Thunderhead Wind Energy Center Interconnection Project

Draft Environmental Assessment
Antelope, Holt, and Wheeler Counties, Nebraska

Western Area
Power Administration

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Abbreviations

AADT	annual average daily traffic
ABB	American burying beetle
APE	area of potential effects
APLIC	Avian Power Line Interaction Committee
AQI	air quality index
ATV	all-terrain vehicle
BBCS	Bird and Bat Conservation Strategy
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CUP	conditional use permit
dBA	A-weighted decibel
EA	environmental assessment
EMF	electric and magnetic fields
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
gen-tie line	generation tie line
GHGs	greenhouse gases
GIS	geographic information system
GPC	greater prairie-chicken
HAPs	hazardous air pollutants
Hz	hertz
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEC	International Electrotechnical Commission
IPaC	Information for Planning and Consultation
kV	kilovolt
Ldn	day-night average sound level
mG	Milligauss
mph	miles per hour
m/s	meters per second
MW	megawatt

NAAQS	National Ambient Air Quality Standards
NDEE	Nebraska Department of Environment and Energy
NE-14	Nebraska Highway 14
NE-70	Nebraska Highway 70
NEPA	National Environmental Policy Act
NGPC	Nebraska Game and Parks Commission
NHPA	National Historic Preservation Act
NLEB	northern long-eared bat
NNHP	Nebraska Natural Heritage Program
N_2O	nitrous oxide
NPPD	Nebraska Public Power District
NRCS	Natural Resources Conservation Service
O&M	operations and maintenance
O_3	ozone
OSHA	Occupational Safety and Health Administration
PEIS	Wind Energy Final Programmatic Environmental Impact Statement
PM	particulate matter
ROW	right-of-way
rpm	revolutions per minute
SCADA	supervisory control and data acquisition
SF_6	sulfur hexafluoride
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SPP	Southwest Power Pool, Inc.
Thunderhead	Thunderhead Wind Energy LLC
TWEC	Thunderhead Wind Energy Center
UGP	Upper Great Plains
USFWS	U.S. Fish and Wildlife Service
WAPA	Western Area Power Administration
WPFO	western prairie fringed orchid

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

Thunderhead Wind Energy LLC (Thunderhead) has requested to interconnect its existing approximately 300-megawatt (MW) Thunderhead Wind Energy Center (TWEC) to the Western Area Power Administration's (WAPA's) existing Grand Island-Fort Thompson 345-kilovolt (kV) transmission line in Holt County, Nebraska (Interconnection Project). The project area is located in portions of Wheeler, Antelope, and Holt Counties, Nebraska, near Neligh, Nebraska, approximately 135 miles northwest of Omaha, Nebraska, and 100 miles southwest of Sioux City, Iowa. An overview of the location where Interconnection Project operations and maintenance (O&M) would occur is shown in Figure 1-1.

At the time the TWEC was constructed, Thunderhead held a Generator Interconnection Agreement with Nebraska Public Power District (NPPD) and Southwest Power Pool, Inc. (SPP), to interconnect TWEC to NPPD's Holt County Substation. NPPD's Holt County Substation was the eastern terminus for the proposed 345-kV R Project transmission line being developed by NPPD and on which NPPD had started construction. In June 2020, the U.S. District Court for the District of Colorado vacated one of the federal permits for NPPD's R Project, thereby delaying completion of the R Project transmission line. Due to that delay, in August 2021, NPPD and SPP agreed to, and did modify, a Notice to Construct issued by SPP to remove from the R Project the portions of the Holt County Substation necessary for the interconnection of TWEC. Thunderhead, NPPD, and SPP also agreed to a revised Generator Interconnection Agreement that assigned the construction of the Holt County Substation to Thunderhead as a network upgrade. As a result of these actions by NPPD, SPP, and Thunderhead, the nature of the TWEC connection became a generation project interconnecting to the WAPA Grand Island-Fort Thompson 345-kV transmission line via the NPPD Holt County Substation, which triggered the need for this environmental assessment (EA) review by WAPA.

WAPA's decision on Thunderhead's Interconnection Project constitutes a major federal action under the National Environmental Policy Act of 1969 (NEPA), thereby triggering NEPA review by WAPA. This EA analyzes and discloses potential environmental impacts associated with the Interconnection Project. This EA tiers to the analysis conducted in the Upper Great Plains (UGP) Wind Energy Final Programmatic Environmental Impact Statement (PEIS), a document prepared jointly by WAPA and the U. S. Fish and Wildlife Service (USFWS). The UGP Region encompasses all or parts of the states of Iowa, Minnesota, Montana, Nebraska, North Dakota, and South Dakota. The UGP PEIS assesses environmental impacts associated with wind energy development and identifies environmental commitments to avoid and reduce those impacts. As stated in the Executive Summary of the UGP PEIS, if wind energy project developers implement the applicable evaluation process, environmental commitments, and conservation measures identified in the UGP PEIS, the NEPA evaluation for that wind energy project may tier to the analyses in the UGP PEIS.

Applicable material from the UGP PEIS is incorporated by reference in this EA in accordance with 40 Code of Federal Regulations (CFR) 1501.11 and 1501.12. The analysis in this EA is Interconnection Project–specific and focuses on site-specific issues not addressed in sufficient detail in the UGP PEIS. This EA is intended to be read together with the UGP PEIS, and the EA and UGP PEIS together form the NEPA documentation for the proposed federal action. Thunderhead has committed to implementing the applicable environmental commitments and conservation measures from the UGP PEIS to allow for tiering.

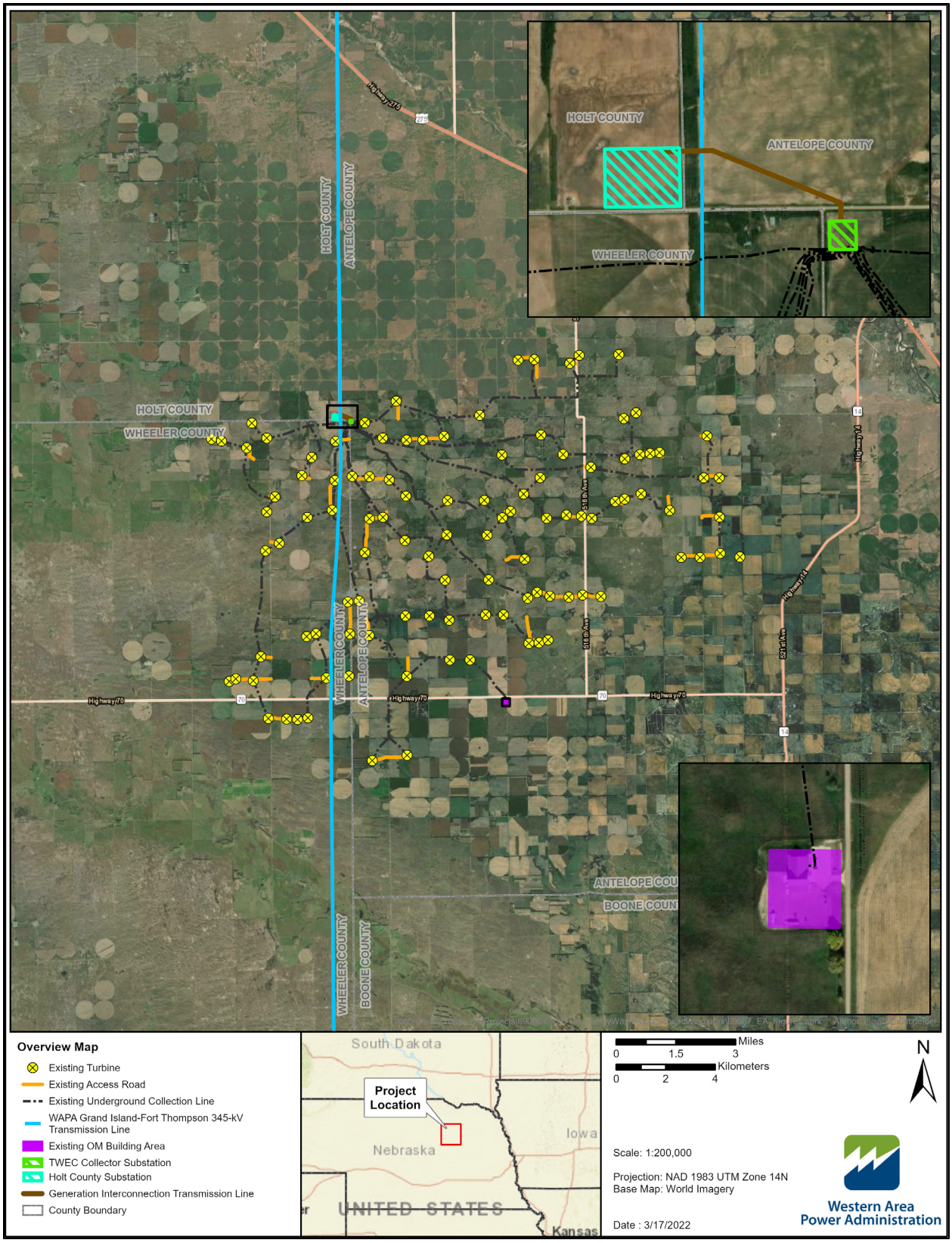

Figure 1-1. Interconnection Project overview.

1.2 PURPOSE AND NEED FOR FEDERAL ACTION

In accordance with the SPP Tariff and the Federal Power Act, as described in Section 1.1.1 of the UGP PEIS, WAPA must consider and respond to Thunderhead's request to interconnect to WAPA's existing Grand Island-Fort Thompson 345-kV transmission line.

1.3 THUNDERHEAD WIND ENERGY LLC GOALS AND OBJECTIVES

Thunderhead's goals and objectives for the Interconnection Project are to provide a source of clean, renewable energy in support of governmental and commercial renewable energy production and greenhouse gas (GHG) emissions reduction policies and targets. To accomplish these goals and objectives, the Interconnection Project must be technically, environmentally, and economically feasible. To that end, Thunderhead needs to:

- interconnect the TWEC to a regional transmission line with a voltage between 115 kV and 345 kV;
- reduce adverse environmental impacts and duplicative facilities by utilizing the TWEC's existing infrastructure as already constructed in anticipation of interconnecting in Holt County, Nebraska;
- generate and transmit energy from the financed and fully constructed TWEC facility to the regional grid system to provide revenue to offset facility costs; and
- deliver energy to the regional transmission grid in a timely and expeditious manner.

CHAPTER 2. PROJECT DESCRIPTION

2.1 DESCRIPTION OF PROPOSED ACTION AND NO ACTION ALTERNATIVES

This EA analyzes two alternatives, the Proposed Action and the No Action Alternative.

2.1.1 Proposed Action

WAPA proposes to allow Thunderhead to interconnect its TWEC facility to WAPA's UGP Region existing Grand Island-Fort Thompson 345-kV transmission line via the NPPD Holt County Substation. WAPA would perform the following construction and commissioning work necessary to accommodate the interconnection:

- Installing two new steel monopole approach structures on existing foundations. One structure would be approximately 160 feet tall, and the second would be approximately 135 feet tall. Additionally, a 120-foot-tall steel lattice structure would be removed.
- Stringing 751 feet of conductor between WAPA's transmission line and NPPD's Holt County Substation.
- Installing and/or commissioning of any necessary protective relays, remote terminal units, etc. at the Holt County Substation and existing WAPA facilities.

These activities are expected to take approximately 3 weeks to complete, and all work would be accomplished within WAPA's existing right-of-way (ROW). No vegetation clearing or earth work is needed to complete the above-described activities.

If the interconnection is approved, Thunderhead would operate and maintain the TWEC and associated facilities for a period of 50 years, as described in the following sections.

Because it is speculative what the environment, regulatory landscape, and recycling, reuse, and/or disposal technologies will be that far in the future, there are no proposed TWEC-specific decommissioning activities. Any future decommissioning activities would be completed consistent with the general requirements described in Sections 3.5, 3.6.4, and 3.6.6 of the UGP PEIS and applicable federal, state, and local requirements at that time.

Collectively, the activities described above are called the Interconnection Project or Proposed Action.

Per the requirements of 40 CFR 1501.9(e)(1)(i–iii), WAPA has determined that actions associated with Thunderhead's prior request to interconnect to NPPD's R Project are not connected actions to the Interconnection Project and do not fall within the scope of this environmental review. The major construction and ground-disturbing actions associated with the TWEC, generation tie line (gen-tie line), and Holt County Substation were substantially completed prior to Thunderhead's request for approval to interconnect to WAPA's transmission line. Minor commissioning work within the existing ROW, such as conductor stringing and tensioning and erecting structures on existing foundations, remains. Further

details on this determination can be found in Appendix A. The excluded review components include the following:

- Construction of the TWEC approximately 300-MW wind facility and internal components, including access roads, collector lines, collector substation and O&M facility.
- Ground-disturbing construction of the 0.4-mile gen-tie line.
- Construction of the Holt County Substation.

2.1.2 Thunderhead Wind Energy Center

The existing TWEC consists of turbines, access roads, underground collection system, collector substation, O&M facility, and gen-tie line as described below.

2.1.2.1 Wind Turbines

The TWEC consists of 108 wind turbines for a total nameplate capacity of approximately 300 MW. The turbines are arranged in several staggered, offset rows across the terrain and are generally oriented perpendicular to prevailing winds. Figure 1-1 shows the locations for the 108 wind turbines that have been constructed. Thunderhead obtained all necessary permits and approvals for construction of the TWEC facility in August 2019, and construction was completed in November 2020. Each turbine sits on a permanent concrete foundation, also known as a turbine pad, to provide structural support to the assembled turbine. Table 2-1 provides an overview of turbine and turbine pad dimensions.

Table 2-1. Thunderhead Wind Energy Center Turbine Count and Component Dimensions

Turbine	Count	Turbine Pad	Hub Height (feet)	Rotor Diameter (feet)	Blade Length (feet)	Maximum Blade Tip (feet)
General Electric 2.8 MW	98	56-foot diameter, extending 9.0–9.5 feet underground	295	417	204.0	499.0
General Electric 2.3 MW	10	53-foot diameter, extending 9.0–9.5 feet underground	262	381	186.6	452.8

Sources: Leidos (2019); Personal communications, emails between Thunderhead and SWCA (2022).

Per the Federal Aviation Administration's (FAA) final marking and lighting plan, all 108 turbines are painted white; 104 turbines also have synchronized red lights (FAA 2019). Currently, there are temporary, solar-powered red lights on each turbine that are operational. Permanent FAA lights are built into the towers and would be operational when the site has a grid connection.

2.1.2.2 Access Roads

The project area is accessed from county roadways (including Nebraska Highways 14 and 70 [NE-14 and NE-70]) and abuts two state roadways (U.S. Routes 275 and 281), all of which ultimately connect to Interstate 20 (to the east) and Interstate 80 (to the south) (see Figure 1-1). The project area includes approximately 163 miles of existing county roads (including 7 miles of existing two-track roads that Thunderhead widened by approximately 4 feet during TWEC construction activities to meet Nebraska Department of Transportation standards), and 24 miles of turbine access roads constructed on private lands. Approximately 20 miles of county roads within the project area are paved (NE-70 and 516th

Avenue); all remaining roads in the project area are gravel. County roads accessing the site are approximately 30 feet wide and turbine access roads are approximately 16.5 feet wide.

2.1.2.3 Underground Collection Lines

Power generated by the wind turbines would be transmitted through approximately 130 miles of underground collection lines to the collector substation. The existing collection lines consist of a 34.5-kV underground electrical cable system installed approximately 4 to 7 feet below the ground. The collection system is made of up to 12 collector circuits with four to 10 turbines on each circuit. Each turbine is connected to a supervisory control and data acquisition (SCADA) system via fiber-optic cable, which is installed in the same trench as the underground collection lines. Fifty-one aboveground junction boxes were installed.

2.1.2.4 Collector Substation

The TWEC includes a 1.75-acre collector substation. At the collector substation, the electrical voltage would be stepped up from 34.5 kV at the underground collection lines to 345 kV for the gen-tie line. The collector substation houses one station service transformer, 10 circuit breakers, switching devices, auxiliary equipment, a control enclosure (containing equipment for proper control, protection, monitoring, and communications), and other miscellaneous equipment. The entire substation is fenced for safety and security. The facility was constructed with downward-facing outside lighting. Lights would be on when technicians are in the collector substation.

2.1.2.5 Operations and Maintenance Facility

The TWEC includes a 1.96-acre O&M facility. The O&M facility contains a 76,269-square-foot building with a main floor shop and loft for storage, a paved vehicle parking area, and a paved area for outdoor storage of larger equipment and materials. The building has running water, which is provided by the existing rural water system. The entire O&M facility is fenced for safety and security. The O&M has standard house entry downward-facing lighting.

2.1.2.6 Generation Tie Line

A 2,045-foot-long (0.4 mile), 345-kV single circuit gen-tie line would transmit the power from the TWEC collector substation to the Holt County Substation. The gen-tie line was constructed by Thunderhead and is owned, operated, and maintained by NPPD. The gen-tie line includes two 75-foot-high three-pole steel structures and one 110-foot-high steel monopole structure within a 150-foot-wide easement (see Figure 1-1). The gen-tie line is marked with bird diverters that have high wind resistance, are visible at a distance, and adhere to Avian Power Line Interaction Committee (APLIC) guidance: *Reducing Avian Collisions with Power Lines* (APLIC 2012).

2.1.3 Operations and Maintenance

Section 3.4 of the UGP PEIS describes the activities likely to occur during the O&M phases of a typical wind energy project. The same types of activities would occur for the proposed Interconnection Project. For this analysis, the predicted operational life span of the TWEC is 50 years; however, the actual life span of a wind energy project could be longer or shorter. If Thunderhead decides to retrofit the TWEC and extend the life span of the project, Thunderhead would prepare and submit the proposed retrofitting for review and decision to appropriate federal, state, and local permitting agencies with jurisdictional authority over the respective retrofit activities. O&M of the turbines, roads, collection system, and

collector substation would be managed by Thunderhead out of the TWEC O&M facility; the gen-tie line and Holt County Substation would be owned, operated, and maintained by NPPD.

TWEC O&M activities would require approximately 12 full-time employees (one manager, one administrative staff person, and 10 technicians). These full-time employees would drive personal vehicles to and from the TWEC O&M facility daily. Up to an additional seven pick-up trucks (F-150 or F-250 equivalents) would be located on-site to conduct O&M activities. Standard maintenance and groundskeeping at the O&M facility would include beautification, weed pulling, mowing, and other general landscaping. Other than emergency callouts or response to off-hour outages, the O&M activities would be limited to normal business hours.

Turbine access roads on private lands would be maintained by Thunderhead. This could include dust control, grading, or placement of additional gravel as needed. Maintenance of county roads within the site would be the responsibility of the respective county; however, Thunderhead would be responsible for any road damage caused by maintenance or warranty work on the TWEC, as described in the county road use agreements and county permits (Antelope County Commissioners 2018; Wheeler County Board of Commissioners 2019).

2.1.3.1 Wind Turbines

Operations of the wind turbines would be conducted through control and monitoring systems that allow for individual control of the speed, yaw, and pitch of each turbine to address real-time meteorological or other data; increase the ability of turbines to remain online during grid faults and operate in subzero temperatures; and control turbines to address winter ice conditions. Turbines contain a monitoring system that would generate alarms if any set limits were exceeded.

Maintenance of the wind turbines would include visual turbine inspections and remote activities such as turbine resets and troubleshooting, and other upkeep activities. All major components of the wind turbines would undergo routine maintenance on schedules established by the component manufacturer. Generally, routine maintenance activities occur biannually. Routine maintenance would first occur 1 month after commercial operation has begun. After that, maintenance would be performed at 6-month and 12-month intervals. Additional service and repairs would be done as needed. In most cases, this would involve replacing lubricating oils and coolants in transmissions and motors and using small amounts of greases, lubricants, paints, and/or coatings for corrosion control.

Turbine maintenance activities would be conducted at turbine locations. The gearbox of each turbine holds approximately 100 gallons of oil. Each turbine contains a “bellypan” designed to collect spilled oil in the event of a gearbox split or other leak. Used oils generated through routine maintenance could range in the hundreds of gallons for large turbines. Used oil would be stored on-site at the O&M facility’s secondary containment and in-ground oil separator as documented in the spill prevention, control, and countermeasure plan until a licensed material vendor disposes of the oil.

Vegetation management at the turbine pads would include mowing and herbicide use as needed to control invasive or noxious weeds.

On occasion, turbines can experience malfunctions (such as equipment failure) that require nonroutine maintenance work. As noted in the UGP PEIS, over the life of the turbine, some mechanical components may need repair or replacement; however, most turbine designers construct their turbines in modular fashion. Thus, it is likely that most major overhauls or repairs of turbine components would involve removing the components from the site to a designated off-site repair facility. Because most turbine towers are equipped with lifting devices of sufficient capacity to lower or raise individual drivetrain

components, a crane should not be needed for such component replacements. If large equipment, such as a crane, were required to facilitate equipment repair or replacement, any resulting temporary impacts (e.g., establishing a crane pad) would be reclaimed after equipment is removed. Cleaning of a rotor could happen on a rare individual basis but would not be a routine practice. This practice would only occur if the rotor assembly were already lowered from the drive train assembly for maintenance work. In the rare event that rotor cleaning does happen, a third-party contractor would supply their own cleaning agents to complete their task. The contractor would supply appropriate material safety data sheet information for any agents brought on-site.

2.1.3.2 Other Facilities

O&M of the underground collection system would include remote monitoring of the system, visual inspections of the aboveground junction boxes via vehicles or walking the collection line route, and collection line repair or maintenance as needed. If repairs were needed for the underground collection system, disturbance would occur within the confines of the previous construction disturbance (200-foot ROW).

O&M associated with the collector substation would include remote monitoring, in-person inspections, online testing, and vegetation removal within the substation site. Every 3 years, Thunderhead would power off the substation to complete testing, maintenance, and cleaning, which would otherwise be too dangerous to do when the substation is energized. Equipment replacement would only occur on an as-needed basis, for example, in the case of damage or complete failure. All repair work would happen within the existing substation site.

O&M of the gen-tie line would include visual inspections of the conductor and pole structures and replacing these facilities when necessary. Inspections would occur within the TWEC existing easement and on foot or with an all-terrain vehicle (ATV). In rare instances, inspectors may need to use a bucket truck or climb the transmission structures. Repairs and replacements would be accomplished within the easement area and existing road, using standard equipment such as bucket trucks. Bird diverters would be maintained for the life of the gen-tie line. Maintenance of vegetation within the 150-foot-wide easement would be conducted in accordance with landowner requirements and may include periodic tree and bush trimming, application of herbicide, or both.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, WAPA would not allow Thunderhead to interconnect its TWEC facility via WAPA's 345-kV transmission line and would not perform construction or commissioning work to accommodate the interconnection request. WAPA expects that Thunderhead would seek an alternative interconnection; however, specific information regarding timing and location of that alternative interconnection is unknown at this time.

For baseline comparison in this analysis, the No Action Alternative assumes that the TWEC and associated facilities would remain as constructed but would be nonoperational.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

WAPA considered alternatives to the Proposed Action as provided in 40 CFR 1501.9(e)(2). As described in Sections 1.2 and 1.3, WAPA's consideration of alternatives took into account the following factors:

- Technical requirement that transmission lines and substation interconnection facilities have sufficient capacity and voltage (115 kV–345 kV) suitable for transmitting electricity from the TWEC to end use customers.
- Economic goals for site control, access to regional transmission lines, proximity to transmission infrastructure, proximity to load centers, and timeliness.

The nearest alternative existing infrastructure that meets the technical requirements (capacity and voltage) are the Antelope Substation (345 kV) located in Antelope County, Nebraska, and the Norfolk Substation (115 kV) located in Madison County, Nebraska. The Antelope Substation is located approximately 19 miles from the TWEC, and the Norfolk Substation is located approximately 47 miles from the TWEC. These alternative locations would involve significantly more ground disturbance and environmental impacts than the 0.4-mile gen-tie line of the Proposed Action. Although technically possible, WAPA determined Antelope and Norfolk Substations were economically impractical and infeasible alternatives due to a lack of site control, remote proximity to the TWEC, and inability to meet Thunderhead's timeliness goals.

WAPA is aware of a proposed infrastructure project, NPPD's R Project, which offers an alternative interconnection for TWEC. As it is currently proposed, the R Project transmission line would have sufficient capacity and voltage to transmit power from the TWEC and would be in Holt County at the terminus of TWEC's existing gen-tie line, thereby meeting the technical requirements and economic goals. In fact, Thunderhead entered into a generation agreement with NPPD and SPP on December 21, 2016 (amended November 8, 2019) for interconnection to the R Project transmission line and subsequently constructed the TWEC in anticipation of that interconnection; however, NPPD has delayed construction of the R Project transmission line due to a June 2020 decision of the U.S. District Court for the District of Colorado, which vacated USFWS's incidental take permit issued to NPPD for that transmission project. Due to the unknown construction timing of the R Project transmission line and the need for further permitting and environmental review that could result in modifications to the R Project design, it would not meet Thunderhead's economic goals for timeliness and there is no certainty that the final design would meet the technical requirements. For those reasons, on April 26, 2021, Thunderhead formally abandoned plans to interconnect to the R Project.

WAPA determined that alternative locations for the transmission line interconnection to the TWEC are infeasible and impractical and would not achieve WAPA's purpose and need. As such, there were no alternative transmission line interconnection locations carried forward for detailed consideration in this EA.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter contains the impacts analysis for the Proposed Action and No Action Alternative, organized by resource issue. This analysis tiers to the analysis conducted in the UGP PEIS. Chapter 5 of the UGP PEIS discusses the potential direct and indirect environmental impacts of wind energy development across the UGP Region and identified best management practices (environmental commitments) to reduce impacts. This chapter will focus on site-specific information relevant to the proposed Interconnection Project.

Each resource section begins with a description of the existing conditions within a specified analysis area. In many cases, the analysis area is the same as the project area, which includes existing TWEC infrastructure (e.g., turbine locations, roads, collection lines, etc., as shown in Figure 1-1), the existing WAPA ROW, and areas directly adjacent to where O&M activities may take place. For those resources where the analysis area differs from the project area (such as for visual resources, wetlands, or noise) a description of the analysis area is provided.

The project area includes approximately 67.6 acres of permanent disturbance that occurred as part of development of the TWEC (see Chapter 2). Acreages are disclosed by facility type in Table 3-1.

Table 3-1. Thunderhead Wind Energy Center Permanent Disturbance

Facility	Permanent Disturbance (acres)*
Turbines (98 turbines with a 56-foot diameter; 10 turbines with a 53-foot diameter)	5.5
Turbine access roads (24 miles, 16.5 feet wide)	48.0
Improved county roads (7 miles, 4 feet of widening of existing road)	3.4
Collection lines (underground, 100% reclaimed)	0.0
Collector substation	1.8
O&M facility	2.0
Gen-tie ROW (0.4 mile, 150 feet wide)	7.0
Total	**67.6**

* Disturbance occurred prior to WAPA involvement.

Next, the section describes the anticipated impact of the Proposed Action to the resource. The analysis also identifies any environmental commitments that would be incorporated into the Proposed Action to reduce impacts. Finally, the section concludes with a description of the anticipated impact of the No Action alternative to the resource.

3.1 GEOLOGY, SOIL RESOURCES, AND PALEONTOLOGY

3.1.1 Existing Conditions

The TWEC is located within the Great Plains province of the Interior Plains physiographic region. The Great Plains province is characterized by plateau-like flat plains with little relief throughout the area (National Park Service 2017). WAPA has defined the analysis area for geological, soil, and paleontological resources as the project area, which includes existing TWEC infrastructure (e.g., turbine

locations, roads, and collection lines, as shown in Figure 1-1) and areas directly adjacent to where O&M activities may take place.

The soils within the analysis area are primarily deep loamy fine sand and fine sand formed in eolian sands. The soils in the analysis area are not highly susceptible to erosion and are generally good for crop production. Most soils are excessively drained (Natural Resources Conservation Service [NRCS] 2022). A large portion of the analysis area includes previously disturbed soils due to agricultural activity and residential and other development (including 67.6 acres of permanent disturbance associated with the TWEC; see Table 3-1).

Projects are subject to Farmland Protection Policy Act requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a federal agency or with assistance from a federal agency. Of the 67.6 acres of permanent disturbance that occurred as part of the development of the TWEC (see Table 3-1), 6 acres occurred in areas classified as prime farmland, and 15 acres occurred in areas classified as farmland of statewide importance. The remaining TWEC disturbance occurred in areas that are not prime farmland (NRCS 2022).

The potential for fossils in the analysis area at the surface is low due to crop fields and deep eolian sand. The analysis area does not contain significant rock outcrops (NRCS 2022).

No reclaimed or active mines are located within the analysis area. The risk of seismic activity is low and there are no faults within the analysis area (U.S. Geological Survey 2018). Therefore, mineral resources and seismic risk are not addressed further in this EA.

3.1.2 Environmental Consequences: Proposed Action

3.1.2.1 Environmental Commitments

Appendix B contains a list of TWEC siting and construction environmental commitments that were implemented prior to WAPA involvement.

The following environmental commitments would be implemented to reduce potential impacts to geology, soil resources, and paleontology from the Interconnection Project:

- As feasible, maintenance activities would be conducted when the ground is frozen or when soils are dry and native vegetation is dormant.
- Soil erosion control measures would be monitored, especially after storms, and would be repaired or replaced as needed.
- Vehicle traffic would be limited to established roads.

3.1.2.2 Direct and Indirect Impacts

The Proposed Action would not impact geological resources or paleontological resources because no subsurface work is planned. The Proposed Action would also not impact prime farmland or farmland of statewide importance because there would be no additional surface disturbance or conversion of undisturbed areas to nonagricultural uses. The Proposed Action does have potential to cause soil compaction, soil erosion, and surface runoff, primarily due to vehicle and equipment traffic during inspections and equipment repairs. Soil erosion could occur along roads and areas adjacent to TWEC infrastructure where surface runoff may be channeled into natural drainages. Soil compaction could occur in work areas where vehicles, equipment, and human traffic cross the landscape.

3.1.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, soil compaction, erosion, and surface runoff could occur as a result of vehicle, equipment, and human traffic.

3.2 WATER RESOURCES

3.2.1 Existing Conditions

The TWEC is located within the Platte River watershed, which is part of the Missouri River basin surface water drainage system. The project area is split by a ridge and surface water in the project area flows either northeast to the Elkhorn River or southwest to Beaver Creek (U.S. Geological Survey 2022). Both waterways eventually feed into the Platte River.

WAPA has defined the analysis area for potential waters of the United States as a 350-foot radius around turbine locations and a 150-foot buffer around all other Interconnection Project infrastructure. Within the analysis area, desktop analysis and field surveys identified 61 palustrine emergent wetlands totaling approximately 54.42 acres, four palustrine forested wetlands totaling approximately 4.10 acres, four open water features totaling approximately 2.26 acres, and one unnamed ephemeral stream reach and five intermittent or perennial stream reaches totaling 2,497 linear feet (Olsson Associates 2019f) (Appendix C). Figure 3-1 identifies the location of perennial streams, jurisdictional and non-jurisdictional wetlands, and open waters in relation to TWEC facilities. Impacts to these features due to construction of TWEC were carried out under Nationwide Permit 51: Land Based Renewable Generation Facilities. The Self Issued Section 404/401 Permits Package (Olsson Associates 2020) disclosed that the combined temporary impacts to potential waters of the United States were mapped at 4.62 acres, and the combined permanent impacts were mapped at 0.011 acre.

Groundwater for irrigation and livestock purposes in and around the analysis area is provided by the High Plains Aquifer, which is an unconsolidated sand and gravel aquifer (Miller and Appel 1998; Nebraska Department of Natural Resources 2022).

3.2.2 Environmental Consequences: Proposed Action

3.2.2.1 Environmental Commitments

Surface waters, including wetlands, were avoided during the siting phase of the TWEC to the extent practicable (see Appendix B). When avoidance was not feasible, construction activities within water resource areas were completed under the authority of Nebraska Department of Environmental Quality (now Nebraska Department of Environment and Energy [NDEE]) in accordance with the stormwater pollution prevention plan and under the authority of the U.S. Army Corps of Engineers in conformance with Nationwide Permit 51 (Olsson Associates 2020).

The following environmental commitments would be implemented to reduce potential impacts to water resources from the Interconnection Project:

- Where O&M activities occur adjacent to undisturbed surface waters or wetlands, contractors would be required to cover surface water and riparian areas (the zone where dry land meets a water resource) with mats made of timber or similar material.

- Although unexpected, if new ground-disturbing activities became necessary during O&M, contractors would be required to re-establish the original grade and drainage pattern to the extent practicable and place hydrophytic vegetation as applicable within aquatic resources boundaries to maintain water resource function.
- Soil erosion control measures would be monitored, especially after storms, and would be repaired or replaced as needed.
- Travel would be restricted to designated roads; no off-road travel would be allowed except in emergency circumstances.
- A spill prevention, control, and countermeasure plan has been prepared (Southshore Environmental 2021) and would be implemented.
- When O&M activities are conducted adjacent to surface waters, fuels and coolants would be contained in fuel tanks and radiators of vehicles or other equipment. Routine vehicle maintenance, refueling, and staging would occur in the O&M facility, which is not near water resources and has appropriate spill containment infrastructure.
- All herbicide and pesticide mixing and applications would be conducted in accordance with all federal, state, and local laws and regulations and the specific product's label. Herbicide and pesticide application would only be directly applied to localized spots and would not be applied by broadcasting techniques.
- Catch basins, drainage ditches, and culverts would be cleaned and maintained regularly.

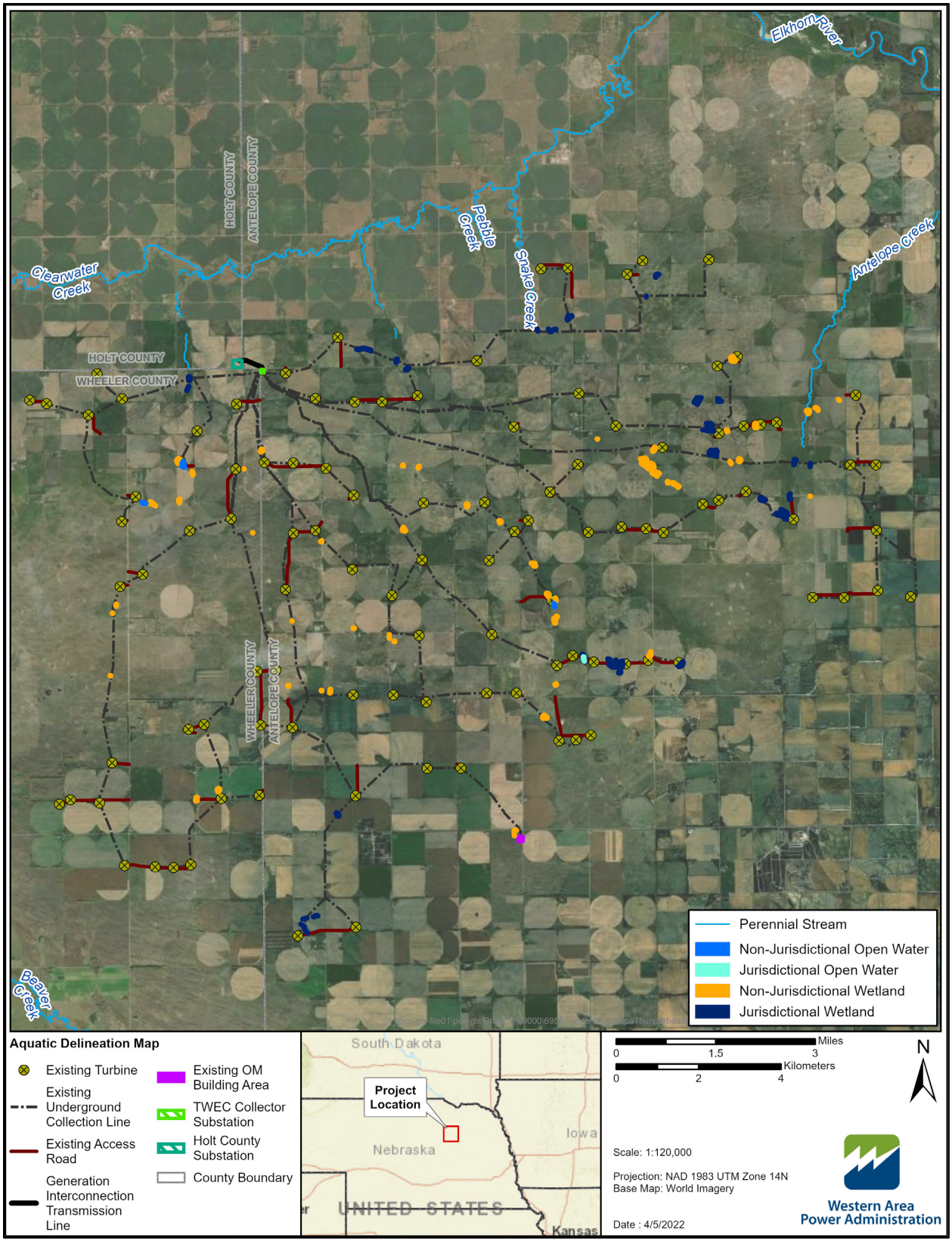

Figure 3-1. Water resources overview.

3.2.2.2 Direct and Indirect Impacts

Operations of the TWEC and WAPA's construction and commissioning work are not expected to impact water resources. Maintenance of TWEC facilities may affect groundwater quantity and quality. The TWEC O&M facility has running water for cleaning and drinking, which is provided by an existing private water well. The Interconnection Project would use approximately 30 gallons a day (7,800 gallons a year) for O&M facility usage and an additional 2,000 to 3,000 gallons during the summer months when the underground lawn sprinkler system would be in use. This amount is far less than area residential use, which averages 218 gallons per day in Nebraska (National Association of Home Builders 2017) and is not expected to measurably affect groundwater quantity.

Large-scale cleaning of equipment, such as turbine rotors and blades, could happen on a rare individual basis but is not a routine practice. In the rare event that cleaning does happen, a third-party contractor would supply all cleaning agents, including water. All cleaning agents would be water based, and any potential runoff would be contained physically during washing or with U.S. Environmental Protection Agency (EPA)–approved absorbents for power washing. The contractor would supply appropriate material safety data sheet information for agents brought on-site and would use the cleaning agents in accordance with product labels and instructions.

Vehicle and equipment use during TWEC operation activities may cause minor runoff and sedimentation to aquatic resources adjacent to and intersecting project features (Table 3-2). Ground-disturbing activities within aquatic resources would adhere to requirements of Nationwide Permit 51 and be conducted under the authority of NDEE.

Table 3-2. Aquatic Resources Impacts from Interconnection Project Operations and Maintenance

Facility	Impacts (acres)
Turbines	0 acres of permanent disturbance within wetlands. Potential minor impact to groundwater quantity due to cleaning.
Access roads	48 acres of roads would continue to be used for O&M travel. This could cause runoff and sedimentation from vehicle use adjacent to and crossing 0.011 acres of water resources.
Collector substation	0 acres of permanent disturbance within wetlands. Potential for minor runoff and sedimentation from vehicle use associated with substation operations or maintenance adjacent to and crossing water resources (see access roads above).
O&M facility	0 acres of permanent disturbance within wetlands. Potential for minor runoff and sedimentation from vehicle use associated with commute to and from the facility adjacent to and crossing water resources (see roads above).
Gen-tie ROW	Potential for minor runoff and sedimentation from vehicle use associated with ROW maintenance when adjacent to and crossing water resources (see roads above).

When applied according to the label instructions, herbicides, which would be used to control noxious weeds and vegetation growth around TWEC facilities, do not pose a risk to water quality in nearby surface water bodies. Accidental spills or leaks from transformers and other liquid-filled devices have the potential to impact water quality if they occur near surface water bodies.

3.2.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, all the impacts described in the previous section would occur as a result of the No Action Alternative as well.

3.3 AIR RESOURCES

3.3.1 Existing Conditions

Ambient air quality and air pollution emissions are regulated under federal and state laws and regulations. In Nebraska, the NDEE has primary responsibility for managing air quality through state regulations. NDEE has also been delegated authority by the EPA to implement federal programs of the Clean Air Act (CAA).

The CAA requires the EPA to set National Ambient Air Quality Standards (NAAQS) for air pollutants considered harmful to public health and the environment. The EPA has set NAAQS for six criteria pollutants: carbon monoxide (CO), nitrogen dioxide, ozone (O_3), lead, sulfur dioxide (SO_2), and particulate matter (PM). Primary standards are established to protect public health, and secondary standards are established to protect public welfare. These standards define the maximum level of air pollution allowed in the ambient air. Pursuant to the CAA, EPA has developed a method for classifying existing air quality in distinct geographic regions known as air basins or air quality control regions. For each federal criteria pollutant, each air basin is classified as in "attainment" if the area is in compliance with NAAQS or classified as "nonattainment" if one or more NAAQS is exceeded. The Interconnection Project is located in Holt, Antelope, and Wheeler Counties. All of these counties are designated as in attainment with all criteria pollutant NAAQS.

CAA regulations also control the release of hazardous air pollutants (HAPs): chemicals that are known or suspected to cause cancer or other serious health effects, such as reproductive effects, birth defects, or adverse environmental effects. EPA currently lists 189 compounds as HAPs. Triennially, the EPA publishes a comprehensive summary of air emissions data, known as the National Emissions Inventory. The most recent National Emissions Inventory data that are available are from 2017 and presented in Table 3-3.

In addition to HAPs, Table 3-3 provides the 2017 emissions for the six criteria air pollutants for the United States, Nebraska, and Holt, Antelope, and Wheeler Counties.

Table 3-3. National Emissions Inventory 2017 Emissions Data

Pollutant	United States (tons)	Nebraska (tons)	Holt County (tons)	Antelope County (tons)	Wheeler County (tons)
NO_x	11,785,882	140,206	2,491	1,369	581
CO	70,794,464	485,858	3,498	4,143	1,252
VOC	43,073,060	111,272	5,918	2,960	1,625
PM_{10}	17,062,926	237,527	10,538	5,881	2,605
$PM_{2.5}$	5,706,842	47,770	1,770	1,018	489
SO_2	2,714,860	7,001	19	22	2
HAPs	6,174,077	70,182	1,457	724	412

Source: EPA (2021).
Notes: NO_x = nitrogen oxides; VOC = volatile organic compound.

The EPA air quality index (AQI) is used for reporting daily criteria pollutant levels to the public. The AQI index is one way to evaluate how clean or polluted an area's air is and whether associated health effects might be a concern. The EPA calculates a daily AQI based on local air monitoring data. When the AQI value is between 0 and 50, air quality is categorized as "good," and criteria air pollutants pose little or no risk. There are no AQI data available for Holt, Antelope, or Wheeler Counties, so AQI data for the nearby county of Knox were used instead. Knox County is adjacent to Holt and Antelope Counties and representative of the air quality of these counties. AQI data provided in Table 3-4 show that air quality is generally good within Knox County and that there is little risk to the general public from poor air quality based on available data for the most recent 5-year period (2016–2020).

Table 3-4. Annual Air Quality Index for Knox County, Nebraska

Year	No. of Days with AQI	No. of Days Rated Good	No. of Days Rated Moderate	No. of Days Rated Unhealthy	Percentage of Days Rated Good	Percentage of Days Rated Moderate	Percentage of Days Rated Unhealthy
2016	350	323	26	1	92.3	7.4	0.2
2017	338	304	34	–	89.9	10.0	–
2018	357	329	28	–	92.2	7.8	–
2019	355	342	13	–	96.3	3.7	–
2020	365	341	24	–	93.4	6.65.5	–

Source: AirNow (2021).

3.3.1.1 Greenhouse Gases

GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several fluorinated species of gas. CO_2 is emitted primarily from the combustion of fossil fuels; CH_4 is emitted from the production and transport of coal, natural gas, and oil; and N_2O is emitted during agricultural and industrial activities. Fluorinated gases, which are synthetic, are emitted from a variety of industrial processes. CO_2 and other GHGs are naturally occurring gases in the atmosphere; their status as a pollutant is not related to their toxicity but instead is due to the added long-term impacts to climate because of their increased incremental levels in the earth's atmosphere.

3.3.2 Environmental Consequences: Proposed Action

3.3.2.1 Environmental Commitments

The following environmental commitments would be implemented to reduce potential impacts to air resources from the Interconnection Project:

- All personnel would adhere to a speed limit of 25 miles per hour (mph) while driving in the project area and would adhere to posted speed limits on public roads.
- All equipment would be maintained in good working order in accordance with manufacturer specifications.
- No burning of waste materials would occur at the project area.

3.3.2.2 Direct and Indirect Impacts

Negligible amounts of dust, vehicle exhaust emissions, and combustion-related emissions from worker trips and equipment use (such as heavy equipment and cranes used during WAPA's construction and commissioning activities) would occur during TWEC O&M activities and WAPA construction and commissioning activities. Also, negligible amounts of HAPs from vehicle exhaust emissions and combustion-related emissions from worker trips and equipment use would occur during TWEC O&M activities and WAPA construction and commissioning activities. Operation of the proposed collector substation is not anticipated to result in HAPs emissions; however, operation of the proposed collector substation could produce minute amounts of O_3 and nitrogen oxide emissions as a result of atmospheric interactions with the energized conductors. These minute emissions would be less than 0.01% of the emissions data presented in Table 3-3 for any of the three counties presented. Impacts to ambient air quality from these emissions would be negligible.

The proposed collector substation would employ sulfur hexafluoride (SF_6)–filled circuit breakers. SF_6 is a GHG, and, therefore, equipment leaks could contribute to air quality impacts. Equipment would undergo routine inspections and preventive maintenance to reduce the risk of leaks. If a circuit breaker leak were to occur, a third-party contractor would be contracted to control and capture leaking material.

Given scope and environmental commitments, direct impacts to air resources would occur on a local scale, rather than a regional, national, or global scale. Indirectly, the Proposed Action would incrementally contribute to overall global GHG emissions (see Section 4.2).

3.3.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, negligible amounts of dust, vehicle exhaust emissions, and combustion-related emissions would be expected due to maintenance activities such as vehicle inspections and routine upkeep.

3.4 NOISE

3.4.1 Existing Conditions

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that interferes with or disrupts normal activities. Although prolonged exposure to high noise levels can cause hearing loss, the principal human response to noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise, the perceived importance of the noise and its appropriateness in the setting, the time of day and the type of activity during which the noise occurs, and the sensitivity of the individual.

Community sound levels are usually presented in terms of A-weighted decibels (dBAs). The A-weighting network measures sound in a fashion similar to how a person perceives or hears sound, which correlates with how people perceive acceptable and unacceptable sound levels. Table 3-5 presents A-weighted sound levels of common sources of noise and the general subjective responses to those noises.

Table 3-5. Typical Sound Levels Measured in the Environment and Industry

Noise Source at a Given Distance	Sound Level (dBA)	Qualitative Description
Carrier deck jet operation	140	–
Civil defense siren (100 feet)	130	Pain threshold
Jet takeoff (200 feet)	120	Deafening
Auto horn (3 feet) Pile driver (50 feet) Rock music concert environment	110	Maximum vocal effort
Jet takeoff (2,000 feet) Shout (0.5 foot) Ambulance siren (100 feet) Newspaper press (5 feet) Power lawn mower (3 feet)	100	–
Heavy truck (50 feet) Power mower Motorcycle (25 feet) Propeller plane flyover (1,000 feet)	90	Very loud/annoying; hearing damage (8-hour, continuous exposure)
Pneumatic drill (50 feet) Garbage disposal (3 feet) High urban environment	80	Very loud
Passenger car, 65 mph (25 feet) Living room stereo (15 feet) Vacuum cleaner (3 feet)	70	Loud/intrusive (telephone use difficult)
Air conditioning unit (20 feet) Human voice (3 feet) Department store environment	60	–
Light auto traffic (50 feet) Residential air conditioner (50 feet) Private business office environment	50	Moderate/Quiet
Living room/bedroom bird calls (distant)	40	–
Library soft whisper (5 feet) Quiet bedroom environment	30	Very quiet
Broadcasting/recording studio	20	Faint
–	10	Just audible
–	0	Threshold of human audibility

Source: Adapted from Table E of *Assessing and Mitigating Noise Impacts* (New York Department of Environmental Conservation 2001).

As a result of the Noise Control Act of 1972, the EPA developed standards for noise levels under various conditions that would protect public health and welfare with an adequate margin of safety. The EPA determined that outdoor day-night average sound levels (Ldns) less than or equal to 55 dBA are sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use. The EPA also identified an Ldn of 55 dBA as the level below which no adverse impact occurs (EPA 1974).

There are no nationwide limits or regulations for wind turbine noise. Instead, the EPA recommends that local governments develop their own noise regulations or zoning ordinances based on the guidelines suggested by the EPA and the American Wind Energy Association. All three counties have zoning

regulations that contain noise standards concerning noise emissions from utility-scale wind farms. Antelope County set a limit not to exceed 50 dBA upon any adjoining, nonparticipating landowner's occupied dwelling and Wheeler County set a limit not to exceed 50 dBA at the nearest habitable dwelling. Both Antelope and Wheeler Counties have exceptions that wind facilities may exceed 50 dBA during periods of severe weather as defined by the U.S. Weather Service or during shutdown or restart for normal maintenance (Hankard Environmental 2019a, 2019b). Holt County's zoning regulations state that no commercial or utility-scale wind farms shall exceed 50 dBA at the nearest structure or occupied dwelling (Holt County 2021).

Although no baseline assessment of existing sound sources was completed for the TWEC, farming and ranching activities and vehicular traffic are assumed to be the largest contributors to ambient noise levels in the project area. There are 163 miles of existing county roads within the project area. NE-70 traverses the southern portion of the project area. NE-70 has a speed limit of 65 mph.

In rural areas, outdoor Ldn values typically range between 35 and 50 dB (EPA 1974), which reflects very quiet to moderate/quiet conditions (see Table 3-5). The UGP PEIS notes that due to low population and industrial activities, noise levels are estimated to be low for the region. The UGP PEIS states that approximately 50.5% of the counties within the region have Ldn of less than 33 dBA (corresponds to wilderness background noise) and 48.6% have Ldn in the range of 33 to 47 dBA, which is typical of rural and undeveloped areas (Eldred 1982). For the purposes of this EA, the ambient noise level of the project area is assumed to fall within the range of 33 to 47 dBA.

3.4.2 Environmental Consequences: Proposed Action

3.4.2.1 Environmental Commitments

Prior to WAPA's involvement, Thunderhead implemented the following measures to reduce noise impacts:

All county setback requirements were implemented, as follows:[1]

- Dwelling units (participating): 1,000 feet
- Dwelling units (nonparticipating):
    - Antelope County: 2,400 feet unless an easement has been signed with said nonparticipating landowner
    - Wheeler County: 2,640 feet unless an easement has been signed with said nonparticipating landowner

The following environmental commitments would be implemented to reduce potential noise impacts from the Interconnection Project:

- Effective exhaust mufflers would be installed and properly maintained on all equipment. All equipment would be maintained in good working order in accordance with manufacturer specifications. Suitable mufflers and/or air-inlet silencers would be installed on all internal combustion engines and certain compressor components.

[1] No noise modeling was conducted for Holt County because there are no turbines in Holt County and, therefore, no noise ordinances to which the Interconnection Project needs to adhere. The closest Holt County residence is 5,142 feet away from the closest turbine.

- Nearby residents would be provided with contact information for Thunderhead's on-site staff in the event that residents have concerns about Interconnection Project operations, including noise complaints.
- Within 24 months of completion of any phase of the wind energy conversion system, the Interconnection Project would be required to perform a sound analysis demonstrating that the Interconnection Project is following Section 8.08.06-13 of the Antelope County zoning regulations.
- Within 24 months of completion of any phase of the wind energy conversion system, the Interconnection Project would be required to perform an acoustical analysis demonstrating that the Interconnection Project is following Section 1604.06-12 of the Wheeler County zoning ordinance.

3.4.2.2 Direct and Indirect Impacts

Noise sources associated with the Interconnection Project would be the wind turbines, the transformer and switchgear from the substation, corona discharges from transmission lines, and O&M activities, which include the use of equipment and vehicles on-site. The predicted noise produced by these facilities is expected to range between 28 to 50 dBA, which is at or below county thresholds of 50 dBA and below 55 dBA (the level that the EPA defines as an adverse impact).

3.4.2.3 Operational Noise: Wind Turbines

Operation of the TWEC wind turbines would result in the generation of mechanical and aerodynamic noise. Mechanical noise is associated with the rotation of mechanical and electrical components. Aerodynamic noise from the wind turbines occurs from the flow of air over and past the blades and is generally increased with rotor tip speed. Low frequency noise (less than 20 hertz (Hz), also called infrasound, is also associated with wind turbines. Infrasound levels of modern wind turbines are typically 50 to 70 dB, which are below the hearing threshold, and no reliable evidence of adverse effects for these levels have been documented (Leventhall 2006).

Per county conditional use permit (CUP) requirements, TWEC completed an acoustical analysis of operations of the wind turbines on noise-sensitive receptors in Antelope and Wheeler Counties that were within 1 mile of the project area (Hankard Environmental 2019a, 2019b, 2022) (Appendix D).[2]

Seventy-nine of the 108 TWEC wind turbines and the collector substation are in Antelope County; the remaining 29 wind turbines are in Wheeler County. The acoustical analysis identified 187 residences and two churches within 1 mile of the project area. No parks or schools were identified as noise-sensitive receptors within 1 mile of the project area.

TWEC contains two different models of wind turbines. The noise analyses utilized the noisier turbines to generate more conservative noise level predictions. In general, wind turbine noise emissions increase with increasing wind speeds up to approximately 10 meters per second (m/s) measured at hub height. The maximum noise emission values used in the analysis were 10 m/s (Hankard Environmental 2019a, 2019b). Predicted wind turbine noise levels ranged from 28 to 50 dBA (Hankard Environmental 2019a, 2019b, 2022). This is akin to faint/very quiet (similar to a broadcasting/recording studio or quiet bedroom environment) up to moderate quiet (similar to a residential air conditioner at 50 feet) levels.

[2] No noise modeling was conducted for Holt County because there are no turbines in Holt County and, therefore, no noise ordinances to which the Interconnection Project needs to adhere. The closest Holt County residence is 5,142 feet away from the closest turbine.

3.4.2.4 Operational Noise: Electrical Infrastructure

Once operational, the gen-tie line could cause corona discharge noise. Corona discharge is the electrical breakdown of air molecules into charged particles and sounds like a crackling or hissing noise or a humming noise. Corona noise is primarily affected by weather (such as rainfall) and, to a lesser degree, by altitude and temperature. The UGP PEIS states that during rainfall events, the noise level at the edge of the ROW of 230-kV transmission line towers would be approximately 39 dBA, whereas the noise levels of a 400-kV line peak in the mid-40 dBA (Chartier et al. 1995; Lee et al. 1996), which is typical of the daytime background noise level in a rural environment. The noise level at a distance of 300 feet would be approximately 31 dBA, which would be lost in the background noise typical of a rural environment at night. Maximum noise levels associated with corona noise typically do not exceed 50 dBA as heard from the edge of the ROW during extreme weather events, and noise levels typically do not exceed 25 dBA during fair weather events—less than the ambient sound levels of a library (EPA 1974). The closest receptor to the gen-tie line is 519 feet away; thus, it is unlikely that corona noise would be detectible at receptors within the project area.

The main sources of noise associated with a substation are the transformer and switch gear. Transformer noise is principally a result of core vibration and is a function of the surface area, whether the transformer is air-filled or oil-filled, and the power rating. In addition to core vibration noise, transformer cooling fans and oil pumps at larger transformer stations generate broadband noise but are limited to periods when additional cooling is required. The fan noise is relatively low and is generally considered secondary to the core vibration noise source. Equipment noise levels may be obtained from manufacturers, equipment tendering documents, or test results. Transformer noise propagates and attenuates at different rates depending on size, voltage rating, and design. Estimated noise levels at distances of 900 and 2,200 feet would be 40 and 30 dBA, respectively, which are typical of day- and night-time background levels in a rural environment. Switchgear noise is generated by the operation of circuit breakers used to break high-voltage connections at 132 kV and above. Switchgear noise is characterized as loud and of short duration. The frequency of switchgear activity is dependent on utility company practices regarding regular testing, maintenance, and rerouting. These operations would occur infrequently and, accordingly, potential impacts of switchgear noise would be minor and intermittent in nature. The closest sensitive receptor to the Holt County Substation is a participating residence located approximately 790 feet away. These noise levels would be minor and intermittent in nature. Because the distance is slightly under 900 feet, estimated noise levels would be approximately 40 dBA, which is akin to living room/bedroom bird calls (distant), but under 50 dBA, which is akin to moderate quiet (similar to a residential air conditioner at 50 feet) levels (see Table 3-5).

3.4.2.5 Maintenance Noise

As a part of O&M activities, traffic would consist of 12 employees driving personal vehicles to and from the TWEC O&M facility. Up to an additional seven pick-up trucks (F-150 or F-250 equivalents) would be located on-site to conduct O&M activities (see Section 3.10.2.2 for discussion of traffic). Maintenance activities involving periodic site visits to wind turbines, transmission lines, substations, and auxiliary structures would involve light- or medium-duty vehicle traffic with relatively low noise levels.

WAPA construction and commissioning activities would require cranes or other heavy equipment during daylight hours over the course of 3 weeks. The use of motorized equipment would temporarily increase ambient noise levels. Most construction equipment sounds are in the 80 to 90 dBA range (American National Standards Institute 2018). The closest receptor in Holt County to the location where WAPA construction and commissioning work would occur is 913 feet away. At that distance, assuming no topographical obstruction other than existing vegetation, equipment noise is estimated to attenuate to

approximately 70 dBA, which would be similar to noise in a business office or near a freeway (Washington State Department of Transportation 2012). This would be above the assumed ambient noise levels (33–47 dBA); these noise impacts would occur intermittently, be short term, and would generally occur during regular business hours. There would not be any changes to existing noise levels once construction and commissioning activities are complete.

3.4.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, noise impacts from maintenance vehicle traffic and the O&M facility would be expected.

3.5 VEGETATION

3.5.1 Existing Conditions

The TWEC is located within the easternmost edge of the Sandhills ecoregion, with a small area of the southeastern portion located in the Tallgrass Prairie ecoregion (Chapman et al. 2001; Schneider et al. 2011). The Sandhills ecoregion contains one of the largest intact native grasslands in North America and is generally devoid of cropland agriculture. The sandy soils are unique to the ecoregion and have led to irregular dunes and interdunal valleys. The Tallgrass Prairie ecoregion is defined by its upland tallgrass, typically dominated by big bluestem, Indiangrass, switchgrass, and Canada wild-rye; however, in eastern Nebraska, the vegetation includes a wide range of community types, ranging from deciduous woodlands to saline wetlands (Chapman et al. 2001; Schneider et al. 2011).

WAPA has defined the analysis area for vegetation as an area that extends approximately 500 feet beyond all TWEC development. This analysis area provides a baseline of existing vegetation conditions adjacent to TWEC infrastructure and connecting vegetation communities located between dispersed facilities (Figure 3-2). Land cover in the analysis area is predominately cultivated crops (61%) and grassland/herbaceous (30%) (Table 3-6). Based on the 2018 field surveys, cultivated crops were primarily observed in the eastern portion of the analysis area. Primary crops cultivated in the area included corn, wheat, and soybeans (U.S. Department of Agriculture 2018). Both native and disturbed grasslands were observed in the areas classified as grassland/herbaceous and/or hay/pasture by the National Land Cover Database (Homer et al. 2015). Dominant plant species in the grassland/herbaceous areas included blue grama, hairy grama, little bluestem, prairie sandreed, sand bluestem, sand dropseed, and sand love grass. Non-native plant species observed in these areas included downy brome, Kentucky bluegrass, smooth brome, and quackgrass. Vegetation cover in these areas varied because they were maintained as grazing or hay pastures for livestock production (Olsson Associates 2019e).

Deciduous forest and shrub/scrub areas comprised approximately 1% of the analysis area and were located along portions of tributaries. Evergreen and deciduous forested areas, planted as shelterbelts around farmsteads and along cultivated crop fields, were also scattered throughout the analysis area. Tree species commonly observed were plains cottonwood, eastern red cedar, elm, oak, and willow (Olsson Associates 2019e).

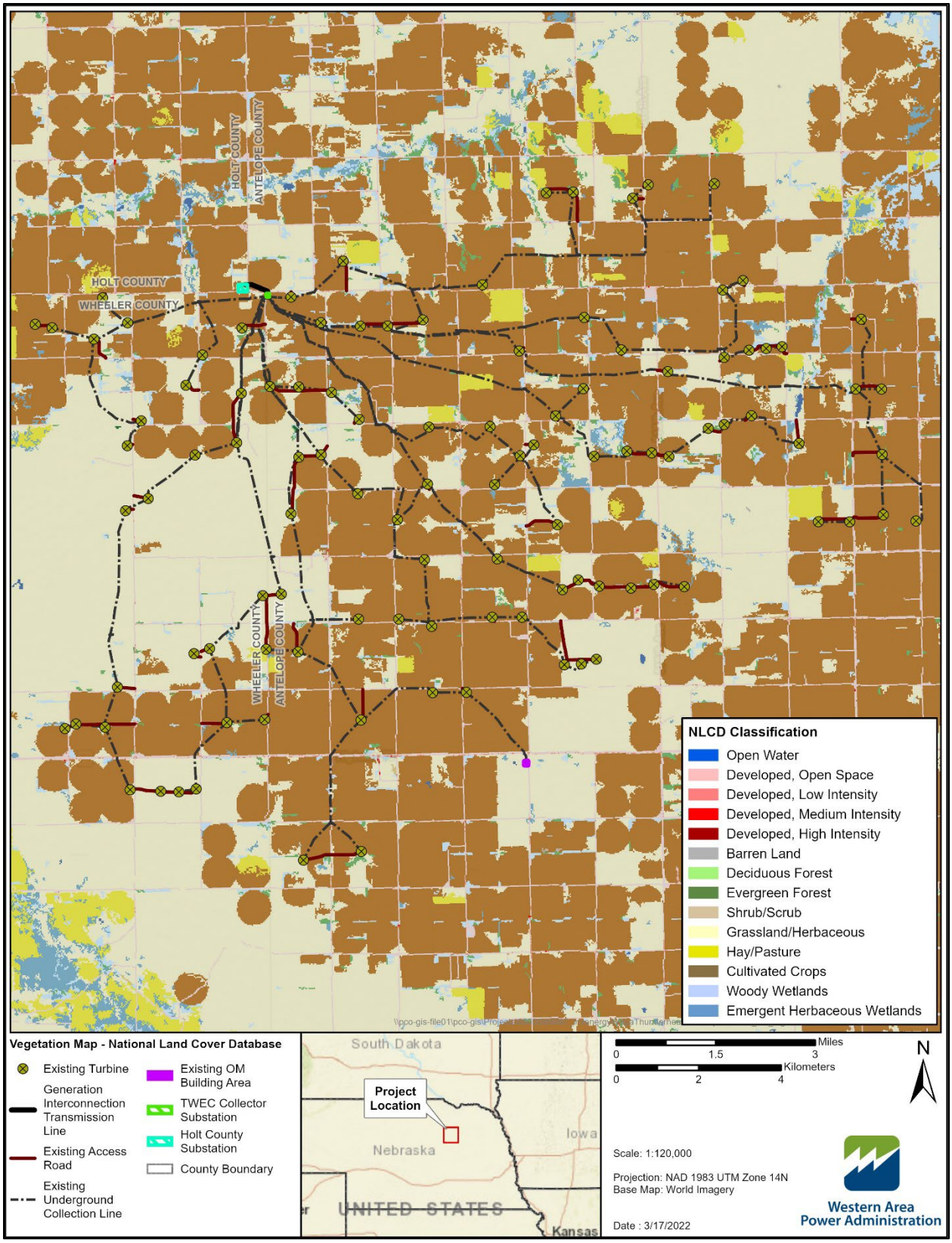

Figure 3-2. Land cover overview.

Table 3-6. National Land Cover Database Land Cover Types within the Analysis Area

Cover Type	Analysis Area	
	Acres	Percentage
Cultivated crops	32,102	61
Grassland/herbaceous	15,585	30
Developed, open space	2,016	4
Woody wetlands	893	2
Hay/pasture	822	2
Deciduous forest	391	1
Emergent herbaceous wetlands	333	1
Developed, low intensity	151	< 1
Open water	19	< 1
Barren land	2	< 1
Shrub/scrub	16	< 1
Developed, medium intensity	2	< 1
Evergreen forest	5	< 1
Total	**52,337**	**100**

Source: Homer et al. (2015).

Nebraska's state wildlife action plan defines a two-tiered approach to identifying those species that may be at risk for extinction or extirpation from the state. Tier I at-risk status includes species that are globally or nationally at risk. The Tier II list includes species that are at risk within Nebraska while apparently doing well in other parts of their ranges (Olsson Associates 2019e). Tier 1 at-risk plant species potentially occurring within a 2-mile buffer of the project area include small white lady's slipper, Hall's bulrush, and western prairie fringed orchid (WPFO) (NatureServe 2017; Olsson Associates 2019e; Schneider et al. 2011). No Tier II plant species were observed. See Section 3.7 for more information on WPFO.

The small white lady's slipper range is confined mostly to the Loup River system in central Nebraska and sites in northeastern Nebraska along the Elkhorn River system. The small white lady's slipper prefers relatively undisturbed meadows and has been observed in roadside ditches but only when adjacent to native meadows (Schneider et al. 2011). The small white lady's slipper appears to be intolerant of cattle grazing because it has not been found in grazed pastures (Panella 2010). Potentially suitable habitat may be present within western portions of a 2-mile buffer of the project area where undisturbed grasslands and emergent wetlands are located (Olsson Associates 2019e).

Hall's bulrush's range in Nebraska is primarily the Sandhills ecoregion. They can be found in the Elkhorn River headwaters and Upper Loup Rivers and tributaries. These areas overlap the western portion of a 2-mile buffer of the project area, and freshwater emergent wetlands observed in the western portion of the project area may provide suitable habitat for Hall's bulrush. This species was not observed during the 2018 site visit (Olsson Associates 2019e).

Twelve species of plants have been identified by the Nebraska Department of Agriculture as noxious weeds present within the state (Nebraska Department of Agriculture 2022): Canada thistle, leafy spurge, musk thistle, plumeless thistle, purple loosestrife, spotted knapweed, saltcedar, phragmites, sericea lespedeza, Japanese knotweed, bohemian knotweed, and giant knotweed.

3.5.2 Environmental Consequences: Proposed Action

3.5.2.1 Environmental Commitments

Prior to WAPA's involvement, Thunderhead implemented the following measures to reduce vegetation impacts:

- All temporary surface-disturbed areas were restored to the approximate original contours, graded, and reseeded as needed to promote successful revegetation, provide for proper drainage, and prevent erosion. Areas to be restored were reseeded pursuant to landowner contracts. If seed mixtures were not specified in landowner contracts, reseeding used native vegetation as recommended by NRCS guidelines.
- A grassland mitigation plan was developed in coordination with the Nebraska Game and Parks Commission (NGPC) and USFWS. The plan, which is included as a part of Appendix B, included compensatory mitigation for 1,114 acres of surface disturbance of native, intact introduced, and fragmented introduced grasslands.

The following environmental commitments would be implemented to reduce potential impacts to vegetation resources from the Interconnection Project:

- Trees would not be cleared or removed within the project area between June 1 and July 31.
- Riparian areas would be avoided to the extent possible during O&M. In the event that maintenance is required in a riparian area, all standard erosion control environmental commitments would apply to all disturbance activities and disturbed areas (e.g., sediment traps, water barriers, erosion control matting, ground protection mats) as applicable to reduce erosion and protect water quality.
- Vehicle traffic would be restricted to designated roads; no off-road travel would be allowed except in emergency circumstances.
- Noxious weeds and unwanted volunteer trees may be controlled in all surface-disturbed areas using herbicides. All herbicide and pesticide mixing and application would be conducted in accordance with all federal, state, and local laws and regulations and the specific product's label. Herbicide and pesticide application would only be directly applied to localized spots and would not be applied by broadcasting techniques.

3.5.2.2 Direct and Indirect Impacts

All temporary surface-disturbed areas were restored to the approximate original contours, graded, and reseeded as needed to promote successful revegetation, provide for proper drainage, and prevent erosion. Areas to be restored were reseeded pursuant to landowner contracts. If seed mixtures were not specified in landowner contracts, reseeding used native vegetation as recommended by NRCS guidelines.

Impacts to vegetation from TWEC O&M activities and WAPA construction and commissioning activities would occur from potential spread of noxious weeds by vehicle use and trampling, compaction, and/or uprooting during O&M activities. This includes routine vegetation maintenance to periodically trim and/or remove trees and bushes that could interfere with Interconnection Project infrastructure and reduce the potential for wildfires. O&M activities would not require any new surface disturbance in previously undisturbed areas and all access would be on existing roads with no overland travel permitted.

3.5.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, any impacts related to maintenance of the TWEC under the Proposed Action would continue to occur under the No Action Alternative. Impacts from TWEC operations and WAPA construction and commissioning activities disclosed under the Proposed Action would not occur under the No Action Alternative, nor would it cause impacts associated with the placement of WAPA interconnection facilities.

3.6 WILDLIFE

3.6.1 Existing Conditions

Various baseline wildlife reports were completed prior to the TWEC siting and construction. These surveys encompass the project area being considered in this EA and are listed in Table 3-7. Survey areas varied in the baseline reports depending on species-specific survey requirements. Species-specific survey methods for the studies in Table 3-7 were developed and implemented in coordination with management agencies with jurisdictional authority or special expertise associated with those species.

Table 3-7. Previously Conducted Thunderhead Wind Energy Center General Wildlife Surveys

Surveys	Date
Avian use, Year 1 (Olsson Associates 2019a)	June 2016–May 2017
Avian use, Year 2 (Olsson Associates 2019b)	June 2017–May 2018
Bat acoustic monitoring (Olsson Associates (2018b)	June 1–November 15, 2016, and March 15–May 31, 2017
Grouse leks, Year 1 (Olsson Associates 2018a)	April 2017
Grouse leks, Year 2 (Olsson Associates 2019c)	April 2018
Raptor nest surveys, Year 1 (Olsson Associates 2017a)	April 2016
Raptor nest surveys, Year 2 (Olsson Associates 2017b)	March and April 2017
Raptor nest surveys, Year 3 (Olsson Associates 2019d)	April 2018

3.6.1.1 General Wildlife

The TWEC occurs in the Sandhills ecoregion, with a very small area of the southeastern portion located in the Tallgrass Prairie ecoregion (Chapman et al. 2001; Schneider et al. 2011). These two ecoregions are capable of supporting significant biodiversity, including birds, mammals, insects, reptiles, and amphibians. Representative avian species include sharp-tailed grouse, long-billed curlew, lark bunting, grasshopper sparrow, western meadowlark, mallard, and blue-wing teal. Representative mammal species include white-tailed jackrabbit, Ord's kangaroo rat, white-tailed deer, coyote, and bobcat (NGPC 2011). The project area is largely rural and agricultural with existing disturbance from both residential and industrial development, including the existing TWEC.

3.6.1.2 Raptors

Avian use studies were conducted for 2 consecutive years starting in June 2016 and concluding in May 2018. Large birds, including raptors, were tracked while in the survey area to document use and high use areas. Ten raptor species were documented within the survey area during large bird use surveys, including

American kestrel, bald eagle, broad-winged hawk, Cooper's hawk, merlin, northern harrier, prairie falcon, red-tailed hawk, rough-legged hawk, and Swainson's hawk. Red-tailed hawks were the most common species, followed by northern harrier (Olsson Associates 2019a, 2019b).

Six species of concern were observed over the course of avian use surveys. Bald eagle is a Tier II species, which is a species that is not globally imperiled, but is classified imperiled or vulnerable in the State of Nebraska (Schneider et al. 2011). Bald eagle is protected under the Bald and Golden Eagle Protection Act of 1940 (16 United States Code 668–668c). Thirty-four observations of bald eagle were recorded during surveys. The peregrine falcon is a Tier II species (Schneider et al. 2011), and one incidental observation was recorded. Merlin is a Tier II species (Schneider et al. 2011), and one observation was recorded during surveys. Prairie falcon is a Tier II species (Schneider et al. 2011), and one observation was recorded during surveys. The sharp-shinned hawk is a Tier II species (Schneider et al. 2011), and one incidental observation was recorded. Swainson's hawk is a Tier II species (Schneider et al. 2011). Seventeen Swainson's hawk observations were recorded during surveys (Olsson Associates 2019a, 2019b). No raptors that are Birds of Conservation Concern have the potential to occur in the analysis area (Information for Planning and Consultation [IPaC]; Appendix F).

Aerial and ground-based raptor nest surveys were conducted in spring 2016, 2017, and 2018 (Olsson Associates 2017a, 2017b, 2019d). The survey area for 2016 and 2017 varied based on the size of the initial potential project sites that ranged from 47,000 acres to 142,780 acres. The 2016 and 2017 survey areas for all raptor nests included an initial project area plus a 10-mile buffer for bald and golden eagle nests and a 2-mile buffer for all other raptor nests. The 2018 survey area included the project area (86,596 acres) plus a 10-mile buffer area for all raptor nests. The 2018 survey encompassed the areas previously surveyed in 2016 and 2017, and also included transects in areas not previously surveyed but within the potential impact areas for the final project. A total of 12 nests were documented within the survey area in 2016. Five of these nests were active bald eagle nests, two nests were active red-tailed hawk nests, two nests were unoccupied but with red-tailed hawks flying above them, and three nests were unoccupied non-eagle nests for an unknown species (Olsson Associates 2017a). A total of 18 nests were observed within the survey area in 2017, in which 10 nests were active bald eagle nests and five were active red-tailed hawk nests (Olsson Associates 2017b). The other three nests consisted of two unoccupied bald eagle nests and one non-eagle nest for an unknown species. A total of 45 nests were documented within the survey area in 2018, of which 14 nests were active bald eagle nests, 12 nests were active red-tailed hawk nests, one nest was an active great horned owl nest, three nests were unoccupied and/or inactive bald eagle nests, one nest was a bald eagle nest with unknown occupancy, one nest was an inactive red-tailed hawk nest, and 13 nests were non-eagle unknown species nests (Olsson Associates 2019d). The location of raptor nests was typically along riparian corridors, near water bodies, and in shelterbelts (Olsson Associates 2017a, 2017b, 2019d).

3.6.1.3 Birds

Birds using or traversing the project area are at risk of colliding with wind turbine blades or the gen-tie line. Additionally, noise and/or human presence during project operation has the potential to displace birds. Accordingly, avian use studies were conducted for 2 consecutive years starting in June 2016 and concluding in May 2018 to assess what kinds of birds utilize the area. Large birds documented during these surveys included waterbirds, waterfowl, owls, vultures, upland game birds, doves and pigeons, large corvids (e.g., ravens, magpies, and crows), among others; small bird types included passerines (songbirds), swifts and hummingbirds, and woodpeckers (Olsson Associates 2019a, 2019b).

Twenty-three large bird species were documented within the survey area, including sandhill crane, snow goose, Canada goose, greater prairie-chicken (GPC), and American crow. Most observations during the

spring and fall were attributed to migrating flocks of sandhill cranes in spring and Canada geese in fall (Olsson Associates 2019a, 2019b).

Forty small bird species were documented within the survey area. Representative species include European starling, house sparrow, western meadowlark, American robin, barn swallow, brown-headed cowbird, brown thrasher, dickcissel, eastern kingbird, grasshopper sparrow, horned lark, red-winged blackbird, and northern flicker.

Three species of concern were observed over the course of avian use surveys. Bell's vireo is a Tier II species (Schneider et al. 2011). Three observations were recorded of Bell's vireo. GPC is a Tier I species (Schneider et al. 2011). The GPC was observed 324 times during surveys. The sandhill crane is a Tier II species (Schneider et al. 2011). Eleven groups totaling 777 individuals were recorded during surveys (Olsson Associates 2019a, 2019b). Birds of Conservation Concern with the potential to occur in the analysis area include black tern, bobolink, chestnut-collared longspur, eastern whip-poor-will, Franklin's gull, lark bunting, lesser yellowlegs, marbled godwit, red-headed woodpecker, and willet (see IPaC in Appendix F).

Grouse lek surveys occurred in 2017 and 2018 to document GPC and sharp-tailed grouse leks within the survey area. In 2017, 54 GPC leks were recorded with attendance ranging from three to 54 individuals. In 2018, 23 GPC leks were observed with attendance ranging from three to 24 individuals. Leks were primarily observed in the west half and central portion of the survey area where larger, contiguous tracts of grassland/herbaceous land cover type was located. No sharp-tailed grouse leks were documented (Olsson Associates 2018a, 2019c).

All of the above-described birds use or traverse habitat in the project area and could potentially fly at an altitude where they would be at risk of being struck by either by operational wind rotors or by other associated infrastructure, such as the gen-tie line. Additionally, these species could be impacted by noise from facility operations. The relative level of these impacts is discussed in Section 3.6.2.2.2.

3.6.1.4 Bats

Suitable bat foraging habitat may exist along stream corridors or over water sources (Harvey et al. 1999). Little information is available on how bats use agricultural areas in the Midwest, although some bat species are known to forage over agricultural fields (Bat Conservation International, Inc. 2012). A study by Coleman and Barclay (2013) suggests foraging may be limited in agricultural areas with pesticide use and livestock grazing because of a reduction in insect availability. Bat roosting habitat may potentially exist in wooded areas and around farmsteads (Freeman et al. 1997).

The Elkhorn River is located approximately 3.5 miles north of the nearest turbine, measured from the northeast corner. Cache Creek, a tributary of the Elkhorn River, traverses the northwest corner of the project area from west to east. Clearwater Creek, a tributary of the Elkhorn River, traverses the central and north-central portions of the project area from west to east. Beaver Creek traverses the southwest corner of the project area from west to east (Olsson Associates 2018b). Wetlands identified by the National Land Cover Database (Homer et al. 2015) are dispersed throughout the project area and appear more numerous adjacent to Cache Creek, Clearwater Creek, Beaver Creek, and their drainages (Olsson Associates 2018b). Wooded areas are very limited within the project area, and those present are most commonly associated with these riparian corridors, shelterbelts, farmsteads, and fence or property lines (Olsson Associates 2018b). Potential habitat in the area includes woody wetlands, deciduous forest, evergreen forest, and emergent herbaceous wetlands (see Table 3-6; see Figure 3-2).

Bat species known to occur within the survey area based on acoustic survey results include big brown bat, silver-haired bat, hoary bat, evening bat, eastern red bat, and tri-colored bat (Benedict 2004; Humboldt State University Bat Lab 2011; Olsson Associates 2018b). Overall mean bat activity in the survey area was low compared to other sites within the Great Plains and Midwest regions (Hein et al. 2013; Olsson Associates 2018b).

3.6.2 Environmental Consequences: Proposed Action

3.6.2.1 Environmental Commitments

Prior to WAPA's involvement, Thunderhead implemented the following measures to reduce wildlife impacts:

- Bird flight diverters were installed on overhead transmission lines installed by Thunderhead within the TWEC footprint.

The following environmental commitments would be implemented to reduce potential impacts to wildlife resources from the Interconnection Project:

- All personnel would adhere to a speed limit of 25 mph while driving in the project area and would adhere to posted speed limits on public roads. If there were no posted speed limits, employees would operate vehicles in a manner consistent with typical public traffic on public roads.
- Ground lighting would be limited to the minimum required for O&M activities. This could include installing motion detectors or timers to turn on lights only when required to meet FAA lighting and other safety requirements.
- Yearly employee education regarding wildlife protection and reporting protocols would be conducted as described in Section 2.7.3.3 of the Bird and Bat Conservation Strategy (BBCS) (Appendix E).
- To avoid attracting eagles, O&M staff would work with landowners to remove domestic livestock carrion discovered on the TWEC's leased lands.
- Good housekeeping practices to remove waste would be followed.
- Turbines would be feathered from March 15 through November 1 (blades would be oriented parallel to wind) so blade movement would be reduced to 3 revolutions per minute (rpm) prior to winds reaching the turbine cut-in speed as discussed in Section 2.7.4 of the BBCS (see Appendix E).
- Monitoring and adaptive management methods described in Appendix A of the BBCS (see Appendix E of this EA), would be used, if necessary, to adjust turbine operational protocols (e.g., cut-in speeds and timing and duration of raised cut-in speeds) to avoid northern long-eared bat (NLEB) take over the life of the Interconnection Project.
- A Whooping Crane Contingency Plan included as Appendix B of the BBCS (see Appendix E of this EA) would be implemented to avoid and reduce collision risk to cranes.
- Bird and bat fatalities at the site would be monitored in accordance with Appendix A of the BBCS (see Appendix E of this EA) to verify the effectiveness of the avoidance and minimization strategies incorporated as part of the Interconnection Project.

- During O&M, TWEC personnel and/or contractors would conduct migratory bird nest searches in advance of O&M-related activities to prevent impacts to nesting birds to the extent that O&M activities overlap with the nesting season for ground-nesting birds, such as the piping plover (April 1 to August 1).

3.6.2.2 Direct and Indirect Impacts

3.6.2.2.1 GENERAL WILDLIFE

Interconnection Project facilities (e.g., turbines, power poles) could alter the way wildlife uses the habitat or displace individuals (BirdLife International 2003; Fernie and Reynolds 2005; Pruett et al. 2009; Sawyer et al. 2006; Steenhof et al. 1993). For example, power poles would provide perch sites for raptors and corvids, thereby increasing predatory levels on other wildlife (e.g., small mammals and domestic and game birds).

TWEC O&M activities, including turbine operations, use of vehicles, noise, and presence of workers could displace individuals into adjacent habitats. Additionally, the potential for direct general wildlife strikes by vehicles during O&M activities could occur. The response of wildlife to these disturbances would be variable and depend on the species, distance, and the type, intensity, and duration of the disturbance. Alteration of migration flyways or local flight paths to avoid wind facilities is considered a form of displacement (Drewitt and Langston 2006). It is likely that birds are already avoiding the nonoperating turbines; however, it is assumed that avoidance would increase upon initiation of operations when the turbines start to rotate. The actual distance from turbines at which displacement of birds could result would be species specific; studies have reported effects on some species at distances ranging from less than 328 feet to 1.9 miles (Strickland 2004). The USFWS (2012) indicated that possible effects on sensitive species may occur at distances greater than or equal to 1 mile from the center of a wind farm during periods of peak sound production. Recent research shows whooping cranes avoiding wind energy infrastructure by up to 3.1 miles when selecting stopover habitat (Pearse et al. 2021).

For species that occur within the project area and are adapted to the predominately fragmented agricultural landscape, such as American robin or red-tailed hawk, displacement or avoidance behaviors are anticipated to be, at most, temporary, as species become adapted to the new operational environment. For species that occur within the project area and are dependent upon contiguous blocks of habitat, such as GPC, impacts may include displacement from previously occupied habitat that was fragmented by the TWEC. This type of avoidance likely has already occurred as a result of the construction of existing infrastructure, and empirical studies have suggested that GPC are less sensitive to wind energy in comparison to other prairie grouse species when comparing preconstruction survival to postconstruction survival (Winder et al. 2013). However, displacement for such species may continue as a result of human activity and vehicle traffic associated with the Interconnection Project. Wildlife strikes from vehicles would be reduced by speed limit and other environmental commitments. In addition, general displacement of species could indirectly further reduce potential mortality caused by wind turbine rotor strikes or gen-tie line interactions.

3.6.2.2.2 RAPTORS AND OTHER BIRDS

The presence of lighting on some turbines might attract birds to the area and increase the potential for collision mortality at both the lit and unlit turbines (Johnson et al. 2002). Flashing (as opposed to steady-burning) red lights appear to be less attractive to birds (Gehring et al. 2009). Per the FAA's final marking and lighting plan, 104 turbines were required to have white paint and synchronized red lights, and four turbines required only white paint. FAA's final lighting plan specifies the use of flashing red lights to mark turbines, thus reducing effects on birds.

Generally, raptors are able to avoid wind turbines (Young et al. 2003). Factors that contribute to the risk potential for migrating raptors include species-specific migration patterns, migration timing, flight style, and topography (Brandes 2005; Kingsley and Whittam 2005). Some species may become more susceptible to turbine collisions because postconstruction conditions at a wind energy facility have increased prey abundance within the vicinity of turbines or associated infrastructure because prey species are drawn to the turbine bases for shelter and food (Illinois Department of Natural Resources 2007). Raptors become susceptible to collisions by looking downward for prey while failing to notice the turbine blades (Illinois Department of Natural Resources 2007). Landfowl birds (such as prairie chicken or grouse) do not generally comprise a high proportion of bird fatalities observed at wind energy projects. Landfowl birds often only fly high enough to clear the height of the existing vegetation; therefore, they do not tend to fly high enough to collide with turbines. Additionally, these birds often avoid habitat with turbines, which also decreases the risk of turbine strikes.

Songbirds (both resident and migratory species) are the most common group of birds killed at many wind energy projects (e.g., Erickson et al. 2004; Johnson et al. 2000; Johnson et al. 2002; Kerns and Kerlinger 2004), often making up more than 80% of reported fatalities (Erickson et al. 2001). On the basis of mortality estimates at existing wind energy projects, the midrange value expected for passerine mortality would be approximately 1.2 to 1.8 birds per turbine per year. This level of mortality may not have any population-level consequences for individual species because of the expected low fatality rates for most species and the high population sizes of the common species, such as European starling, American robin, horned lark, and western meadowlark (Kuvlesky et al. 2007; Young and Erickson 2003). Population effects may be possible for some species, especially rare species, such as Bell's vireo and peregrine falcon; however, no studies to date have documented population effects from turbine collision mortality.

The average numbers of total avian collision (passerines and all other birds) fatalities per turbine and per MW in the United States at the end of 2003 were estimated at 2.11 and 3.04, respectively. The project area lies within the Prairie region (American Wind Wildlife Institute 2019). Based on the results of 61 studies within this region, the median fatality rate was 1.5 birds/MW/year, ranging from 0.07 to 9.1/MW/year. From publicly available postconstruction monitoring data, the mortality per turbine/per year ranged from 1.34 to 12.38 birds per turbine/year (Olsson Associates 2021). Based on the results of postconstruction monitoring at similar facilities within the region of the Interconnection Project, bird mortality rates are expected to be within the range reported from studies at other wind facilities in the region. Using the mortality rates based on MW, the Proposed Action is estimated to potentially cause from 21 to 2,730 bird strike fatalities annually, with a median estimate of 450 bird strike fatalities annually. Over the 50-year life of the project operations, this results in an estimated potential of 1,050 to 136,500 total bird strike fatalities (with a median of 22,500 bird strike fatalities). By way of comparison, approximately 500,000 to 1 million birds are estimated to be killed by wind turbines annually throughout the United States (American Bird Conservancy 2020), whereas approximately 1 billion birds are killed annually by bird strikes with buildings and windows (Loss et al. 2014), and approximately 1.3 to 4.0 billion are killed annually by domestic cats (Loss et al. 2013).

Thunderhead has developed a BBCS consistent with the USFWS Land-Based Wind Energy Guidelines (USFWS 2012) and aspects of the 2013 Eagle Conservation Plan Guidance (USFWS 2013) to avoid and reduce potential impacts to birds from the TWEC (see Appendix E). As part of this conservation strategy, an adaptive management plan would be implemented to enable the incorporation of relevant new information into the TWEC's avoidance, minimization, and mitigation plan. Thunderhead would conduct postconstruction carcass monitoring during TWEC O&M to assess the effectiveness of the TWEC's avoidance and minimization measures. If the number of bird carcasses were greater than expected (see Sections 4.1.2 and 4.2.2 in the BBCS [see Appendix E]), Thunderhead would meet and confer with the USFWS, and any applicable actions agreed upon would be carried out to prevent long term impacts to bird populations. If a particular cause were able to be identified, Thunderhead would develop specific

avoidance, minimization, and/or mitigation measures in consultation with USFWS to address the occurrence (Olsson Associates 2021). This adaptive management plan would reduce the risk of continued collisions of birds with O&M activities.

WAPA construction and commissioning activities would not result in any new surface disturbance in undisturbed areas; however, the presence of two new structures would increase the potential for additional predation, collisions, or displacement through avoidance. This increased potential would be relatively low because of the low number of structures and would be mitigated through the use of bird diverters that adhere to APLIC recommendations. Thunderhead will not apply for a take permit for bald eagles for this project.

3.6.2.2.3 BATS

Relatively low numbers of bat fatalities are observed at most wind energy development projects. Bats most affected by wind facilities appear to be tree-roosting species during their fall migration (Arnett et al. 2008); fatalities increased with decreased distance to wetlands (Johnson, Young, et al. 2000) and increased exponentially with turbine height (Barclay et al. 2007). Actual levels of mortality could vary, however, depending on regional migratory patterns, patterns of local movements through the area, and the response of bats to different configurations of turbines (Young and Erickson 2003). Because long-term studies on bats have not been conducted, it cannot be assumed that population declines are not occurring at sites where bat collisions routinely occur (Kuvlesky et al. 2007).

The American Wind Wildlife Institute has summarized bat fatality data from 2005 through 2012 in their nationwide database collected at land-based wind energy facilities across the United States within regions as defined by USFWS (American Wind Wildlife Institute 2018). The project area lies within the Mountain Prairie region and based on the results of 27 studies within this region, the median fatality rate was 2.4 bats/MW/year, ranging from 0.2 to 19.0/MW/year. From publicly available postconstruction monitoring data, the mortality per turbine/per year ranged from 0.33 to 5.63 bats per turbine/per year (Olsson Associates 2021). Using the mortality rates based on MW, the project is estimated to potentially cause 60 to 5,700 bat strike fatalities annually, with a median estimate of 720 bat strike fatalities annually. Over the 50-year life of the project operations, this results in an estimated potential of from 3,000 to 285,000 total bat strike fatalities (with a median of 22,500 bat strike fatalities).

The BBCS includes measures to avoid and reduce potential impacts to bats from the TWEC (see Appendix E). As part of this conservation strategy, an adaptive management plan would be implemented to enable the incorporation of relevant new information into the TWEC's avoidance, minimization, and mitigation plan (see Sections 4.1.2 and 4.2.2 in the BBCS). This adaptive management plan would reduce the risk of continued collisions of bats with O&M activities. If the number of bat carcasses were greater than expected (see Sections 4.1.2 and 4.2.2 in the BBCS), Thunderhead would meet and confer with the USFWS, and any applicable actions agreed upon would be carried out to prevent long term impacts to bat populations.

3.6.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities remain in place but would not operate. Under this alternative, there would be no increased risk of mortality due to bird and bat strikes from rotor operation, and bird avoidance behaviors would remain the same as under current conditions. These facilities would still be actively maintained; therefore, avoidance due to human activity and risk of mortality due to vehicle collisions would be the same as those described under the Proposed Action.

3.7 THREATENED AND ENDANGERED SPECIES

3.7.1 Existing Conditions

The analysis area for threatened and endangered species (with the exception of NLEB [*Myotis septentrionalis*] and whooping crane [*Grus Americana*]) extends approximately 500 feet beyond all TWEC development. This analysis area provides a baseline of existing habitat conditions adjacent to TWEC infrastructure and connecting habitat located between dispersed facilities that may be used by species. Land cover types for the analysis area are provided in Section 3.5 (see Table 3-6; see Figure 3-2). The analysis areas for NLEB and whooping crane include additional areas that are described in the sections that follow. On December 20, 2021, the USFWS generated an official species list for the Interconnection Project through their IPaC system (see Appendix F). The list includes threatened, endangered, and candidate species for Antelope, Holt, and Wheeler Counties, Nebraska (Table 3-8).

WAPA initiated informal consultation under Section 7 of the Endangered Species Act (ESA) with the USFWS on March 2, 2022. The biological survey reports completed for TWEC siting and construction are applicable to the Interconnection Project because the location of the TWEC and interconnection activities are the same as previously analyzed (although via an interconnection to a different transmission line operated by a third party). The results of previous TWEC biological surveys resulted in consistent observations over multiple years and provide data and conclusions applicable to the Interconnection Project. As appropriate, those surveys are described in the sections that follow.

Table 3-8. Endangered Species Act–Listed Species for Antelope, Holt, and Wheeler Counties

Species (*Scientific name*)	Status
American burying beetle (*Nicrophorus americanus*)	Threatened
Northern long-eared bat (*Myotis septentrionalis*)	Threatened
Pallid sturgeon (*Scaphirhynchus albus*)	Endangered
Piping plover (*Charadrius melodus*)	Threatened
Western prairie fringed orchid (*Platanthera praeclara*)	Threatened
Whooping crane (*Grus americana*)	Endangered

Note: Based on adherence to the applicable requirements of the NLEB 4(d) rule, the O&M of the Interconnection Project (including the TWEC and associated commissioning activities) is consistent with the activities analyzed in the Programmatic Biological Opinion for the 4(d) rule (USFWS 2016).

To reduce potential impacts to all federally listed threatened or endangered species, Thunderhead implemented species-specific environmental commitments during TWEC siting and construction (see Appendix B).

3.7.1.1 American Burying Beetle

The American burying beetle (*Nicrophorus americanus*) (ABB) is known to historically occur in Holt and Wheeler Counties, which include the project area (Jurzenski et al. 2014). ABB is a carrion beetle, typically active at night, whose habitat selection behavior can change depending on soil, vegetation, and other resources, such as availability of carrion (decaying flesh of dead animals) in a region (Holloway et al. 1997).

In Nebraska, remnant ABB populations persist in Loess Canyon's biologically unique landscape and the Sandhills ecoregion (Bedick et al. 1999; Schneider et al. 2011), with the highest densities occurring in

Blaine County (Holloway et al. 1997), approximately 70 miles west of the Interconnection Project. Wet meadows and mixed-grass prairie are the preferred habitat types for ABB in the state. The species typically avoids areas with intense agriculture and development (Jurzenski et al. 2014; McPherron et al. 2012).

In June and August 2016, ABB trapping surveys were conducted in accordance with the USFWS protocol (Olsson Associates 2019g) under the presence and direction of an ESA Section 10(a)(1)(A)–permitted biologist (Dr. Wyatt Hoback) with experience with ABB in Nebraska. Per recovery permit requirements, Dr. Hoback contacted USFWS prior to conducting the ABB surveys, and the results were submitted to the USFWS with 2016 end-of-year recovery reports. Four ABB were captured at one trap location in "poor" habitat within the analysis area (124 feet from nearest existing infrastructure [access road]) (Olsson Associates 2019g). The ABB were all captured in June 2016 in poor habitat adjacent to an unharvested wheat field, and no additional ABB were captured (as summarized in Olsson Associates 2021). Results of the Jurzenski et al. (2014) study indicated that ABB probability of occurrence was positively correlated with the percentage of wet meadows within the surrounding landscape (0.5-mile radius) and negatively correlated with developed, woodland, and agricultural land cover.

ABB habitat in the analysis area was assessed prior to TWEC siting and construction (Olsson Associates 2019g). As part of this habitat assessment, "good" habitat was defined as grassland with native grassland species (tall or mixed-grass prairie) with forbs and/or low wetland meadows that are grazed by cattle or used for haying. "Poor" habitat was defined as areas consisting of cultivated cropland or similar land cover with the potential for large amounts of light pollution and disturbance associated with developed areas, while "marginal" habitat was defined as habitat restricted by cultivated cropland or dry, sandy, upland areas with exposed soil and scattered dry-adapted plants such as yucca (Olsson Associates 2019g).

The majority of potentially suitable ABB habitat in the analysis area is ranked poor quality (85%; 26,705 acres), with some fair habitat (8%; 2,443 acres) and some marginal habitat (7%; 2,290 acres). No good or prime habitat was identified in the analysis area (Olsson Associates 2019g). The impact of TWEC infrastructure by ABB habitat type is presented in Table 3-9. In accordance with environmental commitments, no infrastructure was sited in good habitat.

Table 3-9. Existing Infrastructure Impacts to American Burying Beetle Habitat

Categories	Sum of Acres
Access roads*	–
Marginal	43.76
Poor	1.51
Access roads subtotal	*45.27*
O&M facility	–
Poor	2.0
O&M facility subtotal	*2.0*
Turbines*	–
Marginal	0.10
Poor	5.14
Turbines subtotal	*5.24*
Gen-tie line	–
Poor	7.0

Categories	Sum of Acres
Gen-tie line subtotal	*7.0*
TWEC collector substation	–
Poor	1.8
TWEC collector substation subtotal	*1.8*
Total	**61.31**

* WAPA's commissioning work and portions of the existing TWEC infrastructure are outside of the ABB habitat assessment area (Olsson 2019g) and, therefore, are not accounted for in the table. These project components are in cultivated croplands, which represent poor quality habitat for ABB.

3.7.1.2 Northern Long-Eared Bat

The Interconnection Project is within the range of NLEB, and NLEB may occur within the project area. No known hibernacula (a site where bats hibernate over the winter) for winter habitat are located within 35 miles of the Interconnection Project. Suitable summer (maternity roosting and/or foraging) habitat for the NLEB consists of a wide variety of forested habitats where they roost, forage, and travel and may include some adjacent and interspersed non-forested habitat, such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures (USFWS 2016). Potential suitable summer (maternity roosting and/or foraging) habitat for NLEB in the vicinity of the project area includes the riparian corridors located along Clearwater Creek, Antelope Creek, and their drainages and the wooded areas connected to these riparian corridors. Interconnection Project infrastructure (specifically, one turbine) is located 0.19 mile away from the nearest potential suitable summer (maternity roosting and/or foraging) habitat (Olsson Associates 2018b). The high frequency calls identified during prior acoustic monitoring surveys were unlikely to be *Myotis* species based on visual comparison of identified high frequency calls and known *Myotis* reference calls (Olsson Associates 2018b).

3.7.1.3 Pallid Sturgeon

According to NGPC, the range of pallid sturgeon (*Scaphirhynchus albus*) in Nebraska is the Lower Platte and Missouri Rivers, approximately 51 miles southeast and 45 miles north of the Interconnection Project, respectively (Peters and Parham 2008). Although the project area includes perennial streams that connect to the Missouri River system, the perennial streams identified are unsuitable for pallid sturgeon (i.e., not identified as main channel, secondary channel, and channel border habitats). Further, pallid sturgeon were most recently identified in the Elkhorn River south of the project area near Snyder, Nebraska, approximately 43 miles southeast and downstream from the TWEC (USFWS 2012) and have not been identified further upstream (closer to the TWEC).

The pallid sturgeon has not been documented within the project area.

3.7.1.4 Piping Plover

In northeastern to eastern Nebraska, the piping plover (*Charadrius melodus*) nests along portions of the Missouri, Platte, Niobrara, Loup, and Elkhorn Rivers (University of Nebraska–Lincoln 2022). The Interconnection Project is located approximately 40 miles south of the Missouri River system floodplains. Further, the Interconnection Project is located 55 miles from the Platte River, 3 miles from the Elkhorn River, and 45 miles from the Loup River, and is outside the known breeding range for piping plover (Nebraska Natural Heritage Program [NNHP] 2022). Their preferred nesting habitat includes sparsely vegetated river sandbars, lakeshore housing developments, reservoirs, and sand and gravel mines.

Although identified by the USFWS IPaC as potentially occurring in the project area in northeastern to eastern Nebraska, piping plovers nest along portions of the Missouri, Platte, Niobrara, Elkhorn, and Loup Rivers (University of Nebraska–Lincoln 2022). No suitable nesting habitat for the piping plover exists in the project area, because the Interconnection Project is located approximately 40 miles south of the Missouri River system floodplains. Additionally, no large sand or gravel pits or lakes with shorelines are present in the project area (Olsson Associates 2021).

The piping plover is unlikely to occur within the project area.

3.7.1.5 Western Prairie Fringed Orchid

The WPFO (*Platanthera praeclara*) can generally be found in the Sandhills and Tallgrass Prairie ecoregions of Nebraska and populations are known to exist in Antelope, Holt, and Wheeler Counties (USFWS 2021). In eastern Nebraska, WPFO are typically found in upland prairies and loess soils. In central and northeastern Nebraska, WPFO occur in wet prairies and wet meadows. NNHP documented that the southern portion of the Interconnection Project (NNHP 2022) could be an area where the species was or is present. Field surveys identified emergent wetlands within the project area (Olsson Associates 2021).

The WPFO may occur within the project area. To address potential impacts to WPFO, Thunderhead implemented applicable species-specific environmental commitments during TWEC siting and construction (see Appendix B).

3.7.1.6 Whooping Crane

Whooping crane migration through Nebraska is typically from March through early May (spring) and late September through December (fall and winter). The Interconnection Project is located within the 95% band of the migration corridor, with the western edge of the project area overlapping with the 75% band (Pearse et al. 2015). The Interconnection Project is located approximately 85 miles northeast of the nearest designated critical habitat located in the Platte River Bottoms between Lexington and Denman, Nebraska.

No whooping cranes were observed during avian use surveys conducted June 2016 through May 2018, but groups of four to 500 sandhill cranes were observed flying over the survey area in 2017 and three groups totaling 80 sandhill cranes were observed flying over the survey area in 2018 (Olsson Associates 2021). Although these flocks of sandhill cranes could feasibly have contained some whooping cranes, all observations were of groups flying between 460 feet (0.09 mile) and 1,640 feet (0.31 mile) above the ground, and no on-the-ground use was observed. Among publicly available datasets, no whooping cranes have been observed within the project area (Cooperative Whooping Crane Tracking Project 2021; eBird 2021; Pearse et al. 2020). There was one observation located 3.1 miles southwest of the project area that included four adults foraging in a flooded corn field for 3 days during the 2019 spring migration period (Cooperative Whooping Crane Tracking Project 2021).

Habitat used by whooping crane during migration and winter includes marshes, shallow lakes, lagoons, salt flats, grain and stubble fields, and river sandbars. Preferred whooping crane stopovers are wetlands in level to moderately rolling terrain, away from human activity where low, sparse vegetation permits ease of movement and an open view (Kansas Department of Wildlife and Parks 2011). Areas characterized by wetland mosaics appear to provide the most suitable stopover habitat for whooping crane (USFWS 2009). In Nebraska, most stopover habitat for whooping crane consists of palustrine wetlands and riverine systems, with riverine systems being used much more commonly in Nebraska than in other states along the migration corridor (Austin and Richert 2005).

To assess potential suitable habitat for whooping crane, an analysis area was established that included all land within 3.1 miles of the Interconnection Project; this is supported by Pearse et al. (2021), who found that whooping cranes generally avoided wind turbines by 3.1 miles. Pearse et al. (2015) created whooping crane use intensity grids representing areas within the whooping crane migration corridor that identified low, core, and extended use based on whooping crane tracking information. Areas that had no whooping crane stopovers were identified as unoccupied. The Interconnection Project is not located in a low-use intensity location; however, portions of the larger analysis area to the west and south of the Interconnection Project are located in low-use intensity locations (Pearse et al. 2015). No core intensity cells are located within the Interconnection Project or the larger analysis area.

Whooping crane may occur within the analysis area from March through early May (spring) and late September through December (fall and winter). To reduce potential impacts to whooping crane, Thunderhead implemented applicable species-specific environmental commitments during TWEC siting and construction (see Appendix B).

3.7.2 Environmental Consequences: Proposed Action

3.7.2.1 Environmental Commitments

Based on initial discussions with the USFWS, a biological assessment has been prepared for the threatened and endangered species listed in Table 3-8. WAPA has made preliminary findings of effects for each federally listed species (discussed below). Environmental commitments for water resources (Section 3.2.2.1), vegetation (Section 3.5.2.1), and wildlife (Section 3.6.2.1) would apply for threatened and endangered species. Additionally, the following species-specific environmental commitments would be implemented:

- ABB
  - Personnel and/or contractors would adhere to a speed limit of 25 mph while driving in the project area and would adhere to posted speed limits on public roads to reduce collision with wildlife. This, in turn, would reduce the amount of carrion that could serve as attractants for ABB. In areas where there is no posted speed limit, employees would operate vehicles in a manner consistent with typical public traffic on public roads.
  - Ground lighting would be limited to the minimum required for O&M activities to reduce ABB being attracted to ground lighting. This would also include installing motion detectors or timers to turn on lights only when required to meet FAA lighting and other safety requirements.
  - Good housekeeping practices would be implemented to reduce the possibility of attracting ABB to infrastructure.
  - All mixing of herbicides and pesticides and their applications would be conducted in accordance with all federal, state, and local laws and regulations and in compliance with the specific product's label. Herbicide and pesticide application would be directly applied to a localized spot and would not be applied by broadcasting techniques, thus reducing the likelihood of incidentally impacting ABB.
  - All maintenance activities would occur within areas previously disturbed by construction; therefore, no new ground disturbance would be anticipated to occur during O&M of the Interconnection Project. Turbine maintenance would be typically performed "up-tower" (i.e., O&M personnel would climb the towers and perform maintenance within the tower or nacelle as well as access the towers using pick-up trucks, so no heavy equipment would be needed). In the unlikely event (may never occur) that a large crane is needed for maintenance,

vegetation would be cleared within an area previously disturbed during construction to provide for safe and efficient operation of the crane, but no soil disturbance would be necessary. Ground-disturbing activities may include occasional access to underground collection or communication lines.

- Carrion observed at any project facility would be removed on a regular basis to avoid attracting ABB to the Interconnection Project during their active season (April through September) (Panella 2013).

- NLEB
  - Personnel and/or contractors would not remove existing trees and vegetation beyond the previously disturbed corridor. If necessary, tree clearing would not occur during NLEB pup season (June 1–July 31).
  - Thunderhead would feather turbines from March 15 through November 1 (blades would be oriented parallel to wind) so blade movement would be reduced below 3 rpm prior to winds reaching the turbine cut-in-speed.
  - In accordance with the monitoring plan presented in the BBCS (see Appendix E), Thunderhead would monitor bat fatalities at the site to verify the effectiveness of the avoidance and minimization strategies and whether adjustments to turbine operational protocols (e.g., cut-in speeds, timing, and duration of raised cut-in speeds) would be necessary to avoid NLEB take over the life of the Interconnection Project while maximizing production of clean, renewable, electric power.
  - NLEB discovered on-site during regular construction and maintenance activities would be reported in accordance with the BBCS (see Appendix E).

- Piping plover
  - In accordance with the monitoring plan presented in the BBCS (see Appendix E), Thunderhead would monitor bird fatalities at the site to verify the effectiveness of the avoidance and minimization strategies incorporated as part of the Interconnection Project.
  - Personnel and/or contractors would conduct migratory bird nest searches in advance of O&M-related disturbances to prevent impacts to nesting birds to the extent that O&M activities overlap with the nesting season for ground-nesting birds, such as the piping plover (April 1 to August 1).
  - Personnel and/or contractors would avoid identified nests by observing an appropriate setback (i.e., 160 feet) for all O&M activities to the greatest extent possible (Cohen 2005). If complete avoidance of the buffered area during O&M is not possible, Thunderhead would monitor nests for disturbance during O&M activities.

- WPFO
  - All mixing of herbicides and pesticides and their applications would be conducted in accordance with all federal, state, and local laws and regulations and in compliance with the specific product's label. Herbicide and pesticide application would be directly applied to a localized spot and would not be applied by broadcasting techniques, to avoid incidental application to any potential nearby WPFO.
  - All maintenance activities would occur within areas previously disturbed by construction; therefore, no new ground disturbance would be anticipated to occur during O&M of the Interconnection Project. Turbine maintenance would be typically performed up-tower (i.e., O&M personnel would climb the towers and perform maintenance within the tower or nacelle as well as access the towers using pick-up trucks, so no heavy equipment would be needed). In the unlikely event (may never occur) that a large crane is needed for maintenance,

vegetation would be cleared within an area previously disturbed during construction to provide for safe and efficient operation of the crane, but no soil disturbance would be necessary. Ground-disturbing activities may include occasional access to underground collection or communication lines.

- Access roads would also be maintained as needed to prevent off-road detours caused by ruts or mud holes. All fuels and/or hazardous materials would be properly stored during transportation and at the job site.

- Whooping crane
  - Bird flight diverters consistent with APLIC standards would be placed on the top static wire of any new or upgraded overhead collector, distribution, and transmission line within 1 mile of suitable stopover habitat.
  - A Whooping Crane Contingency Plan would be implemented during the spring and fall migration periods for the life of the Interconnection Project (see Appendix B of the BBCS [see Appendix E of this EA]).

Participation in an environmental awareness training program would be required for all TWEC personnel and/or contractors working on-site. This program would train participants in the proper identification, response protocol, and reporting of sandhill and whooping cranes. Additionally, pamphlets or identification guides would be available to TWEC personnel and/or contractors while conducting work on-site during the migration seasons. All of the environmental training of O&M staff would be done via Microsoft Teams or another virtual platform by Thunderhead's in-house environmental team. This training would occur once a year. There is no requirement to report training to agencies; however, Thunderhead would keep records of the training.

3.7.2.2 Direct and Indirect Impacts

3.7.2.2.1 AMERICAN BURYING BEETLE

The Interconnection Project O&M activities would occur within poor and marginal habitats. Direct effects on ABB may occur as a result of O&M, such as exposure to herbicides and/or pesticides during vegetation management, to any individuals residing within the O&M area. These direct effects are discountable because the Interconnection Project facilities are sited in poor and marginal habitats that beetles are unlikely to occupy, and because of the required adherence to the environmental commitments for vegetation management and carrion removal, which would further reduce the likelihood of ABB being present in such habitat.

The indirect effects of vegetation management during O&M may result in degradation of existing habitat and/or habitat fragmentation; however, because this would occur only within poor and marginal habitats, which are unlikely to be utilized by the ABB, the impact to the species is discountable. Additionally, adherence to environmental commitments (see Section 3.7.2.1) would further reduce the likelihood of beetles being present in the poor and marginal habitats where O&M would occur. With implementation of the species-specific environmental commitments (see Appendix C and Section 3.7.2.1), and for the reasons described above, WAPA determined that the Interconnection Project may affect but is not likely to adversely affect the ABB.

3.7.2.2.2 NORTHERN LONG-EARED BAT

Thunderhead utilized the final NLEB 4(d) rule during TWEC siting and construction (81 *Federal Register* 1900). A Programmatic Biological Opinion was completed on the NLEB 4(d) rule, which addresses

activities excepted from "take" prohibitions applicable to the NLEB under the ESA (87 Statute 884, as amended; 16 United States Code 1531 et seq.). Based on adherence to the applicable requirements of the 4(d) rule, construction of the Interconnection Project was consistent with the activities analyzed in the Programmatic Biological Opinion (USFWS 2016; see also Appendix E of this EA).

Although some researchers speculate that hibernacula may exist in Nebraska, none have been documented (Koch 2013). NLEBs are thought to be present in the east half of Nebraska; however, not many records exist to substantiate this distribution (Benedict 2004). It is likely that hibernacula exist in Nebraska because the NLEB occurs within portions of forested floodplain along the Missouri River and Niobrara River and its tributaries. NLEBs were captured during mist net surveys along the Niobrara River in 2004 (Stantec Consulting Services 2014). Five of 14 acoustic survey stations at a wind farm in north-central Nebraska recorded NLEB calls within forested riparian corridors of tributaries of the Niobrara River in the summer of 2014 (Mattson et al. 2014). Because waterways do not provide continuous forested corridors across the UGP, NLEB use of the large areas of grassland and cropland is likely limited (Stantec Consulting Services 2014). Suitable summer (maternity roosting and/or foraging) habitat in the project area is limited to 1,290 acres of deciduous forest and woody wetlands (approximately 2.4% of the analysis area). Potential direct impacts could result from tree removal, collision mortality, or human disturbance. Indirect effects on NLEB as a result of the removal of suitable habitat is unanticipated because removal of trees, if necessary, would be completed outside of the NLEB pupping season (late May to early July). Because there are no known NLEB concentrations in the project area, displacement impacts would be extremely unlikely to occur. Therefore, impacts to NLEB caused by habitat fragmentation or displacement from Interconnection Project activities are discountable.

Based on best available science, the potential for NLEB collision with a turbine is expected to be low. Thunderhead would also implement a BBCS (see Appendix E) during the Interconnection Project to reduce direct impacts to bat species from collision, should they occur. Other TWEC layout modifications, such as siting of the TWEC infrastructure 1,000 feet away from potential summer (maternity roosting and/or foraging) habitat reduces the likelihood of collision. In addition to setbacks, turbines would be feathered (blades would be oriented parallel to the wind) from March 15 through November 1 so that blade movement would be reduced below 3 rpm prior to winds reaching the turbine cut-in-speed. This feathering of blades has been shown to lower impacts to bat species generally (Baerwald et al. 2009; Young et al. 2009). For these reasons, impacts to NLEB from turbine collision are discountable. Further, the adaptive management plan included in the BBCS provides the measures that would be taken if the NLEB is up-listed from "threatened" to "endangered" and if the 4(d) rule is withdrawn, as is currently proposed by the USFWS (87 *Federal Register* 16442) (see Appendix E).

The Interconnection Project may affect but is not likely to adversely affect the NLEB; however, any take that may occur as a result of the Interconnection Project is not currently prohibited under the ESA Section 4(d) rule adopted for this species at 50 CFR 17.40(o).

3.7.2.2.3 PALLID STURGEON

The Interconnection Project is outside the known range of the pallid sturgeon (Olsson Associates 2019e). No suitable habitat for the pallid sturgeon is located in the project area. Therefore, there is no anticipated risk of exposure to mortality, disruption, displacement, or habitat loss. WAPA determined that the Interconnection Project would have no effect on the pallid sturgeon.

3.7.2.2.4 PIPING PLOVER

The Interconnection Project is outside the known range of piping plover (Olsson Associates 2019e). Transient individuals are not expected to occur in the project area due to lack of suitable stopover and/or

nesting habitat. Therefore, there is no anticipated risk of exposure to collision mortality, disruption, displacement, or habitat loss. WAPA determined that the Interconnection Project would have no effect on the piping plover.

3.7.2.2.5 WESTERN PRAIRIE FRINGED ORCHID

Emergent wetland suitable habitat for the WPFO was identified in the southern portion of the project area; however, the Interconnection Project would not result in additional sedimentation or pollution to emergent wetlands that are potentially suitable habitat for WPFO. Although vegetation management during O&M may occur, adherence to environmental commitments, such as those for herbicide use, and avoidance by a minimum of 100 feet from emergent wetlands would remove the risk of indirect impact to WPFO. WAPA determined that the Interconnection Project would have no effect on the WPFO.

3.7.2.2.6 WHOOPING CRANE

Indirect effects on whooping cranes could result from degradation of existing habitat, loss of potentially suitable habitat, or whooping crane avoidance of the project area. An additional habitat assessment completed in 2022 suggests that the amount of suitable whooping crane stopover habitat that was impacted by O&M of the TWEC is small relative to the availability of similar habitat surrounding the Interconnection Project and within the whooping crane migration corridor (Sandstrom et al. 2022). Further, indirect effects on whooping crane suitable stopover habitat, such as those resulting from surface water runoff and deposition of eroded soils in wetland areas that may be suitable whooping crane stopover habitat, would be controlled by applicable environmental commitments and conservation measures described above.

There is potential that whooping cranes would avoid suitable habitat within the project area due to the presence of wind turbines. Pearse et al. (2021) found that whooping cranes generally avoided wind turbines by 3.1 miles. The additional habitat assessment completed in 2022 suggests that there are 291 acres of suitable whooping crane habitat within the Interconnection Project (Sandstrom et al. 2022). Similar and higher quality habitat exists immediately adjacent to the TWEC, where a whooping crane would likely be displaced (3.1–12.5 miles; 34,882 acres). In addition, suitable habitat located 3.1 to 12.5 miles from the TWEC is present at a relatively higher density than in the project area. Although the energetic cost and impacts to whooping crane survival and reproductive success associated with potential habitat avoidance are unknown, these are likely be insignificant and discountable given the proximity of the unaffected available stopover habitat immediately outside of the project area (34,882 acres located between 3.1–12.5 miles of the project area).

Based on best available science, the potential for whooping crane collision with a turbine is expected to be low (Pearse et al. 2021). Further, Thunderhead would implement a Whooping Crane Contingency Plan (see Appendix B of the BBCS [see Appendix E of this EA]) during the Interconnection Project. This plan includes training of TWEC personnel on whooping crane identification, as well as instructions for turbine shutdown upon observation of a whooping crane within 1 mile of a turbine within suitable habitat. The potential for whooping crane collision with Interconnection Project infrastructure would be further reduced by the placement of bird flight diverters on any new or upgraded overhead collector, distribution, and transmission line within 1 mile of suitable stopover habitat. Other TWEC layout modifications, such as siting of the gen-tie line away from potentially suitable wetland habitats and the exclusive use of underground collection lines, also reduce the risk for collision mortality. Monitoring and project speed limits would reduce the potential for collisions with personnel vehicles. For these reasons, impacts to whooping crane from collision are discountable.

Thunderhead implemented whooping crane–specific environmental commitments during TWEC siting and construction (see Appendix B). Further, as stated previously, Thunderhead has voluntarily prepared and would implement a Whooping Crane Contingency Plan (see Appendix B of the BBCS [see Appendix E of this EA]) for the Interconnection Project. WAPA has determined that the Interconnection Project may affect but is not likely to adversely affect whooping crane.

3.7.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, any impacts related to maintenance of the TWEC under the Proposed Action would continue to occur under the No Action Alternative. Impacts from TWEC operations and WAPA construction and commissioning activities disclosed under the Proposed Action would not occur under the No Action Alternative, nor would it cause impacts associated with the placement of WAPA interconnection facilities.

3.8 VISUAL RESOURCES

3.8.1 Existing Conditions

Visual resources refer to all objects (human-made and natural, moving and stationary) and features (e.g., land forms and water bodies) that are visible on a landscape. These resources can add to or detract from the scenic quality of the landscape or visual appeal of the landscape. A visual impact can be perceived by an individual or group as either positive or negative, depending on a variety of factors or conditions (e.g., personal experience, time of day, and weather or seasonal conditions).

The analysis area for visual resources is a 25-mile buffer around the project area. This analysis area is consistent with guidance from the UGP PEIS, which states that, assuming good visibility, a wind farm with wind turbines approximately 400 feet in overall height could be visible from approximately 25 miles or farther and could potentially cause large visual contrasts at distances less than 7 to 8 miles, and more moderate impacts up to approximately 15 miles, with smaller visual impacts beyond approximately 15 miles.

The analysis area is relatively flat and utilized for cultivated agriculture and grazing lands, which is consistent with WAPA's characterization of the UGP Region in the UGP PEIS. Existing structures include the TWEC, residences, six operational wind farms. existing transmission and distribution lines, roads, agricultural facilities (utilized for agriculture and cattle grazing), and irrigation structures (primarily pivot irrigation). The analysis area encompasses the towns of O'Neill (24 miles from project area), Orchard (12 miles from project area), Plainview (22 miles from project area), Albion (20 miles from project area), Neligh (2.5 miles from project area), Newman Grove (24 miles from project area), and Tilden (12 miles from project area). Travelers throughout the analysis area would include residential, local, or regional traffic along NE-70 and county roads. There are three parks (Pibel Lake State Recreation Area, Ashfall Fossil Beds State Historical Park, and Willow Creek State Recreation Area), 35 schools, and 54 churches within the analysis area. The project area includes 164 residences (56 participating landowners and 108 nonparticipating landowners), approximately 163 miles of existing county roads, and 24 miles of turbine access roads located on private lands. There are no parks and two churches within the project area.

The TWEC contains 108 wind turbines with a hub height of 295 feet, rotor diameter of up to 417 feet, and maximum blade tips of 499 feet. All turbines are painted white, and all but four turbines have synchronized red lights built into the towers. TWEC also includes a collector station, an O&M facility,

and a 2,045-foot-long gen-tie line connecting the TWEC collector station to the Holt County Substation (see Chapter 2 for more details). Downward-facing lights have been incorporated into the collector station and O&M facility as appropriate. The gen-tie line includes two 75-foot-hight three-pole structures and one 110-foot-high single steel monopole structure. All of these structures are currently visible from the receptors mentioned in the previous paragraph.

WAPA has consulted with tribal entities. To date, no visually sensitive locations of concern have been identified within the analysis area.

3.8.1.1 Shadow Flicker

Shadow flicker refers to the phenomenon that occurs when the moving blades of wind turbines cast moving shadows that cause a flickering effect. This can have a disorienting effect on a small segment of the general population. The distance between a wind turbine and a receptor is the main factor that determines whether the receptor would experience shadow flicker or not.

Shadow flicker impacts are not currently regulated in applicable federal, state, or Antelope, Holt, or Wheeler County law, but some jurisdictions elsewhere have adopted an industry standard of no more than 30 hours of shadow flicker per year, or no more than 30 minutes of shadow flicker on the worst day of the year. This standard is delivered from guidelines developed in Germany ("WEA-Schattenwurf-Hinweise" or "Guideline for Identification and Evaluation of the Optical Emissions from Wind Turbines") (Koppen et al. 2017). Antelope County requires that all nonparticipating residences be a minimum of 2,400 feet from turbine locations. Wheeler County requires that nonparticipating landowners be at least 2,640 feet from turbine locations. There are no turbines located in Holt County.

3.8.2 Environmental Consequences: Proposed Action

3.8.2.1 Environmental Commitments

Prior to WAPA's involvement, Thunderhead implemented the following measures to reduce visual impacts:

- Thunderhead selected general locations in which wind farms are not unusual or unique (there are six other wind farms nearby), selected a project site that does not include key recreational areas, and adjusted the locations of turbines to reduce visual impacts to an existing cultural landmark (a church and cemetery).

The following environmental commitments would be implemented to reduce potential impacts to visual resources from the Interconnection Project:

- Ground lighting would be limited to the minimum required for O&M activities. This could include installing motion detectors or timers to turn on lights only when required to meet FAA lighting and other safety requirements.
- There would be no commercial messaging on turbines.

3.8.2.2 Direct and Indirect Impacts

As stated in Section 3.8.1, the existing viewshed has many elements of visual contrast, including the presence of the existing TWEC and six other wind farms in the analysis area. Because the TWEC is existing (including operational FAA lighting), visual impacts would be related to operation of the wind farm, which involves the movement of the turbine blades, blade glinting, shadow flicker, and WAPA

construction and commissioning work. These operational impacts are described in the UGP PEIS and summarized below.

3.8.2.3 Visual Contrasts and Blade Glint

When the rotor blades on turbines are moving, the movement would tend to attract viewers' attention to a greater extent than when the blades are not moving (Gipe 1990, 2002; University of Newcastle 2002). Although blade movement would tend to increase turbine visibility and the associated visual impact at longer distances, some studies have indicated that the visual impacts of moving turbine blades are positive (National Research Council 2007; WIMP 1987, as cited in Gipe 1990), reportedly in part because idle turbines are perceived by some viewers to be nonproductive (Pasqualetti et al. 2002; Thayer 1988).

Sullivan et al. (2012) observed blade glint at a distance of approximately 16 miles. An International Finance Corporation report (2015) notes that glinting can also occur from wind turbine tower surfaces that are new and are not soiled through normal use. Glinting is not expected off TWEC structures because they are painted with low-reflectivity coating that reduces reflections off blades and towers.

Visual contrast from the existing facilities is highest within 8 miles of the project area. For viewers within this area, the large sweep of the moving rotors would tend to command visual attention; however, shadow flicker impacts from rotors moving during operations of the current TWEC would be apparent only within 4,300 feet of the rotors (see Section 3.8.2.4).

Neligh is the only town within 8 miles and, therefore, currently experiences high visual impacts from the existing TWEC. However, it is further than 4,300 feet away from the nearest turbine and would experience no shadow flicker impacts from proposed operations of the TWEC. The towns of Orchard and Tilden are within the 16-mile range and currently experience moderate visual impacts from the existing TWEC, but would experience no operational shadow-flicker impacts.

The parks and towns of O'Neill, Plainview, Albion, and Newman Grove are within the 25-mile range and currently experience low levels of visual impact from the existing TWEC. The additional contrasts associated with the operational movement of the turbine blades, and blade glint would result in negligible changes in visual contrast to these communities when compared to the existing viewshed, which includes existing operating wind farms to the north, south, and east (see Section 4.2). These towns would experience no shadow flicker impacts from operations of the TWEC.

The Interconnection Project would contribute minimally to any changes in sky glow, if at all, because turbine lighting is existing and other facility lighting is downward facing and would be operated only when needed, using motion detectors or timers.

WAPA construction and commissioning activities would have little to no impact to viewsheds because they would be located directly adjacent to existing elements of visual contrast (the Holt County Substation and WAPA transmission line structures) and would be consistent with the existing viewshed and landscape.

Detailed analysis of shadow flicker on residences within the project area is provided below.

3.8.2.4 Shadow Flicker

Shadow flicker impacts fall under two categories: health impacts associated with epileptic seizures, and aesthetic impacts associated with visual disturbance. Aesthetic impacts are highly subjective and can vary based on the number and types of viewers and their attitude towards wind power.

Regarding health impacts, modern day wind turbine blades typically rotate at approximately 20 rpm, resulting in the blade of a three-bladed turbine passing in front of the sun approximately 60 times per minute, or 1 Hz. The Epilepsy Foundation asserts that frequencies below 10 Hz are not likely to cause epileptic seizures (Nielsen 2003); therefore, shadow flicker from the Interconnection Project would not be expected to cause seizures because the frequency of a passing shadow would be too low to result in adverse health effects.

Regarding aesthetic impacts, Nielsen (2003) suggests that when turbines and receptors are separated by distances of 1,000 feet, shadow flicker potential exists only in a few hours after sunrise and before sunset. Shadow flicker is nonexistent during cloudy periods or when the blades are not rotating (Nielsen 2003). At longer turbine-receptor separation distances, the blade shadows become out of focus; although intensity does not diminish, the shadow becomes less noticeable. Studies have shown that shadow flicker impacts typically are significant only up to a distance of approximately 10 rotor diameters from the turbines (Parsons Brinckerhoff 2011).

Shadow flicker modeling completed for the Interconnection Project assessed potential shadow flicker impact levels for all receptors within 4,300 feet of TWEC turbines (equals 10 rotor diameters plus an extra 130-foot buffer) (Stantec 2022). There are 127 nonparticipating and 60 participating residences within 4,300 feet of TWEC turbines. The shadow flicker modeling results indicate that no residences in proximity to the TWEC would experience annual shadow flicker levels at or above 30 hours per year or 30 minutes a day. Most residences are well below these thresholds with the following results: 98 receptors expected to receive less than 10 hours of shadow flicker per year; 24 receptors expected to receive between 10 to 20 hours of shadow flicker per year; and four receptors anticipated to receive between 20 to 30 hours of shadow flicker per year. This equates to 83 receptors experiencing less than 10 minutes maximum per day; 41 receptors experiencing 10 to 20 minutes maximum of shadow flicker per day; and three receptors experiencing between 20 and 30 minutes daily (Stantec 2022). Therefore, none of the receptors within the 4,300 feet of TWEC turbines (10 rotor diameters plus an extra of 130 feet buffer) would experience annual shadow flicker levels at or above 30 hours per year or 30 minutes per day, the accepted industry-wide standard (Appendix H).

3.8.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing, lighted TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained. The No Action Alternative would have no new visual impacts.

3.9 CULTURAL RESOURCES

3.9.1 Existing Conditions

Cultural resources are objects or locations of human activity, occupation, or use, identifiable through field inventory, historical documentation, or oral evidence. These activities represent human social interaction and/or interaction with the natural or built environment. The term encompasses archaeological sites, historic buildings, structures, objects, and districts considered important to a culture, subculture, or community for scientific, traditional, religious, or other purposes, as well as specific areas of the landscape that are important to Native American tribes or other culturally recognizable groups (traditional cultural properties). Cultural resources are recognized as fragile and irreplaceable materials, places, and things with potential public and scientific uses.

The analysis area for cultural resources is a 1-mile area surrounding the Interconnection Project elements (see Chapter 2). This area is coincident with this undertaking's area of potential effects (APE). The current undertaking is subject to compliance with Section 106 of the National Historic Preservation Act (NHPA). Two prior cultural resources studies, dated 2018 and 2019, were not subject to the NHPA but were completed as part of Thunderhead's construction of the TWEC (a prior undertaking with no WAPA involvement). Because their analysis areas overlap with the currently proposed undertaking, the studies are helpful to describe the existing environment; therefore, their results are summarized below.

A Nebraska State Historical Society Master Archeological and Historic Site File review (Class I survey) was conducted in August 2018 (Parks 2018) and considered both archaeological sites and historic properties within the aboveground historic built environment, such as buildings and structures. The analysis area for the Class I survey overlaps with the entirety of this undertaking's APE. The Class I survey found no known or recorded archaeological sites within the analysis area. There were three prehistoric archaeological sites within the TWEC area adjacent to waterways. These recorded sites indicate that humans were active in the region prior to Euro-American settlement; however, because the current undertaking includes no ground disturbance aside from the gen-tie line and WAPA construction and commissioning activities, the Class I survey archaeology results are not applicable to the current undertaking.

The Class I survey also identified 11 the following historic properties within the analysis area:

- Eight farms that, based on a review of 2016 aerial imagery, no longer exist.
- One farm that exists that, based on a review of 2016 aerial imagery, has been physically compromised and lacks integrity.
- One abandoned schoolhouse that has been physically altered and repurposed as a residence.
- The Fairview Church and Cemetery, which has been determined eligible for the National Register of Historic Places under Criterion A as an early rural place of worship in Nebraska.

Two additional historic properties outside of the analysis area and APE but within the TWEC area were also identified via the Class I survey. These consist of one farm that, based on 2016 aerial imagery, no longer exists and one farm that does exist but has been physically compromised and may lack integrity. Thunderhead also adjusted the locations of turbines to reduce visual impacts to the Fairview Church and Cemetery, the only historic property identified that is still extant and retaining integrity (Parks 2018). In 2022, the Nebraska State Historic Preservation Office (SHPO) concurred with the determination that visual and auditory effects on the Fairview Church and Cemetery would exist at a non-significant level (Appendix I).

In 2019, Thunderhead completed a Class I survey, pedestrian survey, and shovel testing (Class III) on state-owned land parcels within the APE, as required by Nebraska's Archaeological Resources Protection Act (82:501–510) requirements for state lands administered by the Nebraska Board of Educational Lands and Funds (Weston 2019).

The cultural resources surveys found no cultural materials on the state-owned parcels. Thunderhead, as part of their prior undertaking, made a recommendation of no historic properties affected on state lands. The Nebraska SHPO concurred with this recommendation on October 28, 2019.

In July 2016, WAPA completed a cultural resources survey of a 9.1-acre APE within WAPA's ROW for an interconnection between its Grand Island-Fort Thompson 345-kV transmission line and NPPD's Holt County Substation. No historic properties were recorded within the APE. This report was reviewed by the Nebraska SHPO, which concurred with WAPA's determination of "no historic properties affected" (see

Appendix I). WAPA has consulted with tribal entities as part of this NEPA process. To date, no cultural resources of concern, such as traditional cultural properties, have been identified.

3.9.2 Environmental Consequences: Proposed Action

3.9.2.1 Environmental Commitments

The following environmental commitments would be implemented to reduce potential impacts to cultural resources from the Interconnection Project:

- Thunderhead has established and implemented unanticipated find provisions so that all site personnel are aware and understand procedures for unanticipated finds. This includes work stoppage and notification requirements. If a discovery were to occur and was determined eligible for the National Register of Historic Places, Thunderhead would consult with WAPA, the Nebraska SHPO, and applicable consulting parties on the need for further testing and/or data recovery.
- Erosion-related and visual resource–related environmental commitments would be implemented as discussed in Sections 3.2.2 and 3.8.2, respectively.

3.9.2.2 Direct and Indirect Impacts

In compliance with Section 106 of the NHPA, WAPA has completed its obligations to take into account potential effects on cultural resources as a result of this proposed undertaking.

The Interconnection Project could indirectly impact the Fairview Church and Cemetery, a historic property. The turbines for the TWEC are already in place, and the added impact of the rotor blades spinning as part of operations would have audible and visual impacts (see Appendix D and Appendix H). Noise and visual impacts are discussed in Sections 3.4.2 and 3.8.2, respectively). No traditional cultural properties were identified via government-to-government consultation between WAPA, the Nebraska SHPO, and tribal entities and, thus, no direct or indirect impacts to traditional cultural properties are expected.

The current undertaking only includes O&M of the TWEC. Thus, any visual and auditory effects resulting from the past construction of the TWEC are not considered. However, potential visual and audible effects of rotating turbine blades on historic properties may change as a result of operation. The UGP PEIS considers visual effects of rotating blades as measured by shadow flicker. It suggests that when turbine and receptor are separated by 1,000 feet or more, potential shadow flicker effects exist for a few hours after sunrise and before sunset. The nearest turbine to the Fairview Church and Cemetery is 2,700 feet away. A shadow flicker analysis has identified that this property would experience no more than 10 minutes of shadow flicker per day (Stantec 2022). Thus, visual effects on the historic property as measured by shadow flicker would be transitory and non-significant due to the low frequency of passing shadow and the low amount of time of when potential shadow flicker could occur.

A noise analysis completed for the prior undertaking is relevant to potential audible effects for the present undertaking. The noise study predicted that wind turbine noise levels for the entire TWEC would range from 28 to 47.1 dBA (Hankard Environmental 2019a, 2019b). The predicted maximum noise level for the Fairview Church and Cemetery (Receptor No. 119, Hankard Environmental 2019:Appendix B) is 46.9 dBA. This level of operational noise is akin to faint/very quiet (similar to a broadcasting/recording studio or quiet bedroom environment) up to moderate quiet (similar to a residential air conditional at 50 feet)

levels, and is consistent with ambient noise levels of rural and undeveloped areas (33–47 dBA) such as the project area.

The Interconnection Project could directly impact unknown archaeological and built environment historic properties through ground-disturbing activities, such as pedestrian and heavy equipment or vehicular traffic. Implementation of environmental commitments (see Section 3.9.2.1) would reduce potential impacts to such historic properties if encountered. O&M of the TWEC would not require any new surface disturbance in undisturbed areas and, therefore, would not impact historic properties.

Based on these analyses, WAPA determined that the Interconnection Project would have no adverse effect on historic properties, and subsequently consulted with the Nebraska SHPO regarding this determination (see Appendix I). On February 25, 2022, the Nebraska SHPO concurred with WAPA's determination of effect (see Appendix I).

3.9.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained. As with the Proposed Action, maintenance activities would occur in previously disturbed ground where no known archaeological or historic properties are located and thus, no direct impacts are expected. There is potential for unknown resources, but implementation of environmental commitments, including Thunderhead's unanticipated discovery protocol, would reduce potential impacts to such historic properties if encountered.

3.10 LAND USE AND PUBLIC FACILITIES

3.10.1 Existing Conditions

The analysis area for land use and public facilities extends approximately 500 feet beyond all TWEC development. This analysis area provides a baseline of existing land uses and public facilities adjacent to TWEC infrastructure and areas between dispersed facilities. The analysis area is rural and agricultural, with interspersed residential areas and commercial operations such as the TWEC. The analysis area is located primarily on privately owned lands, with the exception of approximately 2,767 acres of state lands administered by the Nebraska Board of Educational Lands and Funds, all within Antelope, Holt, and Wheeler Counties.

Of the three counties, only Antelope has a comprehensive plan (amended 2012). One of the objectives of the Antelope County Comprehensive Plan is to provide basic land use conflict and liability protection for residential and agricultural uses by avoiding development of new lands that would result in additional conflicts. Commercial and industrial uses are encouraged to develop along the major highway corridors of the county to reduce land use conflicts and public costs of associated with providing public services, services, and utilities to support these uses (Antelope County 2012). Antelope and Wheeler Counties approved CUPs for TWEC in 2018 and 2019, respectively.

Land use within the analysis area is primarily agricultural (growing crops and/or cattle grazing occurring on approximately 32,105 acres or 61% of the analysis area), or open, undeveloped lands like grasslands, shrublands, and woodlands. Grasslands and herbaceous cover make up approximately 15,585 acres or 30% of the analysis area. Additional information on vegetation and land cover within the analysis area is provided in Section 3.5. The other major land use in the analysis area is developed infrastructure, such as roads, utilities, and the equipment associated with the TWEC. The TWEC consists of nonoperating turbines, access roads, underground collection system, substations, an O&M facility, and gen-tie line.

Power is supplied by Elkhorn Rural Public Power District, water is supplied by a private well, and sewage is disposed of with on-site septic tanks.

The Interconnection Project is 2 miles west of Elgin, 2.5 miles west of Neligh, and 2.75 miles southwest of Clearwater. These communities are very small, with Elgin having the largest population of approximately 1,600, and Neligh and Clearwater both containing populations of under 800 (U.S. Census Bureau 2021). Public and community facilities are located within these jurisdictions and include schools and parks. NE-70 bisects the southern portion of the project area running east–west. County roads run through the project area from east–west and north–south. Annual average daily traffic (AADT) for NE-70 was a total of 1,390 in 2018. Of the total AADT, truck AADT was 225 (Nebraska Department of Transportation 2021). The Interconnection Project can be accessed from all directions. There are no airports, private airstrips, or private helipads within the project area. The closest airport is Antelope County Airport, located 2.7 miles east of the project area and south of Neligh. The Vandersnick private airstrip is located approximately 4.25 miles west of the Interconnection Project and the Landgren Ranch private airstrip is located 8 miles to the west off of NE-70.

3.10.2 Environmental Consequences: Proposed Action

3.10.2.1 Environmental Commitments

The following environmental commitments would be implemented to reduce potential impacts to land use and public facilities from the Interconnection Project:

- All use of public roads would be conducted in compliance with county road use agreements and county permits.
- Routine road maintenance of county roads within the site would be the responsibility of the county; however, Thunderhead would be liable for any road damage caused by O&M work on the wind farm.

3.10.2.2 Direct and Indirect Impacts

TWEC O&M activities and WAPA construction and commissioning activities would result in no new surface disturbance in undisturbed areas and there would be no changes to land use in the project area. CUPs have been issued for the TWEC for Antelope and Wheeler Counties that document that the TWEC is consistent with county plans and is compliant with county regulations.

O&M traffic would occur on existing roads and existing turbine access roads. The addition of approximately 12 personal vehicles and seven work trucks to existing traffic would not cause impacts to traffic and existing roadway uses. Each county would continue maintenance on existing county roads; however, Thunderhead would be responsible for any road damage caused by maintenance or warranty work on the TWEC facilities.

FAA lighting has been installed on the TWEC and the FAA issued no hazard determinations. There would be no impact to commercial air traffic from the Interconnection Project.

3.10.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. These facilities would still be actively maintained; therefore, the No Action Alternative would

result in the same impacts to traffic, as described in Section 3.10.2.2. There would be no impacts to land use or other public utilities.

3.11 SOCIOECONOMICS

3.11.1 Existing Conditions

The Interconnection Project is located in Antelope, Holt, and Wheeler Counties, Nebraska. Because socioeconomic data are typically available at the county level, the analysis area for socioeconomics includes all three counties, as well as a comparison to the state of Nebraska as a means of providing context.

The UGP PEIS describes 10 key measures of economic development: employment, unemployment, personal income, state sales and income tax revenues, population, vacant rental housing, state and local government expenditures and employment, and recreation. Table 3-10 lists these key measures of economic development, with the exception of state income tax because Nebraska does not collect income tax. Data are reported for Antelope, Holt, and Wheeler Counties and Nebraska for the most recent year available.

As can be seen in Table 3-10, median income in 2019 in Antelope, Holt, and Wheeler Counties was slightly lower than the median income in the state (Headwaters Economics 2021a–c). The 2020 unemployment rate in Antelope, Holt, and Wheeler Counties (2.3, 2.4, and 1.8%, respectively) was also lower than that of the state of Nebraska (4.2%) (Nebraska Department of Labor 2022).

Table 3-10. Key Measures of Economic Development

Economic Development Measures (Year)	Antelope County	Holt County	Wheeler County	Nebraska
Employment (2020)	3,821	5,590	540	991,388
Unemployment rate (2020)	2.3%	2.4%	1.8%	4.2%
Median household income (2019)	$49,912	$60,387	$51,591	$61,439
State sales tax revenue (2020)	$2,122,642	$5,955,688	$192,244	$1,941,020,418
Population (2019)	6,341	10,177	783	1,914,571
Rental vacancy rate (2019)	1.1%	2.2%	0.0%	1.8%
State and local government expenditures (2020)	N/A	N/A	N/A	$18,371,873
State and local government employment (2020)	N/A	N/A	N/A	112,115 full time; 42,136 part time
State recreation sector income (2007)	N/A	N/A	N/A	$2.2 billion

Sources: Bureau of Economic Analysis (2021); Headwaters Economics (2021a–c); Nebraska Department of Labor (2022); Nebraska Department of Revenue (2021); U.S. Census Bureau (2021).

Note: N/A = not available.

3.11.2 Environmental Consequences: Proposed Action

3.11.2.1 Environmental Commitments

There are no socioeconomic-specific environmental commitments.

3.11.2.2 Direct and Indirect Impacts

The Interconnection Project would generate approximately $94.3 million in direct economic benefits for local landowners, new local employees, local communities, and the State of Nebraska over the 50-year life of the TWEC, as outlined in Table 3-11. Additional benefits not shown in the table may include local spending on O&M needs such as automotive repair, tires, and gas and general office supplies; however, due to the small number of employees (12), there would likely only be a nominal effect on local businesses.

Table 3-11. Direct Economic Benefit from the Thunderhead Wind Energy Center

Payment	Direct Beneficiary	Approximate Total
Wind lease payments	Interconnection Project landowners	$729,000 per year
O&M	12 full-time employees	$615,000 per year
Taxes	Townships, counties, school districts, and the State of Nebraska	$1,350,000 per year

The estimated number of O&M jobs and their salaries are listed in Table 3-12. Although the salary of some of the workers is less than the median household income in Antelope, Holt, and Wheeler Counties, the small number of workers would not have a material effect on overall county median household income. Similarly, this small number of workers would not meaningfully affect rental vacancy levels, employment/unemployment rate, state sales tax revenue, population, state and local government expenditures, state and local government employment, or state recreation sector income.

Table 3-12. Anticipated Operations and Maintenance Jobs and Salary

Job Classification	Number of Positions	Estimated Annual Salary
Turbine technicians	10	$45,000 per technician
On-site manager	1	$100,000
Administrative assistant	1	$65,000
Total	**12**	**$615,000**

Section 5.10 of the UGP PEIS discusses potential impacts to property values from wind farm projects. Lawrence Berkeley National Laboratory conducted research regarding utility-scale wind energy development's property value effects and produced the seminal work with the largest dataset (Hoen et al. 2009; Hoen et al. 2013).

The Lawrence Berkeley National Laboratory authors collected data on almost 7,500 sales of single-family homes situated within 10 miles of 24 existing wind facilities in nine U.S. states. The analysis finds that if property value impacts exist, they are too small and/or too infrequent to result in any widespread, statistically observable impact, although the possibility that individual homes or small numbers of homes have been or could be negatively impacted cannot be dismissed.

Another study also found "no unique impact on the rate of home sales near wind turbines." The study did find a negative impact to property values near things such as major roads and electricity transmission lines (Hoen and Atkinson-Palombo 2016).

Electricity transmission lines associated with the TWEC facility may have affected property values through the visibility of electrical transmission structures. Other factors, such as health and safety and noise associated with a transmission system, are likely less important in terms of property values (WAPA and USFWS:5-233–236). In a review of the evidence from sales data and interviews with real estate professionals (Grover, Elliot, and Company 2005; Kroll and Priestley 1992), it was found that price differentials for residential properties based on sales data in appraisal studies tended to be small, usually 5% or less, with slightly larger price impacts for agricultural, commercial, and industrial land. It is anticipated that the Interconnection Project would have similar impacts to property value as these studies indicate.

3.11.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate; however, these facilities would still be actively maintained. Therefore, under this alternative, the wind lease payments would still be made and applicable property tax and sales and use tax would continue to be paid. The six employees that are currently maintaining the site would continue to be employed in that capacity.

3.12 ENVIRONMENTAL JUSTICE

3.12.1 Affected Environment

Environmental justice refers to the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, implementation, and enforcement of environmental laws, regulations, programs, and policies (Council on Environmental Quality [CEQ] 1997). Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* requires federal agencies to determine if proposed actions would have disproportionately high and adverse environmental impacts to minority, low-income, and American Indian populations of concern. The UGP PEIS provides direction on how to fulfill agency responsibilities for Executive Order 12898 for wind energy projects such as the TWEC.

The CEQ has developed guidance to assist federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed. The guidance focuses on identifying communities of concern (e.g., minority and low-income populations) using census data. Low-income populations are defined as those living below the poverty threshold (Federal Interagency Working Group on Environmental Justice and NEPA Committee 2016), as identified by the U.S. Census Bureau. Minority populations include the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (CEQ 1997). A minority or low-income population is identified as a community of concern if either 1) the minority or low-income population of the area of analysis exceeds 50% of the population, or 2) the minority or low-income population percentage of the area of analysis is meaningfully greater than the minority or low-income population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997:25). A minority population also exists “if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds” (CEQ 1997:26). The UGP PEIS defines “meaningfully greater” as 20 percentage points above the population size of the comparison geography.

The Interconnection Project is located in Antelope, Holt, and Wheeler Counties, Nebraska. Because socioeconomic and census data are typically available at the county level, population data for these counties are used as the analysis area for identifying communities of concern. The state of Nebraska is

then used as a comparison population for determining whether low-income or minority populations in Antelope, Holt, and Wheeler Counties exceed the thresholds described above for consideration as communities of concern (Table 3-13).

The percentages of minority and low-income populations within the analysis area do not exceed 50%, nor do they exceed the state levels by greater than 20 percentage points. The nearest known community of concern is located approximately 41 miles north of the TWEC. Therefore, this analysis has determined that there are no communities of concern present in the tri-county analysis area.

Table 3-13. Minority and Low-Income Populations in the Analysis Area

	Antelope County	Holt County	Wheeler County	Nebraska
Total population	6,341	10,177	783	1,914,571
Minority Populations	**Percentage of Minority Populations in Analysis Area**			
Hispanic or Latino (of any race)*	3.3	4.9	2.6	10.9
Black or African American – one race	1.0	0.1	0.0	4.8
American Indian and Alaska Native – one race	0.1	0.6	0.0	0.9
Asian – one race	0.2	0.6	0.3	2.4
Native Hawaiian and Other Pacific Islander – one race	0.0	0.0	0.0	0.1
Some other race – one race	1.0	0.2	0.4	2.1
Two or more races	0.4	0.8	0.3	2.6
Total minority population†	2.7	11.6	0.9	12.9
Poverty Prevalence	**Percentage of Population Below Poverty Line in Analysis Area**			
All individuals below poverty line‡	11.1	7.8	13.2	11.1
Families below poverty line	8.1	5.1	9.0	7.2

Source: Headwaters Economics (2021a–c).

* Hispanic refers to ethnicity and is derived from the total population, not as a separate race; i.e., it is calculated differently than the other columns in this table. Therefore, it is considered separately in this analysis.

† Total minority population reflects the total population minus the white alone population as found in Headwaters Economics (2021a–c).

‡ All individuals includes those below the poverty line, regardless of whether they are included as such due to being below the individual income or family income poverty line.

3.12.2 Environmental Consequences: Proposed Action

3.12.2.1 Environmental Commitments

There are no environmental justice–specific environmental commitments.

3.12.2.2 Direct and Indirect Impacts

No communities of concern have been identified in the analysis area; thus, no disproportionately high and adverse human health or environmental effects are expected from TWEC O&M activities or WAPA construction and commissioning activities.

3.12.3 Environmental Consequences: No Action Alternative

No communities of concern have been identified in the project area, and thus, no disproportionately high and adverse human health or environmental effects are expected from TWEC O&M activities or WAPA construction and commissioning activities.

3.13 HEALTH AND SAFETY

3.13.1 Existing Conditions

The following section describes electric and magnetic fields (EMFs) and other hazards in the project area. WAPA has defined the analysis area for health and safety resources as the project area (see Figure 1-1).

3.13.1.1 Electric and Magnetic Fields

EMFs are invisible fields of energy associated with the use of electrical power. Natural and human-made sources of EMFs are commonplace in the United States. Human-made sources of EMFs within the analysis area include the existing WAPA transmission line, Elkhorn Rural Public Power District power lines, as well as ordinary household appliances such as hairdryers, electric shavers, computers, wireless networks, cell phones, microwaves, and remote controls.

Because EMFs are vector quantities, they have a strength and a specific direction and become weaker with distance from the source. Typical EMF levels for a 500-kV power transmission line (such as the existing WAPA line) with a typical line load are: 86.7 Milligauss (mG) at the source, 29.4 mG at 65 feet, 1.6 mG at 100 feet and 3.2 mG at 200 feet. At a distance of 300 feet, EMF is similar to typical background levels found in most homes (National Institute of Environmental Health Sciences and National Institutes of Health 2002).

Potential health effects from EMF have been extensively studied. The studies found a weak link between EMF exposure exposures greater than 3 mG and a slightly increased risk of childhood leukemia. Studies that have been conducted on adults show no evidence of a link between EMF exposure and adult cancers, such as leukemia, brain cancer, and breast cancer (National Institute of Environmental Health Sciences and National Institutes of Health 2002).

There are currently no federal regulations on maximum EMF intensity; two states (New York and Florida) set standards for transmission line magnetic fields ranging from 150 to 150 mG at the edge of the transmission line ROW (National Institute of Environmental Health Sciences and National Institutes of Health 2002). The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a publicly funded, non-governmental organization recognized by the World Health Organization, evaluates scientific peer-reviewed literature on health effects from EMF exposure and regularly issues recommended exposure limits based on well-known biological and health effects of exposure to high levels of EMF. ICNIRP 1998 Guidelines for EMF exposure at 60 Hz are 4,200 mG for occupational exposure and 833 mG for general public exposure (National Institute of Environmental Health Sciences and National Institutes of Health 2002).

3.13.1.2 Ice

Ice building up on a wind turbine blade and being thrown off can present a safety hazard. Available data suggest that many factors determine what happens to ice that is thrown from a wind turbine blade. In most instances, ice pieces simply fall from the blade and land on the ground near the base of the tower as the

air temperature warms; however, large ice pieces have been found hundreds of feet from the tower base (Tetra Tech 2007; Wahl and Giguere 2006). Ice throw can cause injures to people and damage to buildings.

3.13.1.3 Communications

There are no existing commercial or public safety communication towers within 2 miles of the TWEC (Antelope County Commissioners 2018; Wheeler County Board of Commissioners 2019).

3.13.1.4 Aviation Safety

Wind farms can be hazardous to aviation as they contain tall structures with the potential to come into conflict with low-flying aircraft. There are three airstrips located near the project area: the Antelope County Airport, located 2.7 miles east of the project area and south of Neligh; a private airstrip located approximately 4.25 miles west of the project area; and a private airstrip located 8 miles to the west off of NE-70.

The FAA guidelines in 14 CFR 77 for the marking and lighting of wind farms require lights that flash white during the day and at twilight and red at night (FAA 2015); terrain, weather, and other location factors allow for adjustments to the manner in which FAA requirements are applied. Wind farm developers are required to file a notice with the FAA for any construction that could present an obstruction to air navigation due to height and/or location relative to airports. Thunderhead filed a notice with the FAA for the TWEC and no hazard determinations for each turbine were issued by the FAA. Per the conditions contained in each determination, 104 turbines were painted white and have synchronized red lights, and the remaining four turbines were painted white with no synchronized red lights.

3.13.1.5 Fires

Fires have started at wind farm facilities for a variety of reasons, such as electrical shorts, insufficient equipment maintenance, contact with power lines, and lightning. Increased human activity also increases the potential for fires. The International Electrotechnical Commission (IEC) requires that the design of electrical systems for wind turbine generating systems comply with relevant IEC standards.

3.13.1.6 Intentional Destructive Acts

Transmission line projects may be targeted by intentional destructive acts ranging from vandalism and theft to sabotage and acts of terrorism. Vandalism and theft are far more likely for projects in remote areas that serve relatively small populations. Intentional sabotage or terrorist acts would be expected to target much larger electrical facilities, where a loss of service would have substantial regional impacts.

Theft is most likely to involve substation and switchyard equipment that contains salvageable metal (e.g., copper and aluminum) when metal prices are high. Vandalism, on the other hand, is more likely to take place in remote areas and perhaps more likely to involve acts of opportunity (e.g., shooting out transmission line insulators) than premeditated acts.

3.13.2 Environmental Consequences: Proposed Action

3.13.2.1 Environmental Commitments

Prior to WAPA's involvement, Thunderhead implemented the following measures to reduce health and safety impacts:

- As required by and documented in the Antelope and Wheeler CUPs, Thunderhead analyzed commercial and public communication in the area, and the turbine locations were adjusted so that they would not interfere with any existing commercial or public safety communication towers within 2 miles of the TWEC (Antelope County Commissioners 2018; Wheeler County Board of Commissioners 2019).
- Thunderhead filed a notice with the FAA for the TWEC and received determinations of no hazard to air navigation for each turbine. Per the conditions contained in each determination, 104 turbines were painted white and have synchronized red lights, and the remaining four turbines were painted white with no synchronized red lights.
- The collector substation and O&M facilities are fenced. Safety signs are posted around all towers, transformers, and other high-voltage facilities and along roads in conformance with applicable federal and state regulations.

The following environmental commitments would be implemented to reduce potential impacts to health and safety:

- Per the Antelope and Wheeler County CUP approvals, all turbines would operate with a winter ice operation model control algorithm.
- Thunderhead employees would complete a job hazard analysis training annually for vehicle and/or heavy equipment operation that identifies potential hazards and methods for safe operation and identifies personal protective equipment to be used within each vehicle.
- Chain link fencing of the collector substation and O&M facility storage yard would be maintained.
- Thunderhead has prepared a fire protection and prevention plan that outlines protection measures and procedures to address smoking, working around and safe handling of flammable and/or combustible liquids or other materials (including refueling procedures), fire safety training, location of fire extinguishers, firefighting protocols, housekeeping, employee fire safety training and education, and employee notification systems.
- Spark arresters would be maintained on internal combustion engines used in or near the project area.

3.13.2.2 Direct and Indirect Impacts

Because of appropriate setback distances and other environmental commitments, the Interconnection Project poses a low risk to health or safety as a result of EMF, ice throw, communications interruptions, aviation, fires, or intentional destructive acts. All standard maintenance supplies, including greases, lubricants, herbicides, paints, or corrosion-control coatings would be stored at the O&M facility in

accordance with a spill prevention, control, and countermeasure plan (Southshore Environmental 2021). No fuel would be stored on-site, and all vehicles would be refueled off-site.

3.13.2.3 Electric and Magnetic Fields

Once operational, EMFs would exist within the substation, along the gen-tie that connects the facility to the grid, along the WAPA connection to the substation, and along connection lines and near turbine nacelles. The strongest EMF around the substation would come from power lines entering and leaving the substation. The strength of the EMF from equipment within the substations, such as transformers, reactors, and capacitor banks, decreases rapidly with increasing distance. Beyond the substation fence or wall, the EMF produced by the substation equipment is typically indistinguishable from background levels (National Institute of Environmental Health Sciences and National Institutes of Health 2002).

The substation location would not be accessible to the general public; however, the public would have greater accessibility to the gen-tie line and turbine and collection line locations on state or private lands still accessible for agricultural uses. EMFs from the gen-tie line and along the WAPA connection would be similar to or less than those described for the existing WAPA line. The gen-tie line ROW is a minimum of 250 feet wide, so residential exposure has already been limited. A study conducted in October 2004 that measured the EMF at wind turbine nacelles and connection lines identified no EMFs at ground level at a distance of 25 feet from the base of the tower and no EMFs at ground surface immediately above a buried conductor.

People who work near transformers, electrical closets, circuit boxes, or other high-current electrical equipment may have 60-Hz magnetic field exposures of hundreds of mG or more. In offices, magnetic field levels are often similar to those found at home, typically 0.5 to 4.0 mG (National Institute of Environmental Health Sciences and National Institutes of Health 2002). The Center for Disease Control's National Institute for Occupational Safety and Health has published the median and average daily range of exposures to magnetic fields by various types of workers. Table 3-14 provides EMF exposure levels of workers within the electric utility field.

Table 3-14. Electric and Magnetic Field Exposure Levels for Electrical Utility Workers during a Workday

Job Title	Median EMF Level (mG)	Range for 90% of Workers (mG)
Distribution substation operators	7.2	1.1–36.2
Line workers	2.5	0.5–34.8
Electricians	5.4	0.2–34
Clerical worker with computer	1.2	0.5–4.5
Clerical worker without computer	0.5	0.2–2.0

Source: National Institute of Environmental Health Sciences and National Institutes of Health (2002).

The range of exposure for TWEC O&M workers (turbine technicians, on-site manager, and administrative assistant) are expected fall within the ranges shown in the table. Substation, transmission, and gen-tie line service technicians are expected to fall within the range shown for substation and line workers. This average range of field exposures for various types of workers suggests that, during periods of normal operation, exposures would be far below ICNIRP 1998 Guidelines for EMF occupational exposure (4,200 mG). Likewise, adequate physical barriers preventing access to hazardous areas by unauthorized individuals can be expected to keep exposures of the general public to well below applicable guidelines.

3.13.2.4 Ice

All power poles, turbines, and ancillary support facilities and equipment were built according to the safety and design standards set forth in Section 1604.06 of the Wheeler County zoning ordinance and Section 8.08.06 Antelope County zoning regulations. All turbines met residential and road setback distances and safety and design standards within Antelope and Wheeler County zoning regulations. Setbacks were as follows:

- Dwelling units (participating): 1,000 feet.
- Dwelling units (nonparticipating):
    - Antelope County: 2,400 feet unless easement has been signed with said nonparticipating landowner.
    - Wheeler County: 2,640 feet unless easement has been signed with said nonparticipating landowner.
- Roads: 1.1 times the length of a rotor blade if ice braking procedures are put in place during the conditional use process; otherwise 1.5 times the hub height plus the rotor diameter.

Each turbine includes a SCADA communications system that permits automatic, independent operation and remote supervision, allowing continuous control of the wind farm to ensure optimal and efficient operation and early troubleshooting of problems.

3.13.2.5 Communications

The TWEC turbine locations were sited and constructed in compliance with county use permits to prevent interference with any existing commercial or public safety communication towers within 2 miles of the project area.

3.13.2.6 Aviation Safety

The turbine marking and lighting is in compliance with the FAA's final marking and lighting plan (FAA 2019) and should not impact commercial aviation safety. Use of fixed-wing crop dusters is currently restricted by the presence of the existing turbine towers. The operation of the turbines would expand the area of potential collisions approximately 400 horizonal and vertical feet around every wind turbine. Herbicide and pesticide application within the wind farm would likely need to be applied via ground application unless aerial sprayers coordinate with Thunderhead to shut down rotors during herbicide application. Because of the height of the turbines, the risk of collision, and the required turning radius of crop duster aircraft, aerial application of herbicide would be hazardous, particularly in hot weather, within 0.5 to 0.75 mile outside of the TWEC area (Wind Power Monthly 2007).

3.13.2.7 Fires

Potential fire hazards are present at operational wind farms. The probability of a fire occurring, and the extent of the fire and subsequent impacts would depend on multiple factors. The IEC requires that the design of electrical systems comply with relevant IEC standards. Conformance with IEC standard requirements, including lightning protection for the towers and for switchyards and substations, provides adequate control of any potential fire hazards. The Proposed Action conforms with IEC standards.

Thunderhead has prepared a fire protection and prevention plan that outlines protection measures and procedures to address smoking, working around and safe handling of flammable and/or combustible liquids or other materials (including refueling procedures), fire safety training, location of fire

extinguishers, firefighting protocols, housekeeping, employee fire safety training and education, and employee notification systems. These measures and procedures would lower the risk of a fire starting at the facility and ensures that, if one did occur, there would be an appropriate response to quickly extinguish the fire.

3.13.2.8 Intentional Destructive Acts

The highest risk of intentional damage is likely casual vandalism and targeted metal theft. Examples include metal theft, damage to towers and doors from shooting, and dents and dings from attempted break-ins to gain access. Security measures such as fencing, signage, lighting, and locks on equipment and facilities would deter vandals. Resident landowners are likely vigilant concerning unauthorized persons on their property and the presence of TWEC staff would add additional observers. The effects of intentional destructive acts would be wide ranging, depending on the nature and location of the acts, and would be similar to outages caused by natural phenomena such as storms and ice buildup.

In addition to the effects from loss of service, destructive acts could cause environmental effects, such as fires, if a conductor was brought down or if oil spilled from equipment. Fire deterrents within the project area include access roads, which serve as fire breaks, and the regular clearing of vegetation from areas around transformers, riser poles, and the collector substation. The substation has been designed for spill containment, and oil spills would probably be confined to the soil surrounding the electrical equipment. Any spills would be treated by removing and properly disposing of contaminated soil and replacing it with clean soil.

3.13.3 Environmental Consequences: No Action Alternative

Under the No Action Alternative, the existing TWEC facilities would remain in place but would not operate. Therefore, the No Action Alternative would not pose an EMF or ice throw hazard. However, these facilities would still be actively maintained, so the No Action Alternative would have the same impacts to communications, aviation, and fire as the Proposed Action. The No Action Alternative may be at a greater risk for vandalism because the project area would have less human traffic.

CHAPTER 4. CUMULATIVE IMPACTS

4.1 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

The analysis area for cumulative impacts is a 25-mile buffer, which encompasses all other analysis areas referenced in Chapter 3. Past, present, and reasonably foreseeable future actions include projects, activities, or trends that could impact human and environmental receptors. As summarized in the UGP PEIS, these can include renewable energy development, transmission and distribution systems, mining, power generation, oil and gas development, transportation, agriculture, recreation and leisure, and urbanization.

Past, present, and reasonably foreseeable future actions within the 25-mile cumulative impact analysis area are summarized below and depicted in Figure 4-1.

- **Wind Farms:** There are six operational wind farms located within 25 miles of the TWEC. The TWEC, which includes 108 turbines, resulted in approximately 67.6 acres of long-term surface disturbance from turbine foundations, turbine access roads, collector substation, O&M facility, and gen-tie ROW (see Table 3-1). Disturbance acres associated with the additional wind farms are assumed to be similar proportions, relative to the number of turbines.
    - Prairie Breeze Wind Farm – 118 turbines located 9.3 miles southeast of the TWEC
    - Prairie Breeze II Wind Farm – 41 turbines located 18.6 miles east of the TWEC
    - Prairie Breeze III Wind Farm – 20 turbines located 15.5 miles east of the TWEC
    - Laredo Ridge Wind Farm – 54 turbines located 18.6 miles southeast of the TWEC
    - Petersburg Wind Farm – 27 turbines located 21.7 miles southeast of the TWEC
    - Upstream Wind Energy Center – 81 turbines located 12.4 miles northeast of the TWEC
- **Power Transmission and Distribution:** The cumulative analysis area includes portions of WAPA's Grand Island-Fort Thompson 345-kV transmission line (to which the Interconnection Project proposes to interconnect). The analysis area also contains several 69-kV and 115-kV overhead transmission lines. Elkhorn Rural Public Power District operates distribution lines providing power to residences in the area and within the cumulative analysis area. The R Project is a proposed 345-kV transmission line in the analysis area. If constructed, the line would run from Sutherland, Nebraska, to the Holt County Substation, where it would connect to WAPA's Grand Island-Fort Thompson 345-kV line.
- **Agriculture:** The cumulative analysis area is largely rural and contains areas of pivot irrigation and other agricultural uses. These uses are expected to continue into the future; however, future community needs may result in conversion of some agricultural lands for residences, roads, infrastructure or other developments.
- **Residential Uses:** The cumulative analysis area is made up of largely rural residences. There are seven small communities within the cumulative analysis area (Albion, Neligh, Newman Grove, O'Neill, Orchard, Plainview, and Tilden). Residential uses within the cumulative analysis area are expected to continue and potentially grow into the future.
- **Transportation:** The cumulative analysis area roadways include NE-14 and NE-70 and state roadways (U.S. Routes 275 and 281), all of which ultimately connect to Interstate 20 (in the north) and Interstate 80 (in the south). No reasonably foreseeable future actions related to major roadway development have been identified.

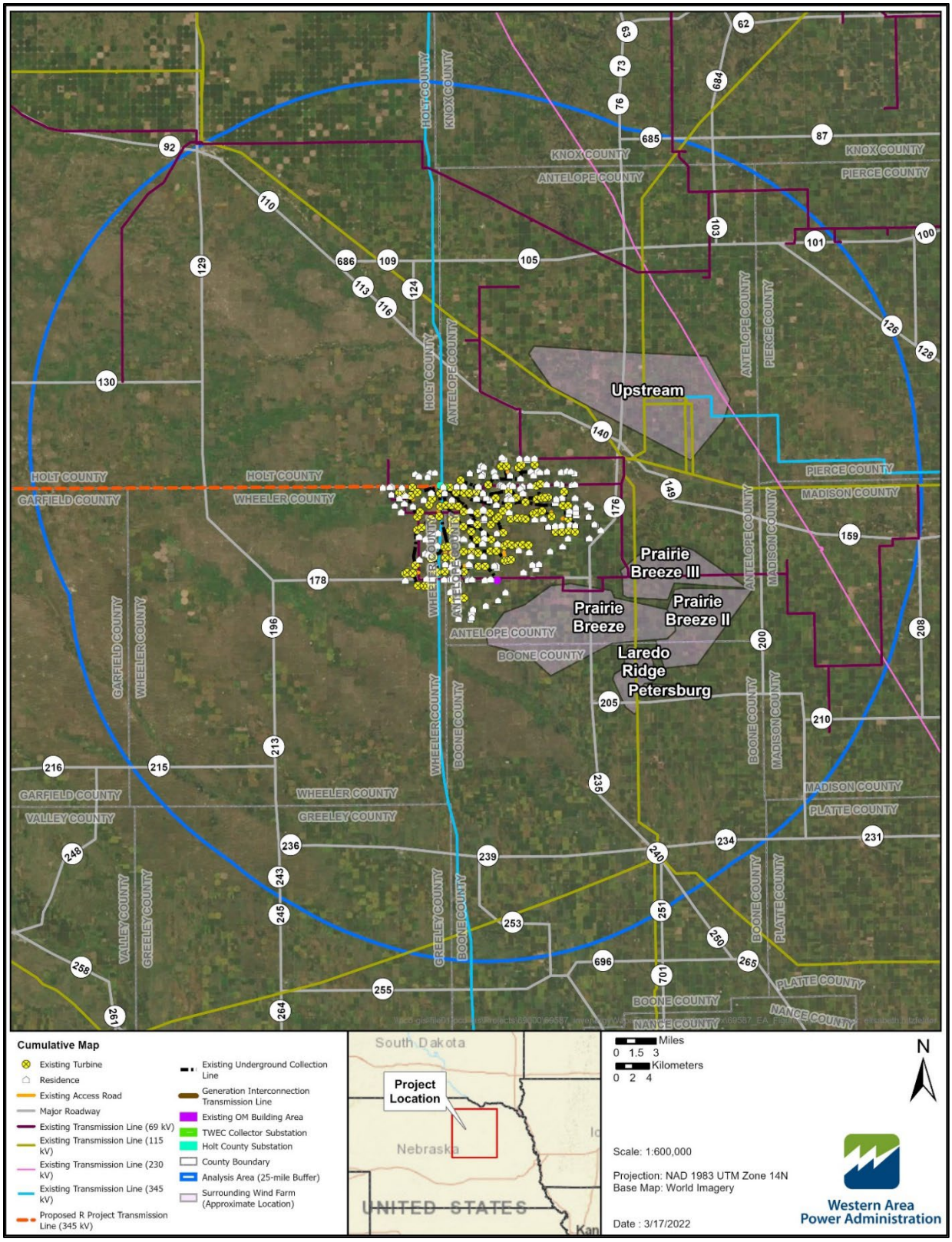

Figure 4-1. Past, present, and reasonably foreseeable future actions within the 25-mile cumulative impact analysis area.

4.2 CUMULATIVE IMPACT ANALYSIS

The cumulative impacts of past, present, and reasonably foreseeable future actions on resources within the UGP Region are analyzed in Section 6 of the UGP PEIS. The incremental contributions of the Proposed Action and No Action Alternatives are within the scope of the cumulative impacts analysis in the UGP PEIS, which projected wind energy development through the year 2030. A summary of cumulative impacts analyzed for each resource area under the UGP PEIS's preferred alternative (of which the Interconnection Project would be considered a part) is provided in Table 6.3-2 of the UGP PEIS; however, because the Interconnection Project does not include any new surface disturbance in undisturbed areas, many of the cumulative impacts described in the UGP PEIS are not relevant to the Interconnection Project and were excluded from Table 4-1 below.

The Interconnection Project includes environmental commitments to avoid or reduce impacts to resources described in Chapter 3. As such, any residual impacts remaining after implementation of the environmental commitments are not expected to measurably contribute to cumulative effects on resources from other past, present, and reasonably foreseeable future actions. Table 4-1 below provides a summary of potential cumulative effects from the Interconnection Project (Proposed Action) and the No Action Alternative.

Table 4-1. Cumulative Impact Summary - Interconnection Project (Proposed Action)

Resource	Potential Cumulative Effects
Geology, Soils, Paleontology and Water Resources	The contribution of the Interconnection Project to cumulative impacts to geology, soils, and paleontology would be negligible because it would not cause new surface disturbance in undisturbed areas. These impacts would be further reduced by environmental commitments to limit erosion or surface flow changes and protect water resources from spills or other disturbances.
Air Resources	The cumulative analysis area is an attainment area. Incremental impacts to air resources would result from present or future ground-disturbing activities, dust from vehicle traffic, and emissions from construction equipment, farming equipment, or other vehicles that could affect the current attainment status. The Interconnection Project includes environmental commitments to reduce potential air resource impacts. The contribution of the Interconnection Project to cumulative impacts to air resources would be minor. GHG emissions are a global issue affected by past, present, and reasonably foreseeable development activities within and beyond the cumulative analysis area. Local development has contributed GHG emissions that have contributed to climate change impacts. This includes conversion of grasslands that served as GHG sinks to other uses. Interconnection Project GHG emissions, although minor, would contribute to global GHG emissions. To the extent the TWEC and other nearby wind projects allow fossil fuel sources to be taken offline, there could be an offsetting impact to GHG emissions.
Noise	The cumulative noise impacts of past, present, and reasonably foreseeable future actions to residential areas and sensitive wildlife would occur primarily from current agricultural activities and traffic. The Interconnection Project would contribute to the incremental increase of noise within the project area; however, given the dispersed nature of wind farms in the cumulative analysis area, noise impacts from TWEC O&M would not be cumulative with other wind farms in the area. Long-term effects associated with TWEC operations would remain below county ordinances for commercial wind farm areas. Traffic noise and maintenance noise would be intermittent or infrequent.
Vegetation Resources	Past and present surface disturbance has affected land cover in the cumulative analysis area and resulted in vegetation and habitat changes or loss. Continued development could result in change, loss, or fragmentation of remaining vegetation and habitat, spread of noxious weeds, and increased risk of fire. The contribution of the Interconnection Project to cumulative impacts to vegetation would be negligible because it would not cause new surface disturbance in undisturbed areas. Additionally, any potential impacts would be limited by environmental commitments to reclaim disturbance and control noxious and invasive weeds.

Resource	Potential Cumulative Effects
Wildlife Resources	Existing and proposed development, traffic, and noise in the cumulative analysis area, including the presence of the TWEC and six nearby operational wind farms, could displace wildlife and potentially impact productivity and/or increase mortality. An existing network of access roads, transmission lines, and turbines have created habitat fragmentation that could increase potential for wildlife (specifically bird and bat) collisions as well as habitat degradation (Gelbard and Belnap 2003; Kuvlesky et al. 2007; Larsen and Madsen 2000). The response of wildlife to these existing disturbances would be variable and depend on the species, distance, and the type, intensity, and duration of the disturbance; however, most species occurring within the cumulative analysis area are common species that have become adapted to the predominately fragmented agricultural landscape. The contribution of the Interconnection Project to cumulative impacts to wildlife would add to avoidance of developed areas (such as areas with turbines) and potential avian and bat mortality. These impacts, however, would be reduced through environmental commitments.
Threatened and Endangered Species	Existing and proposed development, traffic, and noise within the cumulative analysis area, including the TWEC and six nearby active wind farms, could displace and potentially impact federally listed species. The Interconnection Project may affect NLEB though avoidance of potentially suitable habitat and potential collisions with turbines and may affect but is not likely to adversely affect the whooping crane through degradation of existing habitat, loss or avoidance of potentially suitable habitat, or potential collisions with turbines or the gen-tie line. The potential for impacts to these two federal listed species would incrementally contribute to cumulative impacts to these species from the other past, present and reasonably foreseeable development; however, Interconnection Project impacts would be reduced through environmental commitments, including application of the BBCS, the Whooping Crane Contingency Plan, and use of bird diverters on the gen-tie line. The Interconnection Project would have no effect on the ABB, piping plover, pallid sturgeon, and WPFO that could contribute to cumulative impacts.
Visual Resources	The visual landscape in the cumulative analysis area has been continually altered for more than two centuries. The current viewshed is one of a “working” landscape with human-made alterations as prominent features. These include the existing TWEC, six other wind farms, roads, agricultural areas, and rural residences. Past and present development from wind farms and other development have also contributed to current night sky conditions. The Interconnection Project would not increase the number of human-made structures in the viewshed, and while adding some additional contrasts, would not alter the existing visual character in the cumulative analysis area. Operations of the TWEC would contribute to the total cumulative acres within the analysis area that are subject to shadow flicker from any wind turbine, but would not add to existing shadow flicker from other operating turbines at any given residence. The Interconnection Project would contribute only minimally to any changes in sky glow, if at all, because turbine lighting is existing and other facility lighting would be downward-facing.
Cultural Resources	Past and present surface disturbance in the cumulative analysis area has resulted in potential losses of cultural resources or decreased their significance. Development activities also accelerate erosional processes over time, which in turn may cause further damage to resources or decrease their significance. The contribution of future development to adverse cumulative impacts to cultural resources would depend in part on the level of prior land disturbance (i.e., impacts would be lower for project activities in developed areas and higher in previously undisturbed areas). The cumulative impacts to cultural resources would be minimal because it is located in previously disturbed agricultural areas with low likelihood for cultural resources and no new surface disturbance would occur in undisturbed areas. Additionally, any potential impacts would be limited by environmental commitments to protect unanticipated cultural resource discoveries.
Land Use and Public Facilities	Land uses in the cumulative analysis area include the existing TWEC and six other wind farms, county roads, agricultural areas, and residences. Wind energy development is generally compatible with many land uses, including agriculture and livestock grazing, would not affect public facilities or services, and would not substantially change local traffic. The contribution of the Interconnection Project to cumulative land use impacts would, therefore, be minimal and further limited by environmental commitments to repair any damage to roads and other infrastructure in the area.
Socioeconomics	Past and present development in the cumulative analysis area, including agriculture and wind energy development, has provided increased employment opportunities and income, expenditures for goods and services, and tax revenues. Planned projects such as the R Project would also contribute to those benefits. The Interconnection Project would contribute to beneficial impacts to employment, income, and tax revenues in the region while still retaining the agricultural basis of the area. Impacts to property values from the incremental impact of the Interconnection Project could be adverse but the degree of impact would depend on future uses of the land and is subjective.

Resource	Potential Cumulative Effects
Environmental Justice	There are no environmental justice communities identified in the cumulative analysis area.
Health and Safety	Agricultural activities and developments such as roads, transmission lines, and wind farms in the cumulative analysis area all pose potential hazards to human health and safety. Hazards are generally mitigated through appropriate siting and environmental commitments such as signage, fencing, use of Occupational Safety and Health Administration (OSHA)–approved safety equipment, training, etc. The cumulative impacts to health and safety would be minimal and would be limited by environmental commitments that reduce physical hazards, noise, traffic, and issues that could pose a threat to human safety.
No Action	As detailed in Chapter 3, the incremental contribution of the No Action Alternative to cumulative impacts would be the same as the Proposed Action as it relates to maintenance since TWEC facilities would remain in place and would still be actively maintained. The No Action Alternative however would have no incremental contribution to cumulative impacts as it relates to operations of the TWEC and associated facilities and WAPA construction and commissioning activities.

CHAPTER 5. CONSULTATION AND COORDINATION

WAPA held two virtual scoping meetings on December 15, 2021, as part of the 30-day public scoping period, to solicit input on issues to be addressed in the Interconnection Project EA. WAPA invited federal, state, and local agencies to the first meeting and invited the public, including landowners, to the second meeting. WAPA published newspaper announcements and sent mailers to landowners in proximity to the project area that included Interconnection Project information, meeting information, and a comment card. Seven members of the public and four agency staff attended the virtual scoping meetings. The public scoping meeting documentation and comments received from agencies and the public regarding the proposed Interconnection Project are included in Appendix J. WAPA also incorporated all applicable input from agency consultation and coordination associated with construction of the TWEC (Appendix G).

5.1 LIST OF FEDERAL AGENCIES

The following federal agencies were contacted for the purpose of the EA scoping process:

- Advisory Council on Historic Preservation
- FAA
- Federal Emergency Management Agency, Office of Energy Projects
- Federal Highway Administration
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Rural Development
- U.S. Department of the Interior, Bureau of Indian Affairs
- U.S. Department of the Interior, Bureau of Land Management
- U.S. Department of the Interior, National Park Service
- EPA
- USFWS
- U.S. Department of Agriculture, Farm Service Agency, Nebraska State Office
- U.S. House of Representatives
- U.S. Senate

5.2 STATE AND LOCAL AGENCIES

The following state and local agencies were contacted for the purpose of the EA scoping process:

- State of Nebraska Legislature District 40
- State of Nebraska Legislature District 41
- State of Nebraska Governor Pete Ricketts
- Antelope County
- Antelope County Board of Commissioners

- Antelope County Law Enforcement Center
- Holt County
- Holt County Board of Supervisors
- Nebraska Board of Educational Lands and Funds
- Nebraska Chamber of Commerce and Industry
- Nebraska Commission on Indian Affairs
- Nebraska Conservation and Survey Division (Nebraska Geological Survey)
- Nebraska Department of Agriculture
- NDEE
- Nebraska Department of Health and Human Services
- Nebraska Department of Natural Resources
- Nebraska Department of Revenue
- Nebraska Department of Transportation
- NGPC
- NPPD
- Nebraska Power Review Board
- Nebraska State Climate Office
- Nebraska SHPO
- History Nebraska
- Wheeler County
- Wheeler County Board of Commissioners
- Upper Elkhorn Natural Resources District

5.3 NATIVE AMERICAN TRIBES

Pursuant to Section 106 of the NHPA, on November 22, 2021, WAPA initiated tribal consultations with the following 15 tribes, by letter, regarding the proposed Interconnection Project:

- Apache Tribe of Oklahoma
- Cheyenne and Arapaho Tribes, Oklahoma
- Iowa Tribe of Kansas and Nebraska
- Oglala Sioux Tribe
- Omaha Tribe of Nebraska
- Otoe-Missouria Tribe of Indians
- Pawnee Nation of Oklahoma

- Ponca Tribe of Indians of Oklahoma
- Ponca Tribe of Nebraska
- Rosebud Sioux Tribe of the Rosebud Indian Reservation, South Dakota
- Sac and Fox Tribe of the Mississippi in Iowa
- Sac and Fox Nation of Missouri in Kansas and Nebraska
- Santee Sioux Nation, Nebraska
- Winnebago Tribe of Nebraska
- Yankton Sioux Tribe of South Dakota

WAPA received responses from six tribal entities. The Winnebago Tribe of Nebraska and the Pawnee Nation of Oklahoma requested to consult. On January 5, 2022, the Omaha Tribe of Nebraska requested more information on the Interconnection Project, and on January 6, 2022, WAPA sent the tribe the requested additional information. On February 18, 2022, WAPA sent a letter to all tribes outlining its efforts to identify cultural resources in the project area, its determination of effect, the supporting cultural resources reports (also provided to the Nebraska SHPO), and a request for comment and concurrence. On March 2, 2022, the Winnebago Tribe of Nebraska asked whether an informational meeting was planned. When WAPA informed the tribe that no meeting was planned, WAPA offered to meet with the tribe for further consultation. As of March 28, 2022, WAPA has received no response.

The Pawnee Nation of Oklahoma provided a letter on March 10, 2022, stating that the Interconnection Project should not affect the cultural landscape of the Pawnee Nation of Oklahoma, and that if undiscovered properties are encountered, they must be immediately reported to the tribe.

The Santee Sioux Nation, Nebraska, provided a letter on March 13, 2022, stating that they did not wish to consult on the Interconnection Project, and that if potential tribal artifacts or burial artifacts are discovered, proper precautions and notifications should be made.

The Yankton Sioux Tribe of South Dakota provided a letter on March 31, 2022, stating that they do not have an interest in the Interconnection Project, but that if any items of cultural significance arise during the Interconnection Project construction process, they would like to be notified because the Interconnection Project is in an area of interest to their tribal nation.

The Iowa Tribe of Kansas and Nebraska provided an email on March 31, 2022, stating that the project area is outside the area of interest to the tribe.

5.4 NON-GOVERNMENTAL ORGANIZATIONS

The following non-governmental organizations were contacted to participate in the EA scoping process:

- Audubon Nebraska
- Ducks Unlimited, Nebraska Field Office
- Sierra Club
- Nebraska Wildlife Federation

CHAPTER 6. LIST OF PREPARERS

Table 6-1 identifies the personnel responsible for the preparation of this EA.

Table 6-1. List of Environmental Assessment Preparers

Name	Position	Role
Christina Gomer	WAPA Project Manager	NEPA coordinator (natural resources specialist)
Staffan Peterson	WAPA Archaeologist	Cultural and tribal liaison
John Russell	WAPA Supervisory Environmental Protection Specialist	Environmental manager
Brian Pauly	WAPA Biologist	Lead biologist
Gary Hoffman	WAPA Attorney Advisor	Legal support
Shannon Stewart	Thunderhead	Project management and environmental compliance
Amanda Miller	Olsson Associates	Threatened and endangered species lead
Karen Tyrell	West	Threatened and endangered species lead
Matt Petersen	SWCA NEPA Technical Director	Senior NEPA oversight
Janet Guinn	SWCA Senior Environmental Planner	Senior NEPA oversight
Laura Klewicki	SWCA Project Environmental Planner	Project coordination
Amanda Nicodemus	SWCA NEPA Specialist	Vegetation, wildlife, and human health and safety
Erin Wielenga	SWCA Air Specialist	Air resources
Liz Hitzfelder	SWCA Geographic Information System (GIS) Specialist	Data analysis and figure production
Jennifer Wynn	SWCA NEPA Specialist	Noise, visual, and land use and public facilities
Jenny Addy	SWCA NEPA Specialist	Soils, geology, and paleontology
Jennifer Summers	SWCA Environmental Planner	Socioeconomics and environmental justice
John Heule	SWCA Wetland Scientist	Water resources
Melanie Medeiros	SWCA Archaeologist	Cultural resources

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