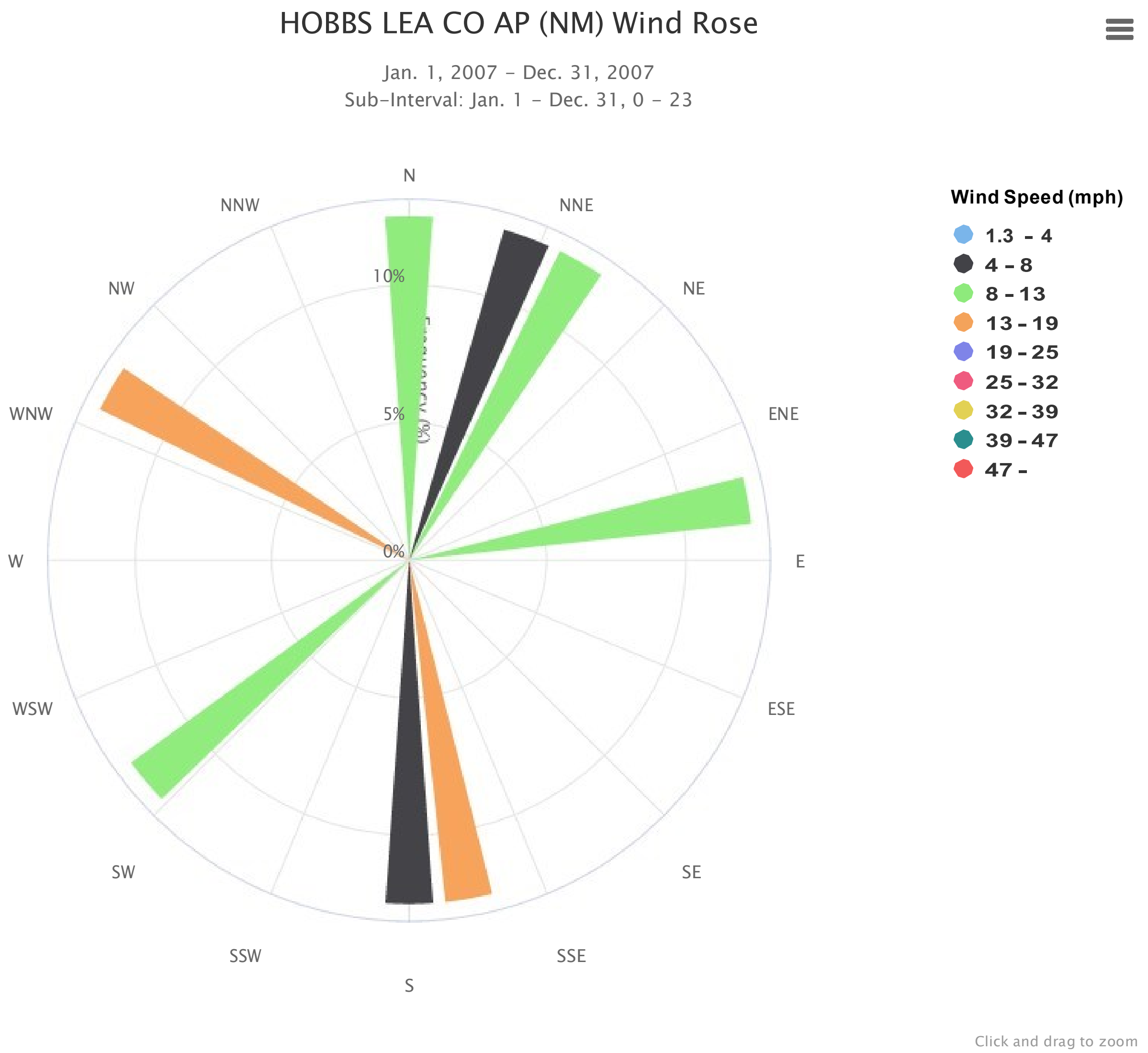
Jan. 1, 2008 – Dec. 31, 2008
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 – 4
4 – 8
8 – 13
13 – 19
19 – 25
25 – 32
32 – 39
39 – 47
47 –
Click and drag to zoom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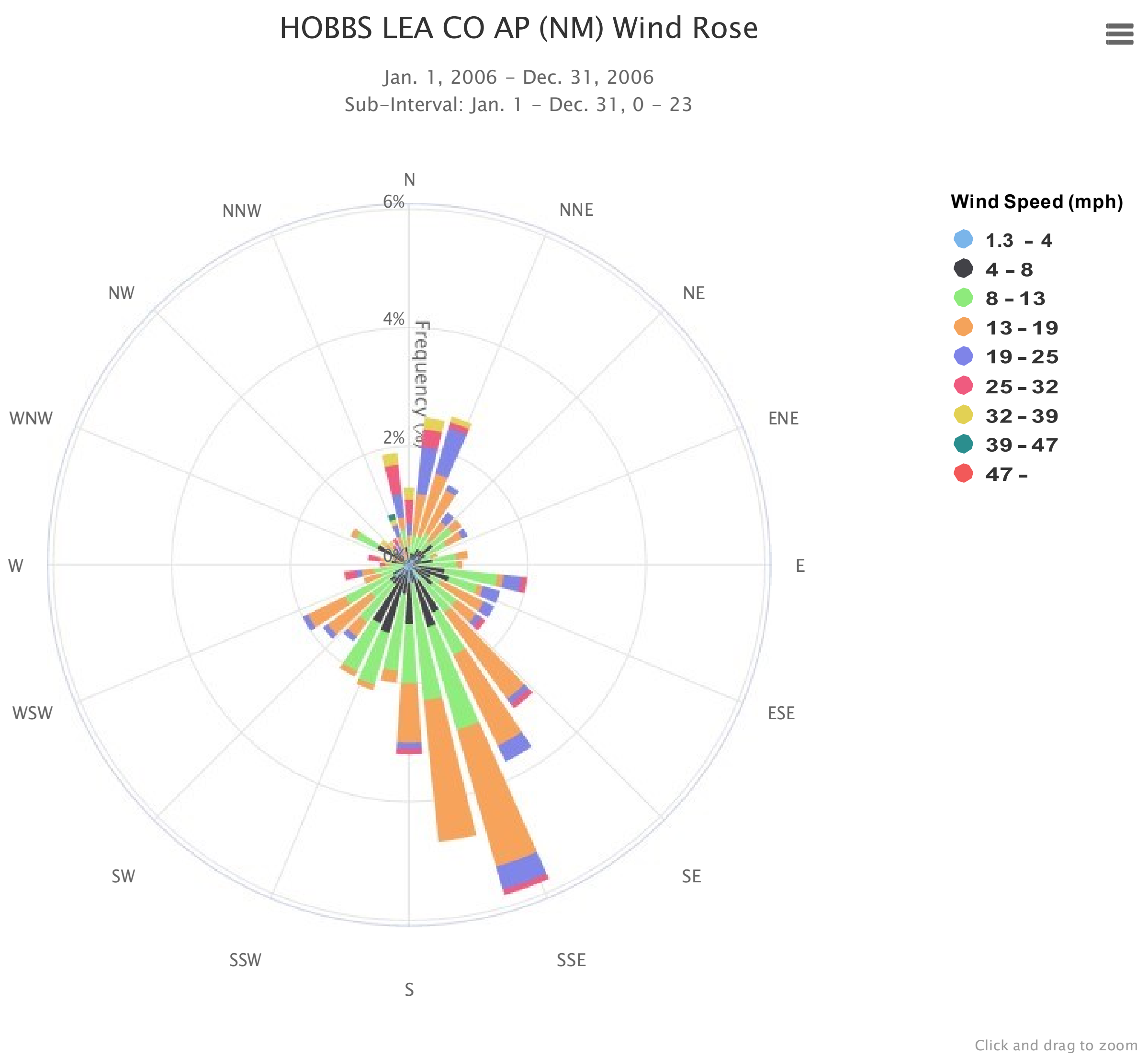
Jan. 1, 2007 - Dec. 31, 2007
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
10%
5%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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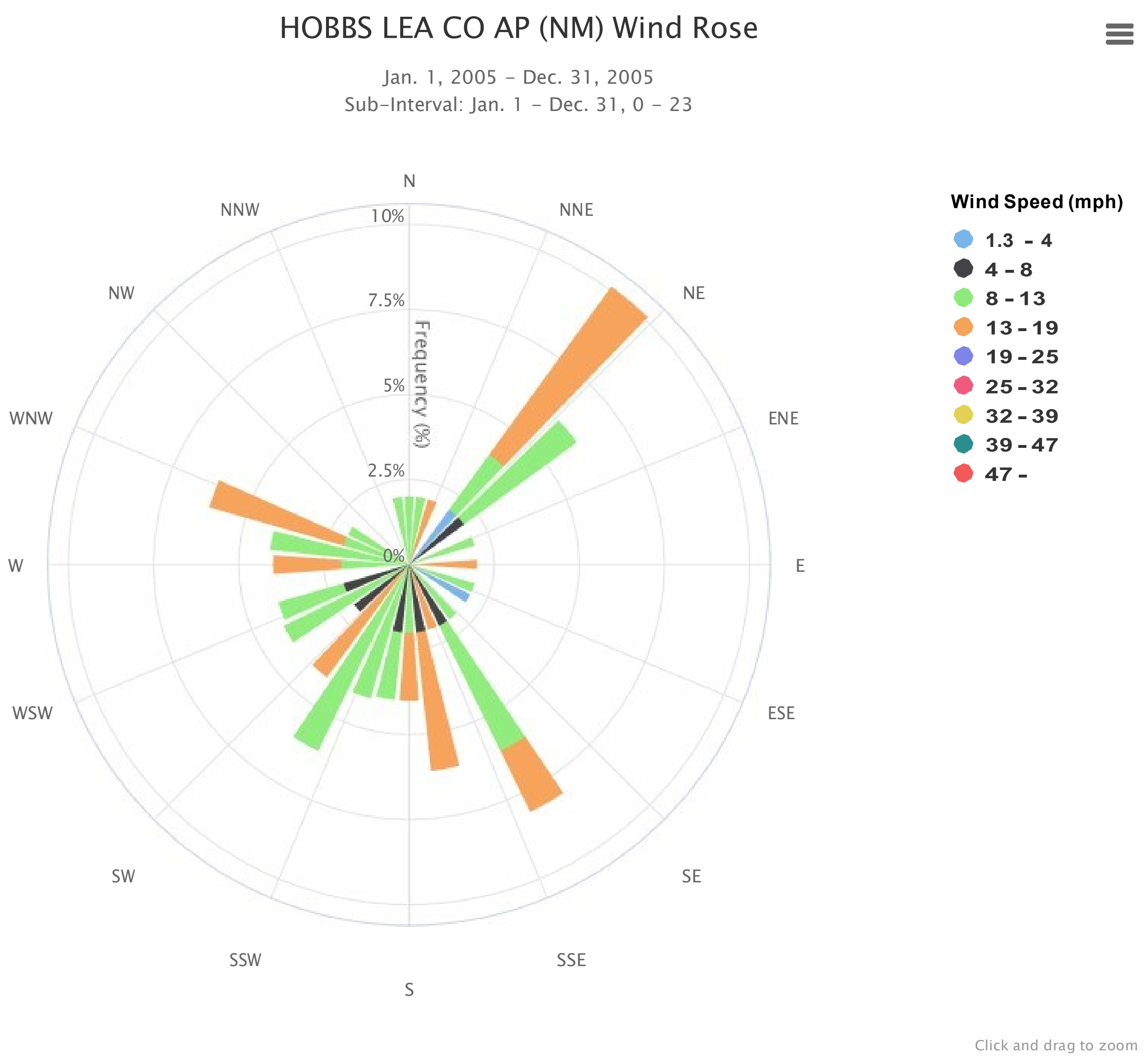
Jan. 1, 2006 - Dec. 31, 2006
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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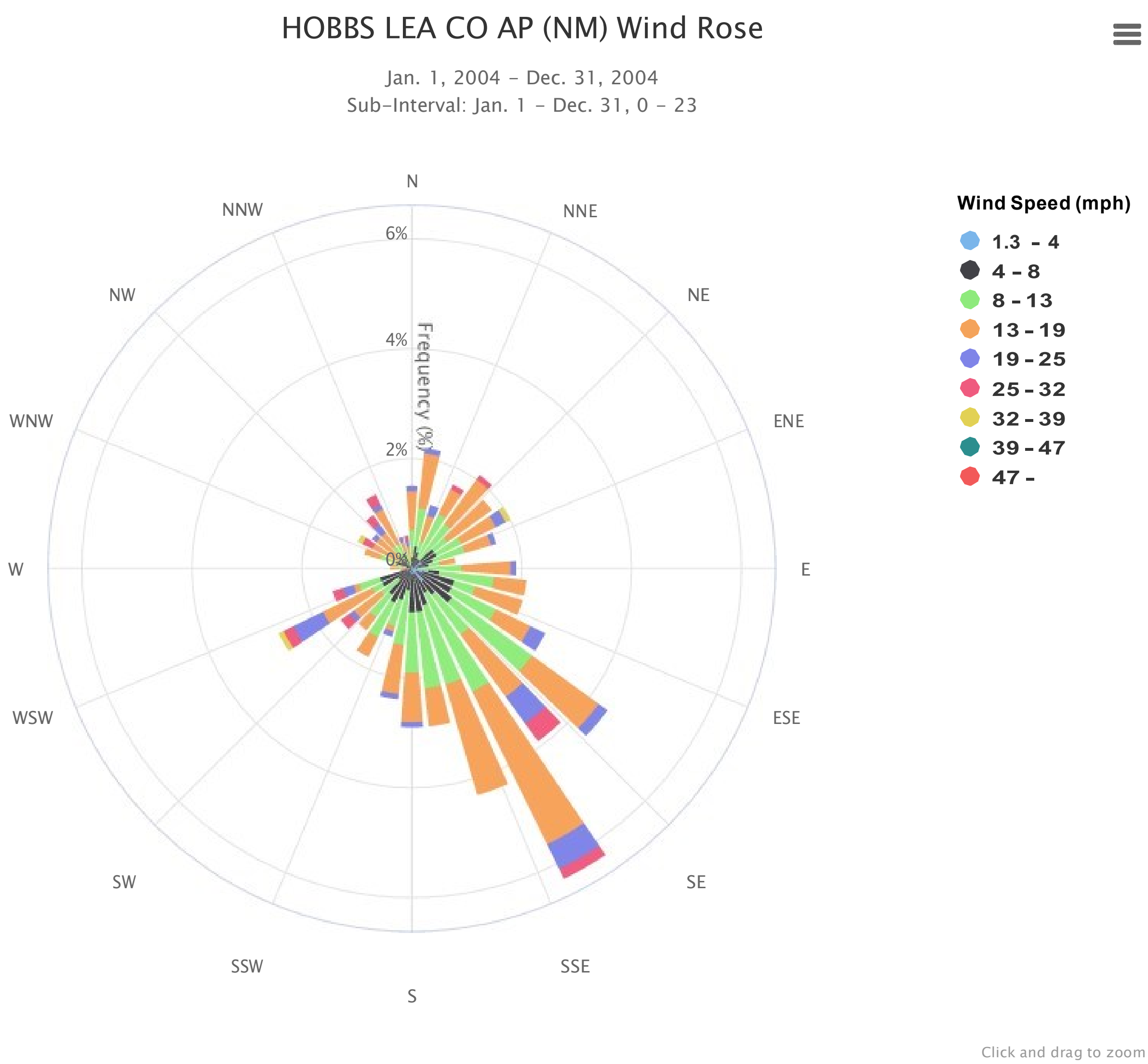
Jan. 1, 2005 - Dec. 31, 2005
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
10%
7.5%
5%
2.5%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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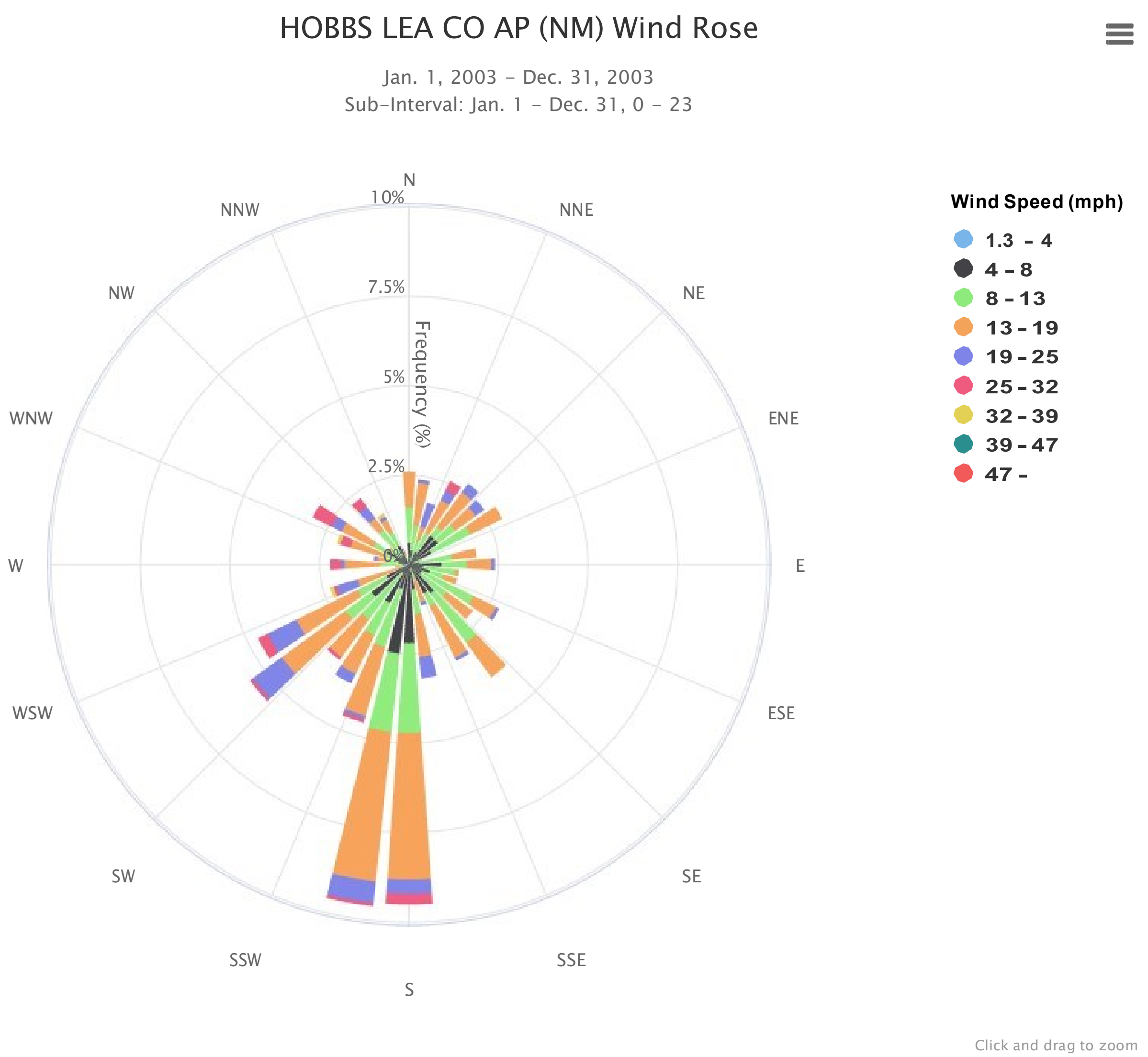
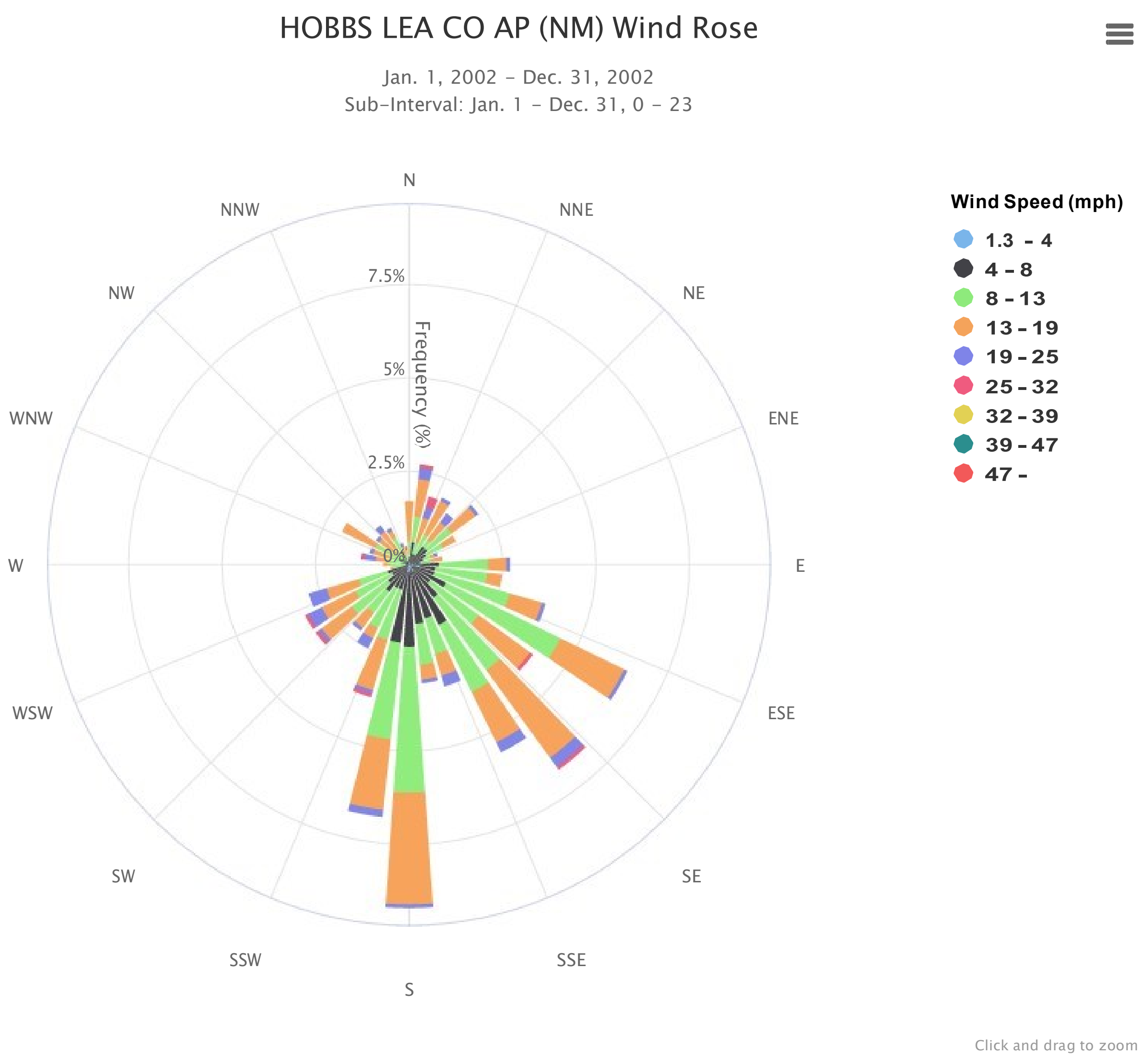
Jan. 1, 2004 - Dec. 31, 2004
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom

ATTACHMENT 5 TO HOLTEC LETTER 5025040

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Jan. 1, 2002 - Dec. 31, 2002
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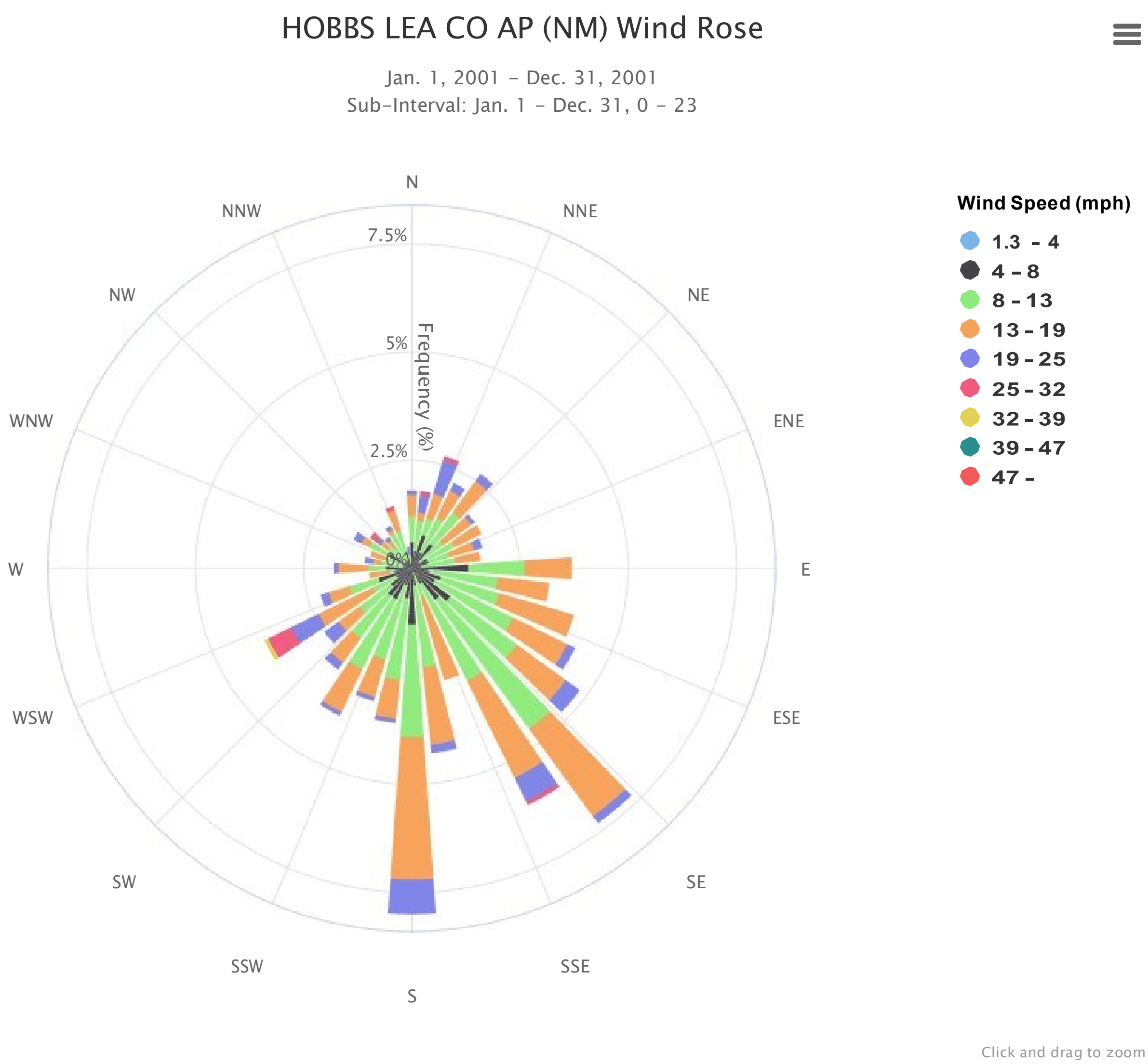
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
7.5%
5%
2.5%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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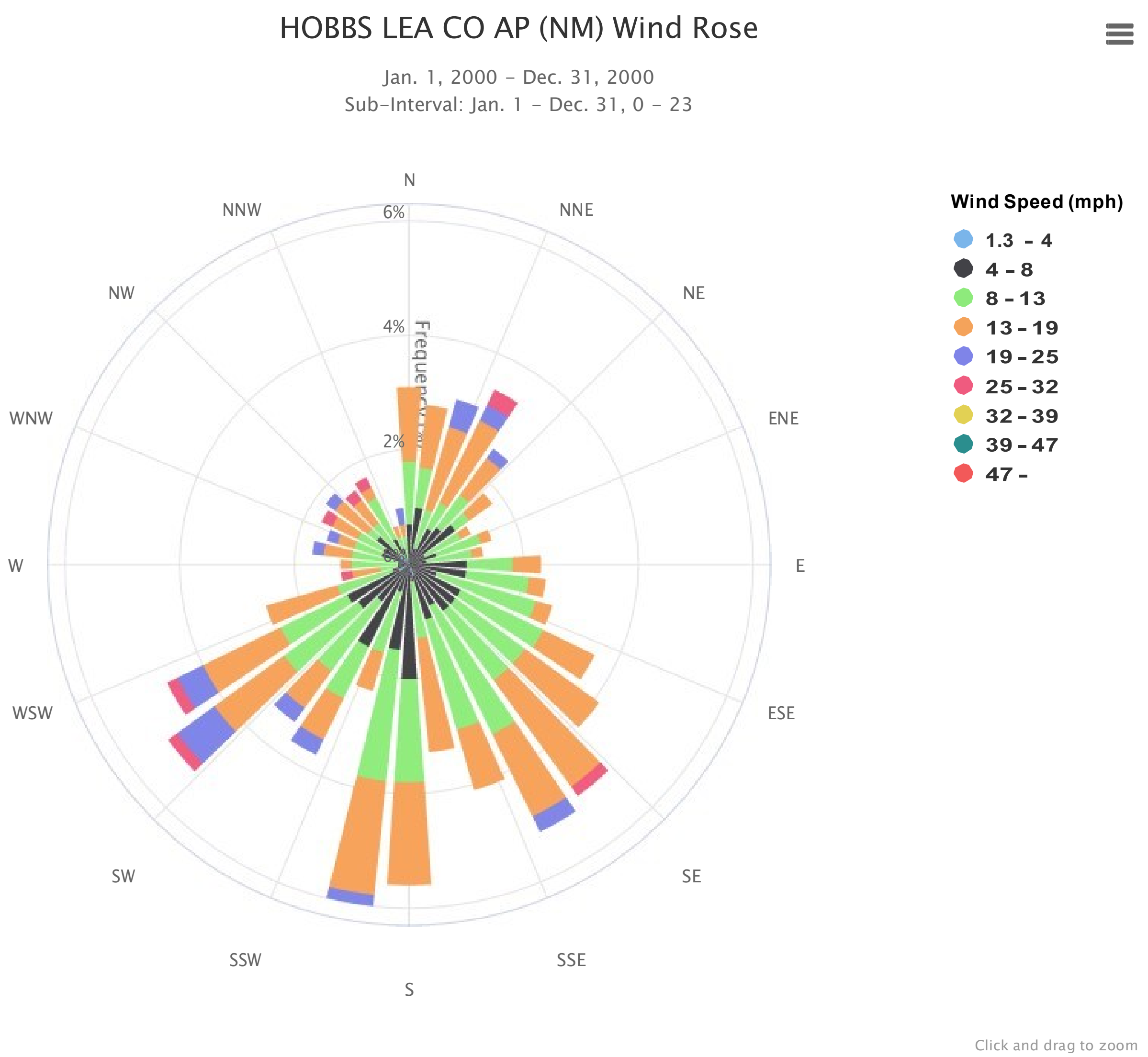
Jan. 1, 2001 - Dec. 31, 2001
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
7.5%
5%
2.5%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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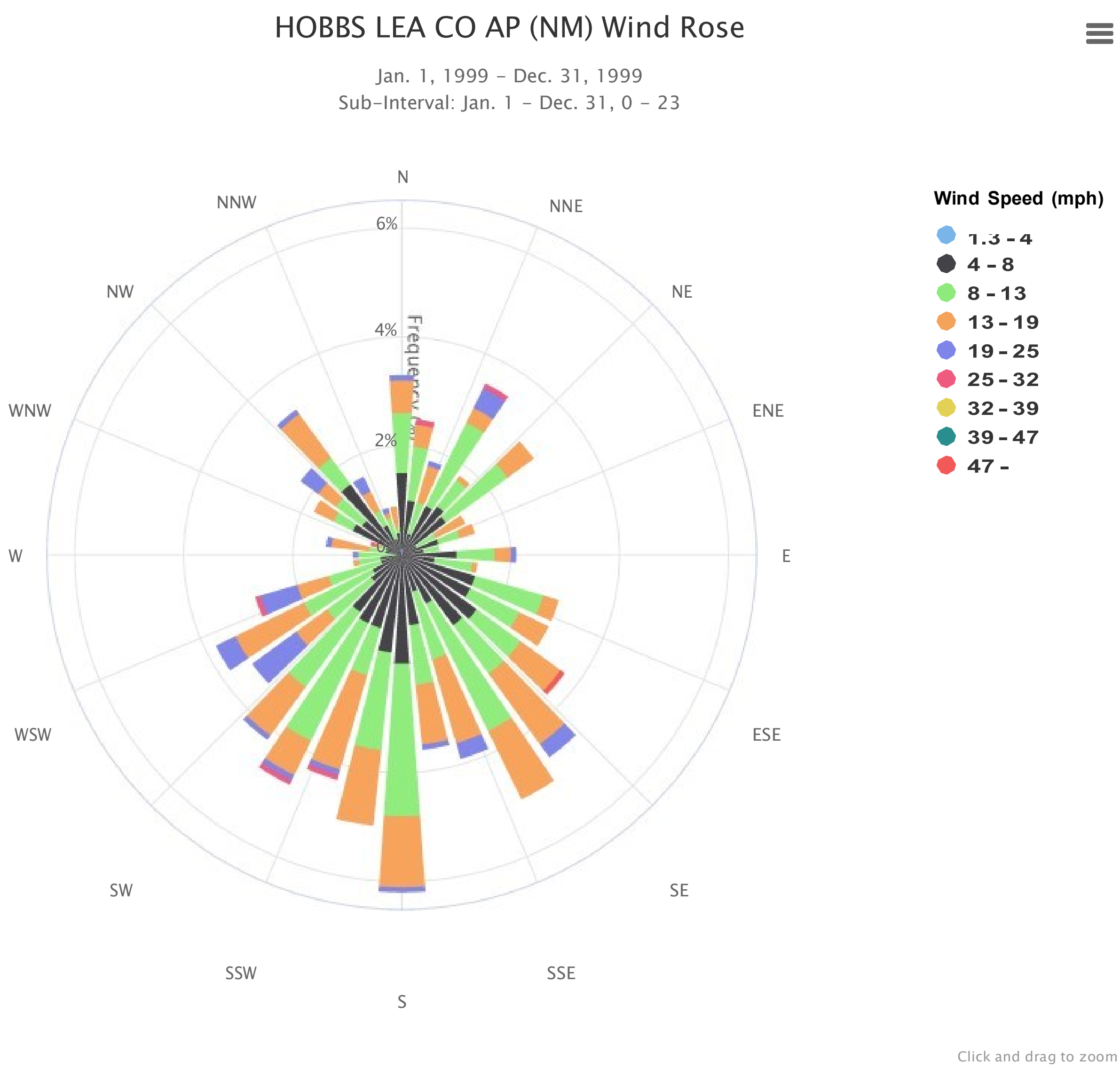
Jan. 1, 2000 - Dec. 31, 2000
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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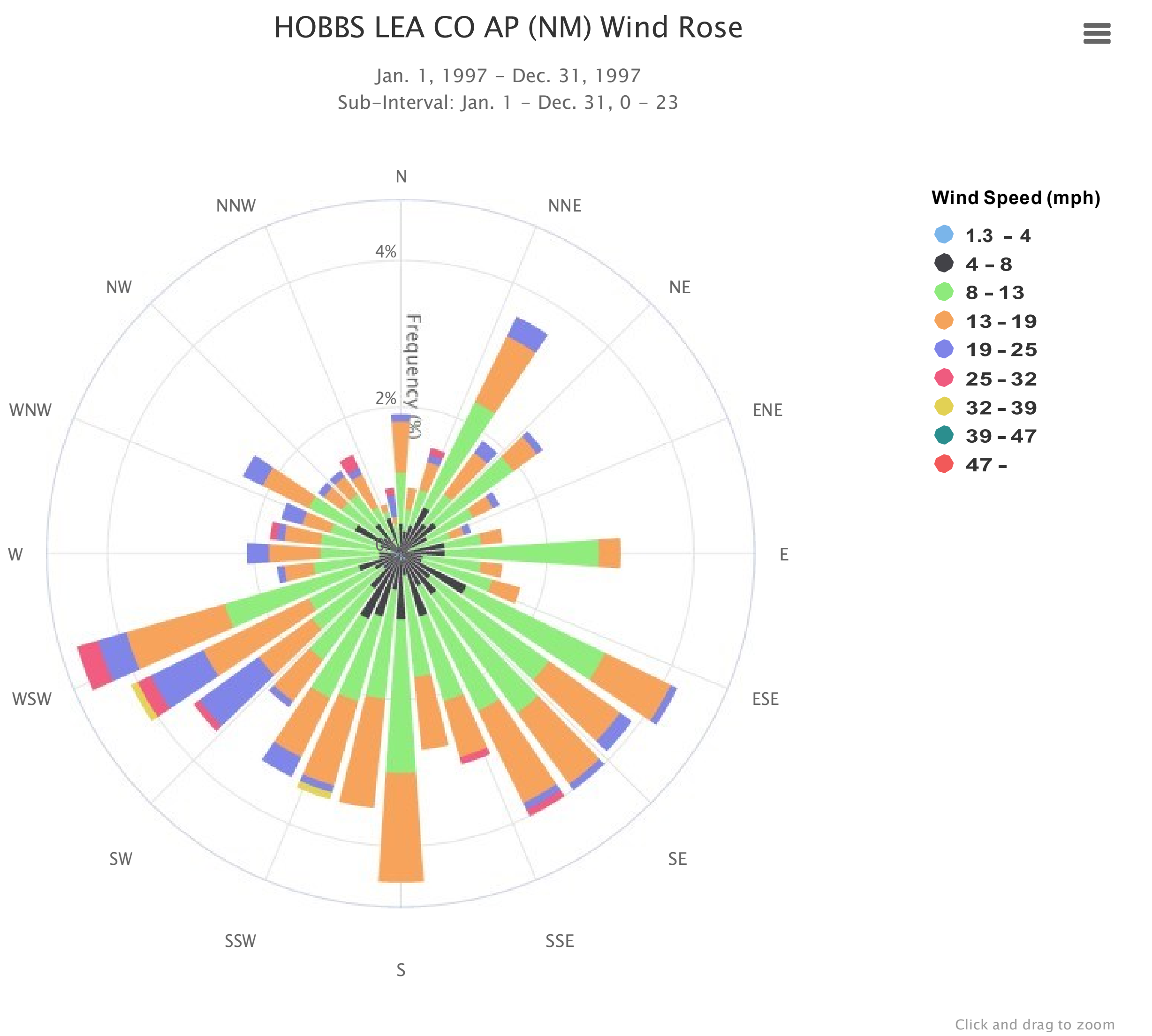
Jan. 1, 1999 - Dec. 31, 1999
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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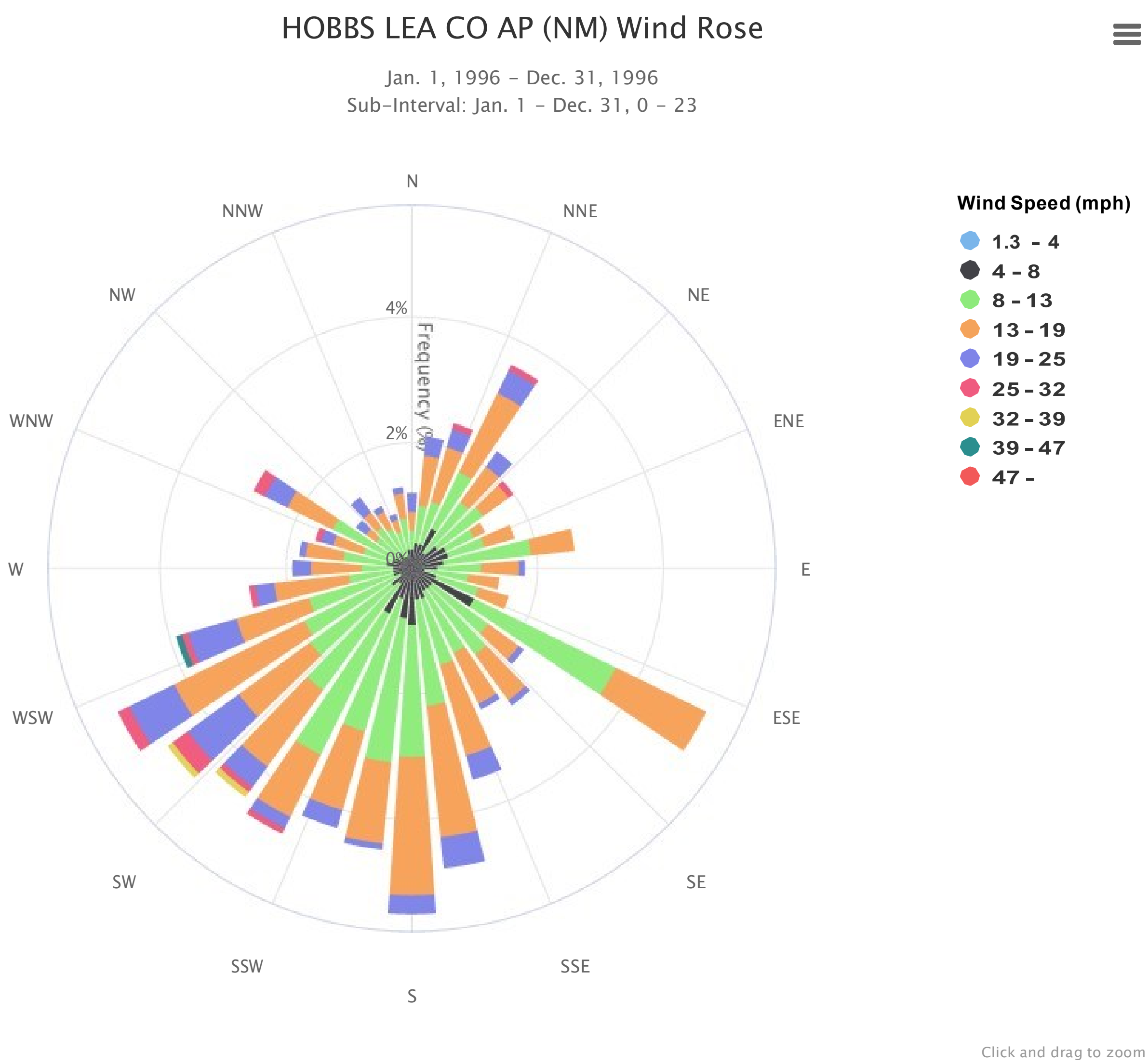
Jan. 1, 1997 - Dec. 31, 1997
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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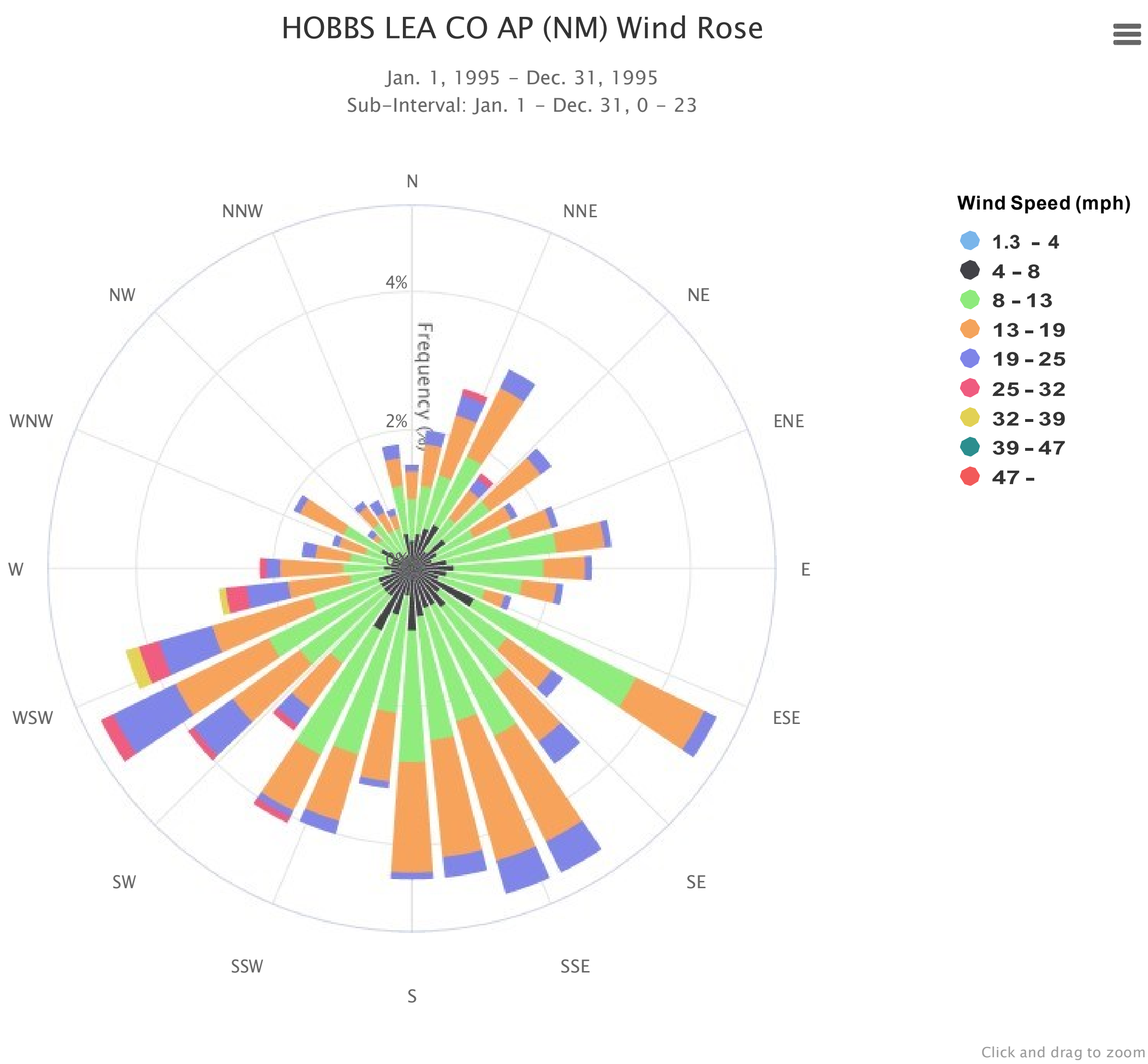
Jan. 1, 1996 - Dec. 31, 1996
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
4%
2%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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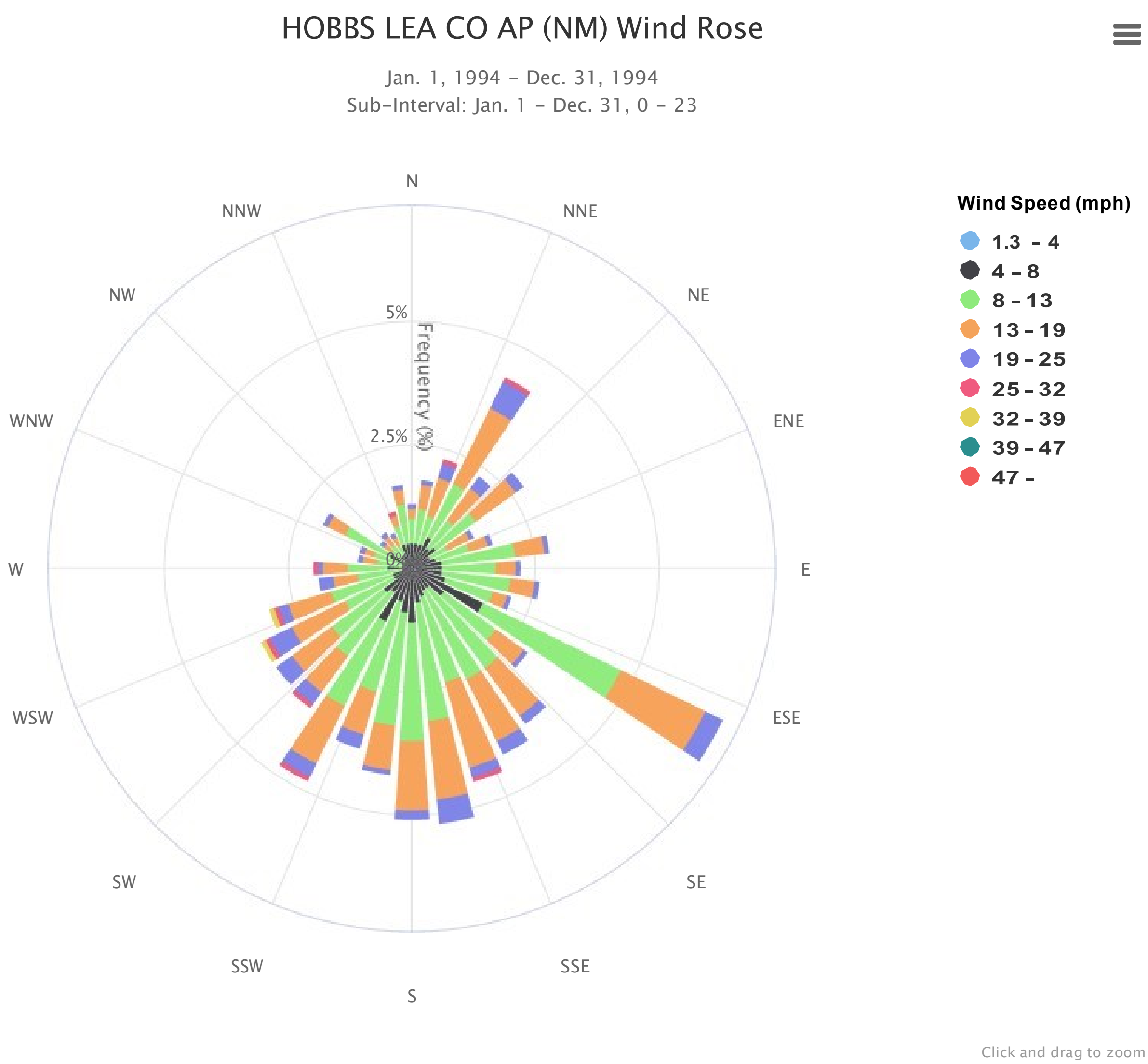
Jan. 1, 1995 - Dec. 31, 1995
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
4%
2%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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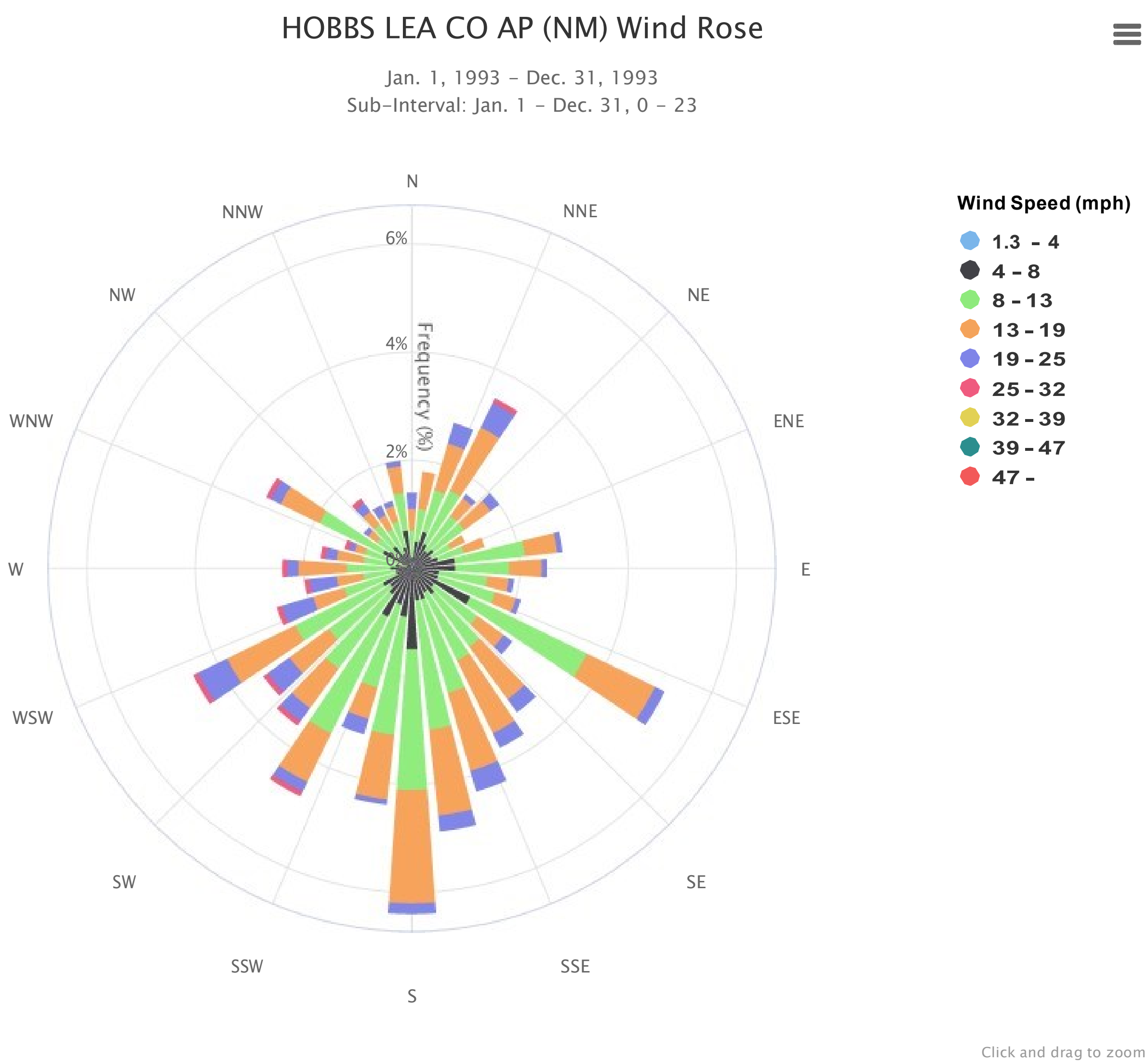
Jan. 1, 1994 – Dec. 31, 1994
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
5%
2.5%
0%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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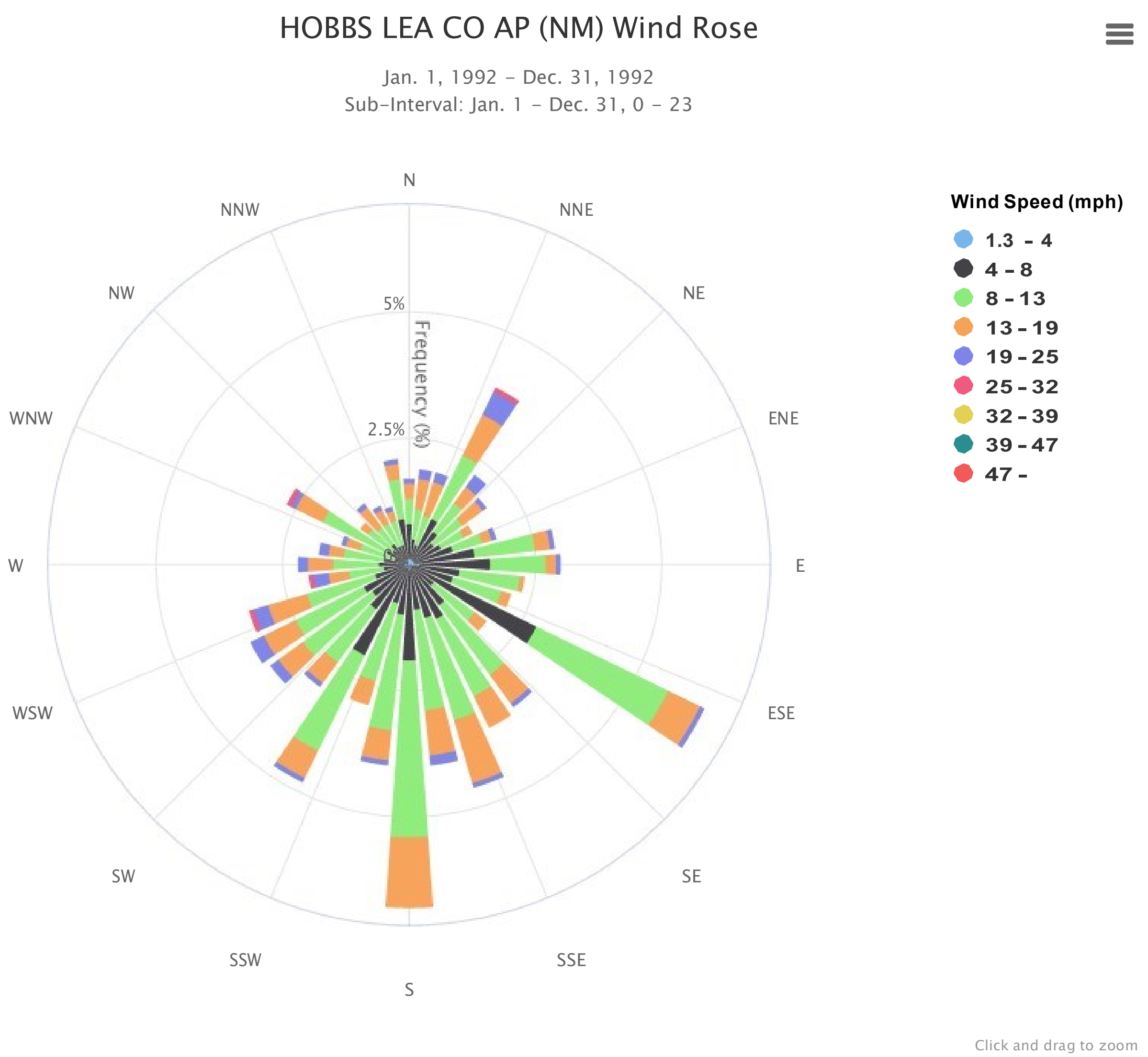
Jan. 1, 1993 - Dec. 31, 1993
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
6%
4%
2%
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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Jan. 1, 1992 - Dec. 31, 1992
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
N
NNE
NE
ENE
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Wind Speed (mph)
1.3 - 4
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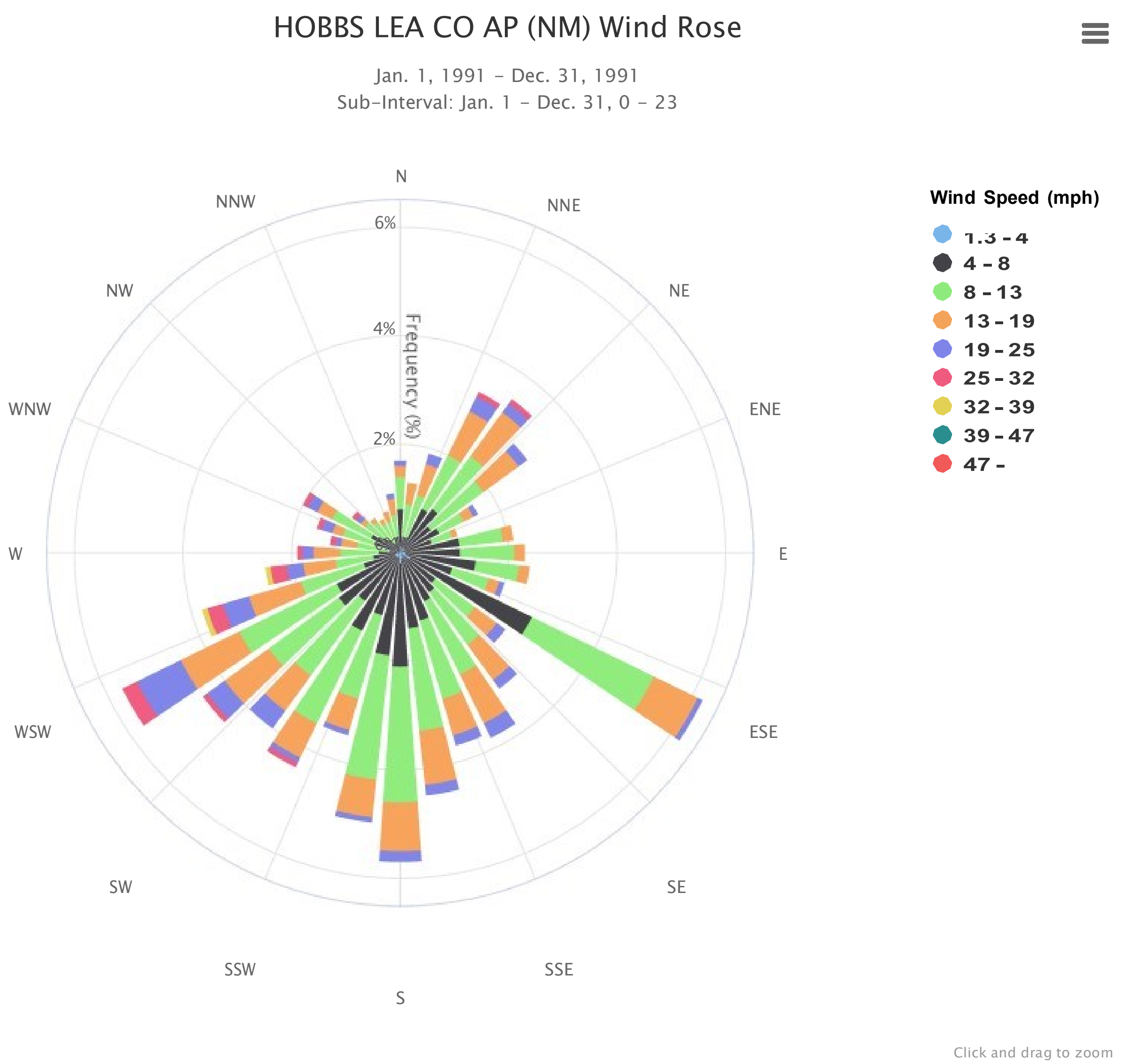
47 -
Click and drag to zoom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Jan. 1, 1991 - Dec. 31, 1991
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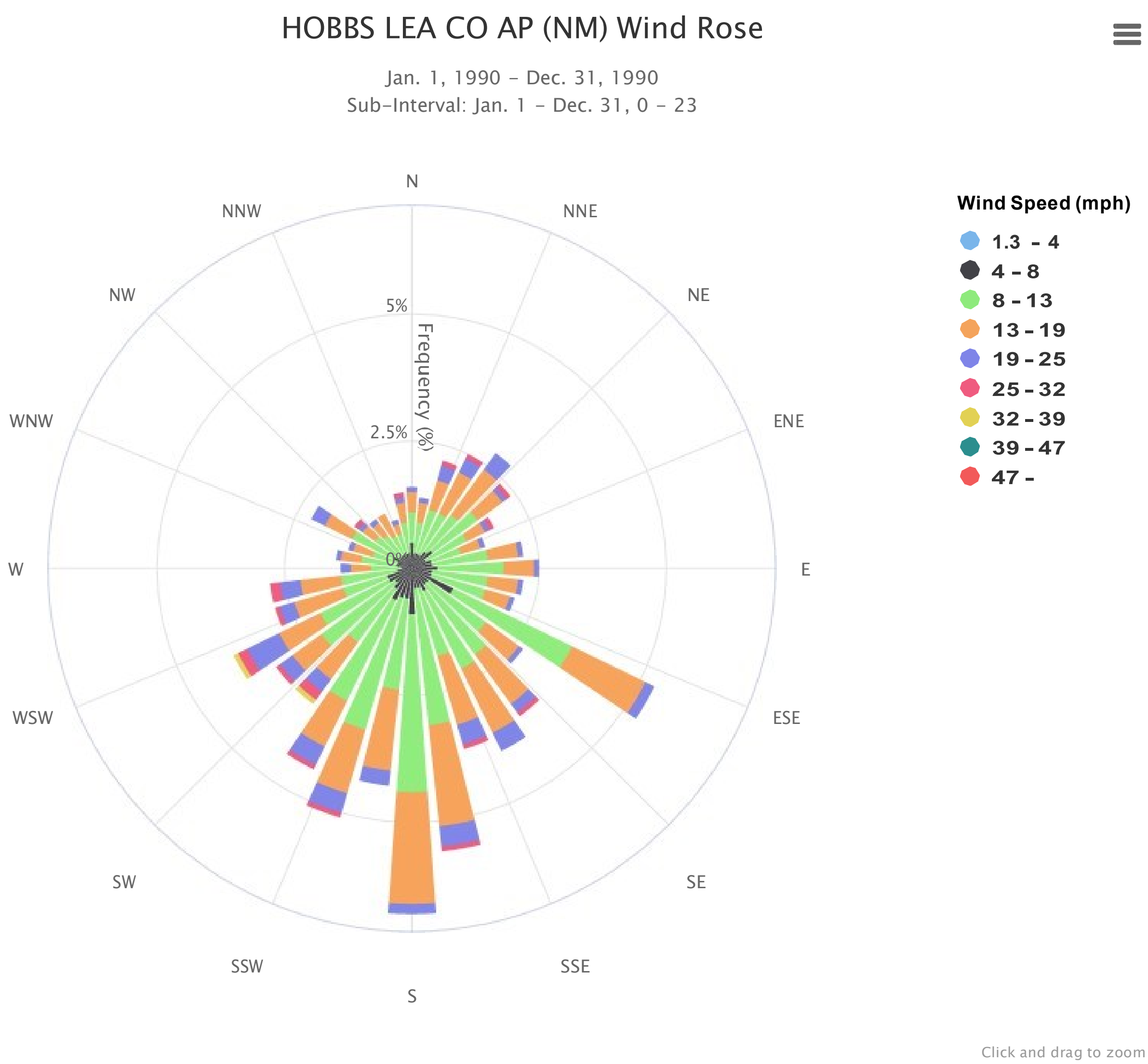
Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
13 - 19
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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Jan. 1, 1990 - Dec. 31, 1990
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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5%
2.5%
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
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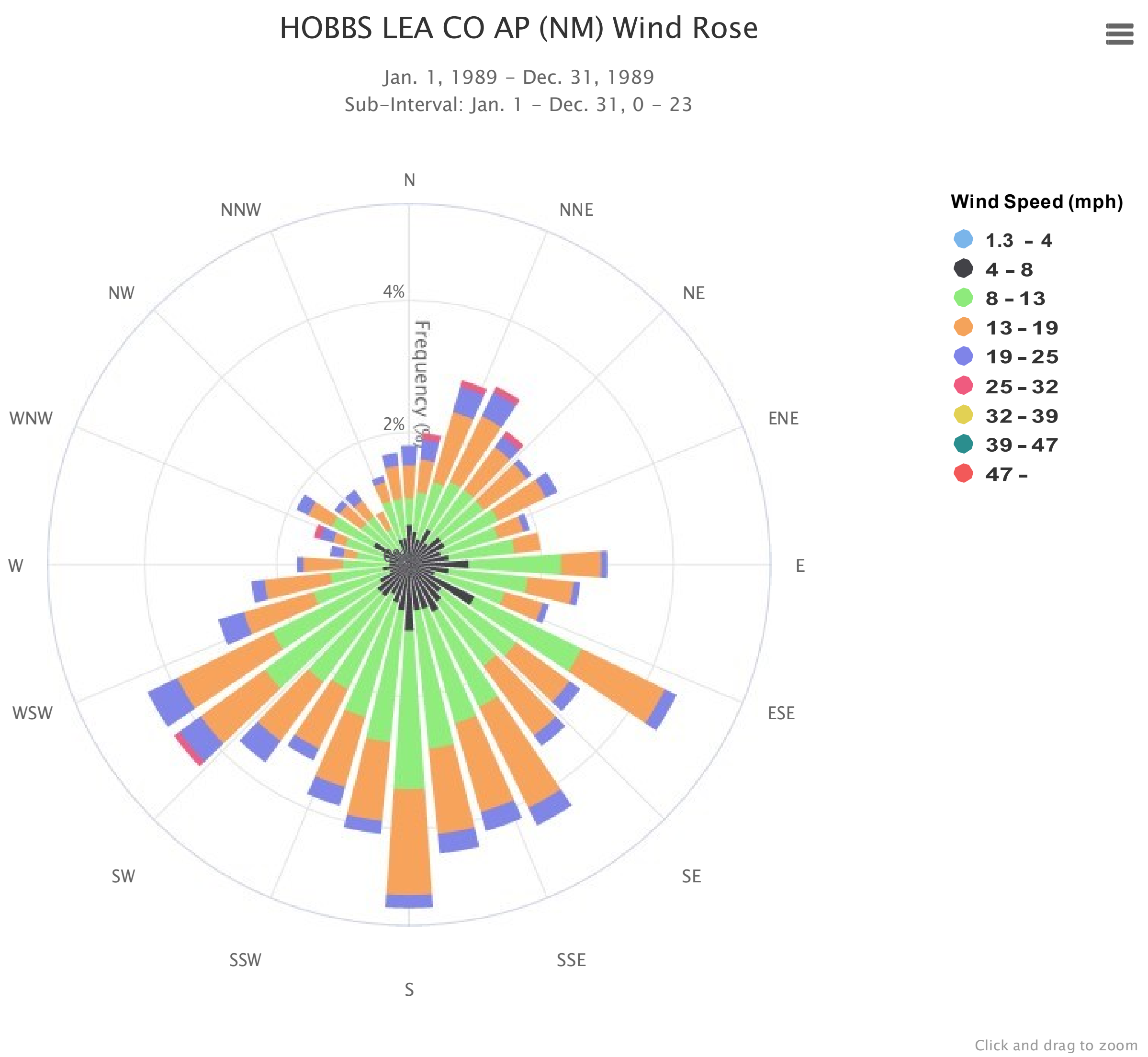
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom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Jan. 1, 1989 – Dec. 31, 1989
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
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19 - 25
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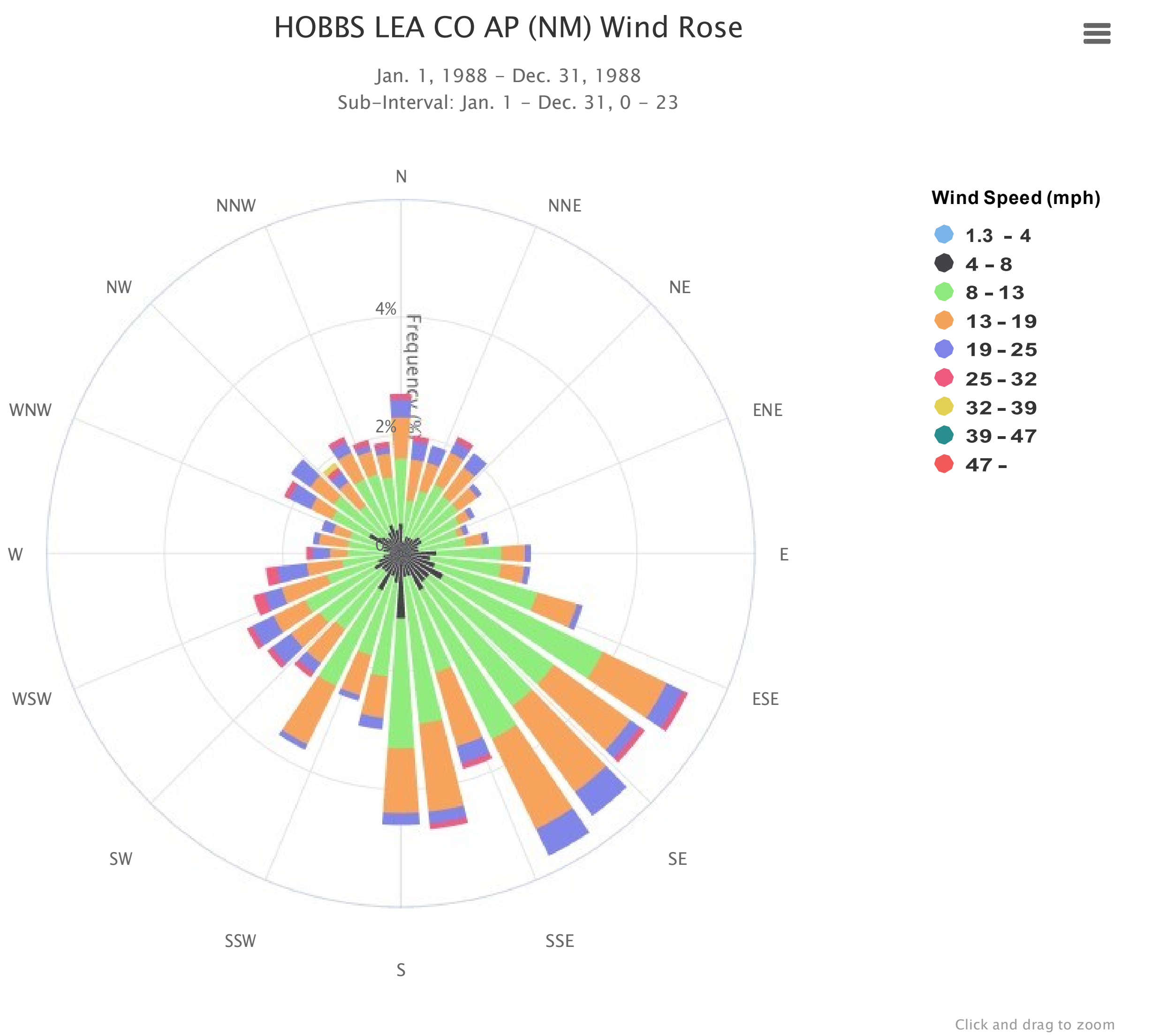
32 - 39
39 - 47
47 -
Click and drag to zoom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Jan. 1, 1988 - Dec. 31, 1988
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
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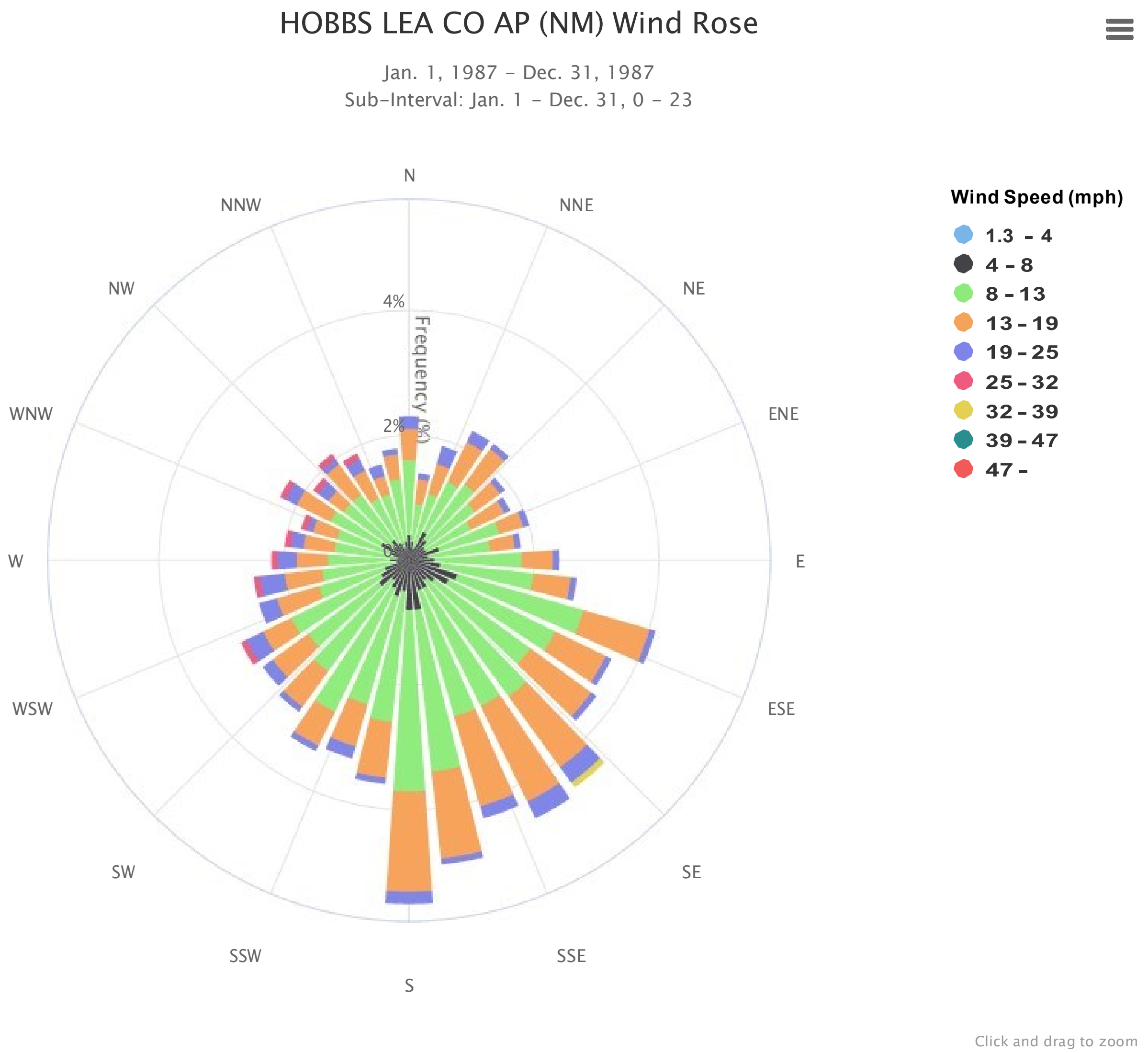
47 -
Click and drag to zoom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Jan. 1, 1987 - Dec. 31, 1987
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Frequency (%)
Wind Speed (mph)
1.3 - 4
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25 - 32
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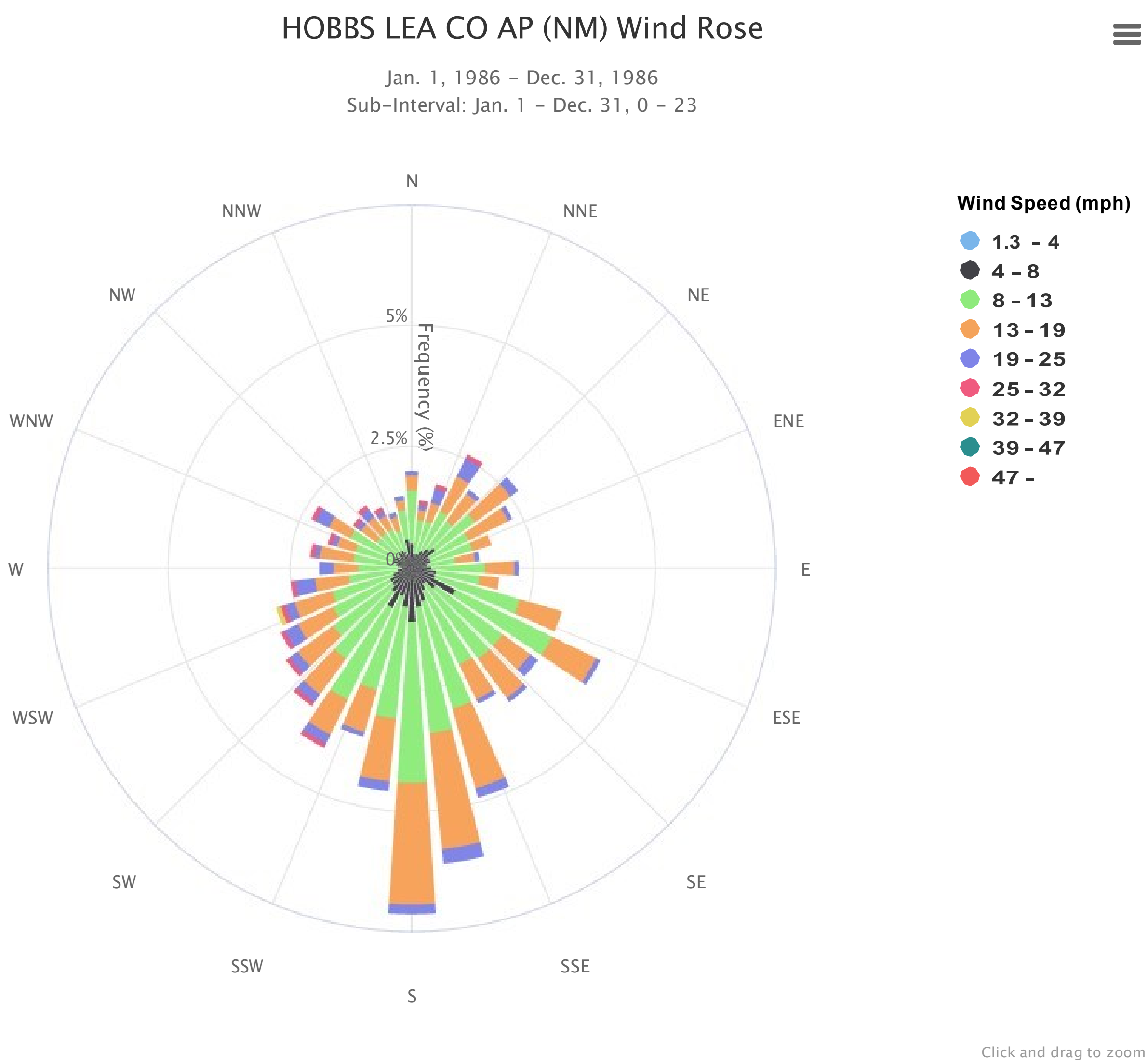
Click and drag to zoom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Jan. 1, 1986 - Dec. 31, 1986
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
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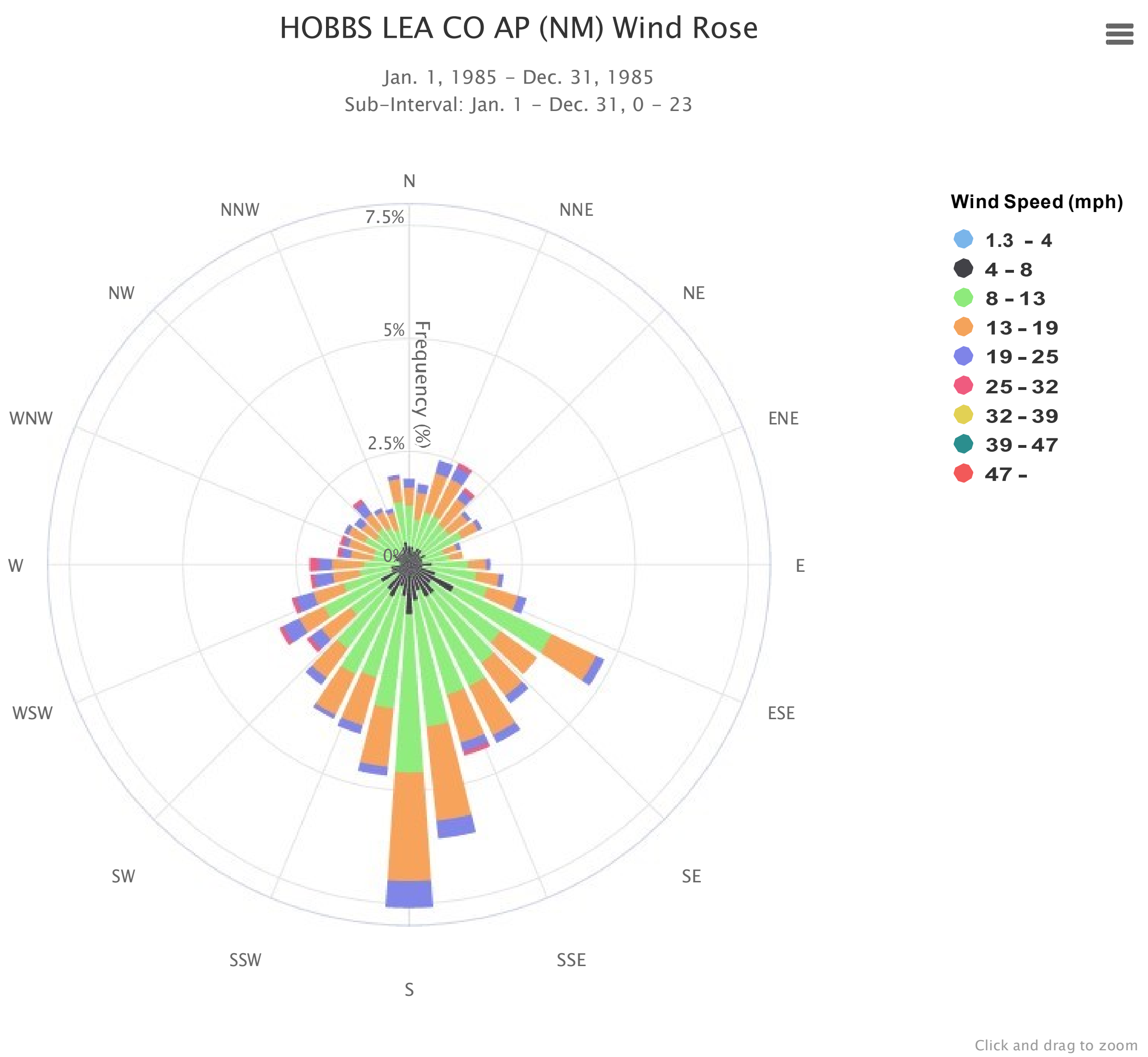
Click and drag to zoom



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Jan. 1, 1985 - Dec. 31, 1985
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
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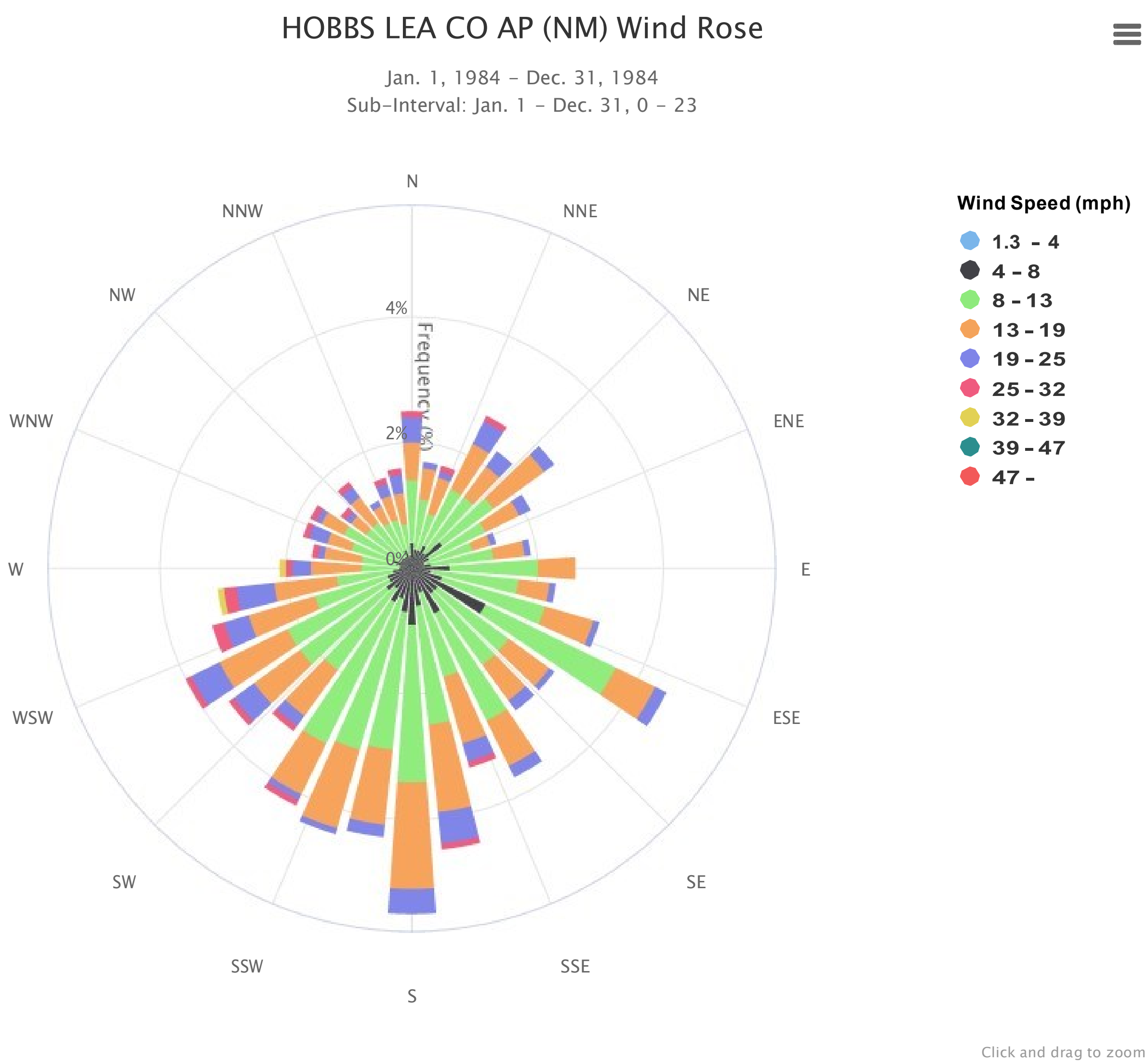
47 -
Click and drag to zoom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Jan. 1, 1984 - Dec. 31, 1984
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
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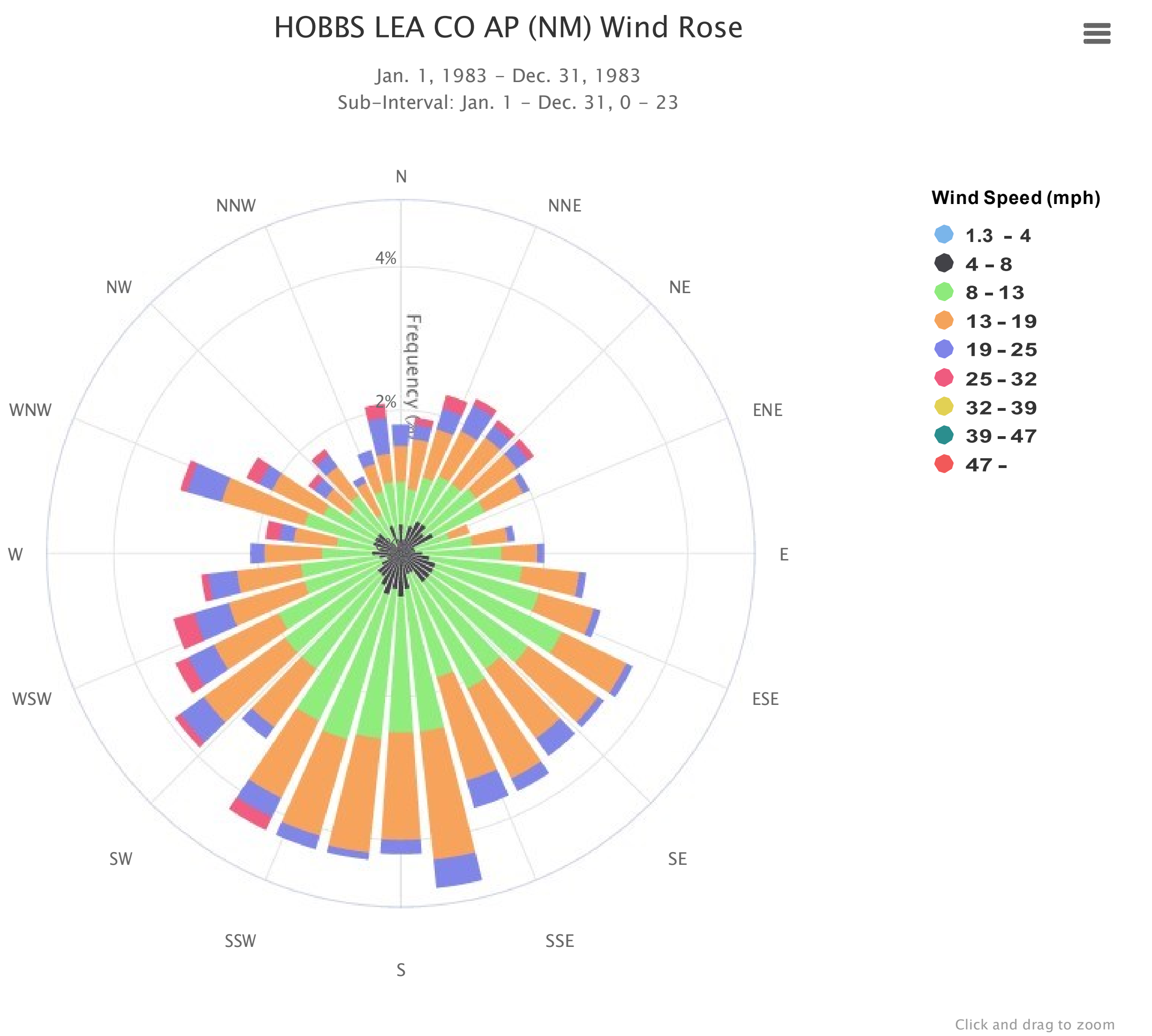
Click and drag to zoom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Frequency (%)
Wind Speed (mph)
1.3 - 4
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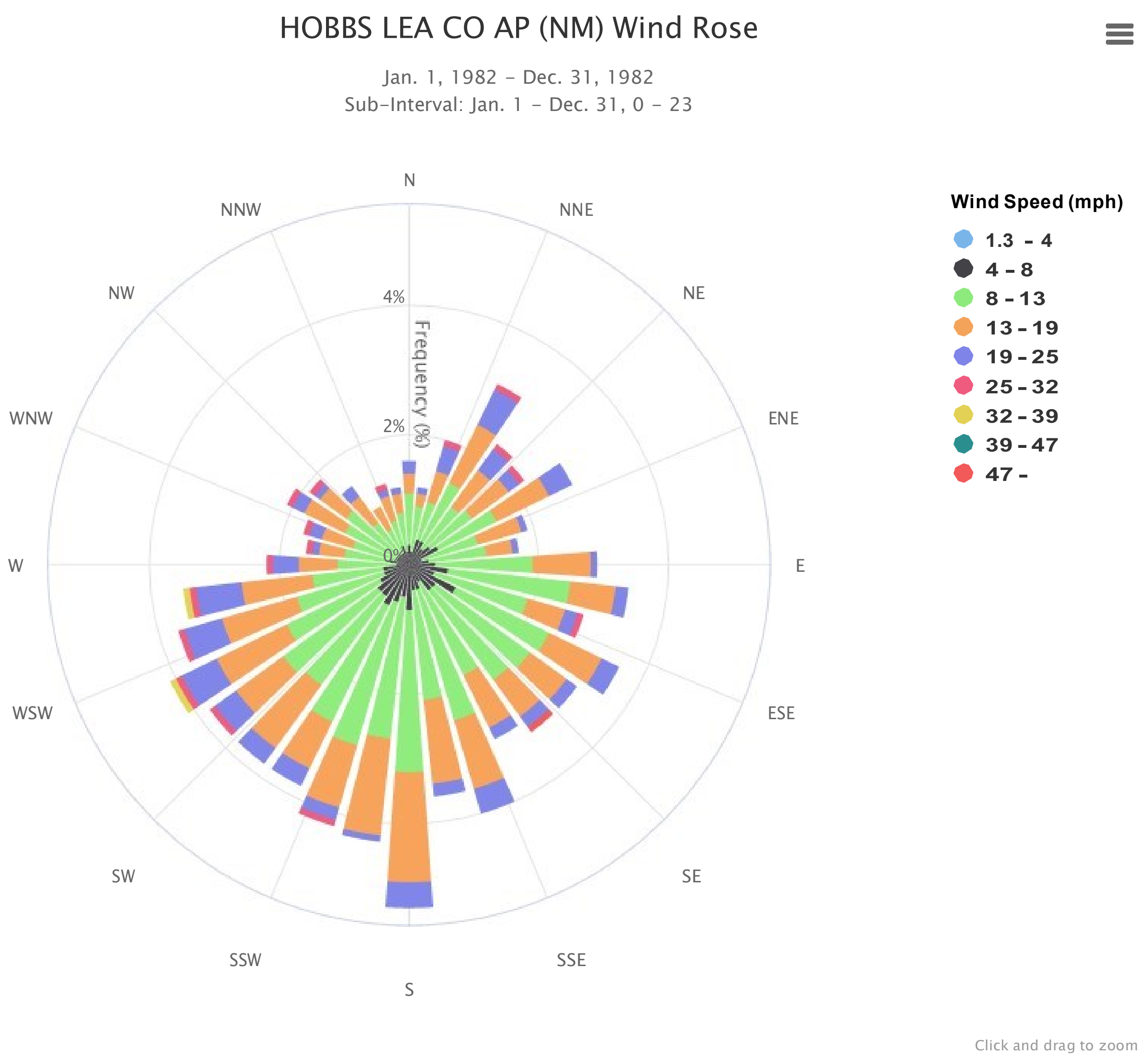
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1982 – Dec. 31, 1982
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 – 8
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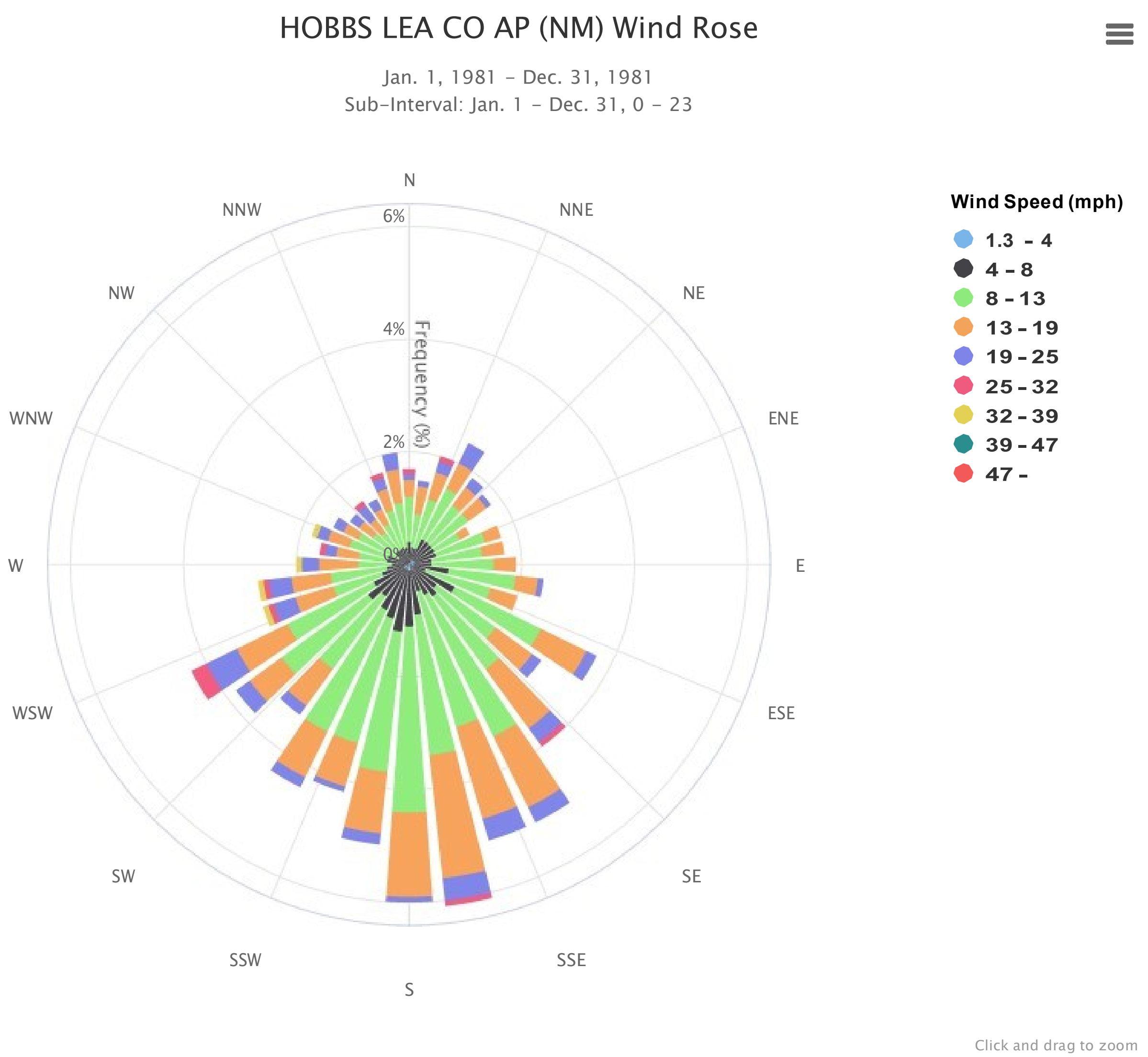
47 -
Click and drag to zoom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Frequency (%)
Wind Speed (mph)
1.3 - 4
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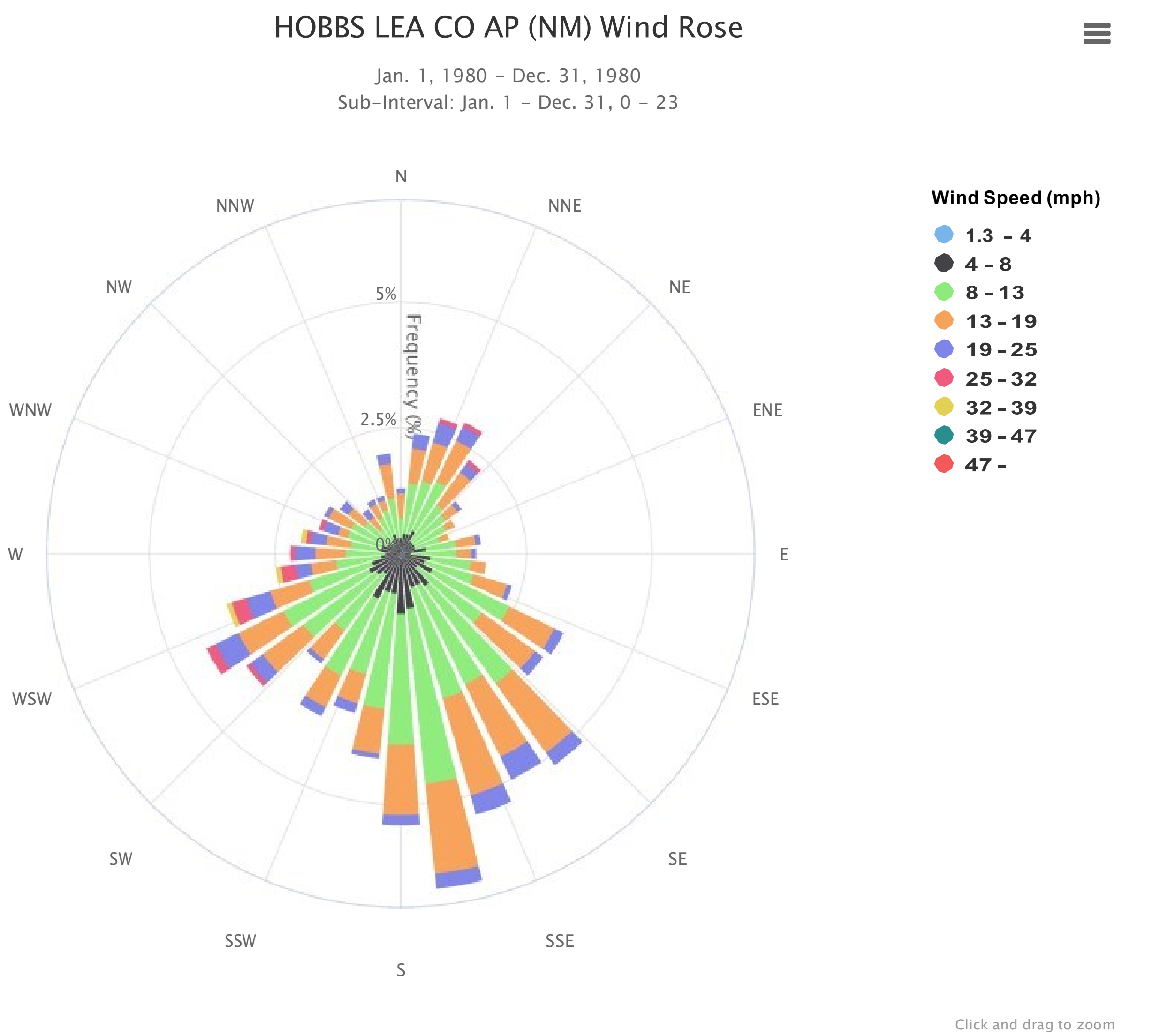
Click and drag to zoom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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
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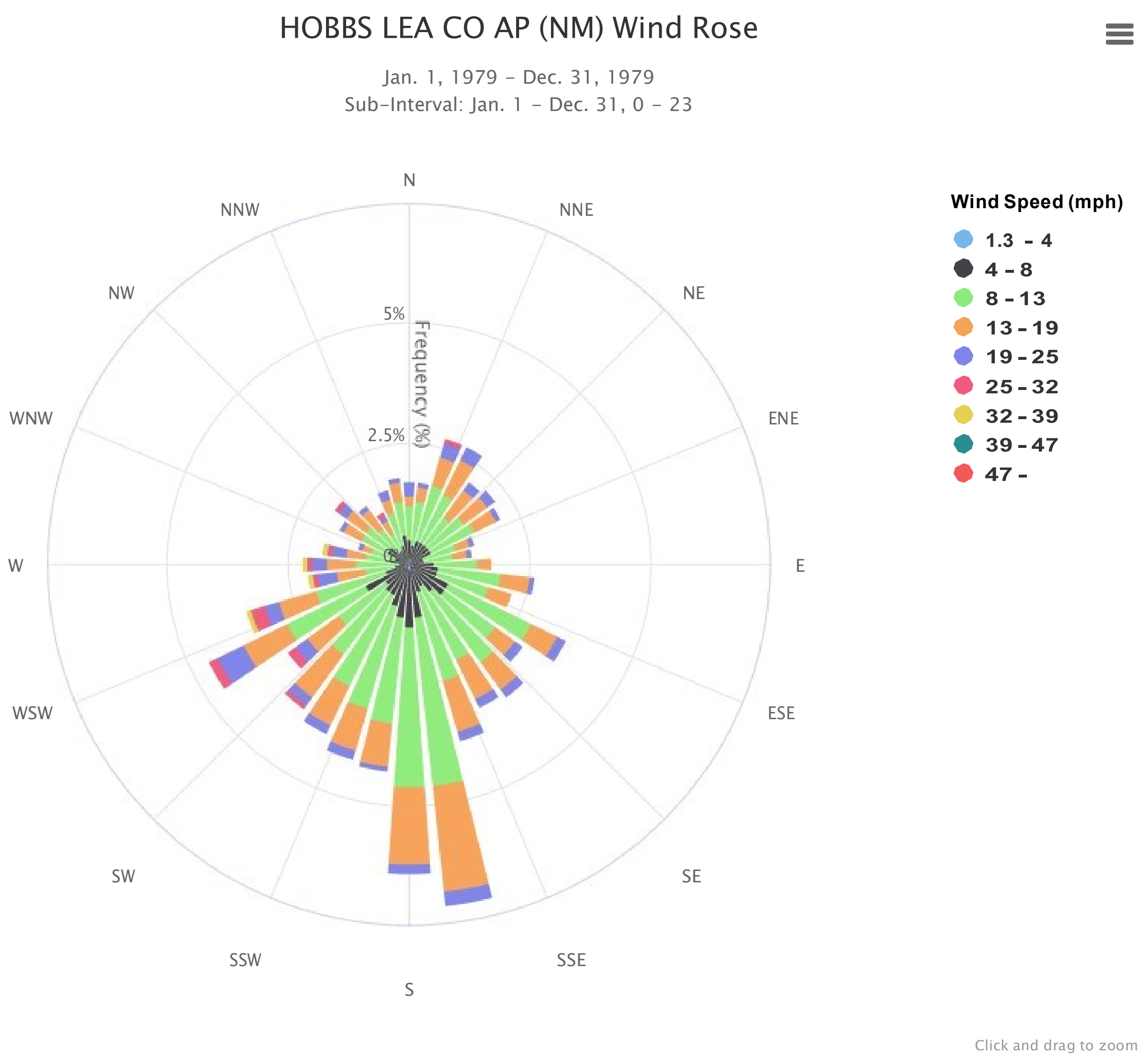
47 -
Click and drag to zoom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Jan. 1, 1979 - Dec. 31, 1979
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Frequency (%)
Wind Speed (mph)
1.3 - 4
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32 - 39
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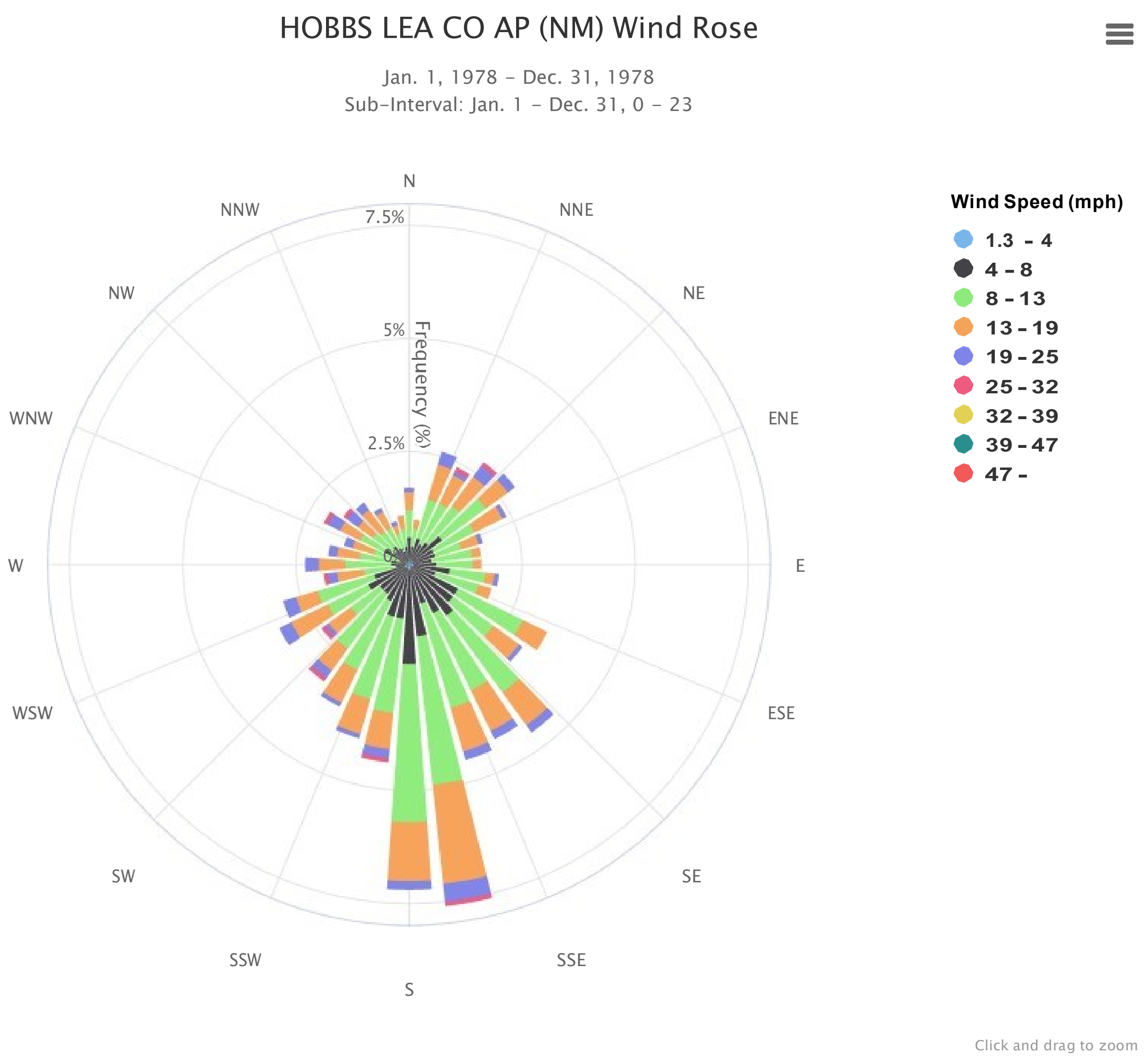
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1978 – Dec. 31, 1978
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
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NNW
7.5%
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2.5%
Frequency (%)
Wind Speed (mph)
1.3 - 4
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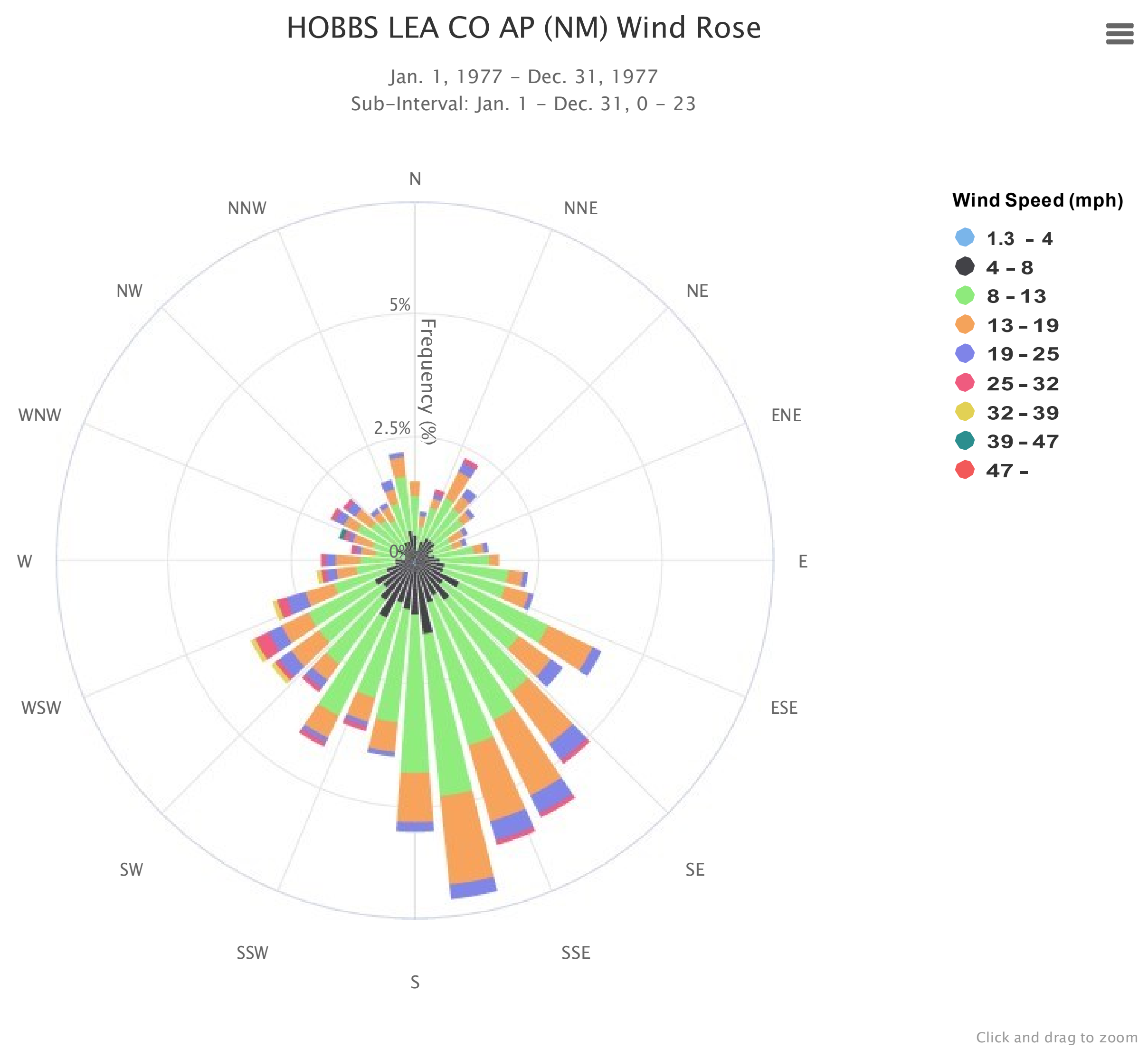
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1977 - Dec. 31, 1977
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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5%
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
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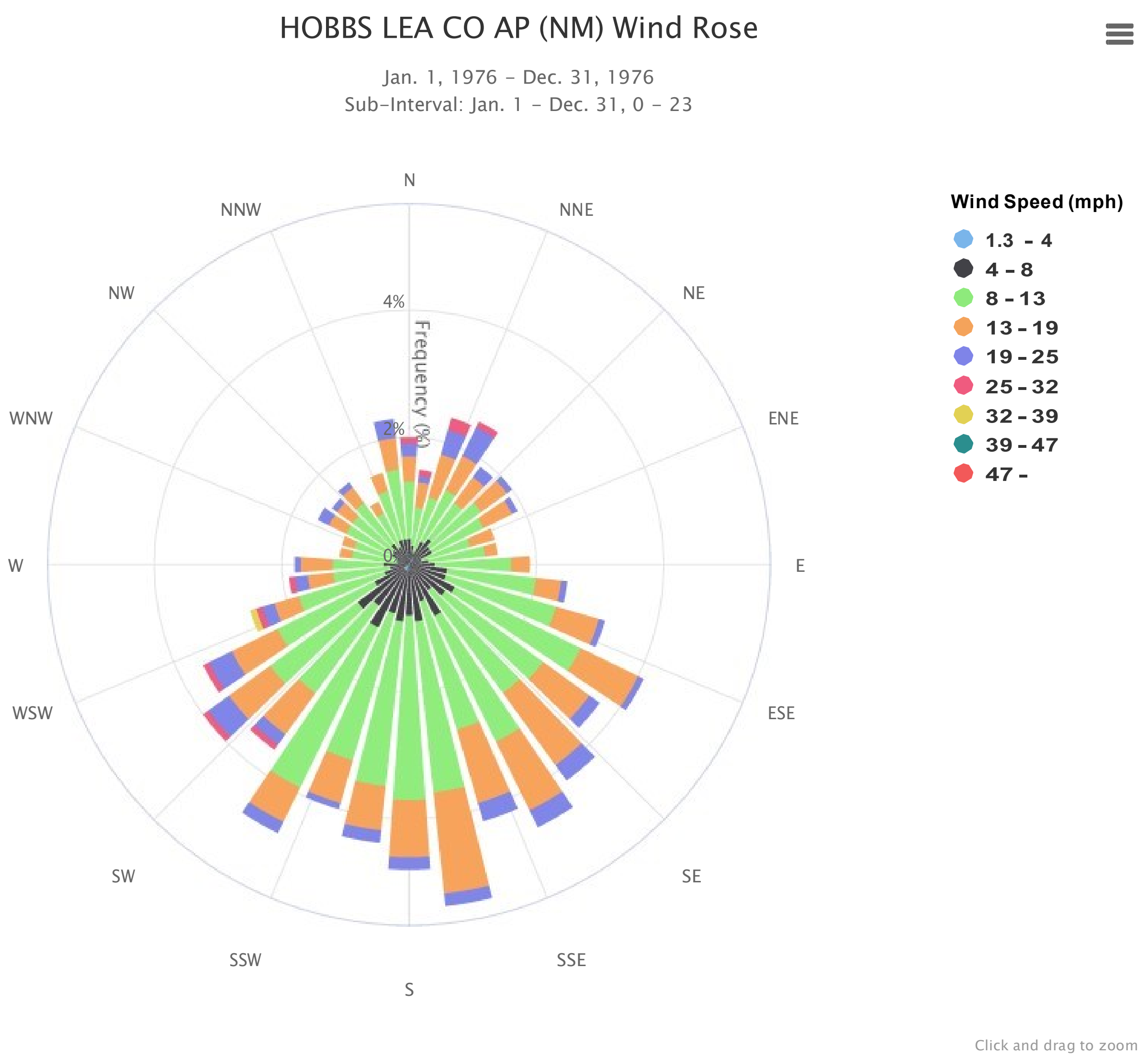
19 - 25
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1976 - Dec. 31, 1976
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
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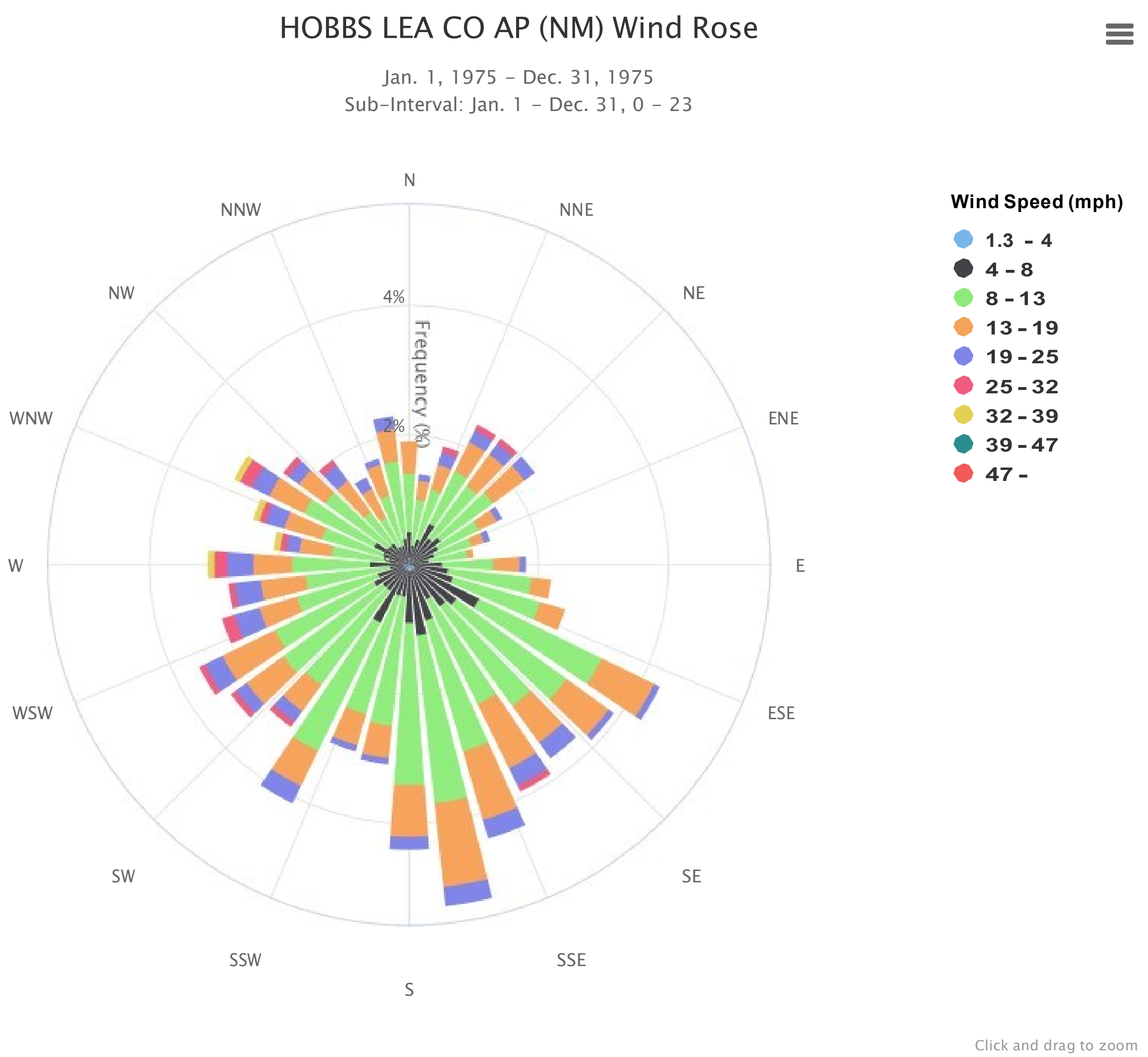
25 - 32
32 - 39
39 - 47
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1975 - Dec. 31, 1975
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
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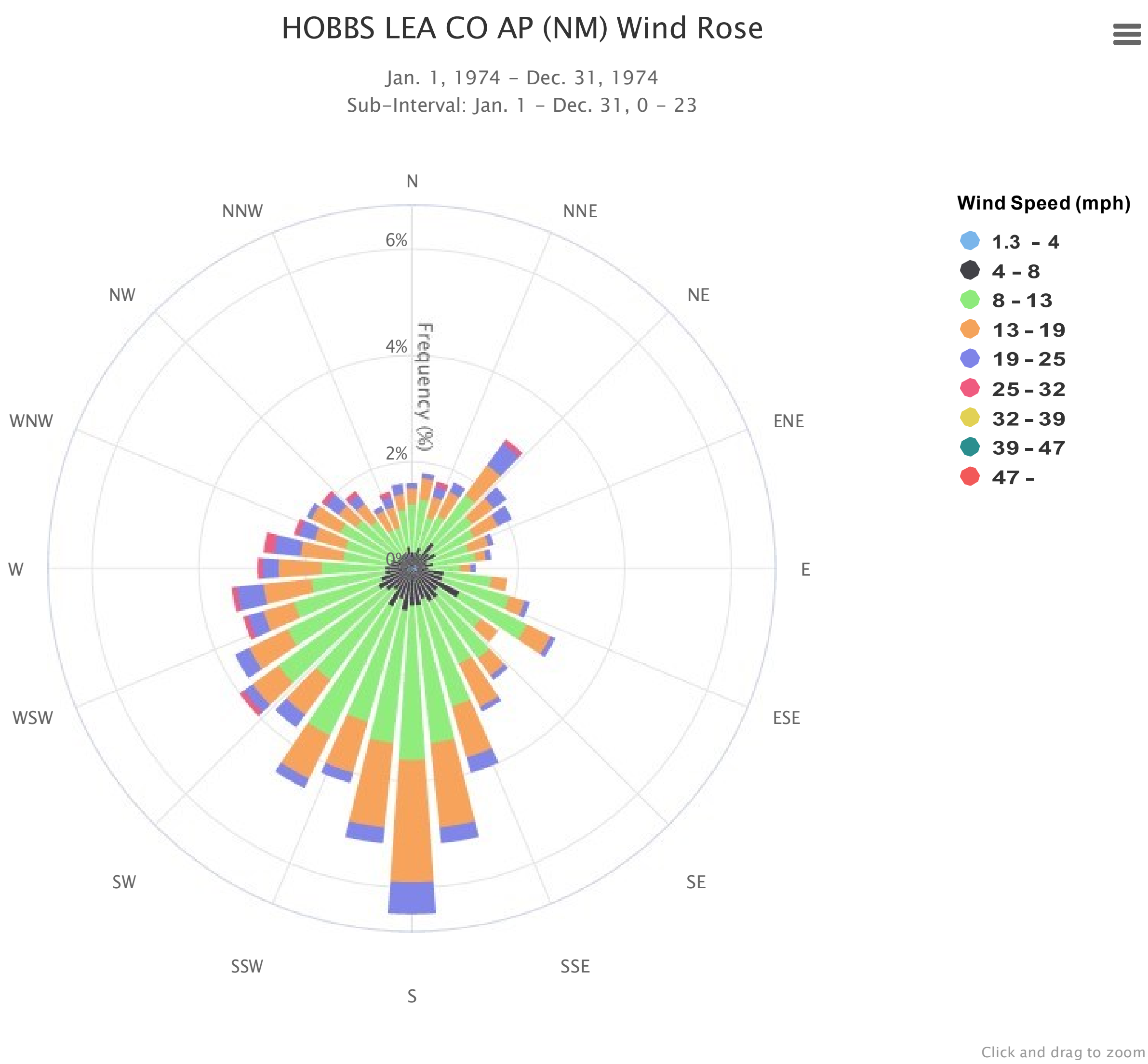
32 - 39
39 - 47
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1974 - Dec. 31, 1974
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
4 - 8
8 - 13
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19 - 25
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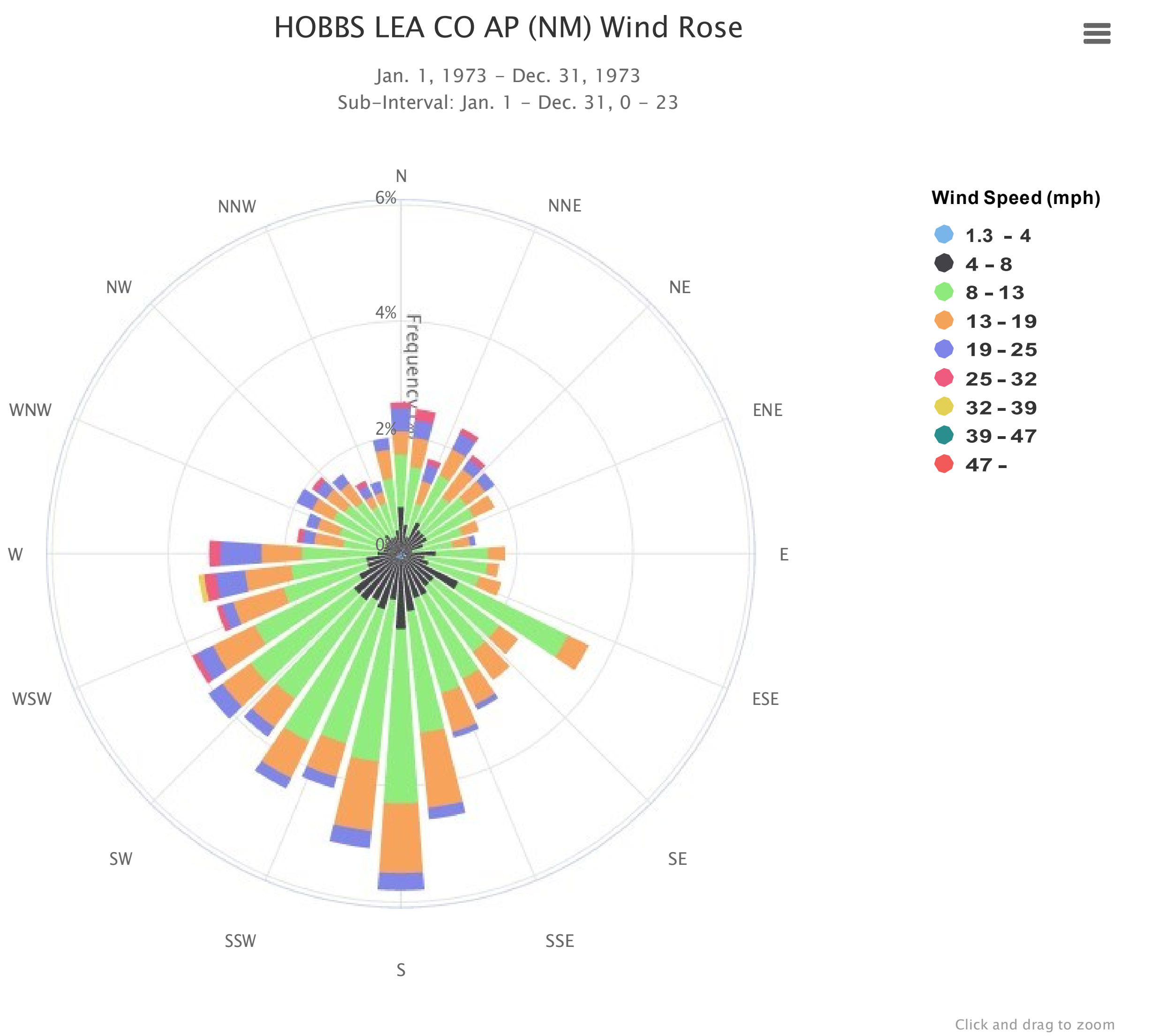
32 - 39
39 - 47
47 -
Click and drag to zoom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Jan. 1, 1973 - Dec. 31, 1973
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency
Wind Speed (mph)
1.3 - 4
4 - 8
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32 - 39
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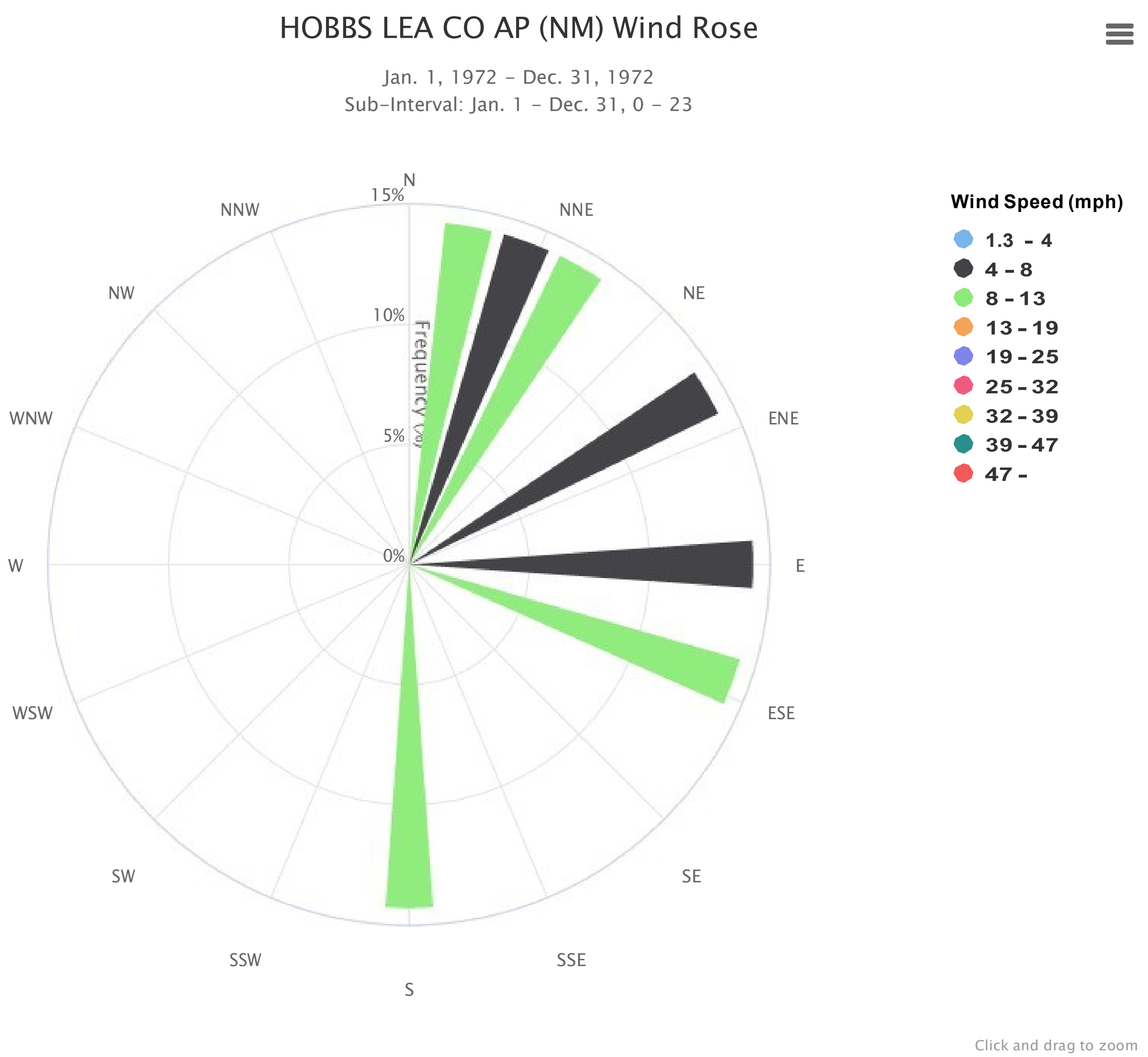
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1972 - Dec. 31, 1972
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
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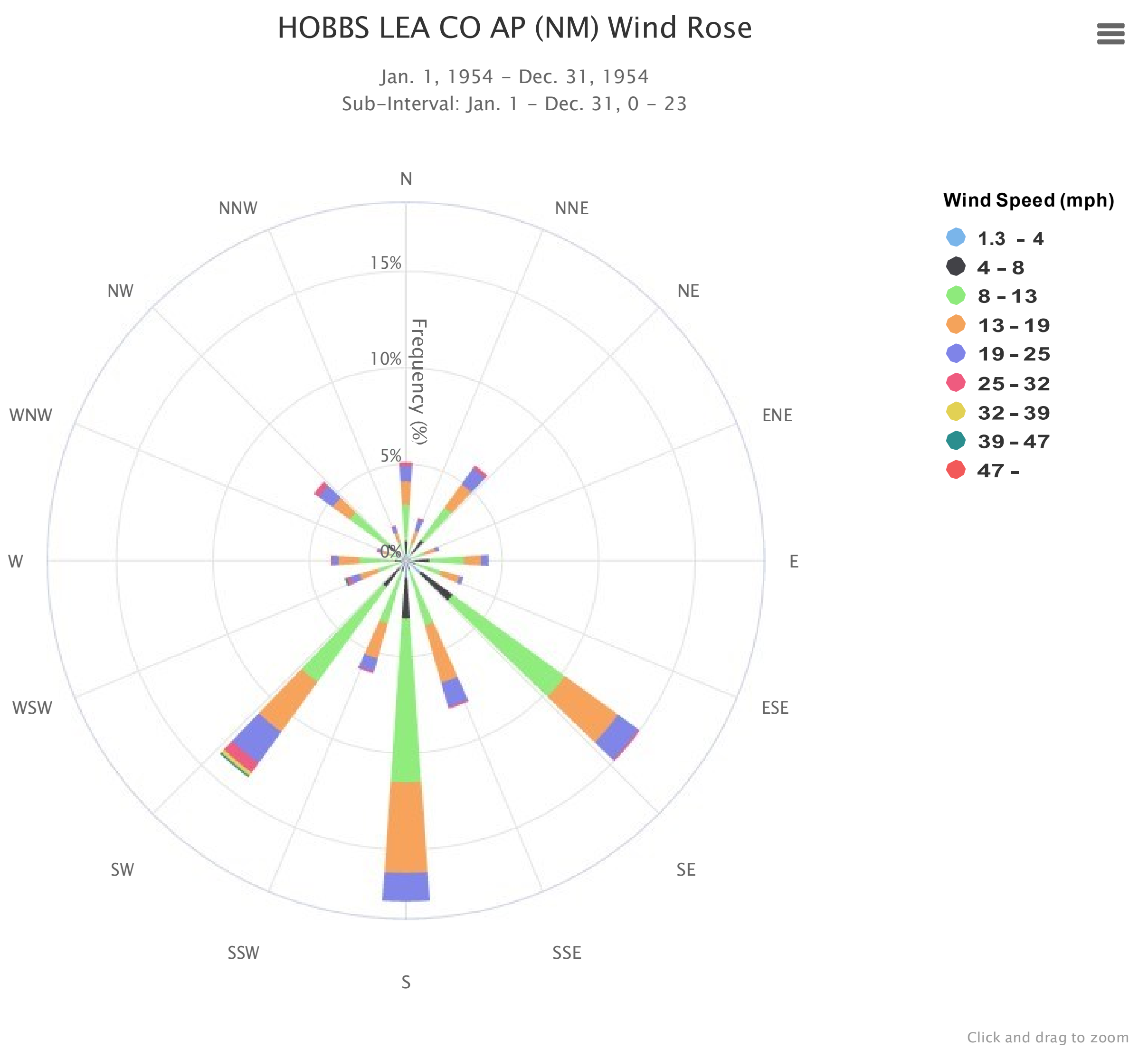
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1954 – Dec. 31, 1954
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
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Frequency (%)
Wind Speed (mph)
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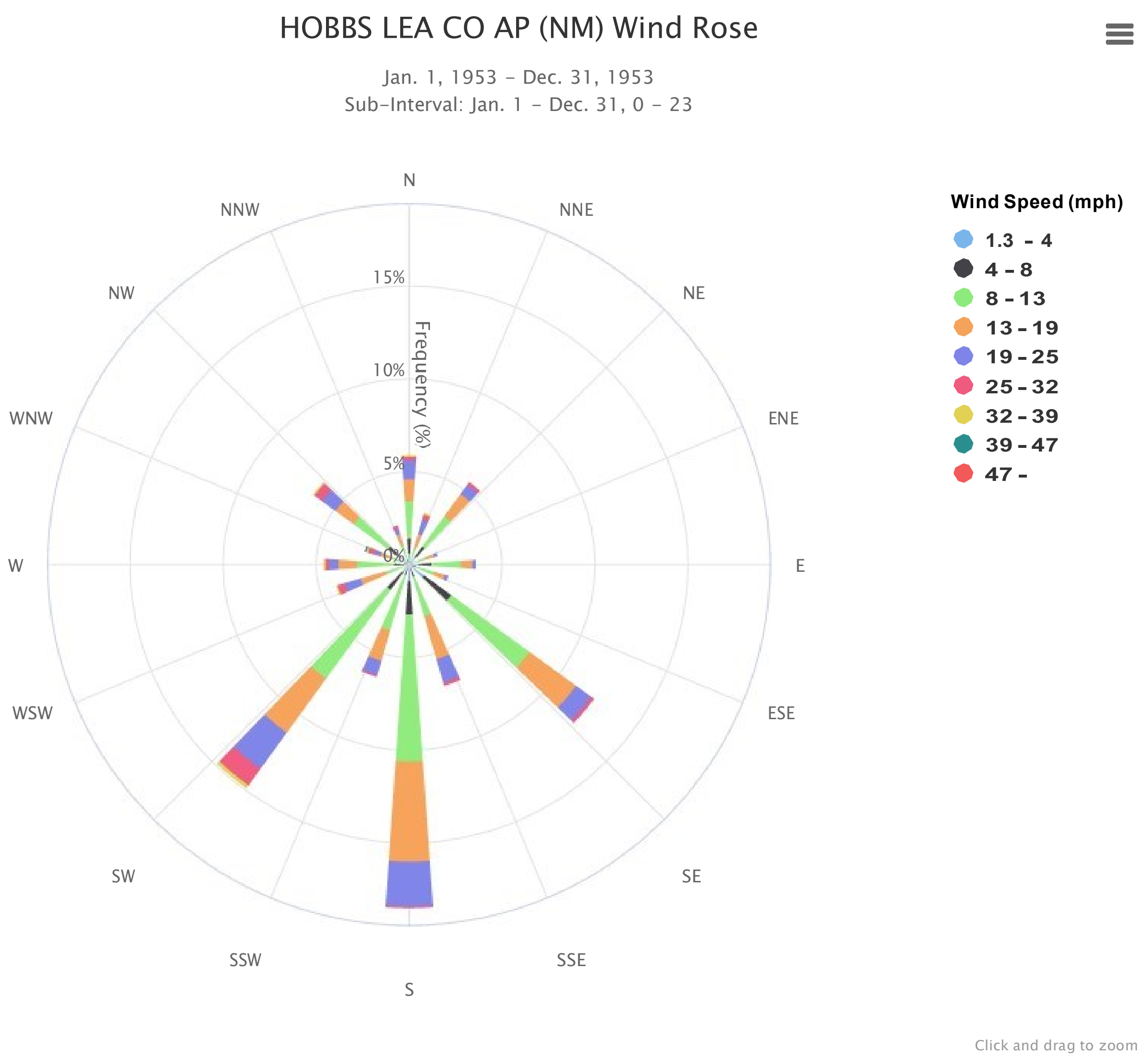
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1953 - Dec. 31, 1953
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
1.3 - 4
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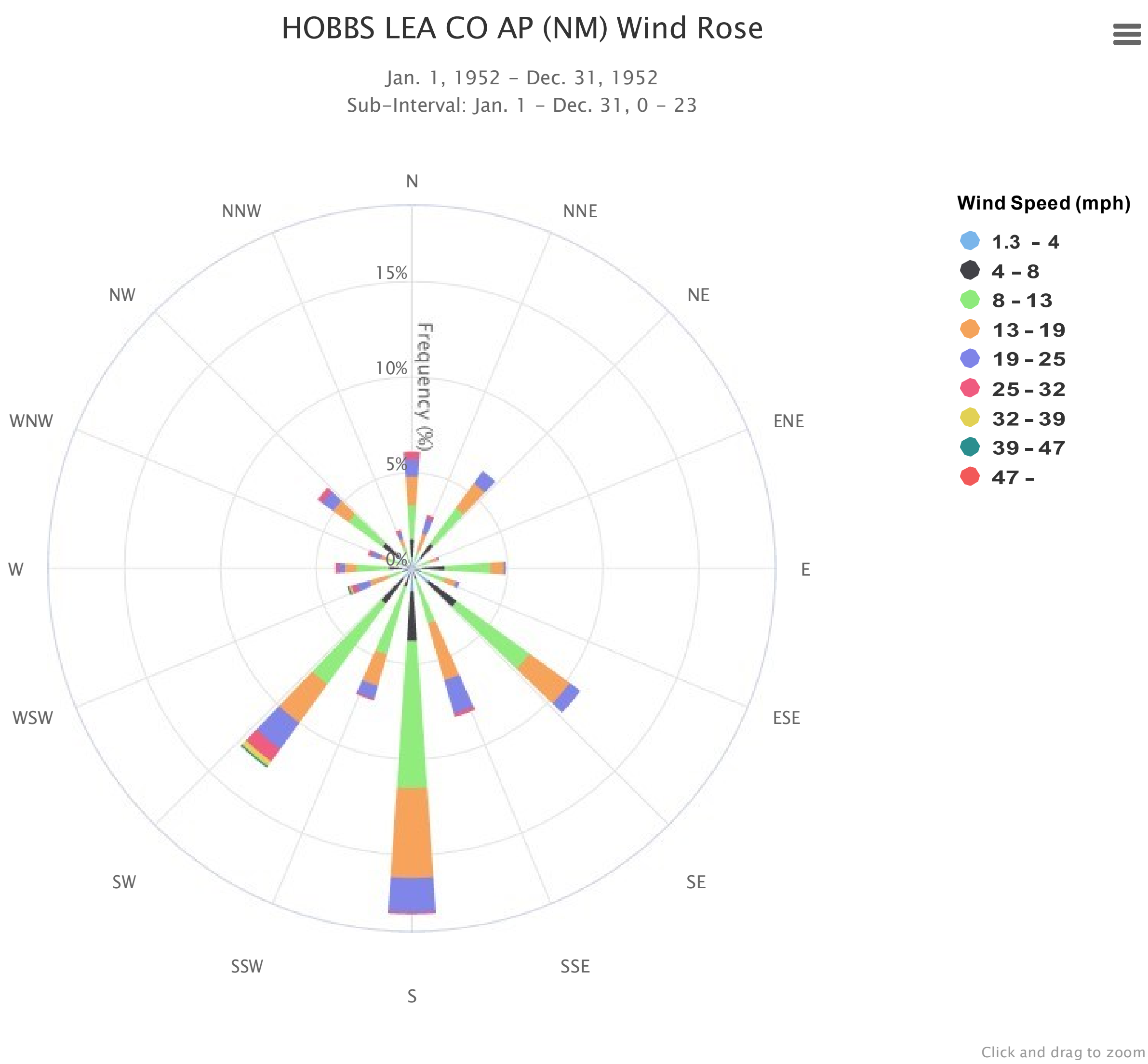
47 -
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1952 - Dec. 31, 1952
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Wind Speed (mph)
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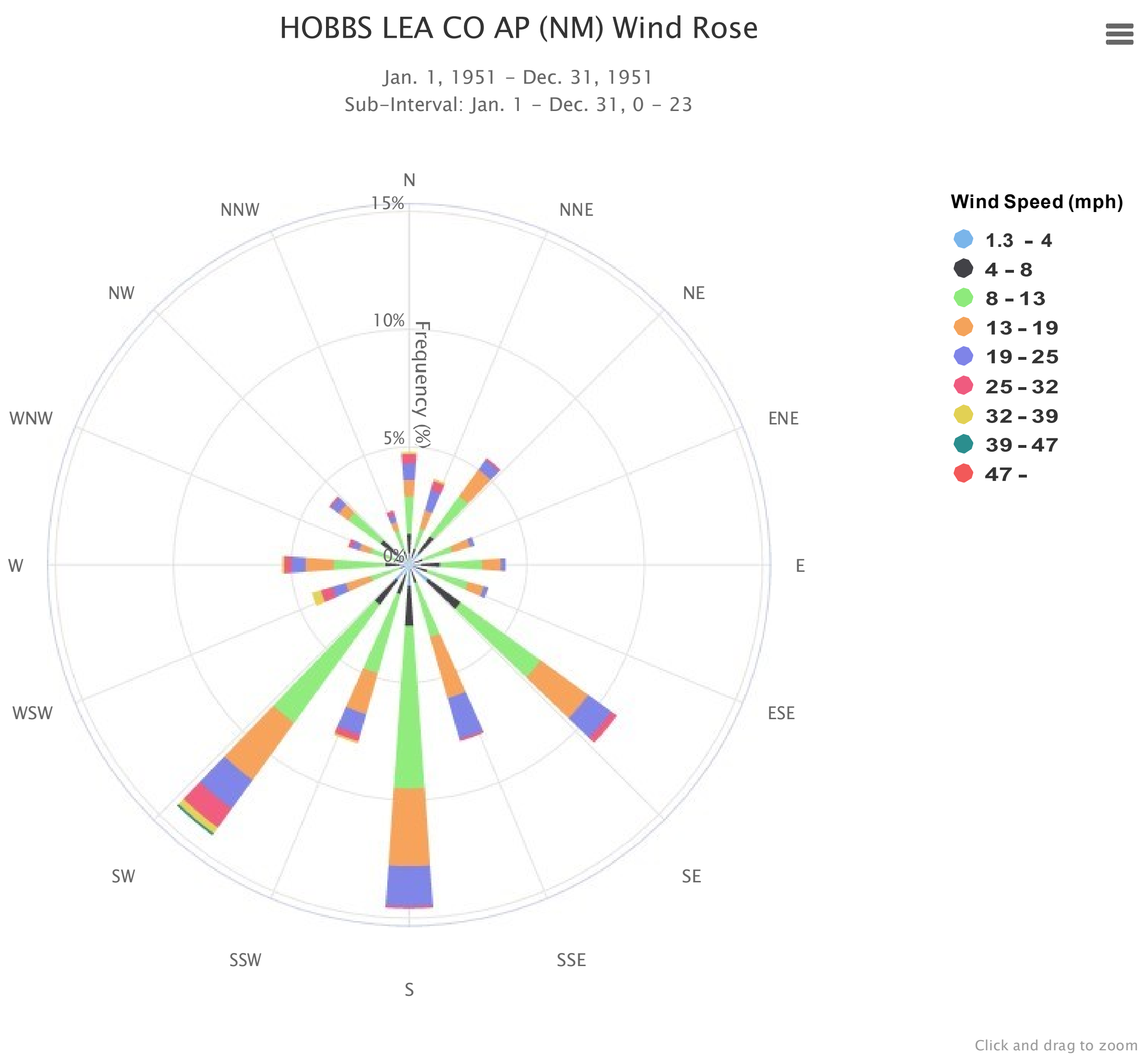
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1951 – Dec. 31, 1951
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
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Frequency (%)
Wind Speed (mph)
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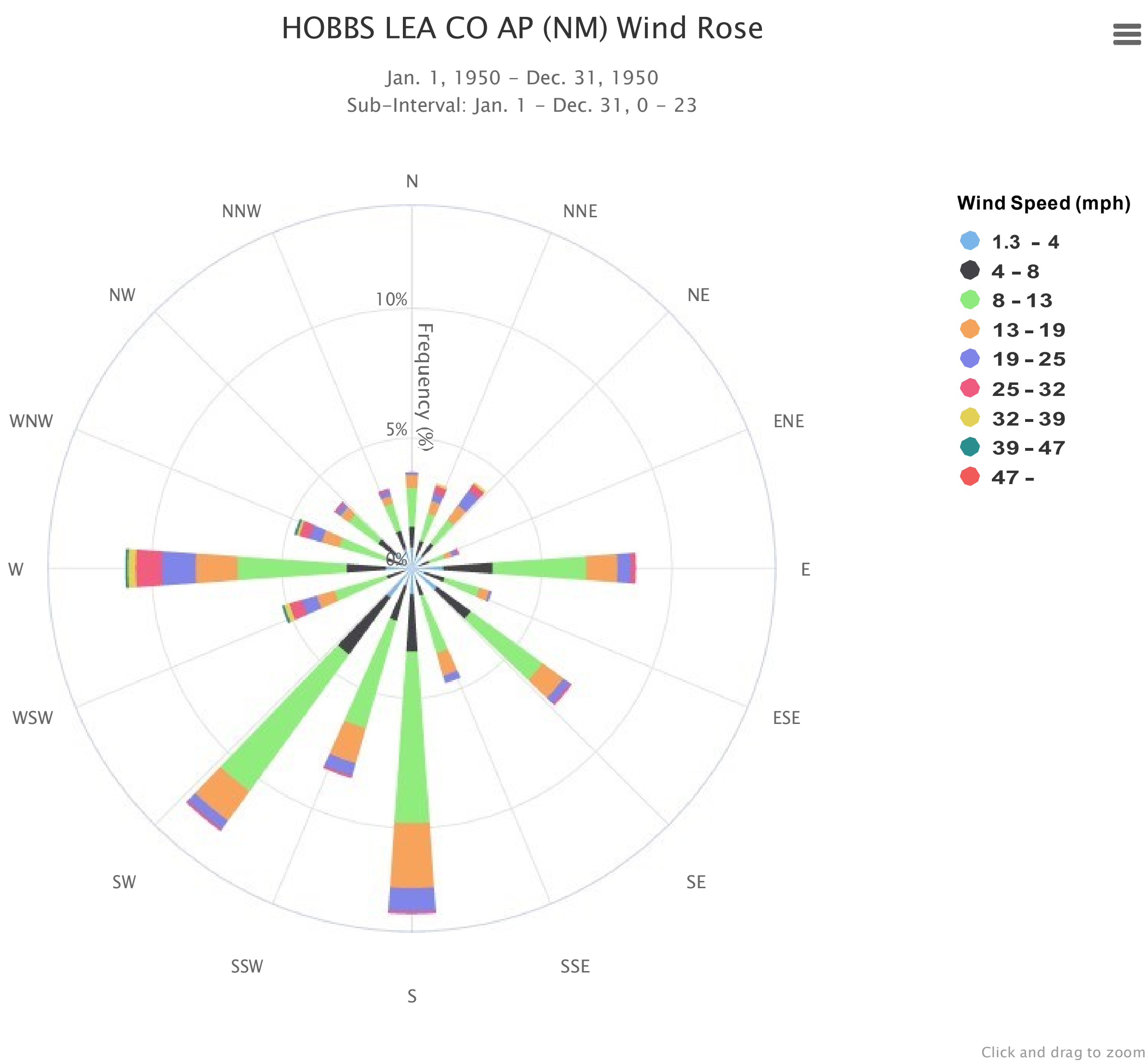
47 –
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1950 – Dec. 31, 1950
Sub-Interval: Jan. 1 – Dec. 31, 0 – 23
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Frequency (%)
Wind Speed (mph)
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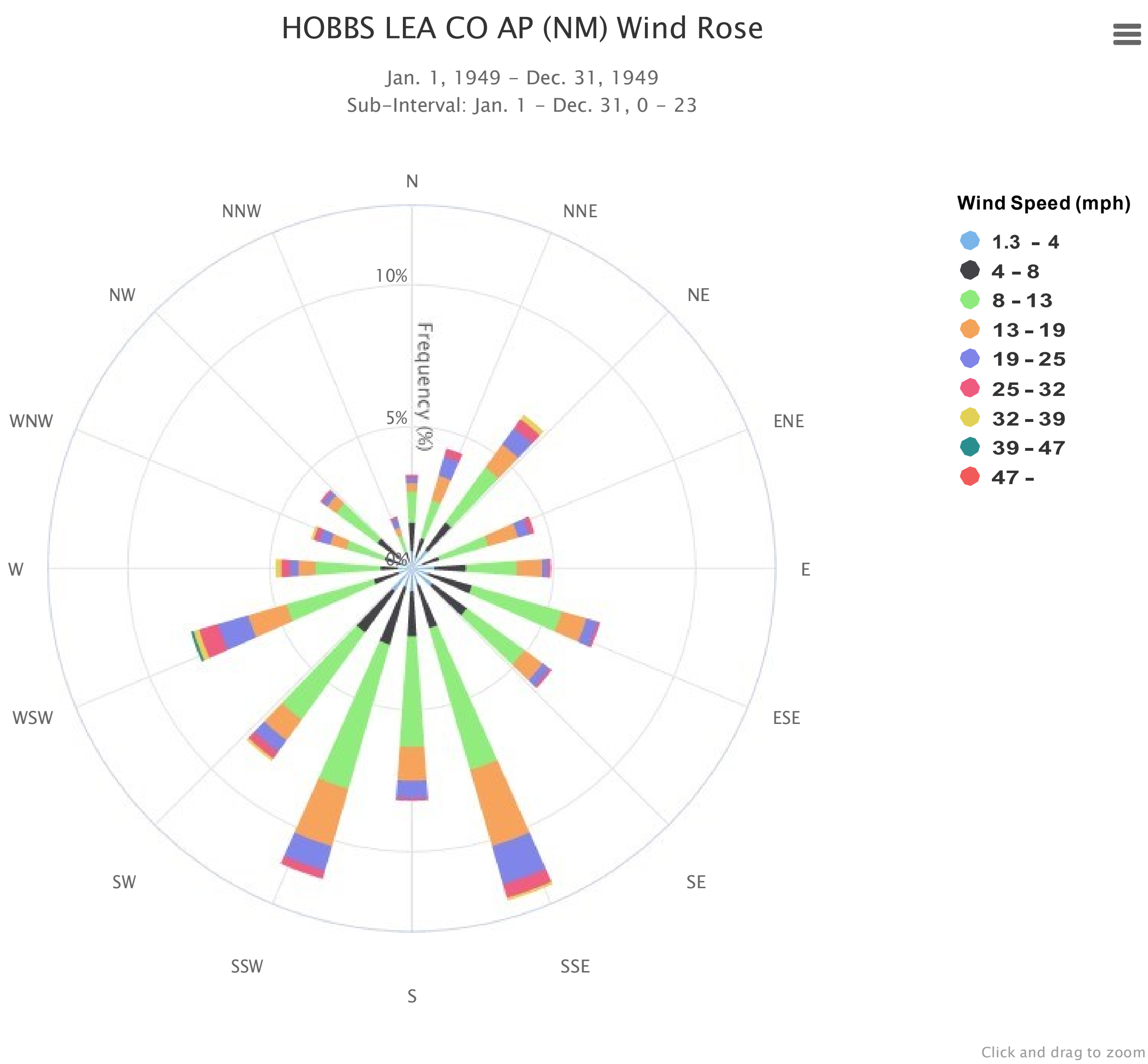
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1949 - Dec. 31, 1949
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Wind Speed (mph)
1.3 - 4
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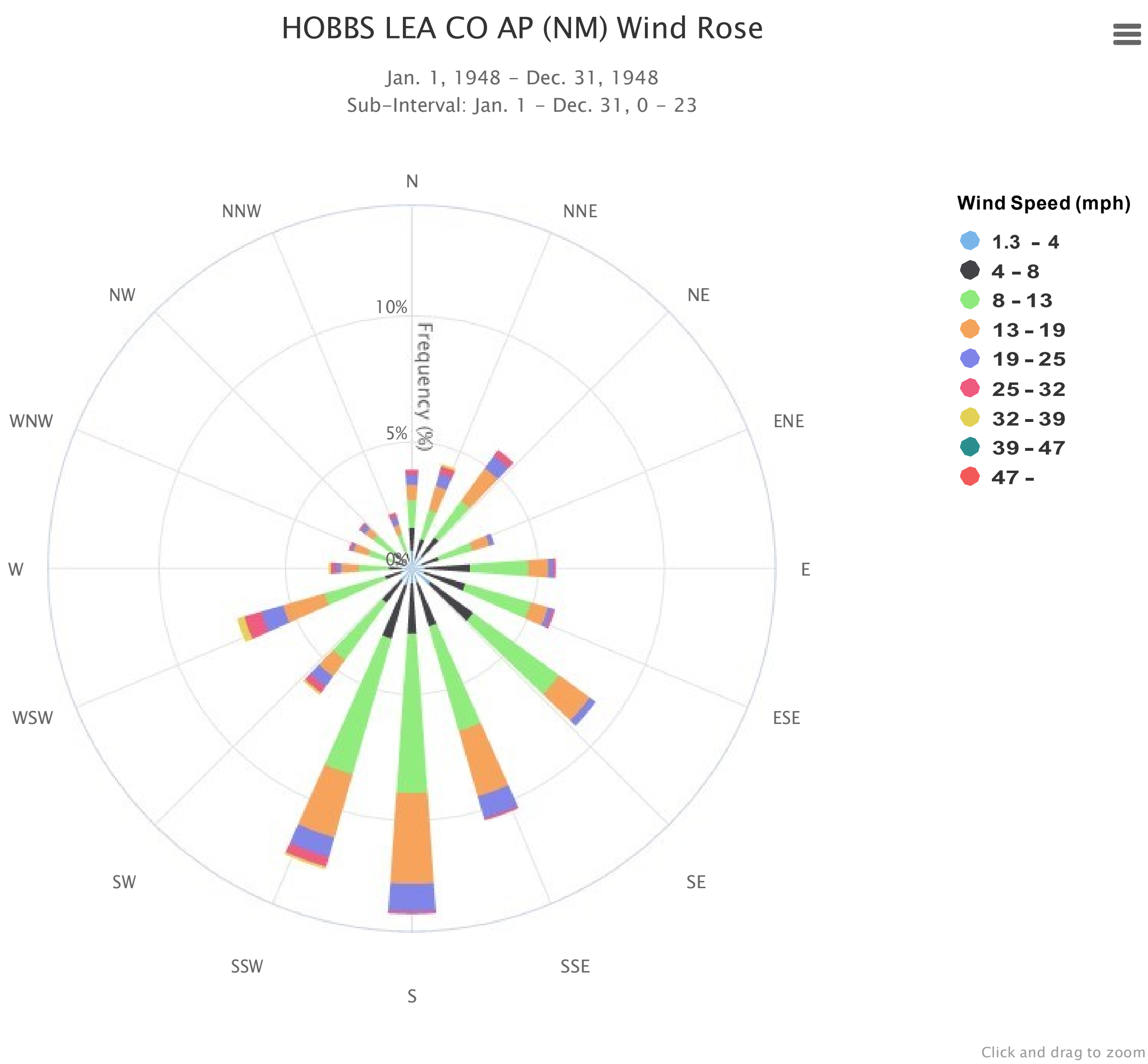
Click and drag to zoom


HOBBS LEA CO AP (NM) Wind Rose
Jan. 1, 1948 - Dec. 31, 1948
Sub-Interval: Jan. 1 - Dec. 31, 0 - 23
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Frequency (%)
Wind Speed (mph)
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Click and drag to zoom

APPENDIX F: DATA CALL FOR THE CISF ENVIRONMENTAL REPORT - SEPTEMBER 2016

CISF Environmental Report Data Call– September 2016

This appendix is a summary of the information Tetra-Tech requested from Holtec to support preparation of the CIS Environmental Report. The questions from Tetra-Tech are in bold font and the responses from Holtec are in regular font.

1. **Provide best available description of the Holtec proposed CISF.**
   a. **Identify and describe all facilities, rail and roads, and infrastructure requirements.**

      Holtec response: The purpose of the CISF is to provide ~12,000 Holtec HI-STORM UMAX spent fuel storage facilities to store spent fuel from all PWR and BWR commercial nuclear power plants throughout the United States.

      The CISF will be a standalone spent fuel storage installation that will have rail access that ties into the existing Texas-New Mexico rail line and vehicular access via U.S. Route 180 in Hobbs, NM.

      In addition to the 12,000 HI-STORM UMAX units, the CISF site will consist of a security building, administrative building, a construction laydown area that contains an equipment storage building, and a cask receiving building where casks will be brought in and repackaged for permanent storage in the HI-STORM UMAX units.

      Note that 12,000 is a bounding value for conservatism to be used in ER development, actual application may contain less.

   b. **Include drawings depicting the facility layout.**

      Holtec response: Note actual drawing are included in the Environmental Report as Figure 3.5.4 and Figure 2.2.2 for phase 1 and the finished facility.

   c. **Describe typical construction process.**

      Holtec response:

      CISF, when completely finished, will house ~12,000 HI-STORM UMAX spent fuel storage facilities. Each phase will consist of constructing 500 units with concrete approach aprons that surround two individual 250 units HI-STORM UMAX ISFSI Pads (see layout drawings). The HI-STORM UMAX system has a total depth of approximately 22.5'. A high level detail of the construction process is illustrated below:

      - A pit must be excavated such that the extents of the facility are taken into consideration as well as the access needed to the excavation pit to support heavy construction equipment/machinery.
      - Once the excavation pit is prepared, the subsurface is compacted/proof-rolled to ensure a stable surface for the impending concrete pours.
      - After surface prep, a mud mat (or leveling slab - ~3" in thickness) is poured to ensure there is an even surface to pour the HI-STORM UMAX Facilities Support Foundation Pad (SFP).
      - After the mud mat is poured, the formwork is errected and the reinforcing steel is staged for the SFP concrete pour; followed by the actual concrete pour itself.
      - Once the SFP is poured, the Cavity Enclosure Containers (CEC) are staged and leveled using designed leveling bolts.

- Upon completion of the CEC leveling process, formwork is erected to grout the CEC baseplates in place; followed by the actual grouting process itself.
- Once the CECs are staged and the baseplates are grouted, the area is prepped for the impending placement of the Self-Hardening Engineering Subgrade (SES) Layer. This layer will be made up of either Engineered Backfill, Controlled Low Strength Material (CLSM) or Lean Concrete. Typically, because this portion of the system is ~16' thick, its completion is done in lifts or layers whose thickness is determined based on an agreed upon construction schedule.
- After the SES layer reaches the appropriate elevation, the top surface is prepped for the top slab or Independent Spent Fuel Storage Installation (ISFSI) Pad. This part of the process is a little more cumbersome because of the steel reinforcement that has to be installed around all of the CEC's that have been staged.
- Once the reinforcement is placed, the concrete is poured for the ISFSI Pad and the pad is finished; this marks the completion of the HI-STORM UMAX system itself.
- For CISF, each HI-STORM UMAX ISFSI Pad will be surrounded on all four sides by an Approach Apron. The Approach Apron is an approximately ~35' wide concrete pathway that allows for the Vertical Cask Transporter (VCT) to rotate appropriately and navigate the HI-STORM UMAX CECs and download the spent fuel canisters in each CEC. These Approach Aprons match the top elevation of the HI-STORM UMAX ISFSI Pad and are typically poured in conjunction with the ISFSI Pads, with a doweled expansion joint between the adjacent pads.

d. Describe typical operations process, including the process of receiving casks and loading into CISF

Holtec response: Shipping casks will arrive via rail car, or possible heavy haul trailer. Operations will be similar for either transport system. Operations consist of:

- Initial receipt inspection of the cask by security personnel, prior to transport into the restricted area.
- Movement of the shipping cask into the cask transfer building, using either an auxiliary locomotive of truck.
- Receipt inspection of the cask by radiological personnel, which includes initial radiological surveys, examination for damage and integrity of the shipping container.
- Transfer of the cask from the shipping car/trailer to the receiving stand, using movable gantry cranes within the cask transfer building.
- Removal of the shipping impact limiters from either end of the shipping cask, using an auxiliary crane or similar method.
- Uprighting the shipping cask from a horizontal to a vertical orientation, using the vertical cask transporter and a cask pivot trunnion of the cask.
- Movement of the cask from the receiving pad to a nearby load-rated concrete pad, within the cask transfer building.
- Installation of temporary scaffolding around the shipping cask, to allow access for opening of the shipping cask.
- Removal of the shipping cask lid, and other operations on the cask in preparation for movement to the storage location.
- Removal of all temporary scaffolding and other equipment from area.

- Lifting and transport of the shipping cask, using the vertical cask transporter, from the cask transfer building to the storage pad, along the evaluated/approved transfer route.
- Alignment of the shipping cask with the storage location, and connection of mating devices with the shipping cask.
- Removal of the lower lid of the shipping cask and lowering of the cask into the storage pad, using the raising/lowering capability of the vertical cask transporter.
- Disconnection and removal of the shipping cask from the storage site.
- Installation of the lid and other necessary components on the storage pad, using the vertical cask transport.
- Return of the vertical cask transporter, with the shipping cask, to the cask transfer building.

e. Discuss security requirements for facility.

Holtec response: The security requirements can be found in 10CFR73.51, specifically in paragraph (d) – Physical protection systems, components, and procedures.

2. What will be the initial metric tons of uranium (MTUs) the facility will store? Will there be expansion plans? What is total quantity of MTUs that the ER should evaluate?

Holtec response: The initial phase will include 500 canisters and the final phase will have 10,000 canisters in Holtec's HI-STORM UMAX system. The load capacity of each canister can be different. The current largest capacity for a PWR canister is 37 fuel assemblies and for a BWR canister is 89 fuel assemblies. The Environmental Report shall evaluate the bounding MTU at the final stage.

3. If expansion is foreseeable, how many phases of facility will be built?

Holtec response: Each phase will be 500 systems and there will be total 20 phases.

4. What date should the ER assume for receipt of NRC license?

Holtec response: 1 year from submittal date per current licensing actions (March 2018)

5. When will construction begin and what will be duration of construction for Phase 1 (and other phases)?

Holtec response: Construction on Phase 1 will begin the first quarter of 2020 (~February/March) and will take between 1 and 1.5 years to complete. It should be noted that for the first phase of construction, all of the support structures will be completed as well (security building, cask receiving building, admin building, construction laydown, etc.). For all remaining phases, assuming 500 HI-STORM UMAX facilities will be built for each additional phase, construction duration will be between 9 months and 1 year.

6. What date should the ER assume for commencing operations?

Holtec response: Assume the facility will be in operation 5 years from the site specific license submittal.

7. What is the expected lifetime of the facility?

Holtec response: Design life is 80 years in total (40 yrs for initial licensing + 40 yrs extension)

9. Describe why other site alternatives were eliminated from consideration for the CISF.

Holtec response: Holtec will use the GNEP siting study for alternative locations, selection criterion, and final selection.

10. Identify and describe operational monitoring plans for the CISF.

Holtec response: Monitoring consists of remote monitoring of storage cell temperatures, radiation monitoring of personnel, radiation monitoring at site boundaries, background radiation monitoring, airborne contamination monitoring, and video security monitoring. Health physics personnel will monitor all radiological operations.

12. How many acres will be disturbed for constructing and operating Phase 1 of the facility?

Holtec response: Construction Phase 1 (which includes 500 HI-STORM UMAX Units, all support buildings, and all new road and railway) will disturb approximately 22.70 acres of land. Conservatively add 20% to make expected land disturbance 27.25 acres for Phase 1.

13. What is the total land disturbance for all phases?

Holtec response: The total land disturbance for an in place completed facility with 12,000 UMAX units is 163.65 acres. Conservatively add 20% to make expected land disturbance 196.5 acres. Note that this entire facility will fit into the Bureau of Land Managements “Area 13”.

14. During construction, what is the acreage for parking and construction laydown area?

Holtec response: The construction laydown area and parking facilities shown on the attached layouts are anticipated to be permanent fixtures to the site. Total acreage dedicated to these facilities are 1.38 acres or ~60,000 ft^2.

15. Provide specific land disturbance and locations for new roads and rail connections and utility services.

Holtec response: The rail line is ~26,378’ long. Knowing this, the expected land disturbance for rail installation based on standard gauge rail widths is ~3.633 acres.

The new roadway is ~5,280’ long. Knowing this, the expected land disturbance for roadway installation based on the department of transportation standard lane and shoulder widths is 4.858 acres.

It is expected that all new utility lines will run along the newly construction roadway and tie into existing systems located adjacent to U.S. Route 180. It is reasonable to assume that the roadway land disturbance acreage includes utility runs as well. However, to make a conservative estimate, add 20% to the roadway disturbance and make the final disturbed acreage value 5.83 acres.

16. Provide peak number of construction workers on site.

Holtec response: Based on current projects at Holtec, it can be expected to have upwards of 80 construction personnel on site during Phase 1 of construction (50 craft, 30 oversight/management).

It is expected that during future phases, this amount will be lessened since all support structures (cask receiving building, admin building, etc.) will already be completed.

17. Provide the steady-state operational workforce once fully operational. Please identify security personnel numbers separately.

Holtec response: The estimated steady-state work force is less than 40 personnel. The estimated steady-state security force is less than 15 personnel.

18. Describe the on-site electrical distribution system requirements and provider. What will be the average electrical energy demand (kW-hours) for the facility? Will there be backup diesel generators?

Holtec response: The electrical distribution system will be expected to support the standard energy demands of all support facilities, along with the security fencing and lighting and temperature monitoring system. It is expected that the energy provider, based on the location of the facility will be Xcel Energy (provides service to both Texas and New Mexico). The average electrical demand for a facility of this size is approximated to be 200 kW-hours. Because of the necessity to keep the security systems up and running, backup diesel generators will be needed.

19. Describe the on-site potable water system requirements and provider. What will be the average potable water demand (gal/yr) for the facility?

Holtec response: The potable water system will be expected to support the demands of all support buildings, along with the mobile concrete batch plant that will be utilized during construction. It is expected that the potable water provider will be the City of Hobbs Water Department. The system should be sized to be able to provide ~20 gallons/minute.

20. Will there be an on-site batch concrete plant? If so, describe.

Holtec response: At this time, the plan is to employ a mobile batch plant that will be deployed to the site during all phases of construction. Each phase of 500 HI-STORM UMAX Units along with their associated Approach Aprons will require ~45,000 cubic yards of concrete to be dispatched.

21. Describe the sanitary sewer system for the site once operational. What will be the capacity of the system?

Holtec response: The sanitary sewer systems will need to support facilities in the cask receiving building, the security building and the administrative building. During peak construction, the capacity of the system should be able to handle ~3,000 gallons per day.

22. Identify any notable sources of noise for the CISF.

Holtec response: Engine noise from the vertical cask transporter has been evaluated, and may require hearing protection for operations in close proximity. Engine noise at site boundaries should be negligible. No other notable noise sources are expected.

23. What will be the height of the tallest facility at the CISF?

Holtec response: The cask receiving building is expected to house the Vertical Cask Transporter (VCT), which when fully extended can reach a height of 49'-2.4". Knowing this, with a 5' clearance from roof trusses, and a roof truss depth of ~5', that puts the total height of the facility at ~60'.

24. Identify the quantities of wastes (cubic meters/yr or cubic yards/yr) generated during operations and describe the process for managing/disposing of wastes, including identification of off-site facilities that may be utilized for the following waste classes:

Holtec response:

a. Hazardous waste:

The operations performed at the site are not designed to directly produce any hazardous waste. Minimal amounts of hazardous waste may be generated on site from use of solvents or other chemicals, not yet identified.

b. Non-hazardous waste:

The operations performed at the site are not designed to directly produce any non-hazardous waste. Waste generated will be commensurate with typical office/personnel waste generated by the estimated steady-state work force.

c. Low-level radioactive waste:

A small amount of LLW may be generated consisting of contamination survey rags, anti-contamination garments and other health physics materials. This solid waste would be packaged and temporarily stored at the cask transfer building until it is transported off-site to a disposal facility. The volume of solid waste is minimal, as it would only be generated as the result of an off-normal event. There is no generation of liquid or gaseous radioactive wastes.

d. Mixed waste:

There is no expected generation of mixed waste.

25. Are all workers at the CISF assumed to be 'radiation workers'? If not, how many radiation workers will there be during operations?

Holtec response: Except for administrative staff, Holtec assume all workers will be radiation workers.

27. What is expected direct radiation dose (mrem/yr) to a maximally exposed individual (MEI) at the closest site boundary?

Holtec response: The 10 CFR 72.104 limit is 25 mrem/year. Holtec would expect the actual value for anybody sitting at the fence all year to be less than 10% of that. This is evaluated in Chapter 7 of the SAR.

28. Please verify that the Final SAR on the Hi-Storm UMAX Canister Storage System (Revision 1, November 29, 2012) is the appropriate document to reference for accidents for the ER.

Holtec response: The appropriate documents to reference are Revision 3 of the HI-STORM UMAX

FSAR (June 29, 2016) and Proposed Rev. 3.D of the HI-STORM UMAX FSAR (UMAX Amd. 3 – 8/30/16)

APPENDIX G: DATA CALL FOR THE CISF ENVIRONMENTAL REPORT – JANUARY 2017

Cost-Benefit Analysis Data Call – January 2017

This appendix is a summary of the information Tetra-Tech requested from Holtec to support preparation of the Cost-Benefit Analysis. The questions from Tetra-Tech are in bold font and the responses from Holtec are in regular font.

Construction Costs

1. **Cost to acquire land**
   Holtec response: $1M - Not purchased yet

2. **Facility construction costs for Phase 1 (if possible, describe method used to estimate capital costs; also, specify whether this is materials only or includes labor, taxes, etc.)**
   Holtec response: Prices include 1% Bonding, Construction Costs, 3% inflation/year (to year 2020), 20% price increase due to location (as recommended in the GNEP site study). Numbers generated from online research, previous projects, and quotes received.

3. **Total construction workforce salaries for Phase 1 (needed separately from facility construction costs in order to prepare tax analysis)**
   Holtec response: Use Prevailing Wage Rates.

4. **Incremental construction costs for each subsequent phase**
   Holtec response: Costs consider the HI-STORM UMAX, site work, building and road realignments, and utilities.

5. **Incremental construction workforce salaries for each subsequent phase**
   Holtec response: Use Wage rates +3%/year.

Operating Costs

6. **Annual operating costs (includes maintenance, security, management, etc.) for Phase 1**
   Holtec response: Based on previous experience an operating budget of $4.5M with $1.3M being labor.

7. **Total operational (includes maintenance, security, management, etc.) workforce salaries for Phase 1 (needed separately from operating costs in order to prepare tax analysis)**

   Holtec response:
   For Train to Pad:
   Assumptions:
   - 4 casks per week – 250 Casks/year.
   - 1 Shift. 8 hrs/day.
   - Both Bays running.
   - $60/hr (2016) – 3% increase/year (unless otherwise noted).
   - Staff (33 people)

- 8RPS
- 2 Admin - $50/hr
- 2 Chemists
- 6 guys for crane/VCT operations
- 12 Riggers
- 2 Maintenance People
- 1 Facilities Manager

For Security:

Assumptions:

- 24/7 Coverage – 3 shifts.
- Manning Factor = 5. $40/hr
- Staff (40 people)
  - Alarm Monitor
  - Shift Supervisor
  - Rovers
  - Search/Break Rover
  - Access Authorization

Additional Admin:

Accounting – 1 Person - $60/hr
Admin Assistant – 1 Person - $30/hr
PM – 2 people - $70/hr

8. Incremental operating costs for each subsequent phase

Holtec response: Security may increase.

D&D Costs

9. Will site be released for unrestricted use following D&D?

Holtec response: Yes, assume zero dose.

10. Value of the land when released for use.

Holtec response: Market Value, no downgrade in cost.

Other Cost Considerations

11. Describe any contingencies

Holtec response: None of the following is included in the supplied cost estimate

- Spare Parts: $13,0000 in equipment * 20% = $2,600,000
- $100,000/year RP consumables
- Water Cost: $0.90 to $1.50 per barrel (42gal/barrel).