Midwest Wind Energy Multi-Species Habitat Conservation Plan

Draft Environmental Impact Statement

Volume I

April 2016

U.S. Fish and Wildlife Service | Midwest Region | Bloomington, MN

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EXECUTIVE SUMMARY

ES-1 Introduction

Private landowners, corporations, state or local governments, or other non-Federal landowners who wish to conduct activities on their land that might incidentally harm (or "take") wildlife that is listed as endangered or threatened under the Federal Endangered Species Act (ESA) must implement measures to avoid impacts to those species, obtain an incidental take permit (ITP) from the U.S. Fish and Wildlife Service (Service), or risk enforcement action by the Service. Take is statutorily defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting a protected animal species.

The *Midwest Wind Energy Multi-Species Habitat Conservation Plan Draft Environmental Impact Statement* (Draft EIS) evaluates the effects of the Service issuing ITPs and concurring with Certificates of Inclusion (COIs) pursuant to section 10(a)(1)(B) of the ESA for activities covered under the proposed Multi-Species Habitat Conservation Plan (MSHCP). The MSHCP was prepared by the Service, with assistance from several planning partners, for wind energy development within an eight-state Plan Area (see Appendix I). If granted, the MSHCP will be implemented as both a "template" HCP for wind energy project proponents and a "programmatic" HCP implemented through a master permittee. Under a template HCP process, the Service will directly issue individual ITPs to applicants that agree to implement the MSHCP. Under a programmatic HCP process, the Service will issue an ITP to a master permittee, who will be responsible for issuing COIs to wind energy companies that agree to implement the MSHCP at their facilities.

The Plan Area encompasses all lands under the political boundary of the Midwest Region of the Service, including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The MSHCP planning partners include state conservation agencies from seven of the eight states within the Plan Area, as well as the American Wind Energy Association, a consortium of wind energy companies, and The Conservation Fund. The geographic area where incidental take authorization will be allowed under the MSHCP is a subset of the Plan Area and specifically excludes lands of particular importance to bat and migratory bird species, as well as a wide range of other wildlife species. These lands, which are referred to as Covered Lands in the MSHCP and this Draft EIS, were identified as a result of the 2012 scoping process for the MSHCP.

Activities covered under the MSHCP, or Covered Activities, include the construction, operation, maintenance, decommissioning and reclamation, and repowering of existing and future land-based commercial wind energy facilities within Covered Lands, as well as monitoring activities.

The MSHCP addresses incidental take of six federally listed bat and bird species, one bat species that may be listed in the future, and the bald eagle, which is protected under the Bald and Golden Eagle Protection Act. These eight species are collectively referred to as Covered Species. For one of the federally listed bat species, the northern long-eared bat (*Myotis septentrionalis*), the Service issued a rule under authority of section 4(d) of the ESA that provides measures that are necessary and advisable to provide for the conservation of the northern long-eared bat. Under the final 4(d) rule, activities within the white-nose syndrome (WNS) zone (defined as the set of counties within the range of the northern long-eared bat within 150 miles of the boundaries of counties where WNS has been detected) not involving tree removal are not prohibited provided they do not result in the

incidental take of northern long-eared bats in hibernacula or otherwise impair essential behavior patterns at known hibernacula. This includes take resulting from the operation of utility-scale wind turbines; however, due to the uncertainty of the 4(d), future uplisting of the species, white nose syndrome, etc., the parties have agreed to keep the northern long-eared bat in as a covered species.

The proposed term of the MSHCP is 45 years. During the first 5 years, existing commercial wind energy projects may apply for and receive incidental take authorizations under the MSHCP; proposed commercial wind energy facilities could opt-in during the first 15 years of the MSHCP. Incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP. The master permit will be issued for a period that is equal to the entire length of the plan (45 years, or whatever the remaining life of the MSHCP is once that entity is in place); however, all individual ITPs and COI will be issued for a period of only 30 years.

Preparation of this Draft EIS has been conducted in accordance with the requirements of the National Environmental Policy Act (NEPA) and its implementing regulations, the U.S. Department of the Interior's NEPA Procedures, and other Service guidance for compliance with those regulations. The Service is the lead Federal agency for preparation of this Draft EIS.

ES-2 Proposed Federal Action and Purpose and Need for Action

The proposed Federal action being evaluated in this Draft EIS is the approval of the MSHCP, the issuance of ITPs, and concurrence with COIs for Covered Species by the Service, pursuant to section 10(a)(1)(B) of the ESA. If granted, the MSHCP will authorize incidental take of the Covered Species that may result from wind energy development activities within Covered Lands over the 45-year term of the MSHCP.

The purpose of the proposed Federal action is to allow the Service to review and approve requests for ITPs and COIs and to streamline the permitting process under the MSHCP which, if granted, will authorize the incidental take of Covered Species resulting from existing and future wind energy development within Covered Lands.

While wind energy facilities can be an important source of clean and renewable electric power generation, wind turbines can impact birds and bats that pass near turning blades, and construction and maintenance of wind facilities and infrastructure can impact species habitat. In particular, commercial wind facilities have been shown to cause high numbers of bat fatalities in many locations, reinforcing the need for the Service to ensure that take of bats from wind turbines is avoided and minimized to the maximum extent practical, and that the impact of any take is fully mitigated.

Accordingly, the need for the proposed Federal action is to provide for broader protection and conservation of Covered Species and their habitats, in compliance with the ESA, while allowing for long-term development, economic and regulatory certainty, and continued operation of existing and future wind energy facilities within Covered Lands. This need is based on the potential that wind-related Covered Activities in the MSHCP could, and are likely to, result in the incidental take of federally listed species, requiring the need for an ITP to lawfully operate. Historically, take of listed species that is incidental to otherwise lawful wind energy development activities has been evaluated and authorized through project-by-project consultations under either section 7 of the ESA (if

another Federal agency is involved) or through a project-specific ITP issued by the Service in compliance with section 10 of the ESA. Issuance of ITPs under the MSHCP, if authorized by the Service, will integrate wind energy activities with landscape conservation needs of Covered Species, and streamline ESA compliance procedures for both the wind energy industry, states, and the Service.

The decision whether to issue ITPs and concur with COIs under the MSHCP will be based upon the statutory and regulatory criteria of the ESA. In applying these criteria, the Service will analyze the effects of Covered Activities on Covered Species, as well as the effectiveness of the proposed conservation strategy in avoiding, minimizing, and mitigating impacts to those species. The determination as to whether the MSHCP meets these criteria will be made after the public has had an opportunity to comment on the Draft and Final EIS and MSHCP, and will be documented in an ESA section 10 findings document, ESA section 7 Biological Opinion, and NEPA Record of Decision developed at the conclusion of the NEPA and ESA compliance processes.

ES-3 Alternatives

NEPA requires that Federal agencies consider a range of reasonable alternatives to the proposed action when evaluating the environmental effects of an action. This Draft EIS describes the components and potential impacts of three action alternatives as well as the alternative of not taking action. The action alternatives reflect a reasonable range of alternatives that meet both the requirements of NEPA and the purpose and need of the proposed action. The action alternatives were developed by the Service, with input from the state conservation agencies responsible for managing natural resources within the Plan Area. Input provided by the public, non-governmental organizations, and other interested stakeholders during the scoping period also informed the development of action alternatives.

The following subsections describe the four alternatives analyzed in this Draft EIS. Table ES-1 presents an overview of the key features of the alternatives.

ES-3.1 Alternative A – Proposed MSHCP Alternative

Under Alternative A, which is the preferred alternative, ITPs or COIs will be issued under the MSHCP for the Covered Activities—construction, operation, maintenance, decommissioning and reclamation, and repowering of existing and future land-based commercial wind energy facilities within Covered Lands, as well as monitoring activities. Incidental take coverage will be provided for the Covered Species; impacts to other federally listed species could either be avoided through siting and best management practices, or addressed through a separate and site-specific ESA section 10(a)(1)(B) permitting process. If impacts to other federally listed species cannot be avoided, and an applicant does not obtain a separate permit for that species, an ITP under the MSHCP will not be issued. Alternative A also includes minimization, monitoring, reporting, and compensatory mitigation requirements as part of the conservation strategy for Covered Species.

During the first 5 years, up to 18,004 MW of existing installed wind energy in Covered Lands could apply for and receive incidental take authorization under the MSHCP after review by the Service, provided they implement the avoidance, minimization, monitoring, and mitigation requirements provided in the MSHCP. An additional 33,000 MW of new commercial wind energy facilities within Covered Lands could opt-in to the MSHCP during the first 15 years of the MSHCP.

ES-3.2 Alternative B – Reduced Permit Duration Alternative

Under Alternative B, future wind facilities in the Plan Area will have 5 years instead of 15 years to opt-in to the MSHCP and the total term of the MSHCP will be reduced from 45 to 35 years. Consistent with Alternative A, existing commercial wind energy projects will still have 5 years to opt-in to the MSHCP, and incidental take authorizations (via an individual ITP or COI) will be issued for a period of 30 years to account for the operational life of most wind projects.

This alternative was developed by the Service to address scoping comments that the Draft EIS consider a shorter term or permit duration under the MSHCP, in part to acknowledge uncertainties surrounding the effects of white-nose syndrome on covered bat species. The shorter-opt in period will allow the Service to consider the potential cumulative effects of white-nose syndrome and wind energy development on covered bat species, while still allowing the wind energy industry to utilize a streamlined permit process that accommodates the anticipated 30 year life span of a wind facility.

Because new wind energy will have 5 years instead of 15 years to opt-in, the number of wind facilities that may receive incidental take authorization under Alternative B will likely be less than that anticipated under Alternative A. For the purposes of comparing alternatives, it is assumed that up to 11,000 MW of new wind energy capacity could be installed in Covered Lands and receive incidental take authorization during the 5 year opt-in period (as compared to 33,000 MW during the 15 years under Alternative A). The same capacity of existing wind energy facilities within Covered Lands—18,004 MW—will be eligible to participate in the MSHCP under Alternative B.

Although incidental take authorization will only be provided for up to 11,000 MW of new wind energy capacity under Alternative B, it is possible that other wind infrastructure will be constructed within the Plan Area over the term of the MSHCP. For the purposes of this Draft EIS, and consistent with Alternative D, it is assumed that an additional 22,000 MW of new wind energy capacity could be constructed in the Plan Area, for a total of 33,000 MW of total build-out capacity. This 22,000 MW of new wind energy under Alternative B could occur anywhere within the Plan Area, but will require either an ESA section 10(a)(1)(B) permit from the Service, or avoidance of impacts to federally listed species.

All other aspects of the MSHCP described for Alternative A will be the same under Alternative B.

ES-3.3 Alternative C – Increased Cut-In Speed Alternative

Under Alternative C, the conservation strategy in the MSHCP will be revised to increase cut-in speeds during high risk periods for covered bats. Specifically, cut-in speeds will be increased to 5 meters per second (mps) during the spring migration period and 6.5 mps during the fall migration period. In addition, cut-in speeds will be increased to 6.5 mps in the summer where the presence of covered bats has been documented, and during specified periods where turbines are located in proximity to maternity colonies and/or swarming /staging areas. All other aspects of the MSHCP will be the same as described under Alternative A.

Alternative C was developed in response to scoping comments requesting the Service consider additional operational restrictions to reduce take of Covered Species.

ES-3.4 Alternative D – No Action Alternative

Under Alternative D, the Service will not issue ITPs or concur with COIs for wind-related construction and operational activities under the MSHCP. Future and existing wind energy developers and operators will continue to be required to either avoid incidental take of federally listed species and eagles through siting and operational changes, or pursue project-specific ESA section 10(a)(1)(B) permits and/or eagle permits, as necessary. Wind energy developers unable to avoid take of federally listed species and/or eagles, and who operate without ESA and Eagle Act permits, could be subject to enforcement action by the Service.

If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring, and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will not be available under Alternative D, and opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service will be limited.

Under Alternative D, this EIS assumes there are 18,004 megawatts (MW) of installed wind energy in the Covered Lands, and up to 33,000 MW of new wind energy capacity could be developed in the Plan Area. New wind energy facilities could be constructed anywhere within the Plan Area and would not be limited to Covered Lands.

Table ES-1. Comparison of Alternatives

Alternative	Description	Master Permit Term[1]	Opt-in Period
Alternative A – MSHCP	• The Service will issue ITPs under the MSHCP for Covered Activities affecting the eight Covered Species. • Incidental take authorization for 18,004 MW of existing wind energy in Covered Lands. • Incidental take authorization for up to 33,000 MW of new wind energy capacity in Covered Lands.	• Permit term is 45 years; incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP.	• 5 year opt-in period for existing facilities and a 15 year opt-in period for future wind facilities.
Alternative B – Reduced Permit Duration	• Incidental take authorization for future wind facilities will be reduced to 11,000 MW to account for the shorter permit duration and opt-in period (compared to 33,000 MW under Alternative A). • An additional 22,000 MW of new wind energy could be constructed in the Plan Area under Alternative B, in addition to the 11,000 MW contemplated for incidental take coverage under Alternative B. • Any additional construction (beyond the 11,000 MW) under Alternative B will require receipt of an ITP from the Service, or avoidance of impacts to federally-listed species. • Additional new wind facilities could be constructed anywhere within the Plan Area and will not be limited to Covered Lands.	• Permit term is 35 years.	• 5 year opt-in period for existing and future wind facilities.

Alternative C – Increased Cut-in Speed	• Incidental take authorization for 18,004 MW of existing wind energy in Covered Lands.
	• Incidental take authorization for up to 33,000 MW of new wind energy capacity in Covered Lands.
	• The conservation strategy will be revised to increase cut-in speeds during high risk periods for covered bats.
	  ○ Cut-in speeds will be increased to 5 mps during the spring migration period and 6.5 mps during the fall migration period.
	  ○ Cut-in speeds will be increased to 6.5 mps in the summer where the presence of covered bats has been documented, and during specified periods where turbines are located in close proximity to maternity colonies and/or swarming/staging areas.
		• Permit term is 45 years; incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP.	• 5 year opt-in period for existing facilities and a 15 year opt-in period for future wind facilities.

Alternative	Description	Master Permit Term[1]	Opt-in Period
Alternative D – No Action Alternative	• Reflects current conditions and serves as the baseline for considering effects of the other alternatives in the EIS. • The Service will not issue ITPs or concur with COIs for wind-related construction and operational activities under the MSHCP. • Assumes 18,004 MW of existing wind energy in Covered Lands. • Assumes 33,000 MW of new wind energy in the Plan Area.	• Not applicable.	• Not applicable.

[1] The individual permit term for Alternatives A – C is 30 years.

ES-4 Environmental Consequences

ES-4.1 Scope of Analysis

A basic tenant of the proposed action—issuance of ITPs and subsequent implementation of the MSHCP—is that the Service does not directly authorize the construction or operation of wind energy projects that may cause take of Covered Species; an ITP from the Service provides an applicant with incidental take coverage from enforcement action under the ESA, and requires the applicant to obtain any other necessary construction or operation-related permits from other entities, as necessary.

Wind energy development projects within Covered Lands are typically authorized by other Federal, state, county, and local agencies or ordinances, depending on their location (*i.e.,* which state or county they are located in) and site-specific resource constraints (e.g., the presence of sensitive habitats, proximity to sensitive noise or visual resource receptors, setbacks). In this case, issuance of ITPs could facilitate development by addressing one of the various statutory and regulatory requirements tied to project authorization, but will not unilaterally approve such development.

Accordingly, the scope of the analysis of potential impacts in the Draft EIS is focused principally on the direct, indirect, and cumulative impacts of the proposed incidental take of Covered Species, as well as any impacts associated with implementing the species avoidance, minimization, and mitigation measures provided in the MSHCP. The Draft EIS is more detailed in its analyses of species and species habitats than for other aspects of the human environment (e.g., air quality, transportation, noise), given the direct relationship between issuance of ITPs and effects on wildlife species and their habitat. Potential impacts to other resource areas are discussed at a more programmatic level to reflect the indirect nature of the proposed action, the geographic breadth of Covered Lands, and the lack of information on the precise location and timing of future wind energy development projects (or to determine which existing wind facilities may "opt" into the MSHCP). In addition, the analysis of construction-related impacts is focused on new wind energy facilities rather than existing facilities, where construction impacts have already occurred and only operation of turbines and maintenance of existing facilities are ongoing.

Given the programmatic nature of the analyses provided in this Draft EIS, the Service will require ITP applicants to complete a NEPA site-specific consistency evaluation process before an ITP will be issued. This process will allow the Service to ensure the programmatic analysis addresses the resources that will be affected while leveraging the programmatic analyses in this Draft EIS to the extent possible. A draft form that will streamline this future evaluation is included in this Draft EIS as Appendix H.

ES-4.2 General Approach to Analysis

The effects analyses in this Draft EIS are discussed at a programmatic level to reflect the indirect nature of the impacts of the alternatives, the geographic scope of Covered Lands, and the lack of specificity on where wind energy development may be located or authorized under the MSHCP. However, where possible, to provide some level of quantification of potential impacts under Alternative A, the effects analysis also considers the outputs from a predictive model developed in support of the MSHCP. This predictive model—referred to as the associated wind power

development potential (build-out) model—was used in the MSHCP to generate a series of realistic scenarios of how build-out of future wind energy development might be distributed across Covered Lands, considering landscape characteristics and associated wind energy development potential (e.g., distance to nearest transmission line, proximity to urban areas, wind power class).

As described in Appendix B of the MSHCP, 100 randomized build-out scenarios were generated by the predictive model and used to assess potential direct and indirect impacts to Covered Species, based, in part, on species range, habitat requirements, and seasonal migration patterns. For the effects analysis, the 100 random outputs from the model were used, where possible, to approximate potential direct impacts to other resource areas by overlaying the model outputs with the extent of a specific mapped resource, such as wetlands and floodplains. Specifically, the model outputs were used to estimate the total acreage of specific mapped resources that new wind energy facilities will potentially encompass. After calculating the total acreage, an assumption was used that up to 5 percent of that area will be converted to turbine locations, access roads, and other associated wind-energy infrastructure. This assumption was based on estimates provided by the American Wind Energy Association that between 2 percent and 5 percent of total land surface (acreage for a wind energy facility) is typically converted from original land uses to turbine locations and associated infrastructure during development of new wind energy facilities. For the purposes of this Draft EIS, this acreage (*i.e.,* 5% of the MSHCP Build-Out Model output) represents the approximate area of direct impact from future wind energy development under Alternative A.

A detailed description of the methods and specifications of the MSHCP Build-Out Model are provided in Appendix B of the MSHCP. The Draft EIS analysis relies solely on the outputs from the MSHCP Build-Out Model; in-other words, the MSHCP Build-Out Model was not rerun specifically for the Draft EIS analysis, and the 100 random outputs used in the MSHCP for the Covered Species assessments are the same outputs considered in this Draft EIS. It is also important to note that the outputs from the MSHCP Build-Out Model are predictive, and should not be construed as specific development footprints. The actual implementation of future wind energy development within the Plan Area over the term of the MSHCP will vary depending on a variety of factors, and will be subject to other Federal or state permitting processes that may require avoidance of specific resources. For example, because the MSHCP Build-Out Model does not specifically account for the location of known wetland habitats, some future wind energy facilities may be sited by the model in wetland habitats. However, through various Federal and state permitting processes (e.g., Section 404 of the Clean Water Act), it is anticipated that wind energy development proponents will be required to avoid wetland areas where possible, and mitigate for wetland impacts where they cannot be avoided. Accordingly, any quantification of potential impacts in this Draft EIS derived from the MSHCP Build-Out Model should be considered representative rather than complete, and in many instances are inflated because the MSHCP Build-Out Model did not account for resource-specific constraints that are required to be accommodated in designing and siting individual facilities.

ES-4.3 Summary of Impacts

This EIS analyzes the potential environmental impacts of the alternatives for the following resource areas.

- Biological resources
  - Vegetation communities
  - Covered Species (including their habitat)
  - Other rare, endangered, threatened and candidate species (including their habitat)
  - Other wildlife species
  - Other fish and aquatic resources
- Water resources
  - Surface waters
  - Floodplains
  - Wetlands
- Geology and soils
- Climate change
- Air quality
- Noise
- Visual resources (including shadow flicker)
- Transportation
- Land resources
- Public services and utilities
- Public health and safety (including wind turbine syndrome)
- Socioeconomics and environmental justice
- Cultural resources

Chapter 4 provides an analysis of the construction and operation related impacts, and Chapter 5 describes the cumulative impacts analysis. Chapter 6 presents the irreversible and irretrievable commitment of resources; unavoidable adverse effects; analysis of short-term use versus long-term productivity; and growth-inducing effects.

Table ES-2 provides the estimated amount of take by alternative for each of the Covered Species, as well as other federally listed species for the duration of the permit term. Table ES-3 provides the intensity of potential impacts for all resource areas analyzed in the Draft EIS.

Table ES-2. Estimated Take of MSHCP Covered Species, Other Protected Bat Species, and Non-Protected Migratory Tree Bats Over the Permit Term

Common Name	Scientific Name	Amount of Take (# of individuals killed) Over the Permit Term			
		Alternative A	Alternative B	Alternative C[1]	Alternative D[2]
MSHCP Covered Species[3]					
Kirtland's warbler	*Setophaga (=Dendroica) kirtlandii*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Potentially less take than Alternative A	99
Least tern – Interior Population	*Sterna antillarum athalassos*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Same as Alternative A	17
Piping plover – Great Lakes population	*Charadrius melodus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Potentially less take than Alternative A	3
Piping plover – Northern Great Plains population	*Charadrius melodus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Potentially less take than Alternative A	41
Bald eagle	*Haliaeetus leucocephalus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Same as Alternative A	4,108
Indiana bat	*Myotis sodalis*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	16,822
Northern long-eared bat	*Myotis septentrionalis*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	29,259
Little brown bat	*Myotis lucifugus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	1,239,838
Other Protected Bat Species					
Big brown bat	*Eptesicus fuscus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	1,898,355
Eastern small footed bat	*Myotis leibii*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	416
Evening bat	*Nycticeius humeralis*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	63,976
Tri-colored bat	*Perimyotis subflavus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	51,389

Common Name	Scientific Name	Amount of Take (# of individuals killed) Over the Permit Term			
		Alternative A	Alternative B	Alternative C[1]	Alternative D[2]
Non-Protected Migratory Tree Bats					
Eastern red bat	*Lasiurus borealis*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	15,821,653
Hoary bat	*Lasiurus cinereus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	9,456,292
Silver-haired bat	*Lasionycteris noctivagans*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	6,587,953
Seminole bat	*Lasiurus seminolus*	Less risk of take than Alternatives B and D	Greater risk of take than Alternative A but less than Alternative D	Less than Alternative A	57,834

[1] Alternative C is the same as Alternative A (MSHCP) but with increased cut-in speeds during high risk periods for increased protection of covered bat species. This is why it is only compared to Alternative A. Alternative C would have the least amount of bat take compared to all alternatives.

[2] The take number under Alternative D (i.e., baseline condition) is the take cap calculated in the MSHCP for baseline conditions. The MSHCP (i.e., Alternative A) did not quantify take numbers under the MSHCP because the effectiveness of the MSHCP (e.g., AMMs) at any one facility will vary depending on site-specific conditions; therefore, all other alternatives are qualitatively evaluated against the baseline condition take number. Alternative D's level of take would be authorized under any of the alternatives, but the level of take would be reduced under Alternatives A, B, and C for most species, as indicated in the qualitative description in the table.

[3] Other protected bat species include those bats that are not Covered Species and are listed as threatened, endangered, candidate, or proposed for listing under the ESA, or are protected under a state endangered species statute by one of the eight states within the Plan Area.

Table ES-3. Intensity of Impacts by Alternative

Resource Area	Alternative A	Alternative B	Alternative C	Alternative D
Biological Resources	Minor to Moderate	Minor to Moderate	Minor to Moderate	Substantial
Water Resources	Minor to Moderate	Minor to Moderate	Minor to Moderate	Minor to Moderate
Geology & Soils	Moderate	Moderate	Moderate	Moderate
Climate Change	Minor to Moderate (positive and negative)	Minor to Moderate (positive and negative)	Minor to Moderate (positive and negative)	Minor to Moderate (positive and negative)
Air Quality	Minor to Moderate	Minor to Moderate	Minor to Moderate	Minor to Moderate
Noise	Minor to Substantial	Minor to Substantial	Minor to Substantial	Minor to Substantial
Visual Resources	Minor to Substantial	Minor to Substantial	Minor to Substantial	Substantial
Transportation	Minor to Moderate	Minor to Moderate	Minor to Moderate	Minor to Moderate
Land Resources	Minor to Substantial	Minor to Substantial	Minor to Substantial	Minor to Substantial
Public Services & Utilities	Minor to Substantial	Minor to Substantial	Minor to Substantial	Minor to Substantial
Public Health & Safety	Minor	Minor	Minor	Minor
Socioeconomics & Environmental Justice	Minor to Moderate (positive and negative)	Minor to Moderate (positive and negative)	Minor to Moderate (positive and negative)	Minor to Moderate (positive and negative)
Cultural Resources	Minor	Minor	Minor	Substantial

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ACRONYMS AND ABBREVIATIONS

°F	degree Fahrenheit
μg/m^3	microgram per cubic meter
ACHP	Advisory Council for Historic Preservation
AMMs	Avoidance and minimization measures
APE	area of potential effects
APLIC	Avian Power Line Interaction Committee
ATSC	Advanced Television Systems Committee
ATV	all-terrain vehicle
AVE	area of visual effect
AWEA	American Wind Energy Association
BCR	Bird of Conservation Concern Region
BLM	Bureau of Land Management
BMP	best management practice
CAA	Clean Air Act
CCP	Comprehensive Conservation Plan
CEC	Commission for Environmental Cooperation
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
COI	Certificate of Inclusion
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel
DNL	day-night average sound level
DNR	Department of Natural Resources
Eagle Act	Bald and Golden Eagle Protection Act
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
Forest Service	U.S. Forest Service

g	standard gravity
GDP	Gross Domestic Product
GHG	greenhouse gas
GIS	geographic information system
HAP	hazardous air pollutant
HEA	Habitat Equivalency Analysis
HEM	Habitat Equivalency Model
HUC	Hydrologic Unit Code
Hz	Hertz
I	Interstate
IOUs	investor-owned utilities
IRAC	Interdepartment Radio Advisory Committee
ITP	incidental take permit
kW	kilowatt
KWMA	Kirtland's Warbler Management Area
LED	light-emitting diode
LRR	Land Resource Region
MBTA	Migratory Bird Treaty Act
mg/m^3	milligram per cubic meter of air
MGIN	Midwest Green Infrastructure Network
MIE	Mitigation Implementing Entity
MLRA	Major Land Resource Area
mps	meter per second
MSHCP	Midwest Wind Energy Multi-Species Habitat Conservation Plan
MSHCP	Multi-Species Habitat Conservation Plan
MW	megawatt
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
National Register	National Park Service National Register of Historic Places
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NHL	National Historical Landmarks
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System

NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NTIA	National Telecommunications and Information Administration
NWI	National Wetlands Inventory
O_3	ozone
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
Pb	lead
PCBs	polychlorinated biphenyls
PM10	particulate matter smaller than 10 microns
PM2.5	particulate matter smaller than 2.5 microns
ppm	part per million
PSD	Prevention of Significant Deterioration
REA	Resource Equivalency Analysis
RHPO	Regional Historic Preservation Officer
Service	U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Officer
SIO	Scenic Integrity Objective
SIP	State Implementation Plan
SMS	Scenery Management System
SO_2	sulfur dioxide
SOx	sulfur oxides
SWPPP	Stormwater Pollution Prevention Plan
TAL	technical assistance letter
THPO	Tribal Historic Preservation Officer
U.S.C.	United States Code
USFS	U.S. Forest Service
USGS	United States Geological Survey
VMS	Visual Management System
VOC	Volatile Organic Compound
VQO	Visual Quality Objective
VRM	Visual Resource Management
WNS	White Nose Syndrome
WTG	wind turbine generator

Chapter 1
Purpose and Need

1.1 Introduction

Private landowners, corporations, state or local governments, or other non-Federal landowners who wish to conduct activities on their land that might incidentally harm (or take) wildlife that is listed as endangered or threatened under the Federal Endangered Species Act (ESA) (16 United States Code [U.S.C.] §§ 1531 to 1544) must implement measures to avoid impacts to those species, obtain an incidental take permit (ITP) from the U.S. Fish and Wildlife Service (Service), or risk enforcement action by the Service. As discussed in Section 1.3.1.2, *Federal Endangered Species Act*, take is statutorily defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting a protected animal species.

The Service is considering issuing ITPs, pursuant to Section 10(a)(1)(B) of the ESA, as amended, under the Midwest Wind Energy Multi-Species Habitat Conservation Plan (MSHCP). The MSHCP was prepared by the Service, with assistance from several planning partners, for wind energy development within an eight-state Plan Area (see Appendix I).

As described in more detail in Section 2.1, if granted, the MSHCP will be implemented as both a "template" HCP for wind energy project proponents and a "programmatic" HCP implemented through a master permittee. Under a template HCP process, the Service will directly issue individual ITPs to applicants that agree to implement the MSHCP. Under a programmatic HCP process, the Service will issue an ITP to a master permittee, who will be responsible for issuing Certificates of Inclusion (COIs) to wind energy companies that agree to implement the MSHCP at their facilities.

The *Plan Area* encompasses all lands within the political boundary of the Midwest Region of the Service, including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin (Figure 1-1). The MSHCP planning partners include state conservation agencies from seven of the eight states within the Plan Area[1], as well as the American Wind Energy Association, a consortium of wind energy companies, and The Conservation Fund. The geographic area where incidental take authorization will be allowed under the MSHCP is a subset of the Plan Area and specifically excludes lands of particular importance to bat and migratory bird species, as well as a wide range of other wildlife species (see Chapter 2, *Proposed Action and Alternatives*) (Figure 1-2). These lands, which are referred to as *Covered Lands* in the MSHCP and this Environmental Impact Statement (EIS), were identified as a result of the 2012 scoping process for the MSHCP.

Activities covered under the MSHCP, or *Covered Activities*, include the construction, operation, maintenance, decommissioning and reclamation, and repowering of existing and future land-based commercial wind energy facilities within Covered Lands, as well as monitoring activities.

The MSHCP addresses incidental take of six federally listed bat and bird species, one bat species that may be listed in the future, and the bald eagle (*Haliaeetus leucocephalus*), which is protected under

[1] The Ohio Department of Natural Resources is not participating as a planning partner in the MSHCP, although potential wind-related activities, mitigation, and monitoring activities within the state of Ohio are considered in the MSHCP.

the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. § 668) (Table 1-1). These species are collectively referred to as *Covered Species*.

For one of the federally listed bat species, the northern long-eared bat (*Myotis septentrionalis*), the Service issued a rule under authority of section 4(d) of the ESA that provides measures that are necessary and advisable to provide for the conservation of the northern long-eared bat. Under the final 4(d) rule, activities within the white-nose syndrome (WNS) zone (defined as the set of counties within the range of the northern long-eared bat within 150 miles of the boundaries of counties where WNS has been detected) not involving tree removal are not prohibited provided they do not result in the incidental take of northern long-eared bats in hibernacula or otherwise impair essential behavior patterns at known hibernacula. This includes take resulting from the operation of utility-scale wind turbines; however, due to the uncertainty of the 4(d), future uplisting of the species, white nose syndrome, etc., the parties have agreed to keep the northern long-eared bat in as a covered species.

The proposed term of the MSHCP is 45 years. During the first 5 years, existing commercial wind energy projects may apply for and receive incidental take authorizations under the MSHCP; proposed commercial wind energy facilities could opt-in during the first 15 years of the MSHCP. Incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP. The master permit will be issued for a period that is equal to the entire length of the plan (45 years, or whatever the remaining life of the MSHCP is once that entity is in place); however, all individual ITPs and COI will be issued for a period of only 30 years.

Table 1-1. Covered Species – Midwest Wind Energy Multi-Species Habitat Conservation Plan

Common Name	Scientific Name	Range in Plan Area	Listing Status[1]	Critical Habitat
Kirtland's warbler	*Setophaga (=Dendroica) kirtlandii*	Michigan, Wisconsin	FE	Not designated
Least tern – Interior Population	*Sterna antillarum athalassos*	Illinois, Indiana, Missouri, Iowa	FE	Not designated
Piping plover – Great Lakes population	*Charadrius melodus*	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	FE	Units within all states within species range in Plan Area
Piping plover – Northern Great Plains population	*Charadrius melodus*	Iowa, Missouri, Minnesota	FT	Not within Plan Area
Indiana bat	*Myotis sodalis*	Illinois, Indiana, Iowa, Michigan, Missouri, Ohio	FE[2]	Specific hibernacula (caves and mines) in Illinois, Indiana, and Missouri
Northern long-eared bat	*Myotis septentrionalis*	Plan Area-wide	FT	Not designated
Little brown bat	*Myotis lucifugus*	Plan Area-wide	None	Not designated
Bald eagle	*Haliaeetus leucocephalus*	Plan Area-wide	Eagle Act	Not designated

Notes:

[1] Listing Status: FE = listed as endangered under Federal ESA; FT = listed as threatened under the Federal ESA; Eagle Act = Protected under the Bald and Golden Eagle Protection Act.

[2] The Service issued a 4(d) rule for the northern long-eared bat, which exempts wind energy development from the ESA's take prohibitions, provided that the development does not result in incidental take in hibernacula or otherwise impair essential behavior patterns at known hibernacula.

Preparation of this EIS has been conducted in accordance with the requirements of the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 *et seq*.), its implementing regulations (40 Code of Federal Regulations [CFR] Parts 1500–1508), the U.S. Department of the Interior's NEPA Procedures (43 CFR Part 46), and other Service guidance for compliance with those regulations. The Service is the lead Federal agency for preparation of the EIS. Additional information on the proposed action, including a copy of this EIS, are available on the Service-sponsored project website at http://midwestwindenergyhcpeis.org/. The MSHCP has its own separate project website at http://www.midwestwindhcp.com/.

1.2 Proposed Federal Action

The proposed Federal action being evaluated in this EIS is the approval of the MSHCP, the issuance of ITPs, and concurrence with COIs for Covered Species by the Service, pursuant to Section 10(a)(1)(B) of the ESA. Section 2.1 provides more detail on the ITP and COI processes. As summarized above, if granted, the MSHCP will authorize incidental take of eight Covered Species

(Table 1-1) that may result from wind energy development activities within Covered Lands over the 45-year term of the MSHCP.

The purpose and need for the proposed Federal action are described below. Chapter 2, *Proposed Action and Alternatives*, provides a detailed description of Covered Lands, Covered Activities, and the conservation strategy for Covered Species provided in the MSHCP.

1.2.1 Purpose and Need for Action

The purpose of the proposed Federal action is to review and approve requests for ITPs and COIs and to streamline the permitting process under the MSHCP which, if granted, will authorize the incidental take of Covered Species resulting from existing and future wind energy development within Covered Lands.

While wind energy facilities can be an important source of clean and renewable electric power generation, wind turbines can impact birds and bats that pass near turning blades and construction and maintenance of wind facilities and infrastructure can impact species habitat. In particular, commercial wind facilities have been shown to cause high numbers of bat fatalities in many locations, reinforcing the need for the Service to ensure that take of bats from wind turbines is avoided and minimized to the maximum extent practical, and that the impact of any take is fully mitigated.

Accordingly, the need for the proposed Federal action is to provide for broader protection and conservation of Covered Species and their habitats, in compliance with the ESA, while allowing for long-term development, economic and regulatory certainty, and continued operation of existing and future wind energy facilities within Covered Lands. This need is based on the potential that wind-related Covered Activities in the MSHCP could, and are likely to, result in the incidental take of federally listed species, requiring the need for an ITP to lawfully operate. Historically, take of listed species that is incidental to otherwise lawful wind energy development activities has been evaluated and authorized through project-by-project consultations under either Section 7 of the ESA (if another Federal agency is involved) or through a project-specific ITP issued by the Service in compliance with Section 10 of the ESA. Issuance of ITPs under the MSHCP, if authorized by the Service, will integrate wind energy activities with landscape conservation needs of Covered Species, and streamline ESA compliance procedures for the wind energy industry, states, and the Service.

The decision whether to issue ITPs under the MSHCP will be based upon the statutory and regulatory criteria of the ESA, as described in Section 1.3.1.2, *Federal Endangered Species Act*. In applying these criteria, the Service will analyze the effects of Covered Activities on Covered Species, as well as the effectiveness of the proposed conservation strategy in avoiding and minimizing impacts to those species. The determination as to whether the MSHCP meets these criteria will be made after the public has had an opportunity to comment on the Draft and Final EIS and MSHCP, and will be documented in an ESA Section 10 findings document, ESA Section 7 Biological Opinion, and NEPA Record of Decision developed at the conclusion of the NEPA and ESA compliance processes.

1.2.2 Scope of Analysis

A basic tenant of the proposed action—issuance of ITPs and subsequent implementation of the MSHCP—is that the Service does not directly authorize the construction or operation of wind energy projects that may cause take of Covered Species; an ITP from the Service provides an applicant with

incidental take coverage from enforcement action under the ESA, and requires the applicant to obtain any other necessary construction or operation-related permits from other entities, as necessary.

Wind energy development projects within Covered Lands are typically authorized by other Federal, state, county, and local agencies or ordinances, depending on their location (*i.e.,* which state or county they are located in) and site-specific resource constraints (e.g., the presence of sensitive habitats, proximity to sensitive noise or visual resource receptors, setbacks) (see Section 1.4.2, *State Permit and Consultation Requirements*). In this case, issuance of ITPs could facilitate development by addressing one of the various statutory and regulatory requirements tied to project authorization, but will not unilaterally approve such development.

Accordingly, the scope of the analysis of potential impacts in the EIS is focused principally on the direct, indirect, and cumulative impacts of the proposed incidental take of Covered Species, as well as any impacts associated with implementing the species avoidance, minimization, and mitigation measures provided in the MSHCP. The EIS is more detailed in its analyses of species and species habitats than for other aspects of the human environment (e.g., air quality, transportation, noise), given the direct relationship between issuance of ITPs and effects on wildlife species and their habitat. Potential impacts to other resource areas are discussed at a more programmatic level to reflect the indirect nature of the proposed action, the geographic breadth of Covered Lands, and the lack of information on the precise location and timing of future wind energy development projects (or to determine which existing wind facilities may "opt" into the MSHCP). In addition, the analysis of construction-related impacts is focused on new wind energy facilities rather than existing facilities, where construction impacts have already occurred and only operation of turbines and maintenance of existing facilities are ongoing.

Given the programmatic nature of the analyses provided in this EIS, the Service will require ITP applicants to complete a site-specific consistency evaluation process before an ITP will be issued. This process will allow the Service to ensure the programmatic analysis addresses the resources that will be affected while leveraging the programmatic analyses in this EIS to the extent possible. A draft form that will streamline this future evaluation is included in this EIS as Appendix H.

1.3 Decisions to Be Made

The decision whether to issue ITPs under the MSHCP will be based on the Service's ESA and NEPA compliance determinations. These determinations will be documented in the ESA Section 10 finding document(s), ESA Section 7 Biological Opinion(s), and the NEPA Record of Decision. These documents will be developed at the conclusion of the ESA and NEPA processes.

The following describes the ESA and NEPA criteria that will be considered in evaluating and making a decision on the proposed action. This section also describes how the requirements of the Eagle Act will be considered in this process.

1.3.1 Key Federal Statutes and Regulations

1.3.1.1 National Environmental Policy Act

NEPA serves as the nation's basic charter for determining how Federal decisions affect the human environment. NEPA requires that any Federal agency undertaking a "major Federal action" likely to

"significantly affect the quality of the human environment" prepare an EIS (42 U.S.C. § 4332). An EIS must provide a "detailed statement" of the environmental impacts of the action, possible alternatives, and measures to mitigate adverse effects of the proposed action. The Service has elected to prepare an EIS for the proposed action for the following reasons:

- The effects of the proposed action, including effects on federally listed species, are uncertain and require a thorough analysis.
- If approved by the Service, the proposed action will cover the largest geographic scope of any permit issued to date (other than a nationwide permit), and will span 45 years.

While NEPA does not mandate a particular result, it requires the Federal agency to follow specific procedures in its decision-making process. The purpose of these procedures is to ensure the agency has before it the best possible information to make its decision, and to ensure the public is provided an opportunity to understand and provide comment on the potential environmental impacts that may be associated with the proposed action.

The EIS process culminates in issuance of a Record of Decision. The Record of Decision documents the Service's decision on the alternative selected for implementation; identifies all alternatives considered and the environmentally preferable alternative (which is not always the same as the alternative selected); explains whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not; and summarizes the monitoring and enforcement program, where applicable, for mitigation.

Issuance of an ITP under Section 10(a)(1)(B) of the ESA is a major Federal action subject to NEPA compliance. Although ESA and NEPA requirements overlap considerably, the scope of NEPA goes beyond that of the ESA by requiring consideration of the impacts of a Federal action not only on wildlife resources, but also on other resources such as water quality, socioeconomics, and cultural resources. This EIS evaluates the potential environmental consequences associated with issuance of ITPs under the MSHCP, as well as the effects of several alternatives, including a No Action Alternative.

1.3.1.2 Federal Endangered Species Act

The purpose of the ESA is to provide a means whereby the ecosystems upon which threatened and endangered species depend may be conserved, and to provide a program for the conservation of such species. The Service and National Oceanic and Atmospheric Administration (NOAA) Fisheries (formerly known as the National Marine Fisheries Service) have responsibilities for conservation and protection of threatened and endangered species under the ESA. NOAA Fisheries is responsible for enforcing provisions of the ESA for most marine and anadromous species. All of the Covered Species addressed in the MSHCP are under the jurisdiction of the Service, which is responsible for terrestrial wildlife and freshwater aquatic species.

1.3.1.3 ESA Section 9

Section 9 of the ESA prohibits take of fish and wildlife species listed as endangered under Section 4 (16 U.S.C. § 1538, § 1533, respectively). The ESA implementing regulations extend, under certain circumstances, the prohibition of take to threatened species (50 CFR § 17.31). Under Section 3 of the ESA, *take* means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S.C. § 1532(19)). The term *harm* in the definition of take is further defined by Federal regulation to mean "an act which actually kills or injures wildlife.

Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering" (50 CFR § 17.3). *Harass* in the definition of take is defined by Federal regulation to include "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, foraging, or sheltering" (50 CFR § 17.3).

1.3.1.4 ESA Section 10

Under Section 10(a) of the ESA, the Service may issue permits to authorize incidental take of listed fish and wildlife species. Section 10(a)(1)(B) defines *incidental take* as take that is "incidental to, and not the purpose of the carrying out of an otherwise lawful activity." Section 10(a)(1)(B) of the ESA also contains provisions for issuing ITPs to non-Federal entities for the take of endangered and threatened species, provided the following criteria are met:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impact of such taking;
- The applicant will develop an HCP and ensure adequate funding for the plan will be provided;
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and
- The applicant will carry out any other measures the Secretary of the Interior may require as being necessary or appropriate for the purposes of the HCP (e.g., implementation agreement, conservation easements, financial endowments).

Regulations governing permits for endangered and threatened species are at 50 § CFR 17.22 and § 17.32.

The Service also considers guidance and policy provided in the *Handbook for Habitat Conservation Planning and Incidental Take Permitting Process* (Service and NOAA Fisheries 1996) during development, review, and implementation of habitat conservation plans. A 2000 addendum to the handbook, also known as the "Five Point Policy" provides additional guidance on the biological goals and objectives, adaptive management, monitoring, permit duration, and public participation components of the HCP planning and implementation process (Service and NOAA Fisheries 2000).

Pursuant to the ESA, the Service may implement one of the following options in evaluating an application for an ITP under Section 10(a)(1)(B):

- Issue an ITP conditioned on implementation of the MSHCP;
- Issue an ITP conditioned on implementation of the MSHCP and other specified measures; or
- Deny the ITP application.

1.3.1.5 ESA Section 7

Section 7 of the ESA requires all Federal agencies, in consultation with the Service, to ensure that any action "authorized, funded, or carried out" by any agency "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of critical habitat (16 U.S.C. § 1536(a)(2)).

Before initiating an action, a Federal action agency must determine whether a proposed project may affect listed or proposed species and/or their critical habitat. If the action agency determines that a project may have an effect, they are required to consult with the Service. If the action agency determines (and the Service concurs) that the project is neither likely to adversely affect any listed or proposed species or modify designated critical habitat, the consultation is concluded. If the action agency determines that a project may adversely affect a listed or proposed species and/or designated or proposed critical habitat, a formal consultation process is initiated.

During formal consultation, the Service prepares a Biological Opinion in response to information provided by the Federal action agency. The Biological Opinion analyzes the effects of the proposed action on listed species and determines if the proposed action is likely to jeopardize the continued existence of the species or destroy or adversely modify designated critical habitat. If the Biological Opinion reaches a jeopardy or adverse modification conclusion, the opinion must develop a "reasonable and prudent alternative" that would avoid that result.

If the Biological Opinion concludes that the project, as proposed, would involve the take of a listed species, but not to an extent that would jeopardize the species' continued existence, the Biological Opinion includes an incidental take statement and specifies reasonable and prudent measures to minimize the impact of the take. The incidental take statement specifies an amount of take that the Service believes may occur as a result of the action. The Service may also make conservation recommendations, which are non-binding, such as identifying additional discretionary conservation measures to reduce adverse effects, or identifying additional needed studies, monitoring, or research that might assist species conservation in furtherance of ESA Section 7(a)(1). If the action complies with the Biological Opinion and the incidental take statement, it may be implemented without violation of the ESA, and the take is thereby exempted.

The issuance of ITPs under the MSHCP is a Federal action that triggers a Section 7 consultation. The Service, as both the Federal action agency and agency responsible for implementing the ESA, will be required to complete an "intra-Service" consultation process that considers the effects of issuance of the ITPs and implementation of the MSHCP on all federally listed species potentially affected by the proposed action. However, due to the lack of specificity on where future projects will be built, a Section 7 consistency evaluation will be completed at the individual project level. The intent of this review is to ensure that the individual projects are meeting the biological goals and objectives of the MSHCP.

1.3.1.6 Bald and Golden Eagle Protection Act

Eagles are protected under the Eagle Act (16 U.S.C. 668-668c), which prohibits take and disturbance of individuals and nests. "Take" under the Eagle Act includes any actions that pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, and disturb eagles. *Disturb* is further defined in 50 CFR § 22.3 as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

Under 50 CFR § 22.11, Eagle Act take authorization may be extended to permittees authorized to take eagles by an ITP issued pursuant to Section 10(a)(1)(B) of the ESA. Take coverage for bald eagles provided through an ITP applies for the duration of the permit, or until the amount or level of

take authorized has been met, provided the permittee complies with all terms and conditions provided in the ITP and the requirements of the Eagle Act. The Service will consider the effects of take of bald eagle under the MSHCP through the ESA Section 10 ITP process.

1.4 Relationship to Other Plans, Regulations, and Laws

This section describes other Federal and state statutes, regulations, and policies that govern wind energy development in the Plan Area. The list of regulations and statutes described in this section is not intended to be comprehensive, and may vary depending on site-specific conditions associated with an individual wind project. Analysis of, and compliance with, these requirements will remain the responsibility of applicants requesting incidental take coverage under the MSHCP. Moreover, compliance with these requirements will be required regardless of the issuance by the Service of an ITP under the MSHCP. Issuance of ITPs under the MSHCP will not conflict with or supersede these requirements.

1.4.1 Federal Permit and Consultation Requirements

Section 1.3.1, *Key Federal Statutes and Regulations,* describes the permit, consultation, and environmental review requirements under NEPA, the ESA, and Eagle Act that are required to support issuance of ITPs by the Service under the MSHCP. Other Federal permits and consultations that may be required to implement the activities covered in the MSHCP over the term of the MSHCP are summarized below.

1.4.1.1 Migratory Bird Treaty Act

A migratory bird is any individual species or family of birds that crosses international borders at some point during their annual life cycle to live or reproduce. The Migratory Bird Treaty Act (MBTA) (16 U.S.C. § 703-712) implements four treaties that prohibit take, possession, transportation, and importation of all migratory native birds (plus their eggs and active nests) occurring in the wild in the U.S.,[2] any recently listed unprotected species in the *Federal Register*, and non-migratory upland game birds, except when specifically authorized by the Service. Under the MBTA, it is unlawful to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner " any migratory bird (16 U.S.C. § 703). In total, more than 1,000 bird species are protected by the MBTA (United States Fish and Wildlife Service 2010).

The MBTA applies to all persons and organizations in the United States, including Federal and state agencies. The MBTA is administered by the Service, with regulation of federally listed migratory birds delegated to the Service's Endangered Species Division. The Service's Migratory Bird Division regulates unlisted migratory birds. Failure to comply with the MBTA can result in criminal penalties.

[2] House sparrow, European starling, and rock pigeon are not protected under the MBTA.

Federal Migratory Bird Special Purpose Utility Permit

The MBTA prohibits the take of migratory birds, including migratory birds listed under the ESA. None of the regulations promulgated under the MBTA expressly allow a permit to be issued for incidental take.[3] However, 50 CFR § 21.27 provides for the availability of "special purpose permits" for activities outside the scope of standard permits, and Section 10 of the ESA allows MBTA coverage through these special purpose permit for migratory birds that are also federally listed.

There are different types of special purpose permits considered by the Service[4]. Utility companies may apply for a Federal Migratory Bird Special Purpose Utility Permit, which allows the utility to collect, transport, and temporarily possess parts and carcasses of migratory birds found dead on utility property, structures, and rights-of-way for avian mortality monitoring or disposal purposes. The permits, which are valid for 3 years, require that companies maintain records of mortalities and injuries, and that they report the information to the Service. Utility companies are not required to obtain special purpose utility permits; they are only necessary if the utility company plans to collect, transport, or possess dead migratory birds or parts, or contract someone to conduct these activities on its behalf. While birds protected under the MBTA may be collected, special purpose utility permits do not authorize take of migratory birds or eagles, nor do they absolve the utility company from liability for take (United States Fish and Wildlife Service 2014).

1.4.1.2 Clean Water Act

The Clean Water Act (CWA) (33 U.S.C. §§ 1251 to 1387) establishes the basic framework for the regulation of surface water quality standards and pollutant discharges into waters of the United States. The CWA regulates both direct and indirect discharges. Sections 404, 402, and 401 of the CWA, which may apply to construction or ground-disturbing activities proposed under the MSHCP, are summarized below.

Section 404

The U.S. Army Corps of Engineers (Corps) requires project applicants to obtain a CWA Section 404 permit if a proposed action would result in the discharge of dredged or fill material into waters of the United States, including wetlands (33 U.S.C. § 1344). Covered Activities that will require placement of fill in waters of the United States will require a permit from the Corps.

[3] On May 26, 2015, the Service issued a Notice of Intent (NOI) to prepare a programmatic EIS to evaluate the potential environmental impacts of authorization of incidental take of migratory birds under the MBTA. The Service is considering rulemaking to address various approaches to regulating the incidental take of migratory birds, including issuance of general incidental take authorizations; issuance of individual permits; development of memoranda of understanding with Federal agencies authorizing incidental take from those agencies' operations and activities; and/or development of voluntary guidance for industry regarding ways to avoid or minimize incidental take. The rulemaking would establish standards for any regulatory approach to ensure that incidental take of migratory birds is appropriately mitigated; measures to avoid or minimize take or to secure compensation may be required. The Service is currently soliciting comments from the public on the scope of the programmatic EIS, the issues that should be addressed, and alternatives to the proposed approaches for regulating incidental take. Additional information on the proposed Migratory Bird Rule is provided at 80 *Federal Register* 30032 (May 26, 2015).

[4] Refer to the Service's Migratory Bird website for a complete listing of special purpose permits that may be obtained by applicants: http://www.fws.gov/migratorybirds/mbpermits/ApplicationForms.html

Section 402

Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permit program to regulate point source discharges of pollutants into waters of the United States. NPDES permits set specific discharge limits and establish monitoring and reporting requirements (33 U.S.C. § 1342). In most cases, the NPDES permit program is administered by states. Each state in the eight-state Plan Area has an approved NPDES permit program. Covered Activities that will result in ground disturbance of more than 1 acre will be required to comply with CWA Section 402.

Section 401

Section 401 of the CWA requires Federal agencies to ensure that their proposed actions, including issuance of permits, do not violate state water quality standards (33 U.S.C. § 1341). Specifically, Section 401 states that a Federal permit or license cannot be issued if it may result in a discharge to waters of the United States that would violate state water quality standards. Table 1-2 summarizes the regulatory entities within the Plan Area responsible for determining if a Federal action is eligible for water quality certification.

The Service anticipates that, if authorized, ITPs issued under the MSHCP will programmatically consider potential impacts to surface water quality and compliance with Federal and state water quality standards. However, project-specific water quality certification, where applicable, will occur when an individual project is proposed. In most instances, water quality certification will be associated with issuance of a CWA Section 404 permit by the Corps.

Table 1-2. State Regulatory Entities for Clean Water Act Section 401 Certifications

State	Regulatory Agency
Illinois	Illinois Environmental Protection Agency
Indiana	Indiana Department of Environmental Management
Iowa	Iowa Department of Natural Resources
Michigan	Michigan Department of Environmental Quality
Minnesota	Minnesota Pollution Control Agency
Missouri	Missouri Department of Natural Resources
Ohio	Ohio Environmental Protection Agency
Wisconsin	Wisconsin Department of Natural Resources

1.4.1.3 Section 106, National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) (54 U.S.C. § 300101 *et seq.*) is the primary Federal law governing the preservation of cultural and historic resources in the U.S. The NHPA requires that historic and archaeological resources eligible for listing on the National Register of Historic Places be considered during planning and implementation of Federal projects. Specifically, the Section 106 process requires that a Federal action agency consult with the applicable State Historic Preservation Offices, the Advisory Council on Historic Preservation, and Native American Tribes to determine if a proposed action could affect properties listed or eligible for listing on the National Register of Historic Places, and to identify ways to minimize and mitigate adverse impacts on such properties.

Issuance of ITPs under the MSHCP is considered a Federal undertaking subject to compliance with the NHPA. As noted above, the Service anticipates that, if authorized, ITPs issued under the MSHCP will programmatically consider potential impacts to historic and archaeological resources protected under the NHPA. Site-specific surveys and assessments of known and potential historic and archaeological resources, as well as any required outreach with State Historic Preservation Offices and development of appropriate avoidance, minimization, and mitigation measures, are required to be completed as individual projects are proposed for inclusion in the MSHCP, with oversight provided by the Service's Regional Historic Preservation Officer. Refer to Section 4.13, *Cultural Resources*, for a more detailed discussion of compliance with the NHPA.

1.4.2 State Permit and Consultation Requirements

Each state in the Plan Area has different regulatory requirements for the development of wind energy projects. As summarized in Table 1-3, siting authority for wind energy development in Illinois, Indiana, Michigan, and Missouri is deferred to local jurisdictions, which may or may not develop ordinances specific to siting and design of wind energy facilities. Additional state regulatory requirements may apply in Iowa, Minnesota, Ohio, and Wisconsin depending on the proposed capacity of the wind facility and other variables. Environmental review under state environmental policy acts is also required in Minnesota (Minnesota Environmental Policy Act) and Wisconsin (Wisconsin Environmental Policy Act). Additional information about state-specific permit and consultation requirements is summarized below.

Table 1-3. State Regulatory Requirements for Siting Wind Energy Projects[1]

State	Siting Authority	State Regulatory Requirements	Description
Illinois	Local governments	NA	There are no state laws or regulations pertaining to the siting, review, or approval of wind energy projects. Local or county ordinances may or may not include siting criteria requirements and/or design standards.
Indiana	Local governments	NA	There are no state laws or regulations pertaining to the siting, review, or approval of wind energy projects. Local or county ordinances may or may not include siting criteria requirements and/or design standards.
Iowa	Iowa Utilities Board and local governments	Location and Construction of Electric Generation Facilities	Pursuant to Iowa Administrative Code 24 Section 199, proposed wind energy projects with a capacity greater than 25 megawatts must obtain a certificate from the Iowa Utilities Board (Iowa Utilities Board 2015).
Michigan	Local governments	NA	There are no state laws or regulations pertaining to the siting, review, or approval of wind energy projects. Local or county ordinances may or may not include siting criteria requirements and/or design standards.

State	Siting Authority	State Regulatory Requirements	Description
Minnesota	Minnesota Public Utilities Commission and local governments	Wind Energy Conversion Systems. Minnesota Environmental Policy Act	Pursuant to Minnesota Statutes Chapter 216 F, proposed wind projects with a capacity greater than 5 megawatts, or 25 megawatts or more if a permit is sought in a county with an authorized permitting authority, must obtain a site permit from the Minnesota Public Utilities Commission (State of Minnesota 2008.) The Minnesota Public Utilities Commission's procedures for review of proposed large energy facilities incorporate compliance with the Minnesota Environmental Policy Act (Minnesota Public Utilities Commission 2015).
Missouri	Local governments	NA	There are no state laws or regulations pertaining to the siting, review, or approval of wind energy projects. Local or county ordinances may or may not include siting criteria requirements and/or design standards.
Ohio	Ohio Power Siting Board and local governments	Power Siting	Pursuant to Ohio Administrative Code Chapter 4906, proposed wind energy projects with a capacity of 5 or more megawatts must obtain a siting certificate from the Ohio Power Siting Board (Ohio Power Siting Board 2015).
Wisconsin	Wisconsin Public Service Commission and local governments	Wind Energy Systems. Wisconsin Environmental Policy Act	Under a cooperative agreement, the Wisconsin Public Services Commission and Wisconsin Department of Natural Resources coordinate the compliance of eligible proposed wind energy projects with the Wisconsin Environmental Policy Act. Pursuant to Wisconsin Administrative Code Chapter PSC 128, proposed wind energy projects with a capacity of 100 megawatts or more, or those built by a state-regulated utility, must be approved by the Wisconsin Public Services Commission. Other wind projects must be approved by local government, but must adhere to the Public Services Commission's wind siting criteria. (Wisconsin Department of Natural Resources 2013).

[1] Adapted from American Planning Association 2013.

1.4.2.1 Illinois

Illinois Endangered Species Protection Act

The Illinois Endangered Species Protection Act (520 I.L.C.S. 10/1 to 10/11) makes it unlawful for any person to possess, take, transport, sell, give, or otherwise dispose of any animal or product thereof of any animal species on the Illinois list of endangered and threatened species. Listing, delisting, or changing the listing status of any species on the Illinois list of endangered and threatened species is the responsibility of the Endangered Species Protection Board. The Illinois Department of Natural Resources (DNR) implements the Illinois Endangered Species Protection Act,

and can issue permits for incidental take of state-listed species. The state statute provides that all federally listed endangered or threatened species that occur in Illinois are also designated state-listed species, without any action required of the Endangered Species Protection Board.

1.4.2.2 Indiana

Nongame and Endangered Species Conservation Act

The Indiana Nongame and Endangered Species Conservation Act (I.C. 14-22-34-1 to 21) prohibits the take, possession, transport, export, processing, shipping, or selling of any species or subspecies of wildlife that is included on the list of Indiana indigenous wildlife determined to be threatened or endangered, or that is federally listed pursuant to the Federal ESA. The Indiana DNR implements the Indiana Nongame and Endangered Species Conservation Act, and can issue permits for incidental take of state-protected species.

1.4.2.3 Iowa

Location and Construction of Electric Generation Facilities

Iowa Administrative Code Chapter 24 Section 199, Location and Construction of Electric Generation Facilities, provides guidelines for determining whether a certificate should be issued to allow construction of a major electric generation facility. Iowa Administrative Code Chapter 24 also provides procedures for determining an applicant's compliance with the permit and licensing requirements of state regulatory agencies. These requirements apply to facilities with a combined nameplate capacity of 25 megawatts or larger; however, the requirements can be waived if the total capacity on each feeder line is less than 25 megawatts. These requirements do not address setback distances for roads, farms, wetlands, or other towers; county and local governments may have additional requirements.

Endangered Plants and Wildlife

Chapter 481B of the Iowa Administrative Code, Endangered Plants and Wildlife, prohibits the unlawful selling, taking, catching, killing, injuring, destroying, or having in possession any animal that is listed as threatened or endangered by the State of Iowa. Pursuant to Chapter 481B, the Iowa DNR may permit the taking, possession, purchase, or sale of state-listed species for scientific or educational purposes, or permit the capture, removal, or destruction of state-listed species that are causing damage to property or that pose a danger to human health.

1.4.2.4 Michigan

Endangered Species Act of the State of Michigan

The Endangered Species Act of the State of Michigan (M.C.L. § 324.36501 to 36507) prohibits the take, possession, transport, import, export, processing, selling, offering for sale, buying, or offering to buy species protected under the Federal or state ESAs. The Michigan DNR may permit the taking of state-listed species for scientific, zoological, or educational purposes, or the removal, capture, or destruction of state-listed species that are causing damage to property or that pose a danger to human health.

1.4.2.5 Minnesota

Wind Energy Conversion Systems

Pursuant to Minnesota Statutes Chapter 216 F, proposed wind projects with a capacity greater than 5 megawatts, or 25 megawatts or more if a permit is sought in a county with an authorized permitting authority, must obtain a site permit from the Minnesota Public Utilities Commission. The Minnesota Public Utilities Commission's procedures for review of proposed large energy facilities incorporate compliance with the Minnesota Environmental Policy Act (Minnesota Public Utilities Commission 2015). For proposed projects intended to generate greater than 50 megawatts, a Certificate of Need or a description of what the applicant intends to do with the power to be generated is required. County and local governments may have additional requirements.

Minnesota Environmental Policy Act

The Minnesota Environmental Policy Act of 1973 (MN Stat § 116D.01) created the environmental review program for the state of Minnesota. The function of the environmental review program is to avoid and minimize damage to Minnesota's environmental resources caused by public and private actions by requiring certain proposed projects to undergo special review procedures prior to obtaining approvals and permits otherwise needed. Environmental review can apply to any proposed action or project that:

- Involves the physical manipulation of the environment, directly or indirectly;
- Involves at least one governmental approval or one form of governmental financial assistance, or is conducted by a government unit;
- Is proposed to take place in the future. Projects constructed or those with all required governmental approvals are not subject to further review unless an expansion is proposed (Minnesota Environmental Quality Board 2010).

1.4.2.6 Missouri

Wildlife Code

The Wildlife Code of Missouri (Missouri Code of Regulations, Title 3, Department of Conservation, Division 10, Conservation Commission, Chapter 20, Wildlife Code), which is administered by the Missouri Department of Conservation, prohibits the importation, transportation, sale, purchase, taking or possession of any endangered species of wildlife, or hides or other parts thereof, or the sale or possession with intent to sell of any article made in whole or in part from the skin, hide, or other parts of any endangered species of wildlife. In addition to state-listed endangered species, all Federal species listed as threatened or endangered are listed as state-endangered in the Wildlife Code. The Missouri Department of Conservation may permit the taking of state-listed endangered species for scientific, educational, or zoological purposes; for biological studies for specific projects where the potential results are of sufficient public value to justify special collection of wildlife; and in instances where state-listed endangered species are causing damage to property.

1.4.2.7 Ohio

Power Siting

The Ohio Power Siting Board regulates wind energy projects greater than 5 megawatts under Ohio Administrative Code, Chapter 4906, Power Siting. Applicants for a certificate to site a wind-powered electric generation facility must provide general information about the proposed project, including financial, environmental, and social and ecological data. The Ohio Power Siting Board conducts an independent review of each application before making a decision on whether to approve an individual wind project for construction.

Division of Wildlife

Chapter 1531 of the Ohio Administrative Code establishes the Ohio Division of Wildlife's authority over Ohio's fish and wildlife, including protected species. Chapter 1531 enables the Ohio Division of Wildlife to adopt rules restricting the taking or possession of native wildlife, or eggs or offspring thereof, found to be threatened with statewide extinction. The Ohio Division of Wildlife can issue permits for the taking of species threatened with statewide extinction for zoological, educational, and scientific purposes, and for propagation in captivity to preserve the species.

1.4.2.8 Wisconsin

Wind Energy Systems

Pursuant to the Wisconsin Administrative Code Chapter PSC 128, proposed wind energy projects with a capacity of 100 megawatts or more, or those built by a state-regulated utility, must be approved by the Wisconsin Public Services Commission. Wisconsin Administrative Code Chapter PSC 128 requires project proponents to file an application for a wind energy system and provide written notice of the filing to property owners in the vicinity of the proposed location. The application must provide general information about the project, including a description of the proposed facilities, a timeline for project construction, and information regarding anticipated impacts.

Wisconsin's Threatened and Endangered Species Laws

Wisconsin State Statute 29.604 and Administrative Rule Chapter NR 27 establish, define, and guide Wisconsin's endangered and threatened species laws. The take of any animal listed as endangered or threatened is prohibited; however, the Wisconsin DNR may issue Incidental Take Permit/Authorizations under specified terms and conditions to take, transport, possess, or export listed endangered or threatened species for educational, zoological, scientific, or preservation purposes.

Wisconsin Environmental Policy Act

The Wisconsin Environmental Policy Act (Wis. Stat. Ann. § 1.11 (1982)) represents the state's environmental policy. The Wisconsin Environmental Policy Act requires the Wisconsin DNR and other state agencies to consider relevant environmental information, analyze appropriate alternatives, and involve broad citizen participation. It applies to state agencies, but it does not apply to local governments or private parties unless their actions involve state agency regulation or

funding. All environmental impact analyses under the Wisconsin Environmental Policy Act receive public review and comment (Wisconsin Department of Natural Resources 2015).

The Wisconsin Public Services Commission's review process under the Wisconsin Environmental Policy Act requires full consideration of environmental impacts for proposed projects. Under a cooperative agreement, the Wisconsin Public Services Commission and Wisconsin DNR coordinate the compliance of eligible proposed wind energy projects with the Wisconsin Environmental Policy Act. The Public Services Commission and Wisconsin DNR have developed application filing requirements that include information and consultation requirements associated with Wisconsin DNR interests and authorities. The agencies cooperatively review developer applications for completeness and develop joint environmental analysis documents.

1.5 Public Involvement

NEPA regulations (40 CFR part 1501) and Service guidelines (550 FW 2.3) specifically identify the need for a public scoping process when preparing an EIS. The scoping process is an open public process initiated prior to preparation of an EIS to help determine the scope of this EIS. In particular, the scoping process should:

- Identify and invite the participation of affected agencies, tribes, and other parties through written comments, public meetings, or other forums;
- Identify the key issues and concerns regarding the proposed action;
- Identify only those potentially significant issues relevant to the proposed action (while eliminating unimportant issues from further study); and
- Define the form, level of detail, and content of the EIS.

The Service initiated the scoping process for the proposed action through publication of an NOI to prepare an EIS; notice of scoping meetings; and request for public comments (80 *Federal Register* 33537 [June 12, 2015]). The following section explains the public participation process in support of the proposed action. Additional detail on the scoping process, including a summary of comments received during the 60-day scoping period, are provided in the scoping report for the proposed project, which is available on the Service-sponsored project website at http://midwestwindenergyhcpeis.org/.

1.5.1 Notice of Intent

Pursuant to NEPA, the Service is required to advise the public that it intends to gather information necessary to prepare an EIS, including information to inform a reasonable range of alternatives that meet the purpose and need of the proposed action. As stated above, an NOI to prepare an EIS for the MSHCP and ITP applications was published on June 12, 2015 (80 *Federal Register* 33537). The NOI announced a 60-day scoping period that ended on August 11, 2015. A copy of the NOI is included as Appendix A to the scoping report, which is available on the project website at http://midwestwindenergyhcpeis.org/.

1.5.2 Scoping Meetings and Comments Received

In July 2015, the Service conducted eight scoping meetings in each of the eight states in the Plan Area including Minneapolis, Minnesota; Madison, Wisconsin; Ames, Iowa; Columbia, Missouri; Lansing, Michigan; Columbus, Ohio; Indianapolis, Indiana; and Bloomington, Illinois. The scoping meetings provided an opportunity for attendees to learn about the proposed action, suggest alternatives to the proposed action, and identify issues of concern for evaluation in the EIS. The scoping meetings were held in the following locations and on the indicated times and dates:

- July 13, 2015; 5:00–7:00 p.m.; Elliott Recreation Center, 1000 E. 14th Street, Minneapolis, Minnesota;
- July 14, 2015; 5:00–7:00 p.m.; Warner Park Community Center, 1625 Northpost Drive, Madison, Wisconsin;
- July 15, 2015; 5:00–7:00 p.m.; Iowa State University Memorial Union, Campanile Room, 2229 Lincoln Way, Ames, Iowa;
- July 16, 2015; 5–7:00 p.m.; Battle High School, Commons, 7575 East Street Charles Road, Columbia, Missouri;
- July 20, 2015; 5:00–7:00 p.m.; Letts Community Center, 1220 West Kalamazoo Street, Lansing, Michigan;
- July 21, 2015; 5:00–7:00 p.m.; Columbus Downtown High School, Commons, 364 South 4th Street, Columbus, Ohio;
- July 22, 2015; 5:00–7:00 p.m.; World Sports Park, Ballroom, 1313 South Post Road, Indianapolis, Indiana; and
- July 23, 2015; 5:00–7:00 p.m.; Illinois Wesleyan University Memorial Center, Young Main Lounge, 104 E. University Avenue, Bloomington, Illinois.

Additionally, an online webinar was held on July 28, 2015 at 1:00 p.m. CST. Webinar participants were able to view and listen to a presentation as well as ask questions about the proposed action.

A total of 17 written comments were received during the scoping period, including three from Federal or state agencies and 14 from public, private or non-governmental organizations. A copy of all written comments received during scoping is included in the scoping report for the project, which is located on the Service-sponsored project website at http://midwestwindenergyhcpeis.org/. The comments and input obtained during the scoping period were considered in developing this EIS. Where appropriate, input from the scoping process is discussed in the relevant section of the EIS. For example, alternatives to the proposed action suggested during the scoping period are described in Chapter 2, *Alternatives*.

1.5.3 Draft EIS Comment Period

All members of the public, including any interested parties, are encouraged to submit comments on all aspects of this Draft EIS. The Draft MSHCP was concurrently released for public review and comment. The Service will consider all comments on the Draft EIS in the preparation of the Final EIS, which will include responses to all substantive comments received. All comments on this Draft EIS must be submitted within the published comment period, which will close 90 days after the U.S. EPA Notice of Availability of the Draft EIS is published in the *Federal Register*. The Service encourages

commenters to be as specific as possible and to substantiate concerns and recommendations when submitting comments on this Draft EIS.

Comments on the Draft EIS may be submitted in writing to:

Regional Director, Attn: Rick Amidon
U.S. Fish and Wildlife Service, Ecological Services
5600 American Blvd. West, Suite 990
Bloomington, MN 55437-1458

Comments may also be submitted electronically via the Federal eRulemaking Portal at http://www.regulations.gov. In the search box, enter Docket Number FWS-R3-ES-2015-0033. Comments submitted electronically will be given the same weight as mailed comments; therefore, comments submitted electronically do not need to be duplicated in writing.

The Service will host two online webinars during the public comment period. The webinar dates have not been determined at this time. Information on how to participate in the webinars will be provided on the Internet at http://www.midwestwindenergyhcpeis.org.

1.6 Organization of the EIS

- Cover Sheet
- Executive Summary
- Table of Contents
- Acronyms and Abbreviations
- Chapter 1, *Purpose and Need*
- Chapter 2, *Proposed Action and Alternatives*
- Chapter 3, *Affected Environment*
- Chapter 4, *Environmental Consequences*
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- Appendix F, *Example Programmatic Agreement for Cultural Resources*
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- Appendix I, *Midwest Wind Energy Multi-Species Habitat Conservation Plan*

Chapter 2
Proposed Action and Alternatives

This chapter describes the alternatives considered in this Environmental Impact Statement (EIS), including:

- An overview of the elements common to all action alternatives (Section 2.1);
- A description of alternatives analyzed in detail (Section 2.2);
- A summary comparison of the alternatives analyzed in detail (Section 2.3); and
- A summary of alternatives considered but not carried forward for detailed analysis (Section 2.4).

2.1 Elements Common to All Action Alternatives

As described in Section 2.2, *Alternatives Analyzed in Detail*, three action alternatives are considered in detail in this EIS. This subsection describes elements common to those alternatives, including the process that, upon Service approval, will be used to issue incidental take permits (ITPs) and concur with Certificates of Inclusion (COI); the Plan Area and Covered Lands; Covered Activities; and Covered Species.

2.1.1 Incidental Take Permit and Certificate of Inclusion Processes

As described in Chapter 9, *Plan Implementation,* of the Midwest Wind Energy Multi-Species Habitat Conservation Plan (MSHCP), if granted, the MSHCP will be implemented as both a "template" HCP for wind energy project proponents and a "programmatic" HCP implemented through a master permittee. Under a template HCP process, the U.S. Fish and Wildlife Service (Service) will directly issue individual ITPs to applicants that agree to implement the MSHCP. Under a programmatic HCP process, the Service will issue an ITP to a master permittee, who will be responsible for issuing COIs to wind energy companies that agree to implement the MSHCP at their facilities. Issuance of COIs by the master permittee will be completed in coordination with, and with concurrence from, the Service. The master permittee is anticipated to be comprised of a board with representation from the wind energy industry[5] and wind energy development-related conservation interests.

For the purposes of this EIS, it is assumed that the same permit issuance process will be used under each of the action alternatives.

2.1.2 Plan Area and Covered Lands

Each action alternative would be implemented within an eight-state *Plan Area* that encompasses all lands under the jurisdiction of the Midwest Region of the Service, including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin (see Figure 1-1). The geographic area where incidental take authorization would will be allowed under the action alternatives, referred to as *Covered Lands*, is a subset of the Plan Area and specifically excludes lands of particular importance

[5] The representative from the wind energy industry must be a member of the American Wind Energy Association.

to bat and migratory bird species, as well as a wide range of other wildlife (see Figure 1-2). The following areas are excluded from Covered Lands[6]:

- Land within 20 miles of known sensitive bat hibernacula[7] identified by the Service and state wildlife agencies; this minimizes the potential for impacts on habitats supporting major concentrations of covered bat species;
- Land within 3 miles of the shores of the Great Lakes[8]; this minimizes the potential for impacts of wind energy development on migrant water, shorebirds, and other migratory birds;
- Land within 1 mile of the edges of major rivers supporting bird migration corridors and/or concentrations of wintering waterfowl;
- Land within floodplain areas along the Mississippi and Illinois rivers; this minimizes the potential for impacts on important bird and bat migratory corridors;
- Land near high bat concentration areas in southern Indiana and Missouri; and
- Land within bird migratory areas in Illinois and around large lakes in Minnesota.

2.1.3 Covered Activities

Activities covered under the action alternatives, or *Covered Activities*, will include the construction, operation, maintenance, decommissioning and reclamation, and repowering of existing and future land-based commercial wind energy facilities within Covered Lands. The use of herbicides to control or remove vegetation is not a Covered Activity. The Service's Land-Based Wind Energy Guidelines (U.S. Fish and Wildlife Service 2012) will also be used to guide wind-related siting and construction activities in Covered Lands.

2.1.3.1 Construction

Construction of a new wind energy facility typically takes 1 to 2 years; however, it is largely dependent on the size of the project and site conditions. Construction activities associated with new wind energy development typically include, but are not limited to, site grading and earthwork; tree cutting and removal; installation of communications and collection systems; construction of access roads and crane pads; improvements to and restoration of public roads in order to gain access to facility sites for construction; construction of concrete batch plants, turbine pads/foundations, equipment laydown yards, access roads and staging areas; installation of turbines and meteorological towers; clearing vegetation from rights-of-way; and construction of transmission/interconnection lines and substations. Construction activities are typically accomplished using heavy equipment, such as graders, earth movers, drill rigs, cranes, and bulldozers. Although existing roads may be used to provide access to the construction site, new roads are often constructed to accommodate construction crews, large equipment, and turbine

[6] None of the action alternatives will preclude the development of wind energy projects outside of Covered Lands; however, those projects will not be eligible for incidental take coverage under the MSHCP (or other action alternative).

[7] Sensitive bat hibernacula generally include Priority 1 and Priority 2 hibernacula as identified by the Service at the time the plan was developed.

[8] Offshore wind energy projects, including wind energy development on the Great Lakes, is not contemplated in (or covered under) the MSHCP or action alternatives.

infrastructure. After construction, temporary work areas (e.g., staging areas and equipment laydown areas) are usually graded to restore topography and seeded to restore vegetation.

2.1.3.2 Operation

Wind turbine generators (WTGs) are the operational component of wind energy projects, with designs and rated generation capacity varying substantially among manufacturers. WTGs typically consist of three rotor blades, a nacelle (which contains the main mechanical components of the WTG), rotor assembly, and either three or four tower pieces connected to a concrete foundation. Representative depictions of several types of WTGs are provided in Figure 2-1.

WTGs are connected to each other, to an operations center, substations, and to the power grid, and are constantly monitored, both on- and off-site. WTGs are typically equipped with external anemometers and a wind vane to provide real-time wind speed and direction information to an electronic controller. WTGs can operate at a fixed or variable rotational speed, and each turbine's speed generates a rated electrical output. WTGs do not start turning until the wind reaches a certain speed (the cut-in speed). Modern WTGs stop turning when winds exceed safe velocities of roughly 80 feet per second (approximately 25 meters per second [mps]) (the cut-out speed).

WTGs have weather instruments that adjust the pitch of the blades to account for changing wind speeds and to maintain a constant rotation per minute. Rotational speeds generally range from 14 to 22 rotations per minute, and modern WTGs are designed to stop turning when winds exceed the cut-out speed. Each WTG also contains an automatic shutdown safety system in the event of excessive vibration, mechanical failures, grid electrical faults, or loss of grid power.

Under the action alternatives, turbines must be feathered (*i.e.,* the pitch adjusted out of the wind so that they will not spin) until they reach the manufacturer's cut-in speed or, during identified periods of risk to Covered Species, until they reach the operational cut-in speed allowed under the action alternative. Operational cut-in speeds allowed during periods of higher risk to Covered Species vary under the action alternatives, as described in Section 2.2, *Alternatives Analyzed in Detail*.

It should be noted that wind technology is always advancing and WTGs will likely continue to become more powerful and efficient in the future. These changes in technology could result in development of WTGs that look and operate differently than described in this draft EIS. Future WTGs could include new and different blade designs, different approaches to control the turbulent flow around the blades, and blade materials that are stronger and lighter. Because of the uncertainty in future wind WTG designs and technologies, the Service has no ability to analyze what the potential effects of those WTGs will be on the environment.

Image 1. Darrieus Rotor Wind Turbine

Image 2. Horizontal Axis Wind Turbine

Image 3. Vertical Axis Wind Turbine

Figure 2-1
Representative Depictions of Wind Turbine Generators
Midwest Wind Energy Multi-Species HCP EIS

2.1.3.3 Maintenance

Maintenance activities will include routine inspections; replacement of turbine parts; application of lubricants; mechanical management of vegetation to reduce wildfire risk and maintain rights-of-way, access roads, and drainage; repair and replacement of infrastructure (e.g., fencing, culvert crossings, substations, administrative buildings, grading, paving, and graveling of access roads); and repair and improvements to drainage. Debris is routinely removed from turbine pads. Rodent control may also be necessary if burrowing activities are observed near turbine pads.

2.1.3.4 Decommissioning and Reclamation

The currently estimated operational lifespan of a new wind energy facility is approximately 20 to 30 years. Once the facility has exceeded its operational lifespan, decommissioning and reclamation may be considered. Typically, decommissioning is completed within 1 year of terminating operations.

Decommissioning typically includes the dismantling and removal of turbines and pads, transformers, connector lines and substations, and other project-related structures such as fences or signage. Reclamation typically includes restoration of the project site to the pre-development condition, or to conditions similar to those surrounding the facility. Reclamation activities may include ripping of compacted soils, removal of graveled or paved surfaces, transport and placement of topsoil, seeding and planting of vegetation, and site contouring to restore more natural drainage patterns. Similar to construction activities, decommissioning and reclamation activities involve the use of heavy equipment and vehicles such as cranes, bulldozers, graders, and backhoes. Tractor trailers and haul trucks are also used to remove salvaged materials from the project site.

2.1.3.5 Repowering

After a project is decommissioned, it may be repowered with new or updated equipment. Repowering typically requires replacement of WTGs, and may necessitate increasing the footprint of existing tower pads and access roads to accommodate transport and assembly of new WTGs.

2.1.4 Covered Species

Incidental take coverage will be provided for eight species under all of the action alternatives, including six federally listed bat and bird species, one bat species that may be listed in the future, and the bald eagle (*Haliaeetus leucocephalus*), which is protected under the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. § 668). These species are collectively referred to as *Covered Species* in the EIS (see Table 2-1).

Table 2-1. Species Considered for Incidental Take Coverage under Action Alternatives

Common Name	Scientific Name	Range in Plan Area	Listing Status[1]	Critical Habitat
Kirtland's warbler	*Setophaga (=Dendroica) kirtlandii*	Michigan, Wisconsin	FE	Not designated
Least tern – Interior Population	*Sterna antillarum athalassos*	Illinois, Indiana, Missouri, Iowa	FE	Not designated
Piping plover – Great Lakes population	*Charadrius melodus*	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	FE	Units within all states within species range in Plan Area
Piping plover – Northern Great Plains population	*Charadrius melodus*	Iowa, Missouri, Minnesota	FT	Not within Plan Area
Indiana bat	*Myotis sodalis*	Illinois, Indiana, Iowa, Michigan, Missouri, Ohio	FE	Specific hibernacula (caves and mines) in Illinois, Indiana, and Missouri
Northern long-eared bat	*Myotis septentrionalis*	Plan Area-wide	FT	Not designated
Little brown bat	*Myotis lucifugus*	Plan Area-wide	None	Not designated
Bald eagle	*Haliaeetus leucocephalus*	Plan Area-wide	Eagle Act	Not designated

[1] Listing Status: FE = listed as endangered under Federal ESA; FT = listed as threatened under the Federal ESA; Eagle Act = Protected under the Bald and Golden Eagle Protection Act.

2.2 Alternatives Analyzed in Detail

This section describes the four alternatives considered in detail in this EIS:

- Alternative A – Proposed MSHCP Alternative
- Alternative B – Reduced Permit Duration Alternative
- Alternative C – Increased Cut-In Speed Alternative
- Alternative D – No Action Alternative

These alternatives reflect a reasonable range of alternatives that meet both the requirements of the National Environmental Policy Act and the purpose and need of the proposed action, as described in Section 1.2.1, *Purpose and Need for Action*. These alternatives were developed by the Service, with input from the state conservation agencies responsible for managing natural resources within the Plan Area. Input provided by the public, non-governmental organizations, and other interested stakeholders during the scoping period also informed the development of alternatives (see Section 1.5, *Public Involvement*, for a description of the public outreach and scoping process).

2.2.1 Alternative A—Proposed MSHCP Alternative

Under Alternative A, the preferred alternative, ITPs or COIs will be issued under the MSHCP for Covered Activities described in Section 2.1.3. Incidental take coverage will be provided for the eight Covered Species listed in Table 2-1; impacts to other federally listed species could either be avoided

through siting and best management practices, or addressed through a separate and site-specific ESA Section 10(a)(1)(B) permitting process. If impacts to other federally listed species cannot be avoided, and an applicant does not obtain a separate permit for that species, an ITP under the MSHCP will not be issued. Alternative A also includes minimization, monitoring, reporting, and compensatory mitigation requirements as part of the conservation strategy for Covered Species.

During the first 5 years, up to 18,004 MW of existing installed wind energy in Covered Lands could apply for and receive incidental take authorization under the MSHCP after review by the Service, provided they implement the avoidance, minimization, monitoring, and mitigation requirements provided in the MSHCP. An additional 33,000 MW of new commercial wind energy facilities within Covered Lands could opt-in to the MSHCP during the first 15 years of the MSHCP.

2.2.1.1 Existing and Future Wind Energy Capacity in the Plan Area

The MSHCP provides estimates of both installed (existing) wind energy within the Plan Area and an estimate of additional (new) wind energy capacity that may be installed over the 45-year term of the MSHCP (Leidos 2015). These estimates are summarized below.

Installed Wind Energy

By the end of 2015, the Plan Area will support approximately 18,004 MW of installed wind energy (Leidos 2015). Figure 2-2 depicts the approximate location and capacity of these facilities.

Under Alternative A, existing commercial multi-turbine wind energy facilities that occur within Covered Lands may "opt-in" during the first 5 years of the MSHCP, provided they meet all of the requirements of the MSHCP and implement the required avoidance, minimization, and mitigation measures applicable to their facility. Implementation of MSHCP-required avoidance, minimization, mitigation, and monitoring measures at existing facilities will substantially reduce impacts to Covered Species relative to existing conditions. There will be no limit on the number of qualifying existing wind energy facilities within Covered Lands that may request incidental take coverage under the MSHCP; however, for the purposes of this analysis, we have assumed that no more than 18,004 MW of installed wind energy will opt-in to the MSHCP.

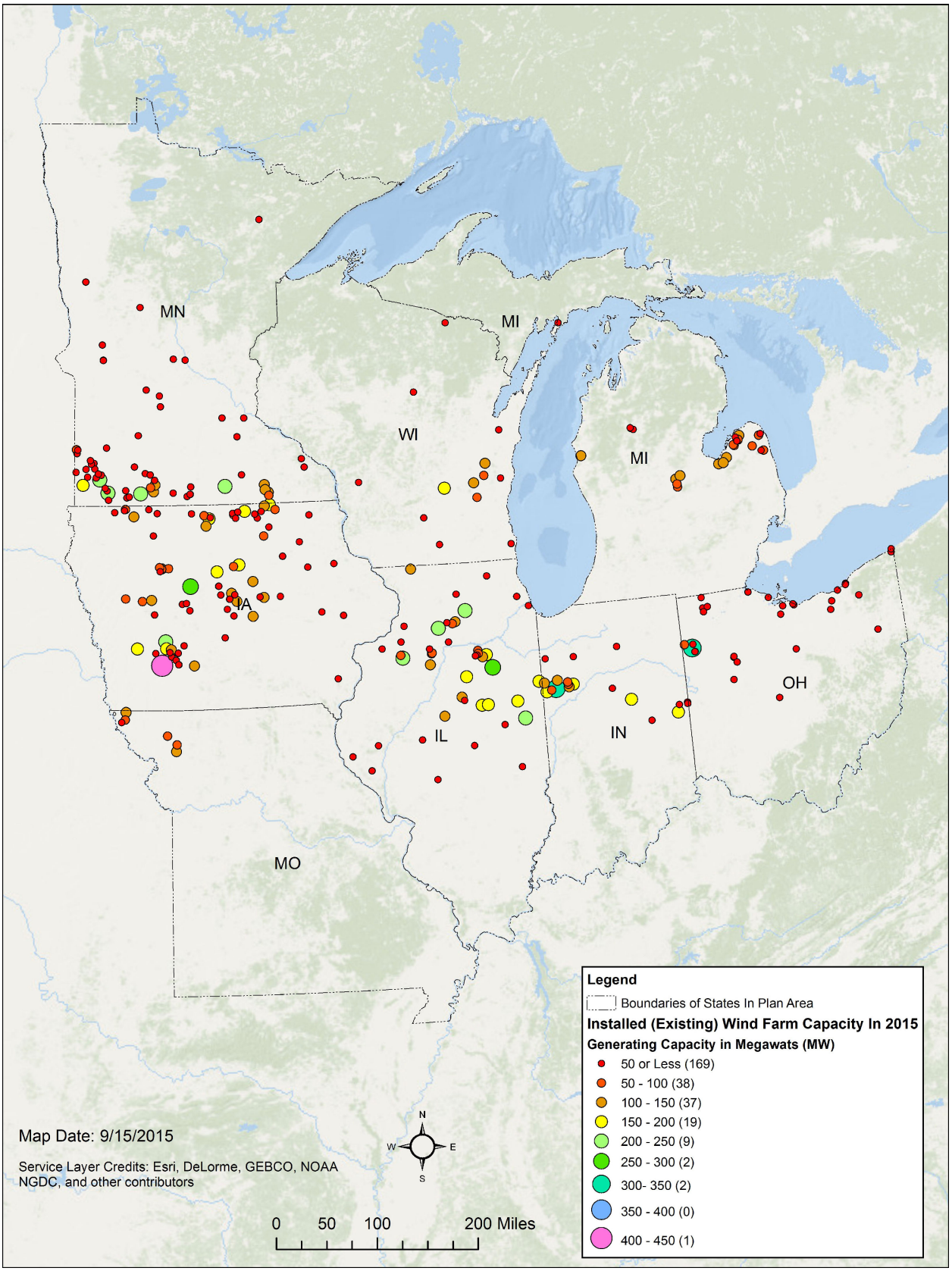

Figure 2-2
Installed Wind Energy Facilities in the Plan Area (2015)
Midwest Wind Energy Multi-Species HCP EIS

Regional Wind Energy Build-Out

New wind energy facilities may be constructed anywhere within Covered Lands during the first 15 years of the MSHCP under Alternative A. Although the exact location of future development is unknown, Alternative A estimates that up to 33,000 MW[9] of new wind energy capacity may be installed in the Plan Area during the initial 15 years of the MSHCP (Table 2-2). Accordingly, under Alternative A, the Service will consider incidental take authorization for up to 33,000 MW of new wind energy capacity within Covered Lands.

Table 2-2. Maximum Anticipated Build-Out of New Wind Energy Projects

State	Build Out (MW)[1]
Iowa	9,765
Illinois	4,094
Indiana	5,848
Michigan	727
Minnesota	2,030
Missouri	971
Ohio	7,108
Wisconsin	2,457
TOTAL	33,000

Source: ESRI 2015.
MW = megawatts.
[1] Estimate mean MW (2016 to 2030).

Estimates of future development provided in the MSHCP were generally based on historic (2010 and 2012) wind energy industry growth in each state and current and anticipated renewable portfolio standard requirements for the region. Actual implemented build-out of new wind energy projects may be less than the maximum anticipated build-out, depending on the number and generation capacity of wind energy projects issued take authorizations under Alternative A. In addition, future build-out of wind energy facilities may vary by state depending on a variety of factors, such as natural gas prices, utility preferences, and load growth (Leidos 2015). As a result, although Alternative A assumes that no more than 33,000 MW of new wind energy capacity will be authorized in Covered Lands under the MSHCP, there is no requirement that the state level estimates in Table 2-2 be met; build-out within states may vary provided the maximum capacity of 33,000 MW is not exceeded.

2.2.1.2 Conservation Strategy

This section describes the conservation strategy for Covered Species under Alternative A, including measures to avoid, minimize, and mitigate impacts from Covered Activities; monitoring and reporting requirements; and adaptive management requirements. This information is summarized from Chapter 5, *Conservation Plan*, and Chapter 7, *Monitoring, Adaptive Management and Reporting*, in the MSHCP.

[9] The 33,000 MW of estimated new wind energy capacity reflects the manufacturer's installed *rated capacity*, or the designed maximum output of a generator under specific conditions.

General Avoidance and Minimization Measures

Under Alternative A, proposed and existing wind energy projects will be required to complete applicable surveys prior to submitting ITP applications under the MSHCP (Table 2-3). Survey results will be used to identify project-specific avoidance and minimization measures; identify estimated levels of take of Covered Species and impacts to Covered Species habitats; and to calculate compensatory mitigation requirements.

Table 2-3. Survey Requirements – Alternative A

Survey Requirement (SURE)	Summary
SURE1: Determine the presence of habitat for covered bat species within and adjacent to the wind energy facility site.	**Proposed Wind Energy Facilities**. Proposed wind energy facilities are required to conduct pre-construction surveys for covered bat species habitat at the facility site and within 2.5 miles of the facility site boundary. Surveys will be conducted by a U.S. Fish and Wildlife Service (USFWS) approved biologist. Depending on site conditions and available data, the existence of habitat for covered bat species may be determined using a desktop (e.g., remote sensing using aerial imagery and existing land cover data) and/or ground-based analysis to identify habitat types (e.g., foraging habitat, hibernacula, maternity roosts, swarming habitat). Information on potential hibernacula (e.g., mine portals, karst topography) within 20 miles of the proposed facility site will be gathered from existing sources (e.g., USFWS, state resource agencies). Under this AMM a map must be prepared of habitat types present within 2.5 miles of the facility boundary at a minimal mapping unit of one acre. The information gathered during the initial assessment of habitat is the basis for designing and implementing preconstruction presence/absence surveys for covered bat species (see SURE 2). **Existing Wind Energy Facilities**. Existing wind energy facilities are required to conduct covered bat species habitat surveys as described for proposed wind energy facilities unless, with the concurrence of USFWS, existing survey information is sufficient to assess the presence of habitat with a 2.5 mile radius of the existing facility boundary.

Survey Requirement (SURE)	Summary
SURE2: Conduct presence/absence surveys to determine occurrence of covered bat species and presence of significant habitat or resources.	**Proposed Wind Energy Facilities**. Where bat habitat is identified based on the results of habitat surveys in SURE1, pre-construction presence/absence surveys will be conducted for covered bat species within the proposed facility site to detect the presence or likely absence of covered bat species. Presence/absence surveys, data analysis, and reporting will be conducted in accordance with the USFWS approved survey methods and guidance presented in Appendix G of the MSHCP. Surveys will be conducted by a qualified biologist with all required permits. Pre-construction surveys must be conducted prior to implementation of activities that change the condition of the site, such as site preparation, land clearing or construction. Pre-construction surveys are conducted to determine (a) species occurrence, (b) bat use activity levels (e.g., detections, relative abundance, seasonal timing, areas of concern), and (c) presence (or probable presence) of significant bat habitat in the area of the proposed facility, including hibernacula (winter roosts), maternity roosts, swarming sites, and migration/movement corridors. If potential hibernacula are found under SURE1, swarm surveys will be conducted in appropriate months for the species and location as part of the pre-construction surveys. Proposed surveys, data analysis, and reporting must be developed in coordination with the USFWS (see Appendix G of the MSHCP for an example survey methodology). Surveys will be conducted during each season when covered bat species may be present for one full survey year. All required permits must be obtained if netting or handling specimens. Survey reports, including all raw data, must be submitted with ITP applications and COI requests. **Existing Wind Energy Facilities**. Existing wind energy facilities are required to conduct summer covered bat species presence/absence surveys prior to applying for a take authorization. Presence/absence surveys will be conducted in accordance with the USFWS approved survey methods described in Appendix G of the MSHCP and as amended in the future. Survey reports, including all raw data, must be submitted with ITP applications and COI requests.
SURE3: Determine the presence of covered bird species habitats.	**Proposed Wind Energy Facilities.** If a proposed wind energy facility is located within the range of a covered bird species, pre-construction surveys must be conducted for covered bird species habitat at facility sites (for Kirtland's warbler within a 1 mile radius of the facility site boundary – see SURE5). The presence of covered bird species habitat within the facility site may be determined by a desktop and/or ground-based analysis of to determine the presence of covered bird species habitat types (e.g., foraging, nesting, migration). A map of all covered bird species habitat must be produced at a minimal mapping unit of 1 acre. The information gathered during this assessment of habitat is the basis for designing and implementing preconstruction presence/absence surveys for covered bird species (see SURE4). **Existing Wind Energy Facilities.** Existing wind energy facilities applying for a take authorization are required to conduct covered bird species habitat surveys as described for proposed wind energy facilities unless, with the concurrence of USFWS, existing survey information is sufficient to the habitat map.

Survey Requirement (SURE)	Summary
SURE4: Conduct presence/absence surveys for interior least tern, piping plover, and bald eagle.	**Proposed Wind Energy Facilities**. If nesting, foraging, or high quality migration habitat is found to occur for interior least tern, piping plover, and bald eagle within the boundary of a proposed or existing wind energy facility (see SURE3), species-specific presence/absence surveys must be conducted in the habitat to detect the presence or likely absence of the applicable covered bird species. Presence/absence surveys for bald eagle will be conducted in accordance with the USFWS approved survey methods described in Appendix G of the MSHCP. It is anticipated that habitats for interior least tern and piping plover are not present within the Covered Lands; however, if habitat for these species is present, the project proponent will coordinate with the USFWS to determine the survey methods. Surveys will be conducted by a qualified biologist with all required permits. Surveys must be conducted during each season when a covered bird species may be present for a minimum of one full survey year. Additional surveys may be required by USFWS depending on the species and circumstances of the specific facility. If available for the site, existing survey information that meet the standards of the survey protocol may be used to determine if habitat in the facility area is occupied or the project proponent may presume that the habitat is occupied for the purpose of determining applicable AMM and mitigation requirements. **Existing Wind Facilities**. Existing wind energy facilities are required to implement surveys for interior least tern and piping plover as described for proposed facilities. Bald eagle surveys are not required as described for proposed facilities. The determination of presence/absence of bald eagles will be based on an assessment of existing bald eagle survey and other relevant available information.
SURE5: Conduct surveys to determine occurrence of Kirtland's warbler, level of habitat use, and presence of significant habitat or resources.	**Proposed Wind Energy Facilities**. For proposed wind energy facilities that are sited outside of a Kirtland's Warbler Management Areas (KWMA; see Figure 4-6 of the MSHCP), but support Kirtland's warbler nesting habitat (see Figure 5-1 of the MSHCP) within 1 mile of proposed wind turbine locations, pre-construction surveys must be conducted within 5 years before the initiation of construction to determine the presence of habitat and the presence/absence of Kirtland's warbler in or within 1 mile of the facility site (see Figure 5-1 of the MSHCP). Kirtland's warbler surveys will be conducted by a qualified biologist with required permits using the survey methods described in Appendix G of the MSHCP. If a singing male is detected, it is assumed that the habitat is occupied by a breeding pair of Kirtland's warbler. **Existing Wind Facilities.** Existing wind energy facilities applying for a take authorization are required to conduct Kirtland's warbler presence/absence surveys as described for proposed wind energy facilities unless, with the concurrence of USFWS, existing survey information is sufficient to determine the presence/absence of Kirtland's warbler.

Survey Requirement (SURE)	Summary
SURE6: Determine the proximity of proposed wind energy facilities to bald eagle use areas.	Using publically available information, determine the proximity of the proposed or existing wind energy facility to known bald eagle use areas (e.g., foraging areas, nesting sites, travel corridors). Recommended information sources are described in the USFWS's Eagle Conservation Plan Guidance, Module 1-Land Based Wind Energy (see Appendix G of the MSHCP). If results of the evaluation indicate that the proposed or existing facility is in a bald eagle use area, the project proponent will conduct surveys to gather site-specific bald eagle use information (e.g., flight patterns through the planned or existing wind energy facility) using methods approved by the USFWS.

Additional general avoidance and minimization measures that apply to all covered bat species are summarized in Table 2-4. General avoidance and minimization measures that apply to all covered bird species are summarized in Table 2-5.

Table 2-4. General Avoidance and Minimization Measures for Covered Bat Species – Alternative A

Avoidance and Minimization Measure (AMM)[1]	Summary
Project Siting, Turbine Siting, and Design Criteria	
AMM GEN1: Minimize operations-related impacts on covered bat species near hibernacula.	This AMM applies to all applicable activities of new and existing wind energy facilities. Project proponents will contact the USFWS and applicable state wildlife agencies to determine if any hibernacula used by covered bat species are known within the vicinity of the wind energy facility or that are located during pre-construction and presence/absence surveys (see SURE1). Project proponents must either: (1) site new or relocated turbines away from current or historical hibernacula of any of the covered bat species, or (2) if siting turbines in these areas cannot be reasonably avoided with the concurrence of the USFWS, those turbines will be subject to the feathering and cut-in speed regime and described in the species-specific AMMs, and the tree clearing limitations in AMM GEN4. Avoidance requires siting turbines at least: • 20 miles from current or historical hibernacula supporting greater than 10,000 individuals of covered bat species. • At least 10 miles from current or historical hibernacula supporting between 1,000 and 9,999 individuals of covered bat species. • At least 5 miles from current or historical hibernacula supporting between 1 and 999 individuals of covered bat species. This requirement is applicable to newly discovered hibernacula or historical hibernacula not addressed through hibernacula data used to identify the Covered Lands. "Historical hibernacula" are known occurrences of hibernacula for which the physical conditions of the hibernacula are still intact and functional for the species (i.e., the hibernacula habitat has not been destroyed).

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM GEN2: Minimize impacts on covered bat species hibernaculum.	This AMM applies to all applicable activities of proposed wind energy facilities. The following measures will be implemented to protect bat species hibernaculum's below-ground geology, airflow patterns, karst topography/ hydrology or entrance(s). If blasting or drilling will occur within 0.5 mile of a hibernaculum entrance or known underground workings, these activities can only occur from May 1- August 1 to ensure hibernating bats are not affected. In addition, if the hibernaculum can be accessed by the project proponent, monitors will be installed to detect underground vibrations. If underground vibrations are detected within the hibernaculum, a geotechnical analysis must be conducted to ensure there will be no impacts to the hibernaculum's below-ground geology, airflow patterns, hydrology, etc. Access into hibernacula will follow established white-nose syndrome procedures.
AMM GEN3: Minimize impacts on covered bat species in summer habitat.	This AMM applies to all applicable activities of proposed wind energy facilities. To avoid impacts on occupied summer habitat, project proponents must site wind turbines and other facility features at least 1,000 feet from documented summer period covered bat species capture locations, document maternity colonies, and patches of forest and wetlands, tree lines, and riparian corridors. If siting facility components in these areas cannot be reasonably implemented with the concurrence of the USFWS, the tree clearing limitations in AMM GEN5 must be applied. If siting of wind turbines in these areas cannot be avoided, the applicable wind turbine operational guidelines described in the species-specific AMMs must be implemented.
Construction, Maintenance and Decommissioning	
AMM GEN4: Avoid impacts on covered bat species winter habitat	This AMM applies to all applicable activities of proposed wind energy facilities. To avoid impacts to hibernacula of covered bat species, project proponents must avoid forest clearing within 0.25 mile of any known occupied or historical hibernacula (using the locations of hibernacula identified in AMM GEN1). Forest clearing at distances greater than 0.25 miles to the distances from hibernaculum that support the bat populations described in AMM GEN1 must be limited in extent such that use of the hibernaculum by bats will not be impacted.[10]

[10] As described in the MSHCP, the USFWS will make a determination during its evaluation of ITP applications and consistency review of COIs if the proposed forest clearing will impact the use of a hibernaculum.

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM GEN5: Implement timing constraints to avoid construction impacts to covered bat species documented to be present within the wind energy facility boundary.	This AMM applies to all applicable activities of proposed wind energy facilities. Except in emergency situations where there is a risk to public safety, the following timing constraints apply: • No tree clearing of suitable spring staging/fall swarming habitat from March 15 to May 31 and August 1 to November 15 in areas that are less than 20 miles from a hibernacula supporting greater than 10,000 individuals of covered bat species; or less than 10 miles from a hibernacula supporting between 1,000 and 9,999 individuals; or less than 5 miles from hibernacula supporting fewer than 999 individuals of covered bat species. • No tree clearing within occupied summer habitat from April 1 to September 30. • No construction activities within 0.5 mile of documented roost trees or other structures from April 1 to August 15 to avoid noise disturbance during maternity period. In coordination with the USFWS, specific avoidance and minimization measures may be developed to permit clearing during the active season on a site-specific basis. If agreement can be reached on specific measures, these measures will be documented by both the responsible USFWS the project proponent as having been implemented.
AMM GEN 6: Minimize cutting of hazard trees and limbs.	This AMM applies to all applicable activities of new and existing wind energy facilities. Except in emergency situations where there is a risk to public safety, avoid cutting of hazard trees or tree limbs that provide suitable habitat for covered bat species between April 1 and September 30. If cutting of individual hazard trees that have roost site characteristics (peeling bark, cracks, crevices) cannot be avoided during the bat active period, then an emergence survey must be conducted to document whether or not bats are currently roosting in the tree. If no bats are observed, the tree may be cut the day following the second night of the survey. If bats are observed, it must be assumed to be a roost tree for covered bat species and tree clearing must wait until after September 30.

[1] See Chapter 5 of the MSHCP for a more detailed discussion of general avoidance and minimization measures that apply to all covered bat species.

Table 2-5. General Avoidance and Minimization Measures for Covered Bird Species – Alternative A

Avoidance and Minimization Measure (AMM)[1]	Summary
Construction, Maintenance and Decommissioning	
AMM GEN7: Lighting protocol for turbines/ substations/ meteorological towers.	**Proposed Wind Energy Facilities**. Proposed obstruction avoidance lighting must be approved by the Federal Aviation Administration (FAA). To minimize any potential effects from FAA lighting on birds, proposed and repaired facilities will use the lowest intensity lighting allowed by FAA on nacelles and meteorological towers. Lights will be of reduced intensity and will use the longest duration between flashes allowable under FAA regulations and emit no light during the "off phase." In addition to FAA required lights, keep lighting at both operation and maintenance facilities and substations located within half a mile of the turbines to the minimum required. A limited number of lights are expected to be installed on substations, operations and maintenance facilities, and above turbine tower doors for security and maintenance purposes. To reduce potential attraction of birds at night, these lights will be minimized except where necessary for security and minimum intensity lighting will be used to the maximum extent practicable. No steady burning lights will be left on at buildings and instead, motion detector lighting or infrared light sensors will be used. Lights will be shielded downward to minimize skyward illumination, and high intensity, steady burning, bright lights such as sodium vapor or spotlights will not be used. **Existing Wind Energy Facilities**. If the existing obstruction avoidance lighting has not been approved by FAA, the necessary lighting to achieve compliance must be installed. Any additional lighting installed over the term of the MSHCP will comply with the requirements described for proposed wind energy facilities.
AMM GEN8: Permanent meteorological towers must be free standing with no guy-wires.	This AMM applies to proposed wind energy facilities. Permanent meteorological towers associated with proposed wind energy facilities must be constructed without guy-wires. Temporary meteorological towers with guy-wires may be constructed, but must be fitted with bird flight diverters or high visibility marking devices and removed within 1 year of initial facility operations unless otherwise approved by the USFWS.

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM GEN9: Bury collector and communication lines and follow APLIC Standards	**Proposed Wind Energy Facilities**. Connector and communications lines must be buried unless, with the concurrence of the USFWS, burial of the lines is impracticable (e.g., where shallow bedrock exists) or where greater adverse impacts to biological resources would result. Above-ground low and medium voltage lines, transformers and conductors will follow the 2012 or most recent Avian Power Line Interaction Committee's (APLIC) Suggested Practices for Avian Protection on Power Lines. Overhead lines may be used when the lines parallel tree lines, employ bird flight diverters, or are otherwise screened so that collision risk is reduced. Overhead lines may be acceptable if sited away from high-use bird crossing locations (e.g., between roosting, nesting, and feeding areas. The lines should be marked in accordance with APLIC collision guidelines. For proposed wind energy facilities, planned associated power and communications lines will be either buried or clearly marked following APLIC standards to deter bird strike. **Existing Wind Energy Facilities**. Any new connector and communications lines that may be installed over the term of the MSHCP must be buried as described for proposed wind energy facilities.

[1] See Chapter 5 of the MSHCP for a more detailed discussion of general avoidance and minimization measures that apply to all covered bird species.

Species Specific Avoidance and Minimization Measures

In addition to the survey requirements and general avoidance and minimization measures described above, species-specific avoidance and minimization measures for Covered Species will be implemented under Alternative A. These measures are summarized in Table 2-6, and the cut-in speeds by season for covered bat species are provided in Table 2-7.

Table 2-6. Species-Specific Avoidance and Minimization Measures – Alternative A

Avoidance and Minimization Measure (AMM)[1]	Summary
Indiana Bat, Northern Long Eared-Bat, and Little Brown Bat	
AMM INBA1: During all times of year and periods of night when Indiana bat may be at risk, feather all turbines prior to reaching manufacturer set or bat-specific (tailored) cut-in speeds.	During all times of year and periods of night when Indiana bat may be at risk, feather all turbines prior to reaching manufacturer set or bat-specific (tailored) cut-in speeds. Wind turbines will be operated at the cut-in speeds[11] by season in occupied Indiana bat habitat during each season as indicated in Table 5-4 of the MSHCP. Differences in cut-in speeds reflect the differences in risk for Indiana bat collisions with turbine blades among the seasons. All facilities must implement the cut-in speed requirements for the spring and fall migration periods. Summer cut-in speed requirements only apply to wind energy facilities that have documented the presence of Indiana bat during surveys conducted under survey requirement SURE2. The cut-in speeds for spring migration, summer, and fall migration in Table 5-4 of the MSHCP will be superseded by the cut-in speed requirements shown in the last two columns of Table 5-4 of the MSHCP if there is risk for take of individuals from turbines located within 1,000 feet of maternity colony habitat or near swarming/staging areas as defined in AMM GEN1. Applicable cut-in speed restrictions in Table 5-4 of the MSHCP will be in effect from 30 minutes before sunset to 30 minutes after sunrise at facilities potentially affecting a maternity colony or swarming/staging areas, and from sunset to sunrise under other site conditions. Turbines need not curtail cut-in speeds as described in Table 5-4 if air temperatures are at or below 50 degrees Fahrenheit (^{o}F) based on a rolling average of 10 minutes. For proposed wind energy facilities, if the temperature rises above 50°F based on a 10-minute rolling average, turbines must return to the applicable site-specific cut-in speed in Table 5-4 of the MSHCP. Existing wind energy facilities will return to the applicable site-specific cut-in speed in Table 5-4 of the MSHCP as quickly as possible within the technological limits of the facility.

[11] All wind speed requirements identified in the AMMs refer to real-time measurements at the rotor hub height of turbines.

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM NLEB1: During all times of year and periods of night when northern long-eared bat may be at risk, feather all turbines prior to reaching manufacturer set or bat-specific (tailored) cut-in speeds.	During all times of year and periods of night when northern long-eared bat may be at risk, feather all turbines prior to reaching manufacturer set or bat-specific (tailored) cut-in speeds. Wind turbines will be operated at the cut-in speeds[12] by season in occupied northern long-eared bat habitat during each season as indicated in Table 5-6 of the MSHCP. Differences in cut-in speeds reflect the differences in risk for northern long-eared bat collisions with turbine blades among the seasons. All facilities must implement the cut-in speed requirements for the spring and fall migration periods. Summer cut-in speed requirements only apply to wind energy facilities that have documented the presence of northern long-eared bat during surveys conducted under survey requirement SURE2. The cut-in speeds for spring migration, summer, and fall migration in Table 5-6 of the MSHCP will be superseded by the cut-in speed requirements shown in the last two columns of Table 5-6 of the MSHCP if there is risk for take of individuals from turbines located within 1,000 feet of maternity colony habitat or near swarming/staging areas as defined in AMM GEN1. Applicable cut-in speed restrictions in Table 5-6 of the MSHCP will be in effect from 30 minutes before sunset to 30 minutes after sunrise at facilities potentially affecting a maternity colony or swarming/staging areas, and from sunset to sunrise under other site conditions. Turbines need not curtail cut-in speeds as described in Table 5-6 of the MSHCP if air temperatures are at or below 50°F based on a rolling average of 10 minutes. For proposed wind energy facilities, if the temperature rises above 50°F based on a 10-minute rolling average, turbines must return to the applicable site-specific cut-in speed in Table 5-6 of the MSHCP. Existing wind energy facilities will return to the applicable site-specific cut-in speed in Table 5-5 of the MSHCP as quickly as possible within the technological limits of the facility.

[12] All wind speed requirements identified in the AMMs refer to real-time measurements at the rotor hub height of turbines.

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM LBBA1: During all times of year and periods of night when little brown bat may be at risk, feather all turbines prior to reaching manufacturer set or bat-specific (tailored) cut-in speeds.	During all times of year and periods of night when little brown bat may be at risk, feather all turbines prior to reaching manufacturer set or bat-specific (tailored) cut-in speeds. Operate wind turbines at cut-in speeds[13] by season in occupied little brown bat habitat—spring migration, summer, fall migration, and swarming/staging—as indicated in Table 5-8 of the MSHCP. Differences in cut-in speeds reflect the differences in risk for little brown bat habitat collisions with turbine blades among the seasons. All facilities must implement the cut-in speed requirements for the spring and fall migration periods. Summer cut-in speed requirements only apply to wind energy facilities that have documented the presence of little brown bat habitat during surveys conducted under survey requirement SURE2. The cut-in speeds for spring migration, summer, and fall migration in Table 5-8 of the MSHCP will be superseded by the cut-in speed requirements shown in the last two columns of Table 5-8 of the MSHCP if there is risk for take of individuals from turbines located within 1,000 feet of maternity colony habitat and near swarming/staging areas as defined in AMM GEN1. Applicable cut-in speed restrictions in Table 5-8 of the MSHCP will be in effect from 30 minutes before sunset to 30 minutes after sunrise at facilities potentially affecting a maternity colony or swarming/staging areas, and from sunset to sunrise under other site conditions. Turbines need not curtail cut-in speeds as described in Table 5-8 of the MSHCP if air temperatures are at or below 50° F based on a rolling average of 10 minutes. For proposed wind energy facilities, if the temperature rises above 50°F based on a 10-minute rolling average, turbines must return to the applicable site-specific cut-in speed in Table 5-8 of the MSHCP. Existing wind energy facilities will return to the applicable site-specific cut-in speed in Table 5-8 of the MSHCP as quickly as possible within the technological limits of the facility.
Kirtland's Warbler	
AMM KIWA1: Avoid Siting of Turbines in or Near Kirtland's Warbler Habitat.	This AMM applies to all applicable activities of proposed wind energy facilities. Wind turbines must not be sited within Kirtland's Warbler Management Areas (KWMAs) (see Figure 4-6 of the MSHCP for location of KWMAs). Siting turbines within 0.5 mile of a KWMA and within 0.5 mile of other documented Kirtland's warbler breeding sites must also be avoided. If siting turbines in these areas cannot be reasonably avoided with the concurrence of the USFWS, direct physical impacts on Kirtland's warbler's nesting territory or nests will be avoided and the limitations on construction timeframes, seasonal clearing, and seasonal operational curtailment will be conducted as described in AMM KIWA2 and AMM KIWA3.
AMM KIWA2: Site Facility Infrastructure, Turbines, and Other Features to Minimize Impacts on Occupied Kirtland's Warbler Habitat.	This AMM applies to all applicable activities of new and existing wind energy facilities. Within occupied breeding habitat, avoid removal of occupied Kirtland's warbler habitat. If habitat removal cannot be reasonably avoided with the concurrence of the USFWS, the seasonal clearing restrictions described in AMM KIWA3 will apply.

[13] All wind speed requirements identified in the AMMs refer to real-time measurements at the rotor hub height of turbines.

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM KIWA3: Implement Timing Constraints to Avoid Impacts on Nesting Kirtland's Warblers.	This AMM applies to all applicable activities of new and existing wind energy facilities. Construction, maintenance or decommissioning activities may not be conducted that would impact habitat within 0.25 mile of nest sites from May 1 to August 15. If a singing male is identified during pre-construction surveys, the presence of a nest is assumed (even if a nest is not found) and no construction, maintenance, decommissioning impacts are permitted within a 0.25-mile radius from where the male was observed from May 1 to August 15.
AMM KIWA4: Implement Operational Shut-Downs for Kirtland's Warbler During High Risk Periods and in Specific High Risk Areas.	This AMM applies to new and existing wind energy facilities. The following operational shut-downs for Kirtland's warbler will be applied during the following high risk periods and in identified specific high risk areas: • Feather turbine blades during daylight hours within 0.5 mile of occupied Kirtland's warbler breeding sites from May 1 through August 15 • Feather turbine blades at dawn (2 hours before sunrise to 1 hour after sunrise) and dusk (1 hour before sunset to 1 hour after sunset) within 0.5 mile of KWMAs from March 15 to May 30 (spring migration period) and August 15 to October 30 (fall migration periods).
Bald Eagle	
AMM BAEA1: Minimize Construction-Related Disturbances During the Bald Eagle Nesting Season.	This AMM applies to all applicable activities of proposed wind energy facilities. If results of the applicable pre-construction surveys indicate that bald eagles are nesting within 0.5 mile[14] of a wind energy facility construction site, construction activities may not occur during the Plan Area-wide breeding season (January 1–August 31) unless the project proponent can demonstrate to the USFWS that 1) the nesting pair has abandon the nest site or 2) young produced at the nest site have fledged prior to August 31. Project proponents may request the USFWS to adjust the Plan Area-wide avoidance period (January 1–August 31) based on the nesting period, if known, for bald eagles in the vicinity of the proposed facility should it differ from the Plan Area-wide breeding season.
AMM BAEA2: Avoid the Removal of Nesting and Roosting Trees.	This AMM applies to all applicable activities of proposed wind energy facilities. Except in emergency situations where there is a risk to public safety, wind energy facilities will avoid removal of trees and snags within 0.25 mile of trees and snags used as nesting or winter roosting sites by bald eagles within the previous three years.

[14] Bald eagle nesting territories can range from 0.5 km^2 (0.2mi^2) to 4 km^2 (1.5 mi^2). The 0.5-mile avoidance distance assumes a typical nesting territory size of 0.8 mi^2.

Avoidance and Minimization Measure (AMM)[1]	Summary
AMM BAEA3: Minimize operations-related take.	This AMM applies to all applicable activities of proposed wind energy facilities. To minimize the potential for operations-related take of bald eagle, proposed wind energy facilities must site wind turbines at least 1.6 miles from bald eagle nest sites known to have been occupied within the previous 3 years[15] and at least 1 mile from known bald eagle winter roost sites. Turbines may be sited closer to nest sites and winter roost sites if, based on pre-construction survey data, the project proponent can demonstrate to the USFWS that turbines will be sited in locations that avoid travel corridors (e.g., flight paths between nest/roost sites and foraging areas) used by nesting and wintering bald eagles.
AMM BAEA4: Remove carcasses within 0.25 miles of turbines.	This AMM applies to new and existing wind energy facilities. To minimize the potential for operations-related take of bald eagle, weekly searches will be conducted within 0.25 miles of wind facility turbines to locate and remove large animal carcasses (e.g., livestock, deer) that can attract foraging bald eagles near turbines. Project proponents are required to obtain any permits that are required to allow for the removal and disposal of carcasses. Carcass searches and removal are required for wind energy facilities that are located within known bald eagle breeding, wintering, and migration foraging areas.
See Chapter 5 in the MSHCP for a more detailed discussion of species-specific avoidance and minimization measures for Covered Species.	

[15] Based on largest bald eagle home range size observed by Garrett *et al.* (1993) along the Columbia River.

Table 2-7. Cut-In Speeds by Season for Covered Bat Species – Alternative A

AMM Element	Facilities with No Maternity Colony or Hibernaculum Present (hibernaculum to turbine distances described in AMM GEN1)			Facilities with Maternity Colony Present	Facilities with within Swarming/Staging Distances of Hibernaculum described in AMM GEN1
	Spring Migration	Summer	Fall Migration		
Effective dates	April 1–May 31	June 1-July 31	August 1–October 31	April 1–October 30	August 1–November 15 and March 15–May 31
Cut-in speed	Feather below manufacturers cut-in speed	Feather below manufacturers cut-in speed	Cut-in 5.0 m/s, if 50°F or higher	See below	Cut-in 6.5 m/s, if 50°F or higher
Turbines less than 1,000 feet from forest habitat	Not applicable	Not applicable	Not applicable	Cut-in 6.0 m/s, if 50°F or higher	Not applicable
Turbines greater than 1,000 feet from forest habitat[2]	Not applicable	Not applicable	Not applicable	Cut-in 5.0 m/s, if 50°F or higher	Not applicable

[1]Take must not exceed the authorized limit and if take approaches the authorized limit, cut-in speeds may be adjusted through adaptive management to ensure authorized limit is not exceeded.

[2]Unlike the Indiana bat and northern long-eared bat, the little brown bat is more likely to fly over open spaces and, therefore, little brown bat may be at greater risk for collision with wind turbines located further away from forest habitat than Indiana bat and northern long-eared bat depending on site-specific conditions.

Compensatory Mitigation

The conservation strategy for Alternative A includes mitigation to compensate for the direct take of Covered Species and the loss or degradation of occupied habitat from implementation of Covered Activities. As summarized below, the type and amount of mitigation required to address the impact of take of Indiana bat, northern long-eared bat, little brown bat, and bald eagle will be calculated using the Service's species-specific Resource Equivalency Analysis (REA) model. Similarly, the Service's species-specific Habitat Equivalency Analysis (HEA model) will be used to identify required compensatory mitigation for the loss and/or degradation of occupied habitat for the covered bat species, Kirtland's warbler, and bald eagle. Existing programs will be used to provide compensatory mitigation for piping plover and Interior least tern. Although mitigation requirements are identified for each Covered Species, a mitigation site may be credited as mitigation for more than one Covered Species if all of the habitat requirements of the species for which mitigation is being provided are present in the mitigation site (e.g., "mitigation stacking").

Additional information on how compensatory mitigation requirements will be calculated under Alternative A, and how mitigation sites will be identified and managed, is provided in Chapter 5, *Conservation Plan*, of the MSHCP.

Covered Bat Species

The REA model for Indiana bat includes three options for mitigating the impacts of take:

1. Protection of existing summer habitat
2. Restoration of summer habitat within the range of maternity colonies
3. Protection of occupied hibernaculum (including installation of new cave gates and, replacement of old cave gates)

These existing options may be revised over the term of the MSHCP if new information regarding the efficacy of these mitigation options becomes available or other forms of suitable mitigation are identified and incorporated into the REA model.

Individual wind energy facilities will be required to use the REA model to calculate project-specific mitigation debts and the corresponding amounts of summer and winter habitat to be mitigated. Additionally, the selection of suitable mitigation sites will be based on the characteristics of specific project impacts.

The mitigation requirements for impacts on occupied bat habitat will be based on the Service's HEA model. The HEA model requires that the land cover types that supported occupied habitat and that will be impacted by the development of a wind energy project be replaced by restoring in-kind habitat at a ratio that replaces the affected habitat values and accounts for the length of time necessary for the restored habitat to develop habitat functions. The actual mitigation requirements for each wind energy project will be calculated based on the actual footprint impacts of each proposed wind energy project on occupied habitat.

For some projects, the mitigation credit for protection and/or restoration of Indiana bat habitat may be extended to cover other Covered bat species, as long as they occupy the mitigation site.

Kirtland's Warbler

Options for mitigating the impact of operation-related take of Kirtland's warbler under Alternative A include:

- Restoring habitat through the management of jack pine stands through logging, burning, seeding and replanting on a rotational basis
- Removal of brown-headed cowbirds to reduce nest parasitism rates

These activities can be conducted within the core range of the species in the northern Lower Peninsula of Michigan and outside of the Kirtland's warbler's core nesting range, within newly occupied areas in the Upper Peninsula of Michigan and Wisconsin. Mitigation for take of Kirtland's warbler will be integrated into existing conservation programs for protecting, enhancing, and managing Kirtland's warbler habitat after approval by the Service. Mitigation may also be provided through the protection and management of important migration stopover areas should such sites become identified over the term of the MSHCP.

The mitigation requirements for impacts on Kirtland's warbler habitat will be based on the Service's HEA model. The actual mitigation requirements for each wind energy project will be calculated using the HEA model based on the actual footprint of each proposed wind energy project on occupied habitat.

Interior Least Tern and Piping Plover (Great Lakes and Northern Plain Populations)

Mitigation for take of interior least tern and piping plover will be integrated into existing programs (e.g., restoration of breeding habitat within portions of its occupied breeding range within or outside of the Plan Area) for protecting, enhancing, and managing nesting habitats for these species. Permit holders will provide funding to Service-approved conservation programs that are implementing species-specific habitat restoration projects.

Bald Eagle

Mitigation actions are designed to increase bald eagle survival and reproductive potential by 1) protecting and maintaining existing occupied habitat to maintain the distribution and availability of nesting and winter roost sites and 2) reducing unnatural sources of bald eagle mortality. Mitigation requirements for take associated with existing wind energy facilities that receive take authorizations will be calculated on a per facility basis for new wind energy facilities. Options for mitigation for the impacts of take of bald eagle include the protection and restoration of habitat, retrofitting of power lines to reduce the risk for electrocution, and reducing the potential for ingestion of lead by bald eagles to reduce lead-related morbidity and mortality.

Management of Compensatory Mitigation Lands

Mitigation sites will be acquired and protected in perpetuity by a Mitigation Implementing Entity (MIE) and by COI holders and individual permittees. The MIE is anticipated to be a not-for-profit environmental organization experienced in habitat conservation, restoration, and management across regional landscapes. The MIE will be contractually responsible to the Master Permittee and individual permittees for implementing all off-site mitigation requirements for COI holders and individual permittees that choose to implement their mitigation through the MIE. COI holders and individual permittees that elect to fulfill their mitigation obligations through the MIE will need to coordinate with the MIE to determine their mitigation fees and to provide the necessary mitigation funding assurances. All MIE proposed mitigation sites must be approved by the Service before they can be credited under the MSHCP as mitigation.

Monitoring and Reporting

Under Alternative A, applicants will be required to implement a compliance and effectiveness monitoring program to achieve the following objectives:

- Document compliance with the MSHCP and terms and conditions of take authorizations, including limits set on the incidental take of Covered Species.
- Documentation of take of Covered Species and wind turbine-related fatalities of other native species.
- Detect changes in Covered Species use of mitigation habitats from baseline habitat conditions.
- Produce scientifically valid data that are relevant and informative to adaptive management decision-making and that integrate with other monitoring efforts (e.g., other HCP monitoring programs, statewide and nationwide monitoring of Covered Species).
- Document and evaluate the effectiveness of mitigation measures in achieving MSHCP biological goals and objectives.

- Determine if the MSHCP operations-related avoidance and minimization measures are effective in reducing take of Covered Species as well as to provide data and information to maintain or improve their effectiveness.
- Provide information necessary to indicate whether adjustments in MSHCP implementation are necessary to better ensure that biological goals and objective are achieved.
- Assess progress toward achieving the biological goals and objectives.

The monitoring program will include compliance monitoring requirements during the siting, design and construction phase; compliance and effectiveness monitoring requirements during the operational phase of wind facilities; and compliance monitoring for compensatory mitigation sites. Compliance monitoring in the siting, design and construction phases and the operational phase will be focused on ensuring the general and species-specific avoidance and minimization measures provided in Tables 2-4 through 2-6 are implemented. Mitigation site compliance monitoring will be used to document that habitat protected and restored under the MSHCP was successful, adequately protected, and is providing the habitat benefits for the Covered Species for which the site was intended to mitigate impacts.

Effectiveness monitoring of operating wind facilities will be used to determine if operation-related avoidance and minimization measures are reducing take of Covered Species. Specifically, effectiveness monitoring under Alternative A will rely on the Evidence of Absence model.

Annual reports documenting the results of all monitoring efforts will be submitted to the Service for review.

Additional information on the monitoring program under Alternative A is provided in Chapter 7, *Monitoring, Adaptive Management, and Reporting*, of the MSHCP.

Adaptive Management

Habitat conservation plans are required to contain adaptive management when there are substantial gaps in information concerning Covered Species that may pose significant risk after the issuance of an ITP. These uncertainties may include lack of ecological data (e.g., food sources, foraging habitats, and territory size), uncertainty about habitat or species management, uncertainty regarding the effectiveness of certain conservation strategies or measures, or uncertainty about the extent of potential effects posed by the activities covered by the ITP. Adaptive management triggers and actions are described in Chapter 7 of the MSHCP and will be implemented under Alternative A.

2.2.1.3 Permit Term

The proposed term of the MSHCP under Alternative A will be 45 years. During the first 5 years, existing commercial wind energy projects within Covered Lands may apply for and receive incidental take authorization under the MSHCP after review by the Service, provided they implement the avoidance, minimization, monitoring and mitigation requirements provided in the MSHCP. Proposed commercial wind energy facilities within Covered Lands could opt-in to the MSHCP during the first 15 years of the MSHCP. Incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP. The Master Permittee will be issued a permit for up to 45 years. Individual COIs will be issued for 30 years.

2.2.2 Alternative B—Reduced Permit Duration Alternative

Under Alternative B, future wind facilities in the Plan Area will have 5 years instead of 15 years to opt-in to the MSHCP and the total term of the MSHCP will be reduced from 45 to 35 years. Consistent with Alternative A, existing commercial wind energy projects will still have 5 years to opt-in to the MSHCP, and incidental take authorizations (via an individual ITP or COI) will be issued for a period of 30 years to account for the operational life of most wind projects.

This alternative was developed by the Service to address scoping comments that the EIS consider a shorter term or permit duration under the MSHCP, in part to acknowledge uncertainties surrounding the effects of WNS on covered bat species. The shorter-opt in period will allow the Service to consider the potential cumulative effects of WNS and wind energy development on covered bat species, while still allowing the wind energy industry to utilize a streamlined permit process that accommodates the anticipated 30-year life span of a wind facility.

Because new wind energy will have 5 years instead of 15 years to opt-in, the number of wind facilities that may receive incidental take authorization under Alternative B will likely be less than that anticipated under Alternative A. For the purposes of comparing alternatives, it is assumed that up to 11,000 MW of new wind energy capacity could be installed in Covered Lands, and receive incidental take authorization, under Alternative B during the 5-year opt-in period (as compared to 33,000 MW during the 15 years under Alternative A). The same capacity of existing wind energy facilities within Covered Lands—18,004 MW—will be eligible to participate in the MSHCP under Alternative B.

Although incidental take authorization will only be provided for up to 11,000 MW of new wind energy capacity under Alternative B, it is possible that other wind infrastructure will be constructed within the Plan Area over the term of the MSHCP. For the purposes of this EIS, and consistent with Alternative D, it is assumed that an additional 22,000 MW of new wind energy capacity could be constructed in the Plan Area, for a total of 33,000 MW of total build-out capacity. Additional new construction under Alternative B could occur anywhere within the Plan Area, but will require either an ESA Section 10(a)(1)(B) permit from the Service, or avoidance of impacts to federally listed species.

All other aspects of the MSHCP described for Alternative A will be the same under Alternative B.

2.2.3 Alternative C—Increased Cut-In Speed Alternative

Under Alternative C, the conservation strategy in the MSHCP will be revised to increase cut-in speeds during high-risk periods for covered bats. Specifically, cut-in speeds will be increased to 5 mps during the spring migration period and 6.5 mps during the fall migration period (Table 2-8). In addition, cut-in speeds will be increased to 6.5 mps in the summer where the presence of covered bats has been documented, and during specified periods where turbines are located in proximity to maternity colonies and/or swarming /staging areas as described in Table 2-8. As described for Alternative A, curtailment requirements will only apply at night, and when the temperature is greater than 50°F. All other aspects of the MSHCP will be the same as described under Alternative A.

Alternative C was developed in response to scoping comments requesting the Service consider additional operational restrictions to reduce take of Covered Species.

Table 2-8. Cut-In Speeds by Season for Covered Bat Species – Alternative C

	Spring Migration	Summer	Fall Migration	Facilities with Maternity Colonies Present	Facilities within Swarming/Staging Distances of Hibernaculum described in AMM GEN1
Effective Dates	April 1 – May 31	June 1 – July 31	August 1 – October 31	April 1 – October 30	August 1 – November 15 and March 15 – May 31
Cut-In Speed	5.0 mps	6.5 mps	6.5 mps	6.5 mps	6.5 mps

mps = meters per second.

[1] Applicable cut-in speed restrictions in effect from a half hour before sunset to a half hour after sunrise, and when air temperatures are higher than 50°F.

[2] All facilities must implement the cut-in speed requirements for the spring and fall migration periods.

[3] Summer cut-in speed requirements only apply to wind energy facilities that have documented the presence of covered bat species in summer during preconstruction surveys (see SURE 2, Table 2-3).

[4] These cut-in speeds supersede those provided for the spring migration, summer, and fall migration periods if there is risk for take of individuals from turbines located within 1,000 feet of maternity colony habitat and near swarming/staging areas (see AMM GEN 1, Table 2-4).

2.2.4 Alternative D—No Action Alternative

Under Alternative D, the Service will not issue ITPs or concur with COIs for wind-related construction and operational activities under the MSHCP. Future and existing wind energy developers and operators will continue to be required to either avoid incidental take of federally listed species and eagles through siting and operational changes, or pursue project-specific Endangered Species Act (ESA) Section 10(a)(1)(B) permits and/or eagle permits, as necessary. Wind energy developers unable to avoid take of federally listed species and/or eagles, and who operate without ESA and Eagle Act permits, could be subject to enforcement action by the Service.

If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and consistent methodologies that allow for comparison across the Plan Area may not be applied. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will not be available under Alternative D, and opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service will be limited.

Under Alternative D, this EIS assumes there are 18,004 megawatts (MW) of installed wind energy in the Covered Lands, and up to 33,000 MW of new wind energy capacity could be developed in the Plan Area.[16] New wind energy facilities could be constructed anywhere within the Plan Area and would not be limited to Covered Lands.

[16] The EIS assumption is based on assumptions used in the MSHCP (see Chapter 4 of the HCP for more detail) and the associated wind power development potential (build-out) model provided in Appendix B of the MSHCP.

2.3 Summary Comparison of Alternatives

Table 2.9 below presents an overview of the key features of Alternatives A through D.

Table 2-9. Comparison of Alternative Features

Alternative	Description	Master Permit Term[1]	Opt-in Period
Alternative A – MSHCP	• The Service will issue ITPs under the MSHCP for Covered Activities affecting the eight Covered Species. • Incidental take authorization for 18,004 MW of existing wind energy in Covered Lands. • Incidental take authorization for up to 33,000 MW of new wind energy capacity in Covered Lands.	• Permit term is 45 years; incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP.	• 5 year opt-in period for existing facilities and a 15 year opt-in period for future wind facilities.
Alternative B – Reduced Permit Duration	• Incidental take authorization for future wind facilities will be reduced to 11,000 MW to account for the shorter permit duration and opt-in period (compared to 33,000 MW under Alternative A). • An additional 22,000 MW of new wind energy could be constructed in the Plan Area under Alternative B, in addition to the 11,000 MW contemplated for incidental take coverage under Alternative B. • Any additional construction (beyond the 11,000 MW) under Alternative B will require receipt of an ITP from the Service, or avoidance of impacts to federally-listed species. • Additional new wind facilities could be constructed anywhere within the Plan Area and will not be limited to Covered Lands.	• Permit term is 35 years.	• 5 year opt-in period for existing and future wind facilities.

Alternative C – Increased Cut-in Speed	• Incidental take authorization for 18,004 MW of existing wind energy in Covered Lands.
	• Incidental take authorization for up to 33,000 MW of new wind energy capacity in Covered Lands.
	• The conservation strategy will be revised to increase cut-in speeds during high risk periods for covered bats.
	  ○ Cut-in speeds will be increased to 5 mps during the spring migration period and 6.5 mps during the fall migration period.
	  ○ Cut-in speeds will be increased to 6.5 mps in the summer where the presence of covered bats has been documented, and during specified periods where turbines are located in close proximity to maternity colonies and/or swarming/staging areas.
		• Permit term is 45 years; incidental take authorizations will be issued for a period of 30 years, up to the 45-year term of the MSHCP.	• 5 year opt-in period for existing facilities and a 15 year opt-in period for future wind facilities.

Alternative	Description	Master Permit Term[1]	Opt-in Period
Alternative D – No Action Alternative	• Reflects current conditions and serves as the baseline for considering effects of the other alternatives in the EIS. • The Service will not issue ITPs or concur with COIs for wind-related construction and operational activities under the MSHCP. • Assumes 18,004 MW of existing wind energy in Covered Lands. • Assumes 33,000 MW of new wind energy in the Plan Area.	• Not applicable.	• Not applicable.

[1] The individual permit term for Alternatives A – C is 30 years.

2.4 Alternatives Eliminated from Further Consideration

2.4.1 Modified List of Covered Species

The Service received several comments during the scoping period suggesting the MSHCP be revised to include additional Covered Species, including specific species (e.g., tri-colored bat [*Perimyotis subflavus*], Ozark big-eared bat [(*Corynorhinus townsendii ingens*], Sprague's pipit [*Anthus spragueii*]); a class of species (e.g., all migratory tree bats); or a more comprehensive list of species (e.g., all federally listed or candidate species known to the Plan Area).

Section 1.6.1 of the MSHCP, *Selection of Covered Species*, describes the process used to identify which species will be considered for incidental take authorization under the MSHCP. As described in that section, four criteria were used to select Covered Species in the MSHCP:

- The species is known to be present or likely to be present within Covered Lands.
- The species is listed or likely to be listed under the ESA during the term of the MSHCP.
- There is potential for incidental take of the species as a result of the operation of wind turbines within Covered Lands.
- Sufficient information about the species was available to assess the impacts of Covered Activities on the species and develop avoidance, minimization, and mitigation measures for the species.

Table 1-3 in the MSHCP lists the 85 species that were considered for coverage in the MSHCP, and summarizes the reasons why they were or were not identified as Covered Species. In many instances, the decision to exclude a species from coverage in the MSHCP was made because the species were not known to occur within Covered Lands, or were unlikely to be adversely affected by proposed wind energy operations. In some instances, the planning partners determined there was insufficient information about the species available to assess the impacts of Covered Activities, or to develop necessary avoidance, minimization, and mitigation measures for the species. For example, it was determined that there was insufficient information to adequately consider eastern small-footed bat (*Myotis leibii*) in the MSHCP. Gray bat (*Myotis grisescens*) is not included in the MSHCP because the potential for take of individuals was determined to be low.

The Service anticipates that the conservation strategy in the MSHCP will benefit many bat species not covered under the MSHCP, including migratory tree bat species. Modifications to cut-in speeds during high risk periods for bats will be of benefit to migratory tree bats particularly during the spring and fall migration periods. In addition, the monitoring requirements in the MSHCP specify that data on mortality of all species impacted at covered wind energy facilities be collected, not just Covered Species, which will generally inform our understanding of the effects of wind turbines on wildlife in general (and may allow for coverage of other species in the MSHCP in the future).

As described in Section 1.1, an application for an ITP under Section 10 of the ESA is voluntary, and requests for species-specific take coverage is at the discretion of the applicant. Where federally listed species are not covered under an ITP, an applicant is required to either avoid incidental take of that species through siting and operational changes, or pursue a project-specific ESA Section 10(a)(1)(B) permit. Wind energy developers unable to avoid take of federally listed species, and who operate without an ESA permit, could be subject to enforcement action by the Service.

Chapter 3
Affected Environment

3.0 Affected Environment

This chapter describes the existing conditions of the environment that may be affected by the proposed action. As described in Chapter 1, *Purpose and Need*, the proposed action considered in this Environmental Impact Statement (EIS) is issuance of incidental take permits (ITP) or Certificates of Inclusion (COI) by the U.S. Fish and Wildlife Service (Service) under the Midwest Wind Energy Multi-Species Habitat Conservation Plan (MSHCP). Thirteen resource areas are described in individual sections of this chapter: biological resources, water resources, geology and soils, climate change, air quality, noise, visual resources, transportation, land resources, public services, public health and safety, socioeconomics and environmental justice, and cultural resources. Each section includes a summary of the sources of information used to described the affected environmental and a description of resources in a specifically defined study area. This information forms the basis for the description of potential effects provided in Chapter 4, *Environmental Consequences*.

3.0.1 Plan Area, Covered Lands, and Study Area

As described in Section 2.1.2, *Plan Area and Covered Lands*, each action alternative would be implemented within an eight-state *Plan Area* that encompasses all lands under the jurisdiction of the Midwest Region of the Service, including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The geographic area where incidental take authorization will be allowed under the action alternatives, referred to as *Covered Lands*, is a subset of the Plan Area and specifically excludes lands of particular importance to bat and migratory bird species, as well as a wide range of other wildlife. The following areas are excluded from Covered Lands:

- Land within 20 miles of sensitive bat hibernacula identified by the Service and state wildlife agencies;
- Land within 3 miles of the shores of the Great Lakes;
- Land within 1 mile of the edges of major rivers supporting bird migration corridors and/or concentrations of wintering waterfowl;
- Land within floodplain areas along the Mississippi and Illinois rivers;
- Land near high bat concentration areas in southern Indiana; and
- Land within bird migratory areas in Illinois and around large lakes in Minnesota.

The study area, as the term is used in this chapter, represents the area considered in characterizing the affected environment, and varies by resource topic. In some cases, the study area is the same as the Plan Area. For other resource areas, the study area extends beyond the boundary of the Plan Area to account for potential effects on resources affected by the Covered Activities. A description of the study area is provided in the introduction to each resource-specific section.

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3.1 Biological Resources

This section describes biological resources in the study area, including vegetation communities, Covered Species, other rare, endangered, threatened and candidate species, and other wildlife, fish and aquatic resources.

3.1.1 Study Area and Approach

The biological resources study area is concurrent with the Plan Area. For some species (e.g., Indiana bat, little brown bat), the study area may extend beyond the Plan Area to account for population-level effects from covered activities (e.g., migration routes that extend outside of the Plan Area).

Vegetation Communities

Vegetation communities in the study area are described using two geographic information system (GIS) data sources: the National Land Cover Database (NLCD) of the conterminous United States (National Land Cover Database 2015) and the U.S. Environmental Protection Agency's (EPA) and Commission for Environmental Cooperation's (CEC) ecoregion mapping of the United States (U.S. Environmental Protection Agency 2013, 2015; Commission for Environmental Cooperation 2006, 2011, 2014). These GIS data were overlain with the study area to quantify and describe vegetation communities and plant species by state in the study area.

Covered Species, Other Rare, Endangered, Threatened and Candidate Species, and Other Wildlife, Fish and Aquatic Species

As noted above, this section addresses Covered Species; other rare, endangered, threatened and candidate species; and other wildlife, fish and aquatic resources. Covered Species include species the Service is considering incidental take authorization for under the action alternatives (see Section 2.1.4, *Covered Species).* Other rare, endangered, threatened, and candidate species include species (wildlife, plant, fish and aquatic), other than Covered Species, that have the potential to occur in the study area and that are listed as threatened, endangered, candidate, or proposed for listing under the Federal Endangered Species Act (ESA), or protected under a state endangered species statute by one of the eight states within the Plan Area (see Section 1.4.2, *State Permit and Consultation Requirements*). Golden eagles, which are protected under the Bald and Golden Eagle Protection Act (Eagle Act), are also considered in the other rare, endangered, threatened, and candidate species sub-section.[17] Other wildlife, fish and aquatic resources include species that are not specifically protected under Federal or state statute but that may occur in the study area. Migratory birds protected under the Migratory Bird Treaty Act (MBTA) are considered in this subsection.

[17] Bald eagles, protected under the Eagle Act, are Covered Species under the action alternatives and are addressed in that subsection.

A variety of sources are used in this section to describe these species and their habitat requirements, including the following information datasets, GIS datasets, and literature sources:

- NLCD GIS data (National Land Cover Database 2015)
- CEC and EPA Level III Ecoregion GIS data (U.S. Environmental Protection Agency 2013, 2015; Commission for Environmental Cooperation 2006, 2011, 2014)
- The Conservation Fund's Midwest Green Infrastructure Network (MGIN) GIS data (The Conservation Fund 2015)
- Federally designated critical habitat GIS data (U.S. Fish and Wildlife Service 2015)
- Lists of federally threatened and endangered species by county (U.S. Fish and Wildlife Service 2015)
- State lists of state threatened and endangered species
- State Wildlife Action Plans (U.S. Geological Survey 2015)
- NatureServe Explorer (NatureServe 2015)
- National Water Quality Assessment Program (U.S. Geological Survey 2015)

The NLCD and CEC and EPA ecoregion GIS analyses completed to characterize the vegetation communities in the study area were also used to inform habitat and species descriptions. In addition, the MGIN and critical habitat GIS data layers were overlain with the study area to quantify and describe terrestrial and aquatic habitats in the study area by state. The MGIN data layer maps the most ecologically viable terrestrial and aquatic habitat in the study area with the greatest potential to support wildlife, including federally and state-listed threatened and endangered species. The Service's critical habitat GIS data layer maps the specific geographic areas (as defined and described under ESA regulations) with the physical or biological features essential to a federally threatened or endangered species for which it is designated.

3.1.2 Existing Conditions

3.1.2.1 Vegetation Communities

This section addresses vegetation communities that are considered common and are not identified by Federal or state agencies as species that are at risk and require special management. Plant species that are at risk and that are managed under special purpose statutes (e.g., the ESA) are defined as special-status species and are discussed in Section 3.1.2.3, *Other Rare, Endangered, Threatened, or Candidate Species.* Refer to Section 3.2.2.3, *Wetlands,* for a discussion of wetland vegetation communities, which are managed and regulated differently than other vegetation communities.

Vegetation communities in the study area are described below by ecoregion and cover class. Appendix C, *Invasive Plants in the Study Area*, provides further information regarding invasive weed species in the study area by state.

Vegetation Communities by Ecoregion

Vegetation communities, plant species, and vegetative structure vary significantly across the study area because of its large geographic scope, and the widely variable natural and anthropogenic

factors that influence vegetation community types. Common factors that determine vegetation community characteristics in a particular region include climate (e.g., temperature and precipitation), topography, soil conditions, hydrology, and land use.

The EPA and CEC have described vegetation and land characteristics on large geographic scales across the United States by mapping large areas with similar biotic and abiotic characteristics into *ecoregions*. Ecoregions are areas where the type, quality, and quantity of environmental resources—such as vegetation, wildlife, soils, geology, climate, hydrology, land use, and land form—are generally similar (U.S. Environmental Protection Agency 2015). Ecoregions serve as a spatial framework for resource management and are effective for regional state environmental reports, resource inventories, and assessments (Commission for Environmental Cooperation 2014). The EPA and CEC have mapped and described ecoregions in a hierarchical scheme that includes Level I, II, and III ecoregions, with Level I providing the coarsest environmental resource information over the largest geographic areas and Level III providing the most refined environmental resource information over the smallest geographic areas. The EPA further mapped a Level IV ecoregion that subdivides the Level III ecoregion; however, no additional or refined vegetation community or species descriptions beyond Level III are provided for Level IV. Of the four ecoregion levels, Level III provides the most detailed information on typical or representative vegetation communities and plant species found throughout an ecoregion. Table 3.1-1 lists the ecoregions and representative vegetation communities and species in the study area, and states where each ecoregion occurs. Figure 3.1-1 shows each ecoregion's location and relative size in the study area.

Table 3.1-1. Ecoregions and Vegetation Communities and Species in the Study Area

Ecoregion Name	Common Vegetation Communities and Species	State
Northern Lakes and Forests	Forest types are mostly coniferous and northern hardwood forests, with sugar maple, red maple, paper birch, yellow birch, aspen, white spruce, balsam fir, hemlock, eastern white pine, jack pine, and red pine. Cooler and wetter sites have black spruce, tamarack, and northern white cedar.	MN, WI, MI
Northern Minnesota Wetlands	A mixed conifer/bog forest, and boreal forest vegetation. Common species include white spruce, black spruce, and balsam fir. There are also areas of maples and white pine. Successional areas contain aspen, paper birch, and jack pine.	MN
North Central Hardwood Forests	Oak savanna, oak-hickory forests, maple-basswood forests, northern hardwoods of maple, beech, and birch are the dominant forest types.	MN, WI, MI
Driftless Area	A mosaic of prairie with little bluestem, Indiangrass, and sideoats grama, and forests of bur oak and white oak. Mesic areas include forests of sugar maple, basswood, and red oak, and riparian forests with elm, river birch, silver maple, and ash.	MN, WI, IA, IL
Southern Michigan/Northern Indiana Drift Plains	Oak-hickory forests, northern swamp forests, and beech forests were typical prior to conversion to agriculture/pasture lands or development. White oak, red oak, black oak, bitternut hickory, shagbark hickory, sugar maple, and beech are the dominant tree species.	MI, IN

Ecoregion Name	Common Vegetation Communities and Species	State
Huron/Erie Lake Plains	Much of the natural vegetation has been cleared for agriculture (e.g., corn, feed grains, wheat, fruits, and vegetables), although some areas remain with red maple, white ash, American basswood, aspen, or with white oak, red oak, black oak, bitternut and shagbark hickories. Originally, elm-ash swamp and beech forests were dominant, with oak savanna typically restricted to sandy, well-drained dunes and beach ridges. Mixed oak forests also occurred.	MI, IN, OH
Northern Glaciated Plains	Most of the region has been converted to farmland that produce crops such as wheat, flax, rye, barley, oats, corn soybeans, sunflowers, and specialty crops; but in its native state, the landscape was characterized by trembling aspen, oak groves, mixed tall shrubs, and intermittent fescue grasslands. Bur oak and grassland communities occupied drier sites. Many areas had transitional grassland containing tallgrass and shortgrass prairie, including big and little bluestem, green needlegrass, blue grama, western wheatgrass, and switchgrass.	MN
Lake Agassiz Plain	In the north, transitional boreal forest, with some aspen parkland to the south. Riparian areas have cottonwood, willow, bur oak, green ash, and elm. The historic tallgrass prairie has been replaced by intensive row crop agriculture (e.g., potatoes, beans, sugar beets, wheat, barley, canola, sunflower, corn, and soybeans).	MN
Western Corn Belt Plains	Once a tallgrass prairie covered with little bluestem, big bluestem, Indiangrass, switchgrass, numerous forbs, and with small areas of bur oak and oak-hickory woodlands, the region has nearly all been converted to agricultural land (e.g., corn and soybeans).	MN, WI, IA, MO, IL
Southeastern Wisconsin Till Plains	A mosaic of vegetation types, representing a transition between the North Central Hardwood Forests and oak savannas of the Driftless Area ecoregions to the west and the tall-grass prairies of the Central Corn Belt Plains to the south. Forested areas feature red and white oak, and areas of beech, sugar maple, and basswood. Prairie areas, now rare, consisted mainly of little bluestem and big bluestem.	WI, IL
Central Corn Belt Plains	Nearly all of the natural vegetation has been replaced by agriculture (e.g., corn and soybeans). Extensive prairie communities intermixed with oak-hickory forests were native, in contrast to the hardwood forests that grew on the drift plains of Southern Michigan/Northern Indiana Drift Plains and Eastern Corn Belt Plains ecoregions to the east. Mesic prairies had big bluestem, Indiangrass, prairie dropseed, switchgrass, dry upland prairies had little bluestem and sideoats grama, and woodlands contained white oak, black oak, and shagbark hickory. Some sugar maple and American elm were on more mesic sites.	WI, IL, IN

Ecoregion Name	Common Vegetation Communities and Species	State
Interior River Valleys and Hills	Bottomland deciduous forests and swamp forests were once extensive on poorly-drained, nearly level, lowland sites but most have been replaced by cropland (e.g., corn, soybeans, wheat, and hay) and pastureland. Along the Mississippi were silver maple, American elm, and green ash, with pin oak, pecan, bur oak, sycamore, honey locust, hickories, and black walnut. Bottomland forests had pin oak, bur oak, Shumard oak, cherrybark oak, overcup oak, swamp white oak, and swamp chestnut oak, and sweetgum. Some upland forests contain mixed oak forests of post oak, southern red oak, white oak, black oak, and shagbark hickory, while mesic sites include beech, yellow-poplar, sugar maple, and northern red oak.	IA, MO, IL, IN
Central Irregular Plains	A mosaic of cropland, woodland, and grassland. Vegetation is a grassland/forest mosaic with wider forested strips along the streams, compared to the Western Corn Belt Plains ecoregion to the north. The grassland is a tallgrass prairie with little bluestem, big bluestem, switchgrass, and Indiangrass, and the forests are oak-hickory woodlands with red oak, white oak, bur oak, chinkapin oak, post oak, shagbark hickory, and bitternut hickory. Agriculture crops include corn, soybean, wheat, alfalfa, hay, and grain sorghum.	IA, MO
Mississippi Valley Loess Plains	In the more gently rolling plains portion to the east, upland forests are dominated by oaks, hickories, and both loblolly and shortleaf pine. To the west, in the more rugged Bluff Hills portion, oak-hickory forest, along with southern mesophytic forests that contain beech, maples, sweetgum, basswood, tulip poplar, southern magnolia, and American holly are found.	MO
Ozark Highlands	Oak-hickory and oak-hickory-pine forest stands are typical. Some savannas and tallgrass prairies were once common in the vegetation mosaic. Post oak, blackjack oak, black oak, white oak, hickories, shortleaf pine, little bluestem, Indiangrass, big bluestem, eastern red cedar glades.	MO
Mississippi Alluvial Plain	Bottomland deciduous forest covered the region before much of it was cleared for cultivation for soybeans, cotton, corn, rich, and wheat. It is one of the most altered ecoregions in the United States. Floodplain forest communities are affected by hydroperiod. River swamp forests contain baldcypress and water tupelo. Hardwood swamp forests include more water hickory, red maple, green ash, and river birch. Higher, seasonally flooded areas include sweetgum, sycamore, laurel oak, Nuttall oak, and willow oak.	MO, IL
Interior Plateau	Natural vegetation is primarily oak-hickory forest, with some areas of bluestem prairie, cedar glades, and mixed mesophytic forest. White oak, northern red oak, black oak, hickories, yellow poplar, red maple, eastern red cedar are typical.	IL, IN, OH
Eastern Corn Belt Plains	Extensive cropland with corn, soybean, and wheat. Historically, beech forests were common on Wisconsinan soils, while beech forests and elm-ash swamp forests dominated the wetter pre-Wisconsinan soils.	MI, IN, OH

Ecoregion Name	Common Vegetation Communities and Species	State
Erie Drift Plain	Much of this region is now farmed; feed grains and forage crops are typical. This area was once largely covered by beech-maple forests, or mixed oak forests with red oak, white oak, and shagbark hickory, and mixed mesophytic forests with sugar maple, yellow birch, beech, and hemlock. Some elm-ash swamp forests grew in the damper lowland areas.	OH
Western Allegheny Plateau	The natural vegetation is mostly mixed mesophytic forest, in contrast with the oak–hickory forest stands of the Interior Plateau ecoregion to the southwest, and the less diverse beech forest of the Eastern Corn Belt Plains ecoregion to the west. Chestnut oak, red maple, white oak, black oak, beech, yellow-poplar, sugar maple, ash, basswood, buckeye, and hemlock occur. Appalachian oak forests are also found in the region.	OH
Eastern Great Lakes Lowlands	Croplands (e.g., grains, corn, soybeans, hay, and fruit) dominate a landscape that was previously an area of mixed coniferous-deciduous wood forests. The remaining forests include sugar maple, yellow birch, eastern hemlock, basswood and eastern white pine; beech occurs on warmer sites. Dry sites are dominated by red oak and pine, eastern white pine and cedar. Wetter sites support red maple, black ash, white spruce, tamarack, and eastern white cedar.	OH

Sources: U.S. Environmental Protection Agency 2013; Commission for Environmental Cooperation 2006, 2011.
IL=Illinois; IN=Indiana; IA=Iowa; MI=Michigan; MN=Minnesota; MO=Missouri; OH=Ohio; WI=Wisconsin.

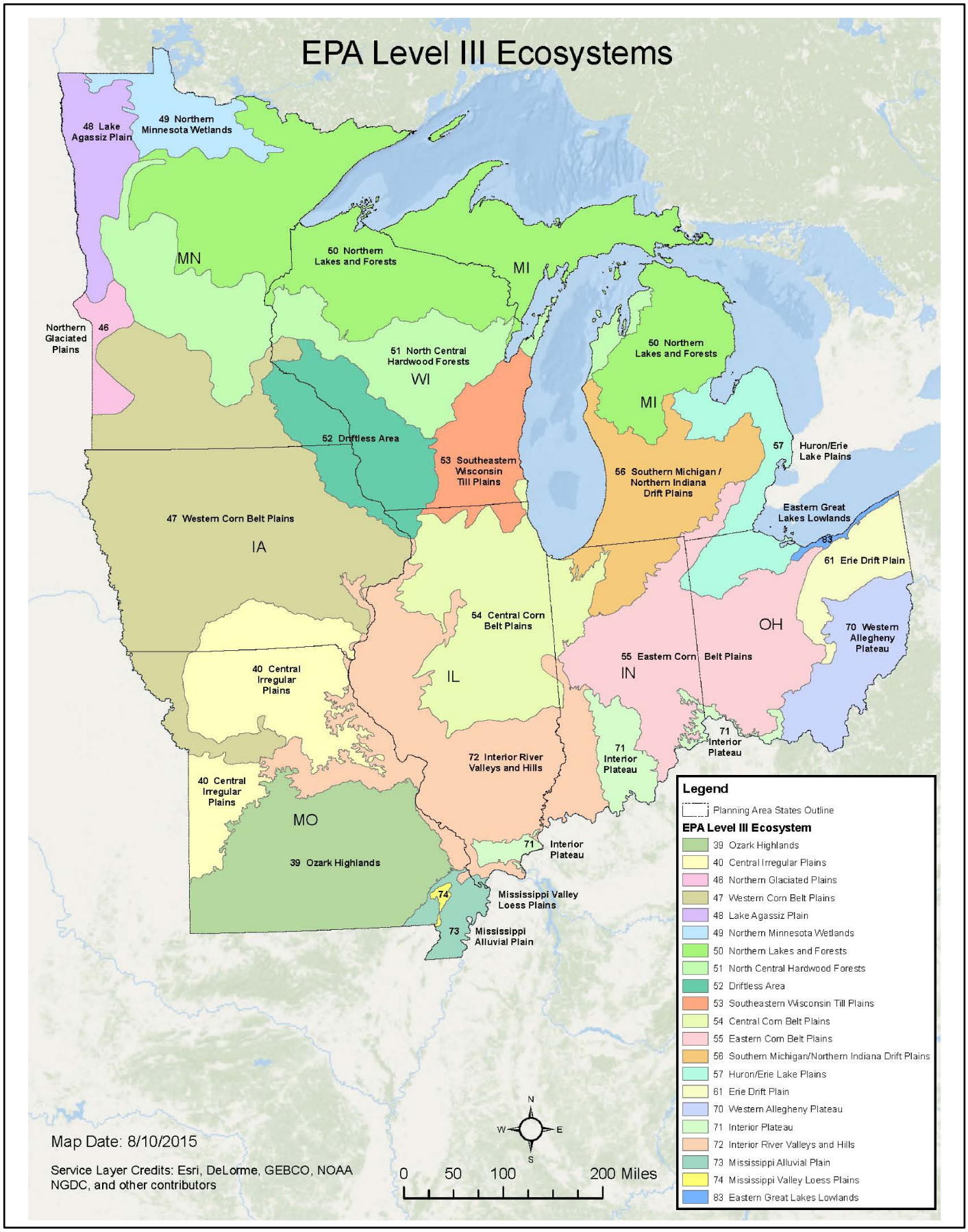

Figure 3.1-1
Study Area Level III Ecoregions
Midwest Wind Energy Multi-Species HCP EIS

Vegetation by Cover Class

The NLCD (2015) provides a means to quantify different vegetation land cover classes in the study area and to provide some measure of the extent of different vegetation communities and plant species for the ecoregions within the study area (Table 3.1-2). The NLCD vegetation cover classes that occur in the study area include forest, shrub, grassland/herbaceous, agriculture, wetlands, barren land, open water, and developed cover types. Table 3.1-2 shows the percent of vegetation cover classes in the study area by state. Table 3.1-3 provides the NLCD definition of each vegetation cover class.

Table 3.1-2. Vegetation Cover Classes in Study Area by State

	Percent (%) of Vegetation Cover Classes in the Study Area							
Vegetation Cover Class	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin
Deciduous Forest	15	22	7	25	14	34	30	30
Evergreen Forest	<1	1	<1	6	3	1	1	2
Mixed Forest	<1	<1	<1	4	3	1	<1	4
Shrub/Scrub	<1	<1	<1	2	2	1	<1	2
Grassland/Herbaceous	1	2	5	4	3	2	2	1
Pasture/Hay	9	7	13	7	8	30	11	11
Cultivated Crops	60	55	65	19	37	21	39	26
Woody Wetlands	1	1	1	17	13	2	1	11
Emergent Herbaceous Wetlands	<1	<1	1	2	6	<1	<1	3
Barren Land (Rock/Sand/Clay)	<1	<1	<1	<1	<1	<1	<1	<1
Open Water	2	1	1	3	6	1	1	4
Developed, Open Space	5	6	5	5	4	4	8	4
Developed, Low Intensity	5	3	2	3	1	2	4	2
Developed, Medium Intensity	2	1	<1	1	1	1	2	1
Developed, High Intensity	1	1	<1	1	<1	<1	1	<1

Source: National Land Cover Database 2015.

The study area across all states is dominated by the two agricultural related vegetation cover classes (e.g., cultivated crops and pasture/hay), followed by deciduous forest. Higher percentages of wetland cover in the three northernmost states—Michigan, Minnesota, and Wisconsin—within the study area are notable, with a higher coverage of woody wetlands compared to emergent herbaceous wetlands. Evergreen forest, mixed forest, and shrub/scrub vegetation cover classes are also slightly greater in the three northernmost states compared to the rest of the study area.

Table 3.1-3. NLCD Definitions of Vegetation Cover Classes

Cover Class	Description
Deciduous Forest	Areas dominated by trees generally greater than about 16 feet (5 meters) tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
Evergreen Forest	Areas dominated by trees generally greater than about 16 feet (5 meters) tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
Mixed Forest	Areas dominated by trees generally greater than about 16 feet (5 meters) tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
Shrub/Scrub	Areas dominated by shrubs; less than about 16 feet (5 meters) tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Grassland/Herbaceous	Areas dominated by grass or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Woody Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Barren Land (Rock/Sand/Clay)	Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Open Water	Areas of open water, generally with less than 25% cover of vegetation or soil.

Cover Class	Description
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover. These areas most commonly include single-family housing units.
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
Source: National Land Cover Database 2015.	

Invasive Plants

Invasive plants are weed species that are typically non-native, and whose introduction is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Invasive plants can adversely affect vegetation communities by outcompeting native vegetation, leading to a reduction in biodiversity and degradation of habitats. Humans are the primary source of invasive plant introduction, and once established, invasive plants are often difficult to contain, control, and eradicate. Each state in the study area identifies and lists invasive plant species under statute or regulation; 198 invasive plant species have been identified in one or more states in the study area. Table 3.1-4 summarizes the number of invasive plants listed under state statute or regulation for each state in the study area, and Appendix C provides the full list of these species.

Table 3.1-4. Number of Invasive Plant Listed Under State Statute or Regulation

State	Number of Invasive Plants
Illinois	42
Indiana	34
Iowa	32
Michigan	37
Minnesota	49
Missouri	11
Ohio	21
Wisconsin	143
Source: Midwest Invasive Plant Network 2015.	

Invasive plants are typically found in areas where the ground or soil has been disturbed, and are commonly found along transportation corridors (e.g., roads, highways, rail lines); utility corridors (e.g., transmission lines and pipelines); in residential, commercial, and industrial areas; around agricultural lands; and other developed, disturbed, or human-influenced areas. The vegetation cover

class information in Table 3.1-2 provides some insight into the locations in the study area that may have existing invasive plants or would have a higher potential or risk for the establishment and spreading of invasive plants. These vegetation cover classes would include pasture/hay, cultivated crops, and the various developed classes, because they all include land disturbance activities that create conditions that would increase the risk of establishment and spread of invasive plants.

3.1.2.2 Covered Species

As noted above, Covered Species include all species the Service is considering incidental take authorization for under the action alternatives, including Kirtland's warbler, piping plover, interior least tern, bald eagle, Indiana bat, northern long-eared bat, and little brown bat. The following sections provide information on each Covered Species, including their status and distribution, habitat characteristics and use, population status and threats, and occurrence in the study area. Table 3.1-5 summarizes the Federal listing status, county distribution, and habitat description of each Covered Species.

Kirtland's Warbler

Status and Distribution

Kirtland's warbler (*Setophaga kirtlandii*) was listed as an endangered species under the ESA in 1967. The breeding range of the Kirtland's warbler is centered almost entirely in the northern portion of Michigan's Lower Peninsula (*i.e.,* Ogemaw, Crawford, Oscoda, Alcona, and Iosco counties), where 98 percent of all singing males occur (Michigan DNR unpublished data cited in U.S. Fish and Wildlife Service 2012a). The remaining 2 percent of singing males are from limited areas in Michigan's Upper Peninsula, Wisconsin (primarily Adams County), and southern Ontario. A few solitary sight records have also occurred in Minnesota and Quebec (Mayfield 1996; U.S. Fish and Wildlife Service 2012a). These warblers arrive at their breeding grounds throughout the month of May and depart for their wintering grounds from late August through late September (Mayfield 1998).

Migration follows an approximate direct route between summer breeding grounds and wintering grounds (primarily the Bahamas and less-so in the Turks and Caicos Islands), passing through many states, including several in the study area, but primarily Michigan and Ohio (Clench 1973; Mayfield 1996; U.S. Fish and Wildlife Service 2012a).

The Service has not designated critical habitat for Kirtland's warbler.

Habitat Characteristics and Use

Kirtland's warbler nesting habitat occurs across a very localized, narrow swath of sandy outwash plains left from the last glaciation found largely in the northern portion of Michigan's Lower Peninsula. The species requires scrubby jack pine barrens at least 30 hectares in size (about 75 acres), though smaller habitat sizes can be used if habitat is ideal (Mayfield 1993; Michigan Department of Natural Resource 2015).

Kirtland's warbler is a ground-nesting species. Nests are placed near the bases of suitable jack pine trees. These trees are 5 to 20 feet (1.3 to 6 meters) in height, interspersed with many small openings of sparse, grassy ground cover. Once jack pine grow too tall, habitat is no longer suitable because the lowest tree branches become too high to conceal the nests. Soils associated with Kirtland's warbler

nesting habitat are sandy and extremely well-drained: an important criterion that prevents flooding of the nests during storm events.

Population Status and Threats

This species represents one of the world's rarest birds, and several decades ago the species was close to extinction. By 1971, the Kirtland's warbler population had crashed to approximately 201 singing males (U.S. Fish and Wildlife Service 2012a). Kirtland's warbler has likely always been rare, but severe population declines are attributed to habitat loss and brown-headed cowbird parasitism. Habitat loss for Kirtland's warbler is the result of both land conversion and fire suppression, which prevents the cyclical re-establishment of early successional jack pines required by the species. The brown-headed cowbird followed agricultural expansion and heavily parasitized Kirtland's warbler nests (U.S. Fish and Wildlife Service 2012a). These threats, coupled with specialized habitat requirements and high levels of endemism led to near-collapse of the species.

The Kirtland's Warbler Recovery Plan (U.S. Fish and Wildlife Service 1985a) mandated habitat acquisition and management, which is reversing the trends of habitat loss and nest parasitism, and appear to be allowing the population to rebuild and expand (U.S. Fish and Wildlife Service 2012a). The 2012 annual range-wide census detected 2,090 singing males, which is the highest number since annual monitoring began in 1951. Nearly all of these were recorded in Michigan, although two dozen were detected in Wisconsin (up from eight in 2008) (U.S. Fish and Wildlife Service 2012b).

In Michigan, 150,000 acres are managed on a rotational basis for 38,000 acres of prime habitat at any given time (Michigan Department of Natural Resources 2015). Approximately 3,000 acres of jack pine trees are planted or seeded annually on state and Federal lands in Michigan. Management activities also includes trapping and removing cowbirds, with 4,000 removed per year since trapping began in 1972 (Michigan Department of Natural Resources 2015). If intensive management actions were to cease, it is likely the species would decline as jack pine stands aged into unsuitable habitat and cowbird numbers rebounded (U.S. Fish and Wildlife Service 2012a).

Occurrence in the Study Area

As described above, Kirtland's warbler nesting occurs within a limited range primarily in Michigan, in lands that are protected and managed for the species. Migration represents a broader distribution within the study area, where migration records exist for each state in the study area, but primarily occurs in Michigan and Ohio, as birds travel to and from their Michigan breeding grounds (U.S. Fish and Wildlife Service 2012a; Clench 1973). Fall migration records are particularly rare because males are not singing; therefore, occurrence in the study area during fall migration may be difficult to detect (Clench 1973).

Piping Plover

Status and Distribution

In 1985, the Service listed piping plover (*Charadrius melodius*) breeding populations in the Atlantic Coast and Northern Great Plains as threatened under the ESA, and the Great Lakes breeding population as endangered. Thirty-seven percent of the global piping plover population breeds in the Northern Great Plains, while the Great Lakes breeding population accounts for only 1 percent of the entire species (Elliot-Smith *et al.* 2009). The study area contains both the federally endangered Great Lakes and threatened Northern Great Plains populations of piping plover.

The Service designated critical habitat in 2001 for the Great Lakes population. Critical habitat includes the beaches and associated habitat used by plovers during the breeding season and extends 1,640 feet (500 meters) inland from the normal high water level. Michigan is the main breeding grounds for the Great Lakes population, while Wisconsin and Ontario support approximately 20 percent of the population (U.S. Fish and Wildlife Service 2012a).

The Service designated critical habitat in 2002 for the Northern Great Plains breeding population in parts of Minnesota, North Dakota, South Dakota, Nebraska, and Montana. Critical habitat consists of alkali wetlands and adjacent shores; river channels with their sandbars and islands; and sparsely-vegetated areas of reservoirs and inland lakes. Only one breeding colony of the Northern Great Plains populations is known to the study area, located near the Canadian border at Lake of the Woods in northwest Minnesota.

Additional discussion of critical habitat in the study area is found in the *Occurrences in the Study Area* section below.

Habitat Characteristics and Use

During the breeding season the Great Lakes population of piping plover is primarily associated with cobble-gravel beaches in open sand dune systems containing non-forested wetlands (Wemmer 2000; Price 2002). Beaches on which piping plovers nest are typically at least 100 feet (30 meters) wide (U.S. Fish and Wildlife Service 2003). Each pair's home range contains a nesting beach and shoreline and wetland foraging habitat (Johnson *et al.* 1997).

Great Lakes plover migrate to wintering grounds found outside of the study area on the Gulf and southern Atlantic coasts, and in Mexico, Cuba, and other Caribbean islands. Northern Great Plains plover migrate primarily to the Texas and adjacent Mexican coasts (U.S. Fish and Wildlife Service 2012d). Migration stopover habitat allows shorebirds like the plover to replenish fat reserves and arrive in good condition on the breeding grounds (U.S. Shorebird Conservation Plan 2000). Stopover habitat for piping plover between the Great Lakes and wintering grounds consists of shorelines of reservoirs, industrial ponds, natural lakes, and rivers (Pompei and Cuthbert 2006). Stopover habitat for the Northern Great Plains population is not well known but is presumed to include similar habitats where sand and mud substrates occur near water.

Great Lakes plover populations arrive on breeding grounds between mid-March to late May and depart for wintering grounds from August through October (Pompei and Cuthbert 2006). Three to four eggs are laid on the beach in a shallow depression with pebbles or shells, which cause the nest to match the surrounding substrate. Sparsely-vegetated beaches within about 16 feet (5 meters) of water are primary feeding areas (Johnson *et al.* 1997). During breeding, plovers fly at elevations several meters above beaches and water.

Migration flight elevations are not well-documented. Dierschke and Daniels (2003) recorded flights of similar plovers in Europe at approximately 164 feet (50 meters). In a review of over 1,200 fall and spring stopover records, Pompei and Cuthbert (2006) reported that 77 percent of sightings were of a single bird, concluding that piping plover does not tend to congregate during migration.

Population Status and Threats

The wild piping plover population in 2006 was estimated to be 8,092; 73 percent of individuals were in the United States and the rest in Canada (Elliot-Smith *et al.* 2009). Of birds in the United

States, fewer than 2 percent were in the Great Lakes population and 50 percent were in the Northern Great Plains population (Elliot-Smith *et al.* 2009).

Breeding pairs are an important measure of breeding success tied to Recovery Plan goals. From 1984 to 2001, Great Lakes piping plover breeding pairs ranged from 12 to 32, increased to 51 in 2002 (U.S. Fish and Wildlife Service 2003), and then 63 in 2008 (U.S. Fish and Wildlife Service 2009a). The majority of these were in Michigan (53 in 2008 and 58 in 2012). In 2008 45.9 percent of the nation's 2,640 breeding pairs were in the Northern Great Plains population (Elliot-Smith *et al.* 2009).

Piping plover was federally listed primarily due to small population size and poor protection of important nesting areas (U.S. Fish and Wildlife Service 2003; U.S. Fish and Wildlife Service 2009). For the Great Lakes population, the Recovery Plan sets a level of at least 150 pairs (300 individuals) in 5 consecutive years to consider changing this population's status to threatened (U.S. Fish and Wildlife Service 2003). For the Northern Great Plains population, the level for delisting from threatened is 1,300 pairs over 15 years (U.S. Fish and Wildlife Service 1988).

The Great Lakes population is primarily threatened by shoreline development, which degrades habitat through residential development, shore stabilization projects, and construction of jetties, boat slips, and piers (U.S. Fish and Wildlife Service 2009a). In addition, increasing beach use by people, vehicles and dogs may crush nests or young or cause adults to abandon nests and chicks. Predation by raptors and mammals is a large threat (Wemmer 2000). Piping plovers nesting in areas of higher human disturbance appear to require larger home ranges to meet their life history needs than those nesting in isolated areas not directly affected by human disturbance (Shutt 1996). Currently, disease is an unlikely threat, but risk may increase as outbreaks of West Nile virus, avian cholera and Type E botulism increase near breeding grounds (U.S. Fish and Wildlife Service 2009a).

The Northern Great Plains population is threatened by construction of reservoirs on rivers and the channelization or alteration of flow in rivers (U.S. Fish and Wildlife Service 2003, 2009a). Cattle and all-terrain vehicles (ATVs) affect nesting success in the Great Plains (Gaines and Ryan 1988) and ATVs affect this population's wintering habitat (Zonick 2000). ATVs are known to affect plover habitat and nesting success (Wheeler 1979). There is also concern that sand and gravel mining in the Great Plains can create nesting habitat for plovers, which is then lost when the mine is reclaimed and used for development.

Occurrence in the Study Area

Breeding habitat in the study area is restricted to the shores of the Great Lakes and at Lake of the Woods, Minnesota. Wintering habitat is located outside the study area. During migration, plovers can be found throughout the study area (Pompei and Cuthbert 2006). Spring movement through the study area begins in late February, with a peak in late March, and draws to a close beginning in May (Elliott-Smith and Haig 2004). Great Lakes birds may leave the nesting grounds in mid-July or August and continue departing through October (U.S. Fish and Wildlife Service 2003; Pompei and Cuthbert 2006). Although birds travel mostly solitarily, piping plovers are distributed widely throughout the study area for 3 months in spring and three months in fall. For the remainder of the year they are either on the breeding or wintering grounds.

Thirty-five critical habitat units for the Great Lakes population occur in Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania and New York; 33 of these units occur in the study area. Of the 201 miles of shoreline designated as critical habitat for the population, 69.2 percent

(139 miles) occurs in Michigan and 21.5 percent (41.3 miles) in the rest of the study area, for a total of 180.3 miles. Only 10.3 percent of the Great Lakes critical habitat (20.7 miles) is found outside the study area. These units in the study area cover 181 miles of shoreline.

The Northern Great Plains population has a total of 19 critical habitat units totaling 183,422 acres, inclusive of over 1,207 river miles. Minnesota is the only state in the study area with Northern Great Plains population designated critical habitat; about 234 acres of critical habitat is designated at three locations around Lake of the Woods in Lake of the Woods County. The remaining critical habitat units outside the study area are found in Montana, Nebraska, North Dakota, and South Dakota.

Interior Least Tern

Status and Distribution

The interior least tern (*Sternula antillarum athalassos*) was federally listed as endangered in 1985 throughout all of its range, which for many states only includes stretches of shoreline habitat of major riverine systems: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana (Mississippi River and its tributaries north of Baton Rouge), Mississippi (Mississippi River), Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and Texas (except within 50 miles of the Gulf Coast). The Service has not designated critical habitat for the interior least tern.

At the time of Federal listing in 1985, about 1,400 to 1,800 interior least terns were believed remaining (U.S. Fish and Wildlife Service 1985b). By the time the interior least tern recovery plan was prepared in 1990, the numbers were thought to be about 5,000 individuals. The goal of the recovery plan was to protect, restore, and enhance shoreline habitat to increase the number of interior least terns to at least 7,000 individuals for a span of 10 years (U.S. Fish and Wildlife Service 1990a).

Though historically the species distribution was much wider, currently, the interior population of the least tern is known in the Mississippi, Missouri, Rio Grande, Arkansas, Canadian, and Red River systems (Lott 2006). Presently, the species is known mainly from the lower Mississippi River (outside the study area). It is not believed to be currently present along the Missouri River in the state of Missouri (Smith and Renken 1990).

Their winter range occurs along coastal areas of Central and South America (Hardy 1957).

Habitat Characteristics and Use

Interior least terns breed and nest in open sandy or gravelly beaches, sand bars, and mudflats along the Mississippi, Missouri, Rio Grande, Arkansas, Canadian, and Red River systems. Birds arrive at breeding areas from late April to early June (Faanes 1983; Hardy 1957). Nests are simple, scraped depressions placed well back from the high water line (Ducey 1998). The nesting season lasts from late April to August. The birds leave the nesting habitat by early September for fall staging and migration (Hardy 1957).

Interior least tern forage within the shallows, where small fish reside (Tibbs 1995), and generally within 328 feet (100 meters) of the nest site (Faanes 1983), though they may travel up to 2 miles to other foraging opportunities found along the shallows in reservoirs, lakes, and river backwaters (Hardy 1957; Nebraska Game and Parks Commission 1997).

Population Status and Threats

Although the recovery goal of at least 7,000 individuals has been well-exceeded, interior least tern remains ineligible for delisting because the species is not self-sustaining and because recovery has only occurred in one area – the lower Mississippi River. Current population estimates are 12,247 interior least tern nesting along the lower Mississippi from Cape Girardeau, Missouri to Baton Rouge, Louisiana (Jones 2011).

The Recovery Plan (U.S. Fish and Wildlife Service 1990a) identified three major causes for the least tern's decline: habitat loss, predation, and human disturbance. As a result, the species had disappeared from previous key river systems, including some or all of the extents of the Missouri, Platte, Mississippi, Arkansas, Cimarron, Canadian, and Red Rivers.

Habitat loss has occurred through altered river course hydrology and dynamics, including dam construction, hydropower development, and river channeling. These have resulted in atypical and untimely flooding in many areas, which inundate nesting sites, and unnatural dry out in other areas which decrease food supplies and increase human and predator access to nest sites (Hardy 1957; Ducey 1981). Mid-channel sand bar removal to accommodate navigation has also removed key nesting habitat. In addition, dams and reservoirs which entrap sediments have limited the formation of new sandbar habitat (Galat and Lipkin 2000).

Predation from domestic animals and human-adapted species such as coyotes and raccoons has had a negative effect on reproductive success (Kruse 1993).

Recreational use of sandy shorelines and sandbars, such as fishing, swimming, camping, and ATV use, has also led to habitat loss and destruction of nest sites and eggs.

Occurrence in the Study Area

Historic or current interior least tern occurrence in the study area is primarily limited to the Missouri River and Mississippi River, and their confluence, in the states of Missouri, Illinois and along the western boundary of Iowa. A portion of southern Illinois is also thought to be used by interior least tern, along the Ohio River (U.S. Fish and Wildlife Service 1990). In addition, interior least terns may travel several miles from nest sites to congregate at staging areas in preparation for fall migration (Lingle 1993). Interior least terns generally follow the major river corridors for migration, but travel several miles from the river itself (Thompson *et al.* 1997; Howell and Engel 1993).

Bald Eagle

Status and Distribution

The bald eagle was listed as an endangered species in 1966 under the Endangered Species Preservation Act, when the entire population in the lower 48 states was estimated at 834 individuals. It was delisted in 2007 when recovery objectives were met, and today the population in the lower 48 states alone is estimated at 97,956 individuals (U.S. Fish and Wildlife Service 2009). The bald eagle remains protected under the Bald and Golden Eagle Protection Act (BGEPA), the Migratory Bird Treaty Act, and the Lacey Act.

Bald eagles are widespread throughout North America, with the largest breeding populations in Alaska and Canada (Campbell et al. 1990; Buehler 2000; U.S. Fish and Wildlife Service 2009).

Partners in Flight (2015) estimate the total North America population as 300,000. The Great Lakes population, which occurs in the Plan Area, accounts for 40 percent (27,617 eagles) of the bald eagle population in the lower 48 states (U.S. Fish and Wildlife Service 2009). There are also large breeding populations along the Atlantic coast from Maryland to Florida, as well as in the Pacific Northwest (Curnutt and Robertson 1994; Buehler 2000; U.S. Fish and Wildlife Service 2009). Smaller breeding populations are found along the Gulf of Mexico and in the Rocky Mountains (Buehler 2000; U.S. Fish and Wildlife Service 2009). Bald eagles also breed in the southwestern United States, but their numbers there are low compared to the rest of the country.

The breeding range of the bald eagle coincides with rivers, lakes, and coastal areas throughout North America. Many eagles, particularly those at inland breeding grounds north of 40°N latitude, either migrate south for the winter along river systems to portions of the United States with suitable food resources and roosting sites, or move to nearby coastal areas or rivers that do not freeze (Buehler 2000). By contrast, those at more southern latitudes typically remain at their breeding grounds year round. In some areas, timing of migration coincides with food resource availability, such as the salmon runs in Alaska and the Pacific Northwest (Hunt *et al.* 1992). Bald eagles breeding in the northern United States typically migrate south along river systems or to the nearest coast; those that do not migrate move to the nearest food source (Swenson *et al.* 1986; Buehler 2000), such as power plant discharge areas or locations with sufficient carrion.

Habitat Characteristics and Use

Northern breeding populations return to their breeding grounds between January and March (Buehler 2000). Bald eagles typically nest along forested coasts, rivers, streams, reservoirs, or large lakes (Buehler 2000; U.S. Fish and Wildlife Service 2009). Nests are often constructed in mature or old-growth trees and snags within 1.24 miles (2 km) of food resources (Buehler 2000; U.S. Fish and Wildlife Service 2009), and less commonly on cliffs, rocky outcrops, and human-made structures (U.S. Fish and Wildlife Service 2009). Bald eagles typically choose the largest nest tree available having a limb structure that supports their heavy nests and provides good visibility and easy access (Buehler 2000). Eagles also tend to select nest trees that, on average, are more than 547 yards (500 m) from human development (Buehler 2000), although some will build within 109 yards (100 meters) of development. Nest tree diameter ranges from 20 to 75 inches (50 to 190 cm) and nest height ranges from 22 to 66 yards (20 to 60 m) (Stalmaster 1987). Nests generally are built against or near the tree trunk, and just below the crown of the tree (Buehler 2000).

Bald eagle home range size varies based upon location, time of year, breeding status, and food availability (Griffen and Baskett 1985; Buehler 2000). Bald eagles defend territories, often using the same territory each year (U.S. Fish and Wildlife Service 2009). Territory size ranges from 0.19 to 1.5 square miles (0.5 to 4 km^2) (Hodges and Robards 1982; Stalmaster 1987; Gerrard *et al.* 1992b; and Buehler 2000).

Egg laying may occur as early as February in southern portions of the Plan Area and as late as April in the Plan Area's northern portions. The incubation period is usually around 35 days (Buehler 2000). Within the Plan Area, young typically fledge between June and August.

Bald eagles primarily hunt from perches or by soaring over foraging areas. Bald eagles usually soar above areas of open water while hunting, although they may at times soar over land. (Buehler 2000). The typical diet of a bald eagle consists primarily of fish, but it will also eat birds, mammals, and reptiles (Buehler 2000). While most prey is captured while flying, eagles opportunistically feed on carrion.

Population Status and Threats

The use of the pesticide DDT, and other types of human-caused mortality, caused the global population of bald eagles to drop to an all-time low in the mid to late 1900s, with only 417 breeding pairs in the contiguous United States (Buehler 2000). In the decades after listing under the ESA and a ban on DDT, the bald eagle population rebounded to 9,789 breeding pairs in the lower 48 states in 2006 (U.S. Fish and Wildlife Service 2009).

Primary ongoing human threats to bald eagles include disturbance and habitat loss from human development, collisions with manmade structures, electrocution, environmental contaminants, illegal take, and climate change (Fraser *et al.* 1996; Buehler 2000; Allison 2012).

Direct and indirect disturbance by human development may cause temporary or permanent loss of nesting, hunting, or roosting habitat (Fraser. 1985; Buehler 2000; U.S. Fish and Wildlife Service 2009). Collisions with vehicles, aircraft, and trains, as well as collisions or electrocutions with overhead lines account for hundreds of bald eagle fatalities (Allison 2012). To date, however, based upon publicly available information, only eight known bald eagle fatalities have been due to turbine collisions, representing less than 1 percent of all human-caused fatalities (Allison 2012; Pagel *et al.* 2013; Nelson pers. comm.). According to Allison (2012), electrocution accounts for 10.4 percent of all fatalities. Poisoning from environmental contaminants including lead shot, heavy metals, pesticides, and oil spills are another major source of mortality in bald eagles (Buehler 2000). Eagles are also killed by people shooting, trapping, and deliberately poisoning them. Climate change threatens bald eagles and has been implicated in shifting egg-laying dates and changes in winter range (Allison 2012).

Occurrence in the Study Area

The largest breeding population of bald eagles in the lower 48 states is in the Plan Area (U.S. Fish and Wildlife Service 2009), where the population is estimated at 97,956 individuals (U.S. Fish and Wildlife Service unpublished data). Most eagles are concentrated in Minnesota, Wisconsin, and northern Michigan. Bald eagles also nest in lower numbers in Iowa, Missouri, Illinois, Indiana, and Ohio (U.S. Fish and Wildlife Service 2007; Sauer *et al.* 2014). Within the Plan Area, eagles tend to nest and concentrate around the Great Lakes and other large water bodies, particularly the Mississippi and Missouri Rivers. Wintering bald eagles have been documented in all eight states of the Plan Area (National Audubon Society 2010).

Indiana Bat

Status and Distribution

The Indiana bat was listed as federally endangered by the Service in 1967. The species is found in forested regions from the U.S. Canada border in the northeast, south to the coastal Plain, and west to the Kansas/Missouri line. The Service designated critical habitat for the Indiana bat in 1977, both in and outside of the study area. Additional discussion of critical habitat in the study area is found in the *Occurrences in the Study Area* section below.

Habitat Characteristics and Use

Indiana bats have the most specialized requirements of any of the covered bat species. In winter, the bats hibernate in caves and mines. Although there are hundreds of documented smaller hibernacula (places where bats hibernate), most Indiana bats are associated with hibernacula that contain more

than 1,000 individuals (U.S. Fish and Wildlife Service 2015c). During summer, most males remain near the hibernaculum, but females may migrate more than 300 miles where they form maternity colonies. Members of a maternity colony may use many roosts (a place where bats sit or rest when not flying) per summer, but almost all of these are beneath exfoliating bark. Large, dead trees with significant solar exposure are especially valuable and may be used by the majority of the colony on most days during a summer. Such trees are termed primary roosts. Secondary roosts are often smaller trees and may be heavily shaded. Secondary/alternate roosts are used most extensively in late summer once juveniles can fly. Males use trees that are similar to alternate roosts. On rare occasions, anthropogenic structures such as buildings and bat boxes are used for roosting. Indiana bats forage primarily in open woodlands, forested wetlands, and in edge habitats where true flies, moths, and beetles are found.

Population Status and Threats

Populations of Indiana bats declined rapidly between the 1960s and the early 1990s likely due to disturbance of hibernating bats, physical changes in hibernacula, chemical contamination, and decline in forest quality. However, by the mid-1990s, populations in the northeast (especially New York) began to rapidly increase. Populations increased in hibernacula in Indiana, Ohio, and Illinois as well. Populations in the historic (pre-1980s) Missouri hibernacula within the Ozarks region continued to decline, but many of these bats may have moved to newly available mines located in eastern Missouri and southern Illinois.

The arrival of White-Nose Syndrome (WNS)—a fungus that thrives in cold environments such as caves—halted recovery in most areas, causing declines of over 90 percent to many of the cave-hibernating bats of the northeast United States. The disease has now spread as far west as the Kansas/Missouri border and all cave-dwelling bats in the region are at risk. Other threats faced by Indiana bats include disturbance during winter (e.g., people exploring caves and waking bats), chemical contamination, modification of hibernacula, loss of summer habitat (which may take bats if they are present), and mortality at wind energy sites. Current range-wide population is estimated at 523,636 bats (U.S. Fish and Wildlife Service 2015c).

Occurrence in the Study Area

The highest summer densities of Indiana bats are found in the study area in northern portions of Ohio, Indiana, Illinois, and Missouri, as well as southern Iowa and Michigan. The species may occasionally occur in southwestern Wisconsin, but is not known to occur in Minnesota.

Hibernating populations within the study area are estimated by the Service as follows: Indiana (185,720 bats), Missouri (185,693 bats), Illinois (56,055 bats), Ohio (4,809 bats), and Michigan (20 bats). Together, these estimates represent a decline of 9.7 percent from the 478,936 Indiana bats estimated in the same region in 2013 to the 432,297 Indiana bats in 2015 (U.S. Fish and Wildlife Service 2015c).

Designated critical habitat for the Indiana bat is present in the study area in Illinois (La Salle County), Indiana (Crawford and Greene counties), and Missouri (Crawford, Franklin, Iron, Shannon, Washington), but not within Covered Lands where wind development may occur under the action alternatives. All critical habitat locations are caves, with the exception of La Salle County, Illinois, which is identified as The Blackball Mine.

Northern Long-Eared Bat

Status and Distribution

The northern long-eared bat was federally listed as threatened by the Service in May 2015. This species occupies forested habitat from the Florida Panhandle north to Nova Scotia and west to Saskatchewan. Prior to the arrival of WNS, northern long-eared bats were common in a variety of habitats, but were often the most common small bat in areas of dense forest cover, such as Appalachia. Concurrent with the arrival of WNS, northern long-eared bats began to rapidly decline, resulting in the listing of the species by the Service.

Habitat Characteristics and Use

The northern long-eared bat is the least selective of habitat of the covered bat species, using a wide variety of habitats at all times of year. Like the other covered bat species, northern long-eared bats hibernate in caves and mines. However, only a very small portion of the population is observed in caves and mines, and when they are observed they are often found in cracks and crevices within these caves. As such, some of these bats may also hibernate in cracks and crevices outside caves and mines.

During summer, most females form maternity colonies in trees, but they tend to be less selective than Indiana and little brown bats. Large dead trees are used by many northern long-eared bats, but large hollow trees may also be used for multiple years. Small trees, even shrubs with cavities or loose bark are sometimes used. Northern long-eared bats regularly use bat boxes, especially in woodland settings, but otherwise are less likely to be associated with anthropogenic roosts than are little brown bats. Northern long-eared bats are capable of foraging in a variety of settings and feed extensively on moths, beetles, and true flies.

Population Status and Threats

As noted above, northern-long-eared bats are in a period of rapid decline, and the species is now listed under ESA as threatened. Available data indicate population declines in WNS-affected regions of 80 to 95 percent. Threats to this species are similar to those listed for the Indiana bat and include mortality of bats at wind energy sites, deaths due to pesticide poisoning, collisions with vehicles, and bats killed/disturbed when roost trees are cut.

Occurrence in the Study Area

Northern long-eared bats occur throughout the study area, although they are rare in the western-most portion of the study area, along the border of Missouri and Iowa. Within the study area, the northern long-eared bat can be found in virtually any habitat where woodlands—ranging from isolated woodlots to riparian strips to contiguous forest land—occur. As such, the species is often the most commonly captured small bat in areas of dense forest, but less frequently encountered in areas with virtually no forest.

Little Brown Bat

Status and Distribution

The little brown bat is not a federally listed, proposed or candidate species, but is currently being assessed by the Service to determine if a protective status should be designated. The little brown bat

ranges from the edge of the Coastal Plain north to Alaska. Until the arrival of WNS, little brown bats were the most abundant bat species throughout most of the study area. However, little brown bats within the study area are currently in a period of rapid decline, and based on data from the northeast, losses of 90 percent are expected.

Habitat Characteristics and Use

Little brown bats hibernate in caves and mines in winter. During summer, most females within the Midwest form maternity colonies that often are in anthropogenic structures such as buildings, bat boxes, and expansion cracks on bridges. Some maternity colonies occur in large dead trees where the bats make extensive use of cracks, crevices, and under exfoliating bark. The diet of little brown bats is dominated by true flies, moths, and beetles which are often captured by foraging above wetlands, waterways, and along the edges of agricultural fields.

Population Status and Threats

Threats to the little brown bat are similar to the Indiana and Northern long-eared bats, with additional impacts associated with the removal of roosts in buildings. Populations often decline from abundant to near extinction within five years of the arrival of WNS (Dzal *et al.* 2011, Francl *et al.* 2012, Turner *et al.* 2011, and Frich *et al.* 2010). Similar large-scale declines have already occurred in caves and mines of Ohio and Indiana and are expected region-wide as the disease progresses to the west. Once the disease has moved through an area even small amounts of take have the potential for population-level effects.

Occurrence in the Study Area

Little brown bats occur throughout each of the states within the study area. Populations are greater in areas with large waterways and in regions with caves and mines.

Table 3.1-5. Covered Species Status, Distribution, and Habitat in the Study Area

Name	Federal Listing Status	Critical Habitat Designation	County Distribution within Study Area	Habitat Description
Bald Eagle *(Haliaeetus leucocephalus)*	Delisted/Bald and Golden Eagle Protection Act	Not Designated	**Illinois:** Statewide **Indiana:** Statewide **Iowa:** Statewide **Michigan:** Statewide **Minnesota:** Statewide **Missouri:** Statewide **Ohio:** Statewide **Wisconsin:** Statewide	Breeding and nests generally within about 2.5 miles (4 km) of sea coasts, bays, rivers, lakes, reservoirs, and other water containing primary food sources (fish, waterfowl, seabirds). Nests usually in tall trees, high objects, or cliffs. Nesting trees include pine, spruce, fir, cottonwood, poplar, willow, sycamore, oak, beech. Communal winter roosts are common.
Indiana bat *(Myotis sodalis)*	Endangered	Designated in Specific hibernacula (caves and mines) in Illinois, Indiana, and Missouri	**Illinois:** Potential occurrences statewide with known occurrences in Adams, Alexander, Bond, Clinton, Ford, Hardin, Henderson, Jackson, Jersey, Johnson, LaSalle*, Lawrence, Macoupin, Madison, McDonough, Monroe, Perry, Pike, Pope, Pulaski, Randolph, St. Clair, Saline, Schuyler, Scott, Union, Vermilion, Washington **Indiana:** Statewide including Crawford* and Greene* where critical habitat has been designated **Iowa:** Adair, Appanoose, Boone, Cedar, Clarke, Dallas, Davis, Decatur, Des Moines, Guthrie, Henry, Iowa, Jasper, Jefferson, Johnson, Keokuk, Lee, Louisa, Lucas, Madison, Mahaska, Marion, Marshall, Monroe, Muscatine, Polk, Poweshiek, Ringgold, Scott, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne **Michigan:** Allegan, Barry, Bay, Benzie, Berrien, Branch, Calhoun, Cass, Clinton, Eaton, Genesee, Gratiot, Hillsdale, Huron, Ingham, Ionia, Jackson, Kalamazoo, Kent, Lapeer, Leelanau, Lenawee, Livingston, Macomb, Manistee, Mason, Monroe, Montcalm, Muskegon, Oakland, Oceana, Ottawa, Saginaw, St. Joseph, Sanilac, Shiawassee, St. Clair, Tuscola, Van	Hibernation occurs in caves and mines, with swarming in surrounding wooded areas. Summer roosting and foraging habitat occurs in wooded stream corridors and in bottomland and upland forests and woods.

Name	Federal Listing Status	Critical Habitat Designation	County Distribution within Study Area	Habitat Description
			Buren, Washtenaw, Wayne **Missouri:** All counties in Missouri including Crawford*, Franklin*, Iron*, Shannon*, Washington*where critical habitat has been designated **Ohio:** Statewide	
Interior least tern *(Sterna antillarum)*	Endangered	Not designated	**Illinois:** Alexander, Jackson, Madison, Massac, Monroe, Pope, Randolph, St. Clair, Union, Wabash **Indiana:** Gibson, Greene, Spencer **Iowa:** Pottawattamie, Woodbury, Polk **Missouri:** Andrew, Atchison, Boone, Buchanan, Callaway, Cape Girardeau, Carroll, Chariton, Clark, Clay, Cole, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Jefferson, Lafayette, Lewis, Lincoln, Marion, Mississippi, Moniteau, Platte, Ralls, Ray, Saline, Scott, St. Charles, Ste. Genevieve, St. Louis, Stoddard, Warren	Sandbars on large rivers, dredged spoil islands, and human-made habitats that include constructed nesting islands and gravel areas near impoundments.
Kirtland's warbler *(Setophaga kirtlandii)*	Endangered	Not designated	**Michigan:** Alcona, Alger, Antrim, Baraga, Chippewa, Clare, Crawford, Delta, Grand Traverse, Iosco, Kalkaska, Luce, Marquette, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle, Roscommon, Schoolcraft **Wisconsin:** Adams, Bayfield, Douglas, Jackson, Marinette, Vilas, Washburn	Young stands of dense jack pine.
Little Brown Bat *(Myotis lucifugus)*	Not Listed (Status Review In-Progress)	Not designated	**Illinois:** Statewide **Indiana:** Statewide **Iowa:** Statewide **Michigan:** Statewide **Minnesota:** Statewide **Missouri:** Statewide **Ohio:** Statewide **Wisconsin:** Statewide	Hibernates in caves and mines – swarming in surrounding wooded areas in autumn. Roosts in buildings and in trees. Forages in woodland and over wetlands.

Name	Federal Listing Status	Critical Habitat Designation	County Distribution within Study Area	Habitat Description
Northern Long-eared Bat *(Myotis septentrionalis)*	Threatened	Not designated	**Illinois:** Statewide **Indiana:** Statewide **Iowa:** Statewide **Michigan:** Statewide **Minnesota:** Statewide **Missouri:** Statewide **Ohio:** Statewide **Wisconsin:** Statewide	Hibernates in caves and mines – swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.
Piping plover - Great Lakes Population *(Charadrius melodus)*	Endangered	Designated Units within all states within species range in Plan Area	**Illinois:** Cook, Lake*. Migration: Bond, Clinton, Fayette, Franklin, Jefferson, Moultrie, Shelby **Indiana:** Lake and LaPorte **Michigan:** Alger*, Alpena, Benzie*, Berrien, Charlevoix*, Cheboygan*, Chippewa*, Delta, Emmet*, Leelanau*, Luce*, Mackinac*, Manistee, Mason*, Muskegon*, Presque Isle*, Schoolcraft* **Minnesota:** St. Louis County*, Sandusky **Wisconsin:** Ashland*, Douglas*, Manitowoc*, Marinette*	Beaches along shorelines of the Great Lakes, with associated sparsely vegetation wetlands and shores used while foraging.
Piping plover - Great Plains Population *(Charadrius melodus)*	Threatened	Designated Unit in Minnesota	**Iowa:** Pottawattamie, Woodbury **Minnesota:** Lake of the Woods* **Missouri:** Andrew, Atchison, Boone, Buchanan, Callaway, Cape Girardeau, Carroll, Chariton, Clark, Clay, Cole, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Jefferson, Lafayette, Lewis, Lincoln, Marion, Mississippi, Moniteau, Platte, Ralls, Ray, Saline, Scott, St. Charles, Ste. Genevieve, St. Louis, Stoddard, Warren	Breeding on bare alluvial deposits of large rivers and dredged spoil islands, and in migration other sparsely vegetated areas near water.

Sources (sites accessed 8/19/15): U.S. Fish and Wildlife Service 2015 (Eagle distribution by county: http://www.fws.gov/midwest/eagle/conservation/baeacounties.html); U.S. Fish and Wildlife Service 2015 (Endangered, Threatened, Proposed and Candidate Species in the Upper Midwest [Region 3]): http://www.fws.gov/midwest/endangered/lists/e_th_pr.html; State lists with county distribution: http://www.fws.gov/midwest/endangered/lists/cty_indx.html.

* denotes Critical Habitat for the species is designated in the County.

3.1.2.3 Other Rare, Endangered, Threatened and Candidate Species

Other rare, endangered, threatened or candidate species include species (wildlife, plant, fish and aquatic), other than Covered Species, that have the potential to occur in the study area and that are listed as threatened, endangered, candidate, or proposed for listing under the ESA, or are protected under a state endangered species statute by one of the eight states within the Plan Area. Golden eagles, which are protected under the Eagle Act, are also addressed in this subsection (See Section 3.1.2.2*, Covered Species*, for a discussion of bald eagle). These species are collectively referred to as special-status species.

Species on state watch lists, often described as species of "special concern," "species of greatest conservation need," or of similar conservation concern, but with no protected status under the ESA or state endangered species statute, are considered in the general discussion of wildlife in Section 3.1.2.4, *Other Wildlife Species*.

Other Rare, Endangered, Threatened or Candidate Species in the Study Area

Federally protected species with the potential to occur in the study area are summarized in Table 3.1-6. These species were identified from review of county occurrence lists developed by the Service, and are listed in Table 3.1-6 by species class (e.g., mammal, plant, fish) and MGIN habitat association (e.g., forest, grassland, wetland) (see *MGIN Habitat* below).

A total of 74 federally listed, proposed or candidate species may occur in the study area, including four mammals, 25 plants, three birds, eight insects, two reptiles, one amphibian, 19 mussels, two crustaceans, eight fish, and two snails (Table 3.1-6). Of these species, 60 percent are plants or mussels.

A state special-status species list was established from state threatened and endangered species lists for each state in the study area. Over 1,300 state threatened or endangered plant, wildlife, and aquatic species are listed in one or more of the states in the study area. Due to the large number of state-listed threatened and endangered species, information on these species is summarized in general terms in a table (grouped by class, habitat, and state) in Appendix B, *State Special Status Animal Species* and Appendix C, *State Special Status Plant Species*.

Table 3.1-6. Federally Protected Special Status Species in the Study Area

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Forest			
Mammals	Canada lynx *(Lynx canadensis)*	Threatened/ Critical Habitat	**Michigan:** Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, and Schoolcraft counties (highest potential for lynx) **Minnesota:** Aitkin, Beltrami, Carlton, Cass, Clearwater, Cook*, Itasca, Koochiching*, Lake*, Lake of The Woods, Marshall, Pine, Roseau, and St. Louis* counties **Wisconsin:** Ashland, Bayfield, Burnett, Douglas, Florence, Forest, Iron, Marinette, Oneida, Price, Sawyer, Vilas, and Washburn counties	Generally occurs in boreal and montane regions dominated by coniferous or mixed forest with thick undergrowth, but also sometimes enters open forest, rocky areas, and tundra to forage for abundant prey.
	Gray wolf – Western Great Lakes Population *(Canis lupus)*	Endangered: WI, MI; IA, IL, IN; OH; Threatened: MN/Critical Habitat	**Michigan:** Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton*, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, and Schoolcraft counties **Minnesota:** Aitkin, Beltrami*, Becker, Carlton, Cass, Clearwater, Cook*, Crow Wing, Hubbard, Itasca*, Kanabec, Kittson, Koochiching*,Lake*, Lake Of Woods*, Mahnomen, Marshall, Mille Lacs, Morrison, Otter Tail, Pennington, Pine, Polk, Red Lake, Roseau*,St Louis*, and Wadena counties **Wisconsin:** Adams, Ashland, Barron, Bayfield, Burnett, Chippewa, Clark, Douglas, Dunn, Eau Claire, Florence, Forest, Iron, Jackson, Juneau, Langlade, Lincoln, Marathon, Marinette, Menominee, Monroe, Oconto, Oneida, Polk, Portage, Price, Rusk, Sawyer, Shawano, St. Croix, Taylor, Vilas, Washburn, Waupaca, Waushara, and Wood counties	Generally occurs in areas with few roads, but apparently can occupy semi-wild lands if ungulate prey is abundant. Minimum of about 3,860 to 5,020 square miles (10,000 to 13,000 sq. km) (with low road density) might be necessary to support a viable population.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
Plants	Running buffalo-clover *(Trifolium stoloniferum)*	Endangered	**Indiana:** Dearborn, Ohio, Ripley, and Switzerland counties **Missouri:** Barry, Benton, Boone, Callaway, Carter, Cedar, Christian, Cole, Cooper, Crawford, Dade, Dent, Dunklin, Howard, Jasper, Laclede, Lincoln, Madison, Maries, Moniteau, Montgomery, Ozark, Phelps, St. Charles, St. Louis, Taney, Texas, Vernon, and Wayne counties **Ohio:** Adams, Brown, Clermont, Hamilton, Hocking, Jackson, Lawrence, Ross, Scioto, Vinton, and Warren counties	Habitat consists mostly of mesic woodlands in partial to filtered sunlight, where there is a pattern of moderate periodic disturbance for a prolonged period, such as mowing, trampling, or grazing. Often found in regions underlain with limestone or other calcareous bedrock, but not exclusively.
	Small whorled pogonia *(Isotria medeoloides)*	Threatened	**Illinois:** Randolph county **Michigan**: Berrien county **Ohio**: Hocking and Scioto county	Acidic soils of dry to mesic second-growth, deciduous or deciduous-coniferous forests with an open herb layer, moderate to light shrub layer, and a relatively open canopy. Frequently occurs on flats or slope bases near canopy breaks.
	Grassland			
Birds	Sprague's pipit *(Anthus spragueii)*	Candidate	**Minnesota:** Clay, Polk, and Roseau counties	Breeding habitat includes short-grass plains, mixed grass prairie, alkaline meadows, and wet meadows, often in proximity to alkali and freshwater lakes.
Insects	American burying beetle *(Nicrophorus americanus)*	Endangered/ Experimental Non-Essential[1] in MO	**Missouri:** St. Clair, Cedar, Bates, and Vernon counties **Ohio:** Athens, Hocking, Morgan, Perry, and Vinton counties	Species is a habitat generalist with a slight preference for grasslands and open understory oak hickory forests, though natural habitat may be open woodlands. Species is recorded from grassland, old field shrubland, and hardwood forests.
	Dakota skipper *(Hesperia dacotae)*	Threatened/ Proposed Critical Habitat	**Iowa:** Dickenson county **Minnesota:** Chippewa(*), Clay(*), Kittison(*), Lincoln(*), Lyon, Murray(*), Norman(*), Pipestone(*), Polk(*), Pope(*), and Swift(*) counties	Restricted to unplowed native prairie on dry to mesic calcareous gravelly soils. Can occur in moderately grazed prairie pastures. Presence of *Zigadenus elegans* is a good habitat indicator.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Karner blue butterfly *(Lycaeides melissa samuelis)*	Endangered	**Illinois**: Lake county **Indiana:** Lake and Porter county **Michigan:** Allegan, Ionia, Kent, Lake, Mason, Mecosta, Monroe, Montcalm, Muskegon, Newaygo, and Oceana counties **Minnesota:** Winona county(extirpated) **Ohio**: Lucas county **Wisconsin:** Adams, Burnett, Chippewa, Clark, Eau Claire, Green Lake, Jackson, Juneau, Marquette, Menominee, Monroe, Oconto, Portage, Shawano, Waupaca, Waushara, and Wood counties	In the Midwest, habitat is dry and sandy, including oak savanna and jack pine barrens, and less often dune communities. Females lay eggs on or near wild lupine plants, where larvae exclusively feed.
	Poweshiek skipperling *(Oarisma poweshiek)*	Endangered/ Proposed Critical Habitat	**Iowa:** Cerro Gordo(*), Dickinson(*), Emmet(*), Howard(*), Kossuth(*), and Osceola(*) county **Michigan**: Hillsdale(*), Jackson(*), Lenawee(*), Livingston(*), Oakland(*), and Washtenaw(*) county **Minnesota:** Chippewa(*), Clay(*), Cottonwood(*), Douglas(*), Kittson(*), La Qui Parle(*), Lincoln(*), Lyon(*), Mahnomen(*), Marshall(*), Murray(*), Norman(*), Pennington(*), Pipestone(*), Polk(*), Pope(*), Red Lake(*), Roseau(*), Swift(*), and Wilkin(*) counties **Wisconsin:** Green Lake(*) and Waukesha(*) county	Habitat usually virgin prairie, but also occurs in fens and grassy lakeshores especially eastward (Michigan and Indiana).
	Rattlesnake-master borer moth *(Papaipema eryngii)*	Candidate	**Illinois:** Cook, Effingham, Fayette, Grundy, Kankakee, Livingston, Marion, and Will counties	Restricted to mesic prairies and associated wetlands in the Midwest, often but not always calcareous.
Plants	Mead's milkweed *(Asclepias meadii)*	Threatened	**Illinois:** Dupage, Henry, Saline, Vermillion, and Will counties **Indiana**: Lake county **Iowa**: Adair, Clarke, Decatur, Ringgold, and Warren counties **Missouri**: Adair, Barton, Benton, Cass, Cedar, Dade, Harrison, Henry, Iron, Johnson, Pettis, Polk, Reynolds, St. Clair, St. Louis, Scotland, Sullivan, and Vernon counties	Mead's milkweed is a species of dry-mesic to mesic tallgrass prairie- a community type which is adapted to and maintained by climate and fire regimes.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
			Wisconsin: Columbia, Dane, Grant, Green, and Iowa counties	
	Prairie bush-clover *(Lespedeza leptostachya)*	Threatened	**Illinois:** Cass, Champaign, Cook, Dupage, Jo Daviess, Ogle, Lee, McHenry, and Winnebago counties **Iowa:** Buena Vista, Butler, Clarke, Clay, Delaware, Dickinson, Emmet, Howard, Kossuth, Lucas, Obrien, Osceola, Story, Warren, and Winneshiek counties **Minnesota:** Brown, Cottonwood, Dakota, Dodge, Goodhue, Jackson, Martin, Mower, Nobles, Olmsted, Redwood, Renville, Rice, and Rock counties **Wisconsin:** Columbia, Dane, Grant, Green, Iowa, Lafayette, Pepin, Pierce, Rock, St. Croix, and Sauk counties	Endemic to the tallgrass prairie region of the upper Mississippi River Valley. Dry gravel prairies and dry-mesic prairies in Illinois and Minnesota.
	Western prairie fringed orchid *(Platanthera praeclara)*	Threatened	**Iowa:** Adair, Bremer, Buena Vista, Cherokee, Clay, Crawford, Fayette, Guthrie, Howard, Kossuth, Mills, Pocahontas, Polk, and Taylor counties **Minnesota:** Clay, Kittson, Lincoln, Mower, Nobles, Norman, Pennington, Pipestone, Polk, Red Lake, Rock **Missouri:** Atchison, Greene, Harrison, Holt, Jackson, Jasper, Johnson, Lawrence, and Vernon counties	This species is most commonly found in full sun on moist to wet calcareous (calcium-rich or alkaline) tallgrass prairies and sedge meadows. It most often grows in relatively undisturbed grassland, but can also be found in moderately disturbed sites.
	Wetland			
Birds	Whooping crane *(Grus americana)*	Experimental, Non-Essential[1]	**Wisconsin:** Adams, Burnett, Calumet, Clark, Columbia, Crawford, Dane, Dodge, Fond du Lac, Grant, Green, Green Lake, Iowa, Jackson, Jefferson, Juneau, Kenosha, LaCrosse, Lafayette, Marathon, Marquette, Monroe, Oconto, Pepin, Polk, Richland, Rock, Sauk, Shawano, Trempealeau, Walworth, Washington, Waushara, Winnebago, and Wood counties	Nesting occurs in dense emergent vegetation in shallow ponds, freshwater marshes, wet prairies, or along lake margins. Habitat during migration includes marshes, shallow lakes, lagoons, salt flats, grain and stubble fields, and barrier islands.
Insects	Mitchell's satyr butterfly *(Neonympha mitchellii)*	Endangered	**Indiana:** LaGrange and LaPorte **Michigan:** Barry, Berrien, Branch, Cass, Jackson, Kalamazoo, St. Joseph, Van Buren, and Washtenaw **Ohio:** Portage county	Sedge meadows and fens. Typically, *Carex stricta* is the dominant sedge. Presence of tall shrubs or tamarack for cover probably important.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
Plants	Eastern prairie fringed orchid *(Platanthera leucophaea)*	Threatened	**Illinois:** Adams, Bond, Boone, Brown, Bureau, Calhoun, Caroll, Cass, Champaign, Christian, Clark, Clay, Clinton, Coles, Cook, Crawford, Cumberland, Dekalb, DeWitt, Douglas, DuPage, Edgar, Effingham, Fayette, Ford, Fulton, Green, Grundy, Hancock, Henderson, Henry, Iroquois, Jasper, Jersey, Jo Davies, Kane, Kankakee, Kendall, Knox, Lake, LaSalle, Lawrence, Lee, Livingston, Logan, Macon, Macoupin, Madison, Marion, Marshall, Mason, McDonough, McHenry, McLean, Menard, Mercer, Montgomery, Morgan, Moultrie, Ogle, Peoria, Piatt, Pike, Putnam, Richland, Rock Island, Saint Clair, Sangamon, Schutler, Scott, Shelby, Stark, Stephenson, Tazewell, Vermillion, Wabash, Warren Washington, Whiteside, Will, Winnebago, and Woodford counties **Indiana:** White county **Iowa:** Decatur, Jackson, Johnson, and Jones counties **Michigan:** Bay, Cheboygan, Clinton, Eaton, Genesee, Gratiot, Huron, Livingston, Monroe, Saginaw, St. Clair, St. Joseph, Tuscola, Washtenaw, and Wayne counties **Missouri:** Carter, Grundy, and Ralls counties **Ohio:** Clark, Holmes, Lucas, Ottawa, Sandusky, WayneWisconsin: Dane, Green Lake, Jefferson, Kenosha, Ozaukee, Rock, Walworth, Waukesha, and Winnebago counties	Mesic to wet prairies and wet sedge meadows. Peripheral habitat includes sedge-sphagnum bog mats, and fallow agricultural fields.
Reptiles	Copperbelly watersnake *(Nerodia erythrogaster neglecta)*	Threatened (northern distinct population segment)	**Indiana:** Kosciusko, St. Joseph, and Steuben counties **Michigan:** Branch, Calhoun, Cass, Eaton, Hillsdale, and St. Joseph counties **Ohio:** Defiance, Hardin, and Williams counties	Lowland swamps, oxbow lakes in floodplains, brushy ditches, and other warm, quiet waters; wooded lakes, streams, or other permanent waters. About 500 to 600 acres of continuous swamp forest is needed to sustain a viable population.
	Eastern massasauga *(Sistrurus catenatus)*	Proposed as Threatened	**Illinois:** Bond, Clinton, Cook, Dupage, Fayette, Knox, Lake, Madison, Piatt, and Will counties **Indiana:** Allen, Carroll, Elkhart, Fulton, Kosciusko,	This snake prefers seasonal wetlands with a mixture of open grass-sedge areas and short closed canopy (edge

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
			Lagrange, LaPorte, Marshall, Noble, Porter, Pulaski, St. Joseph, Steuben, and Tippecanoe counties **Iowa**: Muscatine, Johnson, Mills, Bremer, Pottawattamie, and Louisa counties **Michigan:** Alcona, Allegan, Alpena, Antrim, Arenac, Barry, Berrien, Branch, Calhoun, Cass, Cheboygan, Clare, Clinton, Crawford, Eaton, Emmett, Genesee, Grand Traverse, Hillsdale, Huron, Ingham, Ionia, Iosco, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Lenawee, Livingston, Mackinac, Macomb, Manistee, Mason, Missaukee, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oscoda, Presque Isle, Saginaw, St. Joseph, Shiawassee, Van Buren, Washtenaw, and Wayne counties **Minnesota:** Houston, Wabasha, and Winona counties **Ohio:** Ashtabula, Champaign, Clark, Clinton, Columbiana, Crawford, Erie, Fairfield, Fayette, Greene, Hardin, Huron, Licking, Logan, Lucas, Mahoning, Marion, Montgomery, Ottawa, Portage, Preble, Richland, Sandusky, Trumbull, Warren, Wayne, and Wyandot counties **Wisconsin:** Buffalo, Crawford, Jackson, Juneau, LaCrosse, Monroe, Pepin, Rock, Trempealeau, Walworth, and Wood counties	situations).
	Aquatic			
Amphibians	Ozark hellbender *(Cryptobranchus alleganiensis bishopi)*	Endangered	**Missouri:** Carter, Dent, Douglas, Howell, Oregon, Ozark, Ripley, Shannon, Texas, and Wright counties	Rocky, clear creeks and rivers, usually where there are large shelter rocks. Depends on cool, flowing, well oxygenated water, and needs a coarse (rocky) substrate.
Mussels	Clubshell *(Pleurobema clava)*	Endangered	**Illinois:** Vermilion County **Indiana**: Carroll, DeKalb, Fulton, Kosciusko, Marshall, Pulaski, Starke, Steuben, Tippecanoe, and White counties	Found in clean, coarse sand and gravel in runs where it typically burrows several inches beneath the surface, often just downstream of a riffle or island (U.S. Fish and Wildlife Service

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
			Michigan: Hillsdale County **Ohio**: Ashtabula, Coshocton, Defiance, Franklin, Greene, Hancock, Hardin, Madison, Pickaway, Pike, Ross, Scioto, Trumbull, Union, and Williams counties	1994, 2009a).
	Curtis' pearlymussel *(Epioblasma florentina curtisi)*	Endangered	**Missouri:** Bollinger, Butler, Ripley, and Wayne counties	Occurs in shallow, flowing streams with stable substrates. Known from transitional areas between headwater and lowland stream reaches and occurs in sand to cobble substrates in riffles or runs with up to 30 inches of water (U.S. Fish and Wildlife Service 1986, 2010a).
	Fanshell *(Cyprogenia stegaria)*	Endangered	**Illinois:** White County **Indiana:** Carroll, Daviess, Dubois, Lawrence, Martin, Pike, Posey, Tippecanoe, Wabash, and White counties **Ohio:** Adams, Athens, Brown, Clermont, Coshocton, Gallia, Hamilton, Lawrence, Meigs, Morgan, Muskingum, Scioto, and Washington counties	Inhabits medium to large rivers on shoals of coarse gravel and sand (Jones and Neves 2002). It buries itself in sand or gravel in deep water of moderate current, with only the edge of its shell and its feeding siphons exposed (U.S. Fish and Wildlife Service 1991).
	Fat pocketbook *(Potamilus capax)*	Endangered	**Illinois:** Gallatin, Hardin, Lawrence, Massac, Pope, Wabash, and White counties **Indiana**: Daviess, Dubois, Gibson, Knox, Pike, Posey, and Vanderburgh counties **Missouri**: Clark, Dunklin, Marion, Mississippi, Pike, and Ralls counties	Occurs in large rivers with flowing water and stable substrates. Typically found on a mixture of silt, clay, sand, and gravel substrates and has been collected in depths of a few inches to more than 20 feet (U.S. Fish and Wildlife Service 1989).

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Higgins eye pearly mussel *(Lampsilis higginsii)*	Endangered	**Illinois:** Adams, Carroll, Hancock, Henderson, Jo Daviess, Mercer, Pike, Rock Island, and Whiteside counties **Iowa**: Allamakee, Clayton, Clinton, Des Moines, Dubuque, Jackson, Johnson, Jones, Linn, Louisa, Muscatine, and Scott counties **Minnesota**: Chisago, Dakota, Goodhue, Hennepin, Houston, Ramsey, Wabasha, Washington, and Winona counties **Missouri**: Marion County **Wisconsin**: Buffalo, Columbia, Crawford, Dane, Grant, Iowa, LaCrosse, Pierce, Polk, Richland, Sauk, St. Croix, Trempealeau, and Vernon counties	Occurs in large rivers on stable sand to boulder substrate with low to moderate velocities (U.S. Fish and Wildlife Service 2006a). The species does not occur in areas with silt substrate.
	Neosho mucket *(Lampsilis rafinesqueana)*	Endangered/ Proposed Critical Habitat	**Missouri:** Barry, Barton, Jasper*, Lawrence*, McDonald*, and Newton* counties	Associated with shallow riffles and runs, the species is found on gravel and sand substrate with moderate to swift currents (Obermeyer 2000). Channel stability is also an important habitat factor for the species.
	Northern riffleshell *(Epioblasma torulosa rangiana)*	Endangered	**Indiana:** DeKalb and Pulaski counties **Michigan**: Monroe, Sanilac, and Wayne counties **Ohio**: Defiance, Franklin, Madison, Pickaway, Pike, Ross, Scioto, Union, and Williams counties	Occurs in a wide variety of streams, large and small, preferring runs with bottoms composed of firmly packed sand and fine to coarse gravel. Although it apparently prefers shallow water, it has been found in water to depths of 6 feet. It buries itself to the posterior margin of the shell; however, females may be more exposed, especially during breeding season (U.S. Fish and Wildlife Service 1994).
	Orangefoot pimpleback *(Plethobasus cooperianus)*	Endangered	**Illinois:** Massac and Pulaski counties	Occurs in large rivers. Usually found in 15 to 20 feet of water over sand and gravel substrate (U.S. Fish and Wildlife Service 1984a; Gordan and Layzer 1989).

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Pink mucket *(Lampsilis orbiculata)*	Endangered	**Illinois:** Massac County **Missouri**: Butler, Cedar, Cole, Franklin, Gasconade, Jefferson, Maries, Miller, Osage, Ripley, St. Clair, St. Louis, and Wayne counties **Ohio**: Adams, Athens, Brown, Clermont, Gallia, Hamilton, Lawrence, Meigs, Morgan, Scioto, and Washington counties	Inhabits medium to large rivers with moderate to fast-flowing currents. Occurs in substrates ranging from silt to boulders, gravel, rubble, and sand (U.S. Fish and Wildlife Service 1985c).
	Purple catspaw *(Epioblasma obliquata obliquata)*	Endangered	**Ohio**: Coshocton County	Occurs in large rivers in shallow to moderate water with moderate to swift currents. The purple catspaw is a southern subspecies of the catspaw pearlymussel and is primarily found on boulders and sand substrates (U.S. Fish and Wildlife Service 1992).
	Rabbitsfoot *(Quadrula cylindrica cylindrica)*	Threatened/ Critical Habitat	**Illinois:** Alexander, Clark, Crawford, Jasper, Lawrence, Massac*, Pulaski*, Vermilion*, Wabash, and White counties **Indiana**: Carroll*, Cass, Fulton, Miami, Perry, Pulaski*, Shelby, Spencer, Starke, Tippecanoe*, Wabash, and White* counties **Missouri**: Butler, Jasper*, Madison*, Newton, and Wayne* counties **Ohio**: Coshocton*, Franklin, Madison*, Muskingum, Pickaway, Union*, and Williams* counties	Inhabits small to medium sized streams and some larger rivers (Gordon and Layzer 1989). It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. Specimens also may occupy deep water runs, having been reported in 9 to 12 feet of water. Bottom substrates generally include gravel and sand (Parmalee and Bogan 1998).
	Rayed bean *(Villosa fabalis)*	Endangered	**Indiana:** Allen, Carroll, DeKalb, Fulton, Johnson, Kosciusko, Marshall, Pulaski, Starke, Steuben, Tippecanoe, and White counties **Michigan**: Oakland and St. Clair counties **Ohio**: Adams, Brown, Butler, Clark, Clermont, Coshocton, Darke, Defiance, Delaware, Franklin, Fulton, Greene, Hamilton, Hancock, Hardin, Logan, Lucas, Madison, Marion, Miami, Montgomery, Pickaway, Pike, Ross, Scioto, Shelby, Union, Warren, and Williams counties.	Occurs in sand and cobble in high quality creeks and small rivers, but a few records exist in large rivers. The species has been found in and near riffles, generally in water weeds, and deeply buried in sand and gravel bound together by roots (Watters *et al.* 2009).

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Rough pigtoe *(Pleurobema plenum)*	Endangered	**Indiana:** Lawrence and Martin counties	Occurs in medium to large rivers (U.S. Fish and Wildlife Service 1984b). Found in or on sand, gravel, and cobble substrates and occasionally on flats and muddy sand (U.S. Fish and Wildlife Service 1984b, Gordon and Layzer 1989).
	Scaleshell *(Leptodea leptodon)*	Endangered	**Illinois:** Grundy County **Missouri:** Crawford, Franklin, Gasconade, Jefferson, Laclede, Maries, Osage, Pulaski, St. Louis, and Wright counties	Occurs in medium to large rivers with low to moderate gradient and good water quality. The species has been found in stable riffles and runs on gravel or mud substrates with moderate current velocity. The species is typically is found in areas with high mussel diversity (U.S. Fish and Wildlife Service 2010b).
	Sheepnose *(Plethobasus cyphyus)*	Endangered	**Illinois**: Alexander, Hancock, Kankakee, Massac, Pulaski, Rock Island, Whiteside, and Will counties **Indiana**: Carroll, Cass, Clark, Crawford, Dearborn, Floyd, Fulton, Harrison, Jefferson, Knox, Marshall, Martin, Ohio, Perry, Posey, Pulaski, Spencer, Starke, Switzerland, Tippecanoe, Vanderburgh, Wabash, Warrick, and White counties **Iowa**: Lee, Muscatine, and Scott counties **Minnesota**: Wabasha and Winona counties **Missouri**: Crawford, Franklin, Jefferson, Laclede, Lewis, Marion, Pike, Ralls, and St. Louis counties **Ohio**: Adams, Athens, Brown, Clermont, Coshocton, Gallia, Hamilton, Lawrence, Meigs, Morgan, Muskingum, Scioto, and Washington counties **Wisconsin**: Buffalo, Columbia, Crawford, Dane, Dunn, Eau Claire, Grant, Iowa, La Crosse, Pepin, Richland, Rusk, and Sauk counties	Occurs in large rivers in shallow shoal and run habitats with moderate to swift river flow over coarse sand and gravel substrates. The species has also been recorded over mud, cobble, and even boulders. Stability is an important factor for this species, and individuals have been observed in flow refuges where little movement of particles occurs, even during flood events (U.S. Fish and Wildlife Service 2002b).
	Snuffbox *(Epioblasma triquetra)*	Endangered	**Illinois:** Coles, Cumberland, and Douglas counties **Indiana**: Carroll, Hancock, Huntington, Johnson, Lagrange, Shelby, Tippecanoe, and White counties	Found in small to medium sized swiftly flowing rivers in shallow riffles with rubble and gravel substrates that are

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
			Michigan: Gratiot, Ionia, Kent, Livingston, Oakland, St. Clair, and Washtenaw counties **Minnesota**: Chisago, Hennepin, Ramsey, and Washington counties **Missouri**: Bollinger, Franklin, Gasconade, Jefferson, Phelps, Ripley, St. Louis, and Wayne counties **Ohio**: Adams, Ashtabula, Athens, Brown, Clermont, Coshocton, Delaware, Franklin, Gallia, Greene, Hamilton, Lake, Lawrence, Madison, Meigs, Miami, Montgomery, Morgan, Muskingum, Pickaway, Ross, Scioto, Union, and Washington counties **Wisconsin**: Outagamie, Pierce, Polk, Shawano, St. Croix, Waupaca, and Waushara counties	silt-free (Roe 2002).
	Spectaclecase *(Cumberlandia monodonta)*	Endangered	**Illinois:** Hancock, Henderson, Madison, Massac, Pike, and Rock Island counties **Iowa:** Des Moines, Lee, Muscatine, and Scott counties **Minnesota**: Chisago, Pine, Wabasha, and Washington counties **Missouri:** Cedar, Cole, Crawford, Franklin, Gasconade, Jefferson, Laclede, Maries, Marion, Miller, Osage, Phelps, Pulaski, Ralls, St. Clair, St. Louis, Texas, and Washington counties **Wisconsin:** Buffalo, Burnett, Chippewa, Crawford, Grant, Pierce, Polk, and St. Croix counties	Inhabits large rivers, preferring shallow riffles and shoals with a slow to swift current. It occurs in a variety of substrates from mud to boulders but is typically found aggregated in habitats sheltered from direct current, such as bedrock shelves. Individuals have also been collected in tree stumps, beds of rooted vegetation, and root masses. Like other members of the Margaritiferid family, spectaclecase tends to aggregate with other individuals (U.S. Fish and Wildlife Service 2014b).
	White catspaw *(Epioblasma obliquata perobliqua)*	Endangered	**Indiana:** DeKalb County **Ohio:** Defiance and Williams counties	Occurs in riffle-run reaches of small to moderately large rivers in shallow water with swift current. Specific habitat requirements are unknown, but observed individuals have been described to be buried in stable sand and gravel substrate (U.S. Fish and Wildlife Service 1990).
	Winged mapleleaf *(Quadrula fragosa)*	Endangered	**Minnesota:** Chisago, Ramsey, and Washington counties	Occurs in moderate to large rivers. The species has been found in riffles with

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
			Missouri: Franklin County **Wisconsin**: Polk and St. Croix counties	gravel, sand, and rubble substrates at depths averaging about 3 feet (Hornback *et al.* 1996).
Crustaceans	Cave crayfish *(Cambarus aculabrum)*	Endangered	**Missouri:** McDonald County	Found in most parts of cave streams when present within the cave, with the exception of near the cave entrance. The species typically occurs along walls of pools or along the edges of the stream and is found on a variety of substrates, including: gravel, rubble, or bedrock (U.S. Fish and Wildlife Service 1996).
	Illinois cave amphipod *(Gammarus acherondytes)*	Endangered	**Illinois:** Monroe and St. Clair counties	Occurs in cave streams, both large and small, in two counties in southwestern Illinois. The species is found within the Salem Plateau karst region in areas overlain by glacial deposits and loess. In streams, the species primarily utilizes gravel or cobble with shallow water (less than 4 inches) (U.S. Fish and Wildlife Service 2002a).
Fish	Arkansas darter *(Etheostoma cragini)*	Candidate	**Missouri:** Barry, Barton, Jasper, Newton, Dade, and Lawrence counties	Spring fed headwaters and creeks with cool, clear, shallow water, slow current, and herbaceous aquatic vegetation; often in pools with sand, fine gravel, or organic detritus substrate; sometimes in turbid water away from springs. Eggs are laid in gravel bottoms.
	Neosho madtom *(Noturus placidus)*	Threatened	**Missouri:** Jasper County	Inhabits permanent flow of medium-sized to moderately large, medium-gradient streams, moderate to strong currents; usually in fairly clear water under rocks in riffles with small, loosely packed gravel-pebble.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Niangua darter *(Etheostoma nianguae)*	Threatened/ Critical Habitat	**Missouri:** Benton, Camden*, Cedar*, Dallas*, Greene*, Hickory*, Maries, Miller*, Osage, St. Clair*, and Webster county	Most of the year it occurs in shallow pools and runs having slight currents and gravel or rock substrates. May favor stream reaches with relatively intact banks and riparian corridors, and less agricultural development. Spawning occurs on swift gravel riffles.
	Pallid sturgeon *(Scaphirhynchus albus)*	Endangered	**Illinois:** Alexander, Jackson, Madison, Monroe, Randolph, St. Clair, and Union counties **Iowa:** Fremont, Harrison, Mills, Monona, Pottawattamie, and Woodbury counties **Missouri:** Andrew, Atchison, Boone, Buchanan, Callaway, Cape Girardeau, Carroll, Chariton, Clay, Cole, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Jefferson, Lafayette, Lewis, Livingston, Mississippi, Moniteau, Montgomery, New Madrid, Osage, Pemiscot, Perry, Platte, Ray, St. Charles, St. Genevieve, St. Louis, Saline, Scott, and Warren counties	Large, turbid, free flowing riverine habitat; it occurs in strong current over firm gravel or sandy substrate; it sometimes occurs in reservoirs. In the study area, pallid sturgeons tend to select main channel habitats in the Mississippi River.
	Scioto madtom *(Noturus trautmani)*	Endangered	**Ohio:** Franklin, Madison, Pickaway, and Union counties	Nearly all specimens were taken from the downstream 6 miles of a riffle 18 miles long, at a point where water velocity was decreasing and substrate was composed of sandy gravel with occasional small stones up to about 5 inches (10 cm) in diameter.
	Topeka shiner *(Notropis topeka)*	Endangered/ Critical Habitat	**Iowa:** Boone, Buena Vista, Calhoun*, Carroll*, Dallas*, Greene*, Hamilton*, Hancock, Humboldt, Kossuth, Lyon*, Osceola*, Pocahontas, Sac, Sioux, Webster*, Wright* **Minnesota:** Lincoln*, Murray*, Nobles*, Pipestone*, Rock* **Missouri:** Boone, Caldwell, Callaway, Clark, Cole, Cooper, Daviess, Dekalb, Grundy, Harrison, Mercer, Moniteau, Morgan, Pettis, Putnam, Randolph, Ray, Schuyler	Small prairie (or former prairie) streams in pools containing clear, clean water. Topeka shiner streams generally have clean gravel, rock, or sand bottoms.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
Snails	Tumbling Creek Cavesnail *(Antrobia culveri)*	Endangered/ Critical Habitat	**Missouri:** Taney* County	Small, blind, aquatic snail that occurs on the underside of unsilted rocks. The species is confined to a single cave stream within Tumbling Creek Cave in southwestern Missouri. Little is known about the species' ecology, but it is thought to feed on biofilm, an organic and bacterial layer or detritus found on the underside of rocks. This biofilm has been connected to the input of guano from roosting bats in the cave, particularly the federally listed gray bat (*Myotis grisescens)* (U.S. Fish and Wildlife Service 2003, 2014a).
Insects	Hine's emerald dragonfly *(Somatochlora hineana)*	Endangered/ Critical Habitat	**Illinois:** Cook*, DuPage*, and Will* counties **Michigan**: Alcona, Alpena*, Mackinac*, Menominee, and Presque Isle* counties **Missouri**: Dent*, Iron*, Phelps*, Reynolds*, Ripley*, and St. Francis counties **Wisconsin**: Door*, Grant, Iowa, Kewaunee, Ozaukee*, and Richland counties	Restricted to wetland habitats, characterized by thin soils over bedrock with sedge meadows, marshes, and seeps (U.S. Fish and Wildlife Service 2001). Larvae are found in small streamlets within cattail marshes, hummocks, and sedge meadows. These habitats may be an important limiting factor. Open, vegetated areas are important attributes for adult foraging, and forests, trees, and shrubs provide areas to perch and roost.
	Hungerford's crawling water beetle *(Brychius hungerfordi)*	Endangered	**Michigan:** Emmet, Montmorency, Oscoda, and Presque Isle counties	Occurs in streams with moderate to fast stream flow, good aeration, alkaline water, and inorganic substrate (U.S. Fish and Wildlife Service 2006b). Most found downstream of culverts, debris and beaver dams, and human made impoundments. Streams of occurrence are often seasonal streams with some groundwater input. Although the species does not occur in

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
				streams that become dry, water levels can decrease considerably (U.S. Fish and Wildlife Service 2009b). Within these streams, the species occurs in plunge pools as well as in riffles and other well-aerated stream areas.
	Unique Habitat			
Birds	Rufa red knot *(Calidris canutus rufa)*	Threatened	**Illinois:** Cook and Lake county (Only actions that occur along coastal areas or large wetland complexes during the red knot migratory window of May 1-September 30) **Indiana:** Lake County **Michigan:** Coastal areas (May 1-Sept 30th): Alcona, Alger, Allegan, Alpena, Antrim, Arenac, Baraga, Bay, Benzie, Berrien, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Gogebic, Grand Traverse, Houghton, Huron, Iosco, Keweenaw, Leelanau, Luce, Mackinac, Macomb, Manistee, Marquette, Mason, Menominee, Monroe, Muskegon, Oceana, Ontonagon, Ottawa, Presque Isle, Sanilac, Schoolcraft, St. Clair, Tuscola, Van Buren, and Wayne counties. Wetlands (May 1-Sept 30): Midland, Saginaw, and Shiawassee counties **Minnesota:** St. Louis County **Missouri:** Andrew, Atchison, Boone, Buchanan, Callaway, Cape Girardeau, Carroll, Chariton, Clark, Clay, Cole, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Jefferson, Lafayette, Lewis, Lincoln, Marion, Mississippi, Moniteau, Platte, Ralls, Ray, Saline, Scott, St. Charles, Ste. Genevieve, St. Louis, Stoddard, and Warren counties **Ohio:** Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, and Sandusky counties **Wisconsin:** Ashland and Douglas (along Lake Superior), Brown and Oconto (along Green Bay), Manitowoc, Ozaukee, Milwaukee, and Racine (along Lake Michigan)	On sandy or pebbly beaches, especially at river mouths; feeds on mudflats. Nests on ground in barren or stony tundra and in well-vegetated moist tundra. Sometimes found in marshes and flooded fields.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Golden Eagle *(Aquila chrysaetos)*	Eagle Act	Non-resident wintering range only. **Illinois:** Statewide **Indiana:** Statewide **Iowa:** Statewide **Michigan:** Statewide **Minnesota:** Statewide **Missouri:** Statewide **Ohio:** Statewide **Wisconsin:** Statewide In the Midwestern United States, regular winter inhabitants in the blufflands of southeast Minnesota, western Wisconsin, and northeast Iowa.	Dense forests of blufflands, often utilizing the open, upland prairies as hunting grounds.
Fish	Grotto sculpin *(Cottus specus)*	Endangered	**Missouri:** Perry County	Inhabits cave systems in karst areas, occupying pools and riffles with moderate stream flow and low to moderate stream depth. Uniquely formed cave systems may be the only habitats that provide enough food.
	Ozark cavefish *(Amblyopsis rosae)*	Threatened	**Missouri:** Barry, Greene, Jasper, Lawrence, Newton, and Stone counties	Dark cave waters, primarily clear streams with chert or rubble bottom, occasionally pools over silt or sand bottom.
Snails	Iowa pleistocene snail *(Discus macclintocki)*	Endangered	**Illinois:** Jo Davies County **Iowa:** Clayton, Clinton, Dubuque, Fayette, and Jackson county	Algific talus slopes, usually north facing; lives in leaf litter.
Mammals	Gray bat *(Myotis grisescens)*	Endangered	**Illinois:** Alexander, Hardin, Jackson, Johnson, Monroe, Pike, Pope, and Pulaski county **Indiana:** Clark, Crawford, Floyd, Harrison, Perry, and Spencer counties **Missouri:** Barry, Benton, Boone, Callaway, Camden, Carter, Cedar, Christian, Cole, Crawford, Dade, Dallas, Dent, Douglass, Franklin, Gasconade, Greene, Henry, Hickory, Howard, Howell, Iron, Jasper, Jefferson, Laclede, Lawrence, Madison, Maries, McDonald, Miller, Morgan, Newton, Oregon, Osage,	Caves and mines; rivers and reservoirs adjacent to forests.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
			Ozark, Phelps, Pike, Pulaski, Ralls, Reynolds, Ripley, St. Clair, St. Louis, Shannon, Stone, Taney, Texas, Washington, Wayne, and Wright counties	
	Ozark big-eared bat *(Corynorhinus townsendii ingens)*	Endangered	**Missouri:** Barry and Stone counties	Caves in limestone karst regions dominated by mature hardwood forest.
Plants	American hart's-tongue fern *(Asplenium scolopendrium* var. *americanum)*	Threatened	**Michigan:** Chippewa and Mackinac counties	Found on or near dolomitic limestone (a type of limestone high in magnesium), where it typically occurs in moist crevices, on mossy rock outcrops, or in sinkholes or blowholes of limestone caves.
	Decurrent false aster *(Boltonia decurrens)*	Threatened	**Illinois:** Brown, Bureau, Calhoun, Cass, Fulton, Greene, Jersey, LaSalle, Madison, Marshall, Mason, Morgan, Peoria, Pike, Putnam, St. Clair, Schuyler, Scott, Tazewell, and Woodford counties **Missouri:** Cape Girardeau, Dunklin, Franklin, Howell, Lincoln, Mississippi, Pike, St. Charles, and St. Louis counties	Moist, sandy soil and regular disturbance, preferably periodic flooding, which maintains open areas with high light levels. Natural habitat is lake and river shores and stream banks.
	Dwarf lake iris *(Iris lacustris)*	Threatened	**Michigan:** Alpena, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Mackinac, Menominee, Presque Isle, and Schoolcraft counties **Wisconsin:** Brown and Door counties	Thrives best in close proximity to the northern Great Lakes shores, where it is most often found in young, well-drained soils ranging from sands to gravels to sandy clay loam and organic-enriched sands.
	Fassett's locoweed *(Oxytropis campestris* var. *chartaceae)*	Threatened	**Wisconsin:** Bayfield, Douglas, Portage, and Waushara counties	Open to partially shaded, sandy or gravelly shorelines of small landlocked seepage lakes. Apparently intolerant of competition and shading; not found in abundance where dense grasses, woody shrubs, or trees have become established.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Geocarpon *(Geocarpon minimum)*	Threatened	**Missouri:** Cedar, Dade, Greene, Henry, Jasper, Lawrence, Polk, and St. Clair counties	Sandstone glades and saline prairies. In Missouri, geocarpon grows on moist, sandy soils on exposed sandstone outcrops or glades, where ledges of fine sandstone, interbedded with shale, are exposed along small streams.
	Houghton's goldenrod *(Solidago houghtonii)*	Threatened	**Michigan:** Charlevoix, Cheboygan, Chippewa, Crawford, Emmet, Kalkaska, Mackinac, Presque Isle, and Schoolcraft counties	Primarily in damp, sparsely vegetated, sandy interdunal flats and hollows; sometimes on associated low dunes and beaches or cobble shores, or in nearby fens, marl-bogs, and swales.
	Lakeside daisy *(Hymenoxys herbacea)*	Threatened	**Illinois:** Tazewell and Will counties **Michigan:** Mackinac County **Ohio:** Erie and Ottawa counties	Full sun in dry calcareous sites. Specifically, in thin soils over limestone or dolomite outcrops/exposures and in dry limestone prairies. Occurs nearly exclusively on alvars or on bare rock, in openings of a forest matrix.
	Leafy prairie clover *(Dalea foliosa)*	Endangered	**Illinois:** Boone, Dupage, Kane, Kankakee, LaSalle, Madison, Ogle, Will, Winnebago	The species is disjunct in Illinois, where it is restricted to thin-soiled (< about 148 feet or 4.5dm), wet or moist, open dolomite prairies on river terraces in the northeastern part of the state, particularly along Des Plaines River outwash.
	Leedy's roseroot *(Rhodiola integrifolia leedyi)*	Threatened	**Minnesota:** Fillmore and Olmsted counties	Plants are restricted to crevices in maderate cliffs, a very specialized habitat of specific strata where groundwater seeps through the rock and is cooled by air coming from underground air passages in karst topography.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Michigan monkey-flower *(Mimulus michiganensis)*	Endangered	**Michigan:** Benzie, Charlevoix, Cheboygan, Emmet, Leelanau, and Mackinac counties	Muck-covered sand in flowing water. The necessary combination of full sunlight and cold, clear, flowing water is found in aquatic habitats along forest edges and in small openings along streams and lakeshores.
	Minnesota dwarf trout lily *(Erythronium propullans)*	Endangered	**Minnesota:** Dodge, Goodhue, Rice, and Steele counties	The major populations occur on the slopes of the Straight and Cannon rivers near Faribault, Minnesota. The preferred habitat is the lower parts of wooded north-facing slopes. Plants also grow on floodplains and less frequently near the tops of slopes.
	Missouri bladderpod *(Physaria filiformis)*	Threatened	**Missouri:** Christian, Dade, Greene, and Lawrence counties	Open limestone glades, barrens, and outcrops within unglaciated prairie areas. Occasionally in dolomitic glades. Often associated with grazed pastures.
	Northern wild monkshood *(Aconitum noveboracense)*	Threatened	**Iowa:** Allamakee, Clayton, Delaware, Dubuque, and Jackson counties **Ohio:** Hocking, Portage, and Summit counties **Wisconsin:** Grant, Monroe, Richland, Sauk, and Vernon counties	Algific talus slopes, which is characterized by north-facing, shady carbonate slopes where cold air and moisture pours out of ice filled caves.
	Pitcher's thistle *(Cirsium pitcheri)*	Threatened	**Illinois:** Lake County **Indiana:** Lake, and Porter counties **Michigan:** Alcona, Alger, Allegan, Alpena, Antrim, Arenac, Benzie, Berrien, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Grand Traverse, Huron, Iosco, Leelanau, Mackinac, Manistee, Mason, Muskegon, Oceana, Ottawa, Presque Isle, Schoolcraft, and Van Buren counties **Wisconsin:** Door, Manitowoc, and Sheboygan counties	Pitcher's thistle is a regional endemic restricted to the dune habitats in the western Great Lakes region. The species is a colonizer on open dune ridges, dune blowouts, and along disturbed sites in sand dunes, but is found on stabilized grassy sand terraces, sandy gravel flats and dune valleys as well.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Pondberry *(Lindera melissifolia)*	Endangered	**Missouri:** Butler and Ripley counties	Occurs in seasonally flooded wetlands such as floodplain/bottomland hardwood forests and forested swales, on the bottoms and edges of shallow seasonal ponds in old dune fields, along the margins of ponds and depressions in pinelands, around the edges of sinkholes in coastal areas with karst topography, and along the borders of *Sphagnum* bogs.
	Price's potato-bean (*Apios priceana*)	Threatened	**Illinois:** Union County	Occurs in disturbed areas such as forest openings, wood edges and where bluffs descend to streams. It also grows along highway rights-of-way and power line corridors.
	Short's bladderpod *(Physaria globosa)*	Endangered/ Critical Habitat	**Indiana:** Posey County*	Steep, rocky wooded slopes and talus areas, occurs along cliff tops and bases and cliff ledges. Found adjacent to rivers or streams and on south to west facing slopes. The Indiana population is found within the Shawnee Hills section of the Interior Low Plateau Physiographic Province.
	Short's goldenrod *(Solidago shortii)*	Endangered	**Indiana:** Harrison County	Cedar glades and glade-like habitats (for example, power line rights-of-way, roadside ledges, and meadows/pastures), where droughty soils prevent the establishment of trees and shrubs. Also on roadsides and on dry, rocky, overgrazed pastures.

Species Class	Name	Federal Status	County Distribution in Study Area	Habitat Description
	Virginia sneezeweed *(Helenium virginicum)*	Threatened	**Missouri:** Christian, Dent, Howell, Oregon, Shannon, Texas, Webster, and Wright counties	Found on sinkhole pond margins and wet meadows in the Ozark Highlands. The plant has been found to prefer open growing conditions and is found in a variety of sites in addition to the less disturbed sinkholes and wet meadows including rural airports, roadside ditches, and cattle ranches.
	Virginia spiraea *(Spiraea virginiana)*	Threatened	**Ohio:** Scioto County	Periodically flood-scoured banks of high-gradient mountain streams, meander scrolls, point bars, natural levees, and braided features of lower stream reaches, and occasionally near disturbed rights-of-way. Plants are often seen in silt mud and sand.

Sources (sites accessed 8/19/15): U.S. Fish and Wildlife Service 2015 (Endangered, Threatened, Proposed and Candidate Species in the Upper Midwest [Region 3]: http://www.fws.gov/midwest/endangered/lists/e_th_pr.html); U.S. Fish and Wildlife Service 2015 (State lists with county distribution: http://www.fws.gov/midwest/endangered/lists/cty_indx.html); U.S. Fish and Wildlife Service 2015 (gray wolf: http://www.fws.gov/midwest/wolf/delisting/pdf/FRWolfReinstatementNotice20Feb2015.pdf); National Eagle Center 2015.

Note: Table organized by five MGIN model habitat classes: forest, grassland, wetland, aquatic, and unique habitat. Refer to MGIN habitat in the following subsection for a description of what each habitat class includes.

* denotes Critical Habitat for the species is present in the County.

(*) denotes Proposed Critical Habitat for the species is present in the County.

[1] Experimental, Non-Essential (NEP) species are treated as threatened species when the NEP is located within a National Wildlife Refuge or National Park. NEPs outside of these areas are treated as Proposed species for listing.

Habitat for Other Rare, Endangered, Threatened or Candidate Species in Study Area

Habitat for special status species are described and quantified using two GIS datasets: 1) the Service's designated critical habitat GIS data layer, and 2) The Conservation Fund's MGIN habitat model (The Conservation Fund 2015). The results of the GIS analyses are summarized in Table 3.1-7 (critical habitat) and Table 3.1-8 (MGIN habitat). Figure 3.1-2 illustrates the location of MGIN habitats in the study area.

Designated Critical Habitat

The Service has designated critical habitat for nine species in the study area, and proposed critical habitat for two additional species (Table 3.1-7). Critical habitat is designated for two mammals, two mussels, two fish, one snail, one insect, and one plant; critical habitat is proposed for two insects. Table 3.1-7 summarizes areas and linear distances of designated and proposed critical habitat for 11 species in the study area. Minnesota and Iowa have the greatest areas of critical habitat compared to other states in the study area, mostly due to the large areas of designated critical habitat for the Canada lynx, gray wolf, and Topeka shiner. Indiana and Ohio have little designated critical habitat.

Table 3.1-7. Acres and Linear Miles of Designated and Proposed Critical Habitat in the Study Area

Species	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Wisconsin	Ohio	Total
					Acres				
Canada Lynx	–	–	–	–	5,163,569	–	–	–	5,163,569
Dakota Skipper*		–	–	–	12,944	–	–	–	12,944
Gray wolf	–	–	–	–	5,781,672	–	–	–	5,781,672
Hine's emerald dragonfly	2,874	–	–	14,349	–	301	8,788	–	26,312
Niangua darter	–	–	–	–	–	1,309	–	–	1,309
Poweshiek skipperling*	–	–	2,389	1,727	14,419	–	1,815	–	20,350
Short's bladderpod	–	4	–	–	–	–	–	–	4
Topeka shiner	–	–	4,324,921	–	1,880,799	–	–	–	6,205,720
Tumbling Creek cavesnail	–	–	–	–	–	15	–	–	15
Total	**2,874**	**4**	**4,327,310**	**16,076**	**12,853,403**	**1,625**	**10,603**	**–**	**17,211,895**
					Linear Miles				
Neosho Mucket	–	–	–	–	–	120	–		120
Rabbitsfoot	18	47	–	–	–	68	–	37	170
Total	**18**	**47**	**–**	**–**	**–**	**188**	**–**	**37**	**290**

Source: U.S. Fish and Wildlife Service 2015 (http://ecos.fws.gov/crithab/).
Note: Acres and linear miles rounded to the nearest whole number.
* Species with proposed critical habitat.

MGIN Habitat

The MGIN model maps the most ecologically-viable terrestrial and aquatic habitat in the study area with the greatest potential to support all wildlife, including special status species. It is the most comprehensive and consistent habitat model for the study area, and utilizes dozens of focal and surrogate species, including common and special-status birds, mammals (including bats), amphibians, invertebrates, reptiles, and fish species, to support broad application across all taxa. Because special-status species are incorporated into the MGIN model, it is reasonable to assume a lower probability of encountering these species outside of the MGIN-mapped habitat areas.

Each federally protected species listed in Table 3.1-6 was assigned to one of five habitat categories described in the MGIN model—forest, grassland, wetland, aquatic, and unique habitat—as described below. The MGIN habitat categories also include habitat core areas, which are the nucleus of the ecological network, and corridors, which connect the core areas.

- Forest: Includes mature forests, floodplain and riparian forests, forested bluffs, woodlands, secondary growth young forests, and upland scrub-shrub habitat.
- Grassland: Includes prairies, meadows, old fields, pastures, and savanna (grasslands that are sparsely treed).
- Wetland: Includes forested wetlands (swamps), bogs, fens, sedge meadows, marshes, prairie potholes, shrub wetlands, and mudflats.
- Aquatic: Includes streams, rivers, lakes, and ponds.
- Unique Habitat: Includes habitats that do not fit well in the other MGIN habitats. Unique habitat may include beaches, sandbars, dunes, caves, rock outcrops, barrens, and talus slopes. Because these habitats are limited in distribution and are often nested within the other four habitat types, they are difficult to distinguish using remotely sensed data. Because of this, unique habitats were included as “sites” in the MGIN and the model output is identified as such.

The MGIN also maps areas called hubs, which are important conservation areas. They represent aggregations of multiple habitats meeting size and condition thresholds and provide optimal habitat for wildlife species.

Table 3.1-8 and Figure 3.1-2 summarize the MGIN habitat areas mapped in the study area by state. Wisconsin, Minnesota, Michigan, and Missouri have the greatest areas of MGIN habitats. Forested habitats and hubs make up nearly 60 percent of all MGIN habitats mapped in the study area. Sites cover the least area within the study area, which is expected given their known limited distribution. Sites are not mapped on Figure 3.1-2 due to the map scale and their limited distribution and small area.

Table 3.1-8. MGIN Habitat in Study Area by State (Acres)

MGIN Habitat	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Study Area Total
Core Forest	1,923,653	1,807,830	509,777	9,160,259	9,468,329	7,717,839	3,187,978	6,997,721	40,773,386
Forest Corridor	3,400,307	2,926,979	1,127,446	12,809,185	13,198,150	11,120,581	5,052,569	9,978,787	59,614,004
Core Wetland	519,555	244,225	256,818	4,340,933	6,987,746	344,777	202,419	2,871,890	15,768,363
Wetland Corridor	1,760,928	1,395,234	652,780	10,904,775	15,449,853	1,716,027	1,549,925	8,075,660	41,505,182
Core Grassland	364,331	563,423	1,063,144	325,832	399,306	7,159,289	1,091,356	507,690	11,474,371
Grassland Corridor	1,422,528	2,684,985	4,044,570	1,105,565	2,035,653	12,992,251	3,721,919	2,392,880	30,400,351
Core Aquatic	1,529,212	1,171,138	867,119	5,433,484	7,700,673	2,603,085	965,414	5,212,393	25,482,518
Aquatic Corridor	562,044	268,160	360,397	539,151	371,013	791,065	472,784	313,457	3,678,071
Sites	46,599	127,758	361,102	315,185	1,179,723	91,954	37	80,903	2,203,261
Total	**11,529,157**	**11,189,732**	**9,243,153**	**44,934,369**	**56,790,446**	**44,536,868**	**16,244,401**	**36,431,381**	**230,899,507**
Hubs	3,739,729	3,770,400	2,506,520	18,327,095	22,123,908	17,822,197	6,397,731	15,772,650	90,460,230

Source: The Conservation Fund 2015.

Note: Habitat "core areas" represent the nucleus of the ecological network in the MGIN model. Habitat "corridors" connect the core areas. Habitat "sites" reflect unique habitats often nested within one of the other four habitat types. For some habitats, the areas of Core and Corridor overlap. These acreages do not account for that overlap but simply report the amounts from the model because the habitats are modeled and mapped as individual and distinct habitats regardless of overlap.

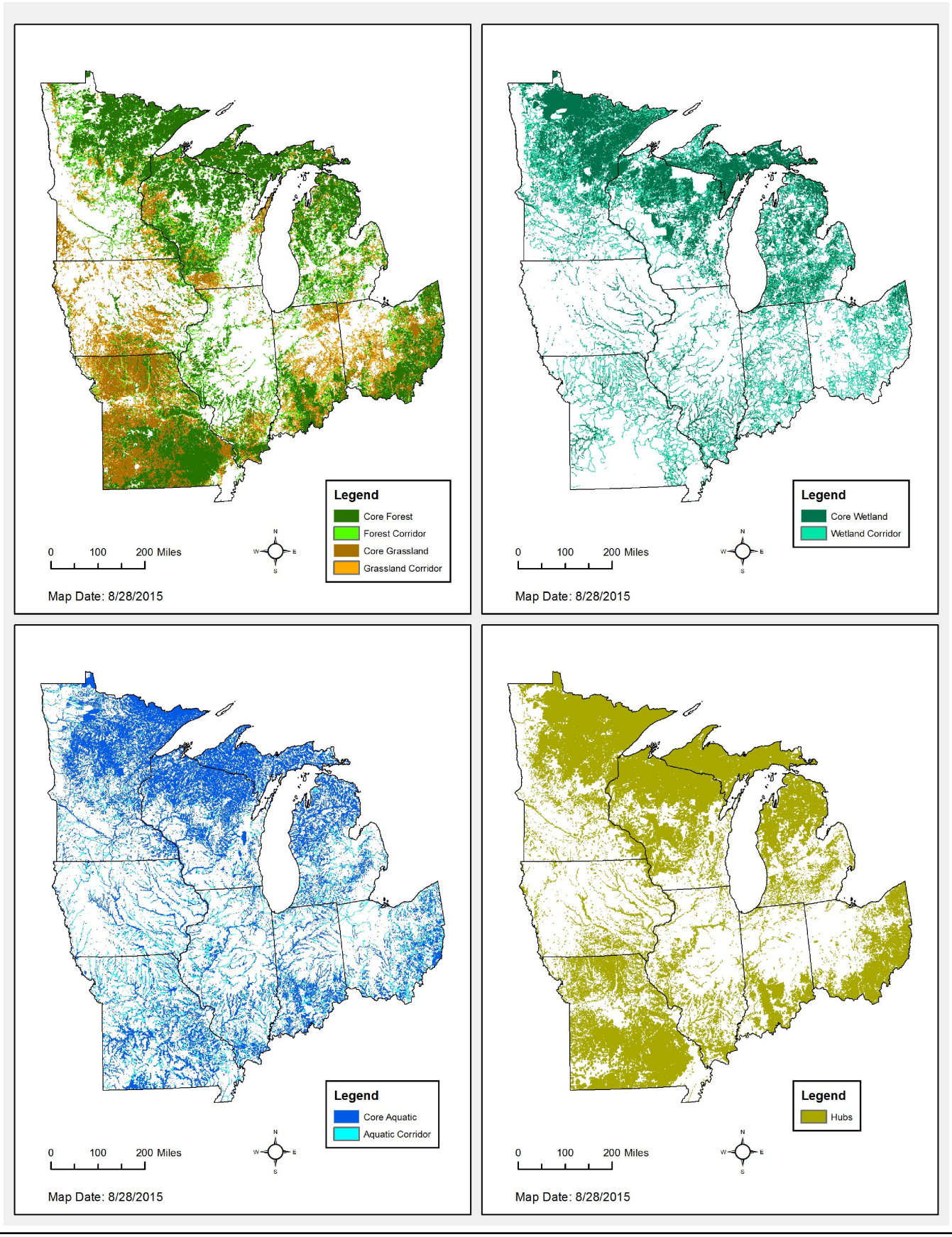

Figure 3.1-2
MGIN Habitats in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

3.1.2.4 Other Wildlife Species

As described above, this subsection describes wildlife species that are not Covered Species (Section 3.1.2.2, *Covered Species*) or protected under Federal or state endangered species statute (see Section 3.1.2.3, *Other Rare, Endangered, Threatened or Candidate Species*), but that may occur in the study area. Migratory birds protected under the MBTA are considered in this sub-section, as are bat species that are not specifically protected by Federal or state statutes. This section also generally describes State Wildlife Action Plans that apply to the study area.

State Wildlife Action Plans in the Study Area

Each state in the study area has developed a Wildlife Action Plan in collaboration with the Service (Association of Fish & Wildlife Agencies 2015). A Wildlife Action Plan considers all the wildlife species in a state, identifies those for which there is a conservation concern due to population trends and threats to habitat and the species, and describes strategies and actions which, if implemented, will stabilize or reverse the declines of those species. Species identified in these plans are referred to as Species of Greatest Conservation Need.

Table 3.1-9 summarizes by class and state the number of Species of Greatest Conservation Need identified in each State Wildlife Action Plan. State Wildlife Action Plans are available on state wildlife agency websites. State agencies responsible for developing and leading the plans in the study area include the following:

- Illinois Department of Natural Resources
- Indiana Department of Natural Resources
- Iowa Department of Natural Resources
- Michigan Department of Natural Resources
- Minnesota Department of Natural Resources
- Missouri Department of Conservation
- Ohio Department of Natural Resources
- Wisconsin Department of Natural Resources

Table 3.1-9. Number of Species of Greatest Conservation Need by State in the Study Area

Species Class	IL	IN	IA	MI	MN	MO***	OH	WI
Mammals	20	22	18	27	22	25	25	14
Breeding Birds	83	40	67	99	97	50	89	84
Reptiles	23	18	31	16	17	18	22	24
Amphibians	14	10	*	14	6	16	10	*
Fish	80	25	68	44	47	68	40	30
Freshwater Mussels & Clams (Mollusks)	29	24	29	28	39	28	31	58
Snails	25	2	8	36	**	21	0	**
Crustaceans/Crayfish	22	2		2	0	17	1	22
Insects, Spiders & Other Arthropods, Other Invertebrates	347	129	58	138	56	90	22	450
Total	**643**	**272**	**279**	**404**	**284**	**333**	**240**	**682**

Source: U.S. Geological Survey 2015.
* Iowa & Wisconsin combine reptiles & amphibians.
** Minnesota & Wisconsin combine mussels & snails.
*** Missouri identified SGCN plants also.

General Wildlife Presence in Study Area by Land Cover Type

Individual species of wildlife are strongly associated with the habitats in which they primarily carry out their life cycles. Accordingly, the general discussion of wildlife in this section is organized around the prevalent land cover types and ecoregions in the study area, as described in Section 3.1.2.1, *Vegetation Communities*.

Although many species of wildlife are widely distributed throughout the study area, those that are sensitive to the size, isolation, configuration, and quality of vegetation communities will most likely be found in MGIN habitat areas within each land cover type (see Table 3.1-8 and Figure 3.1-2). More common wildlife species, of course, also will be found in MGIN habitat areas.

Forest

Upland forest is the dominant land cover in the northern portions of Minnesota, Wisconsin and Michigan, the eastern portion of Ohio, and the southern portions of Ohio, Indiana, Illinois and Missouri. Forest-dwelling wildlife, especially those that require large habitat blocks are more frequently found in these locations than other areas in the study area with lower percentages of forest cover. Common wildlife species typical of the forest land cover type include red squirrel, eastern chipmunk, barred owl, pileated woodpecker, white-breasted nuthatch, wood frog, rat snake, eastern box turtle, and spotted salamander.

Upland forest in the study area consists of deciduous, evergreen and mixed deciduous-evergreen stands; many species of wildlife use one or more of these land cover types during their life cycle, such as large carnivores, ungulates, and some raptors and migratory songbirds. Woody wetlands, which include forested swampland and floodplain forests, comprise an additional 13, 11 and 17 percent, respectively, of the land cover in Minnesota, Wisconsin and Michigan, compared to 1 to

2 percent of the surface area in other states. The majority of the forested acres described above consist of Federal, state or county forest lands primarily used for timber production and recreation. Outside these locations forest cover is largely restricted to river and stream corridors, the edges of lakes and wetlands, and steep slopes.

Forests outside these areas of large and aggregated forests are often not large enough or sufficiently close together to maintain local populations of interior forest songbirds and other species that require interior forest conditions, especially species whose chief threat is forest fragmentation and edge effects. Consequently, populations of uncommon forest wildlife tend to be absent. Many species of migratory passerine birds and bats, however, use small forest patches in formerly extensively forested regions as stopover habitat because there is little other such habitat available.

Grasslands

Grassland and related shrub/scrub and savanna habitats generally cover less than 15 percent of any state's surface area, with the exception of Missouri and Iowa. Extensive areas of pre-Wisconsinan glaciated steeply sloping ground in the Central Irregular Plains of southern Iowa and adjacent and southwestern Missouri bring the grassland and shrub scrub acres in those states to 18 to 19 percent and 33 percent respectively. Consequently, habitat for wildlife that requires large grasslands is more abundant in these locations. Area-sensitivity has been documented in many species of grassland birds and a few other animal species (Johnson and Igl 2001). For this reason, habitat fragmentation and edge effects, including intrusion of woody plants into grasslands, reduce the quality of grassland habitat in the study area. Of formerly dominant vegetation cover types, shrub/scrub and savanna habitats are among the most reduced in acreage in the study area (Noss *et al.* 1995). As a result, species associated mostly with shrub-scrub and savanna comprises a large percentage of the region's uncommon wildlife.

Common wildlife species typical of grasslands cover type include thirteen-lined ground squirrel, meadow vole, red-tailed hawk, Savannah sparrow, grasshopper sparrow, eastern bluebird, bobwhite quail, grass snake, and western fox snake.

Wetlands

Due to extensive drainage efforts over the past century and more in the study area, emergent herbaceous wetlands cover less than 1 percent of Illinois, Indiana, Iowa, and Ohio. Missouri's landscape did not support large herbaceous wetland acreages outside floodplains, contributing also to less than 1 percent land cover by this type. Due to the large acreage of herbaceous wetlands prior to widespread drainage, Minnesota, Wisconsin and Michigan respectively retain 6, 4 and 3 percent of their land surface in this land cover type, primarily in the northern portions of the states. A variety of wildlife require large herbaceous wetlands to persist long term, and consequently many species of wildlife are not present or only exist in small populations outside of these three states.

Common wildlife species typical of the wetlands land cover type include muskrat, beaver, red-winged blackbird, great blue heron, marsh wren, snapping turtle, northern water snake, northern leopard frog, and bullfrog.

Agriculture and Developed Lands

Agricultural and developed lands constitute significant acreage in all states of the study area. Cultivated cropland occupies 55 to 65 percent of the land surface in Illinois, Indiana and Iowa, and 19 to 39 percent in Michigan, Minnesota, Missouri, Ohio, and Wisconsin. Low- to high-density

developed lands for residential and commercial use, including the open space associated with developed areas, cover 7 to 15 percent of the land surface in the eight states of the study area. Species common in and typical of these areas are usually generalists, adaptable and tolerant of disturbance and proximity to human activity. Small areas of upland forest and woody wetlands, grassland, and emergent herbaceous wetland are present in the agricultural and developed regions of the study area, but the region's wildlife which require interior habitat conditions are restricted to the largest, best quality habitat or absent entirely from these regions.

Common wildlife species typical of the agriculture and developed lands cover type include white-tailed deer, coyote, raccoon, gray squirrel, eastern cottontail, opossum, groundhog, wild turkey, killdeer, Canada goose, American robin, American crow, and common garter snake.

Representative Wildlife by Ecoregion

There are 21 Level III Terrestrial Ecoregions in the study area (see Section 3.1.2.1, *Vegetation Communities*). Wildlife occurring in these ecoregions includes bird species protected under the MBTA, game species managed by state fish and wildlife agencies, and species considered common in or typical of the ecoregion. Wildlife species representative of the study area are presented by ecoregions in Table 3.1-10.

Table 3.1-10. Wildlife Species Representative of the Study Area by Ecoregion

Ecoregion Name	Common and Typical Wildlife Species*	State
Northern Minnesota Wetlands	Black bear, gray wolf, white-tailed deer, snowshoe hare, mink, river otter, bald eagle, osprey, common loon, northern goshawk, sharp-tailed grouse	MN
Northern Lakes and Forests	Moose, black bear, gray wolf, white-tailed deer, snowshoe hare, ruffed grouse, pileated woodpecker, bald eagle, turkey vulture, common loon, northern goshawk, merlin, spruce grouse, eastern red-backed salamander	MN, WI, MI
North Central Hardwood Forests	White-tailed deer, coyote, gray fox, red fox, beaver, raccoon, fisher, otter, mink, gray squirrel, wild turkey, sandhill crane, turkey vulture, ruffed grouse, Canada goose, wood thrush, northern long-eared bat, wood turtle	MN, WI, MI
Driftless Area	White-tailed deer, coyote, gray fox, red fox, beaver, raccoon, fisher, otter, mink, gray squirrel, red-shouldered hawk, broad-winged hawk, turkey vulture, ruffed grouse, wild turkey, wood thrush, northern long-eared bat, wood turtle	MN, WI, IA, IL
Southern Michigan/ Northern Indiana Drift Plains	White-tailed deer, coyote, red fox, gray fox, beaver, river otter, mink, Canada warbler, upland sandpiper, wood thrush, northern long-eared bat, wood turtle, common mudpuppy	MI, IN
Eastern Great Lakes Lowlands	White tailed deer, black bear, red fox, coyote, snowshoe hare, red and gray squirrel, chipmunk, and other small mammals. Bird species include cardinal, wood thrush, screech owl, osprey, mourning dove, green heron, pileated and red-bellied woodpecker, Canada warbler, Canada geese, mallard, wood duck, American and black ducks	OH
Western Allegheny Plateau	White-tailed deer, gray fox, woodchuck, gray squirrel, wild turkey, ruffed grouse, barred owl, pileated woodpecker, ovenbird, Kentucky warbler, northern water snake, dusky salamander	OH

Ecoregion Name	Common and Typical Wildlife Species*	State
Interior Plateau	Black bear, white-tailed deer, bobcat, gray fox, pine vole, cardinal, mockingbird, summer tanager, brown thrasher, snapping turtle	IL, IN, OH
Interior River Valleys and Hills	White-tailed deer, badger, weasel, raccoon, bobwhite quail, Carolina chickadee, red-back salamander, copperbelly water snake, timber rattlesnake, eastern box turtle, snapping turtle	IA, MO, IL, IN
Ozark Highlands	White-tailed deer, coyote, bobcat, beaver, gray bat, wild turkey, eastern bluebird, bobwhite, warblers, collared lizard, many salamanders	MO
Northern Glaciated Plains	Significant numbers of waterfowl at the edge of the prairie pothole region. White-tailed deer, coyote, snowshoe hare, cottontail, red fox, northern pocket gopher, Franklin's ground squirrel, sharp-tailed grouse and black-billed magpie	MN
Lake Agassiz Plain	Significant numbers of waterfowl at this edge of the prairie pothole region. White-tailed deer, coyote, red fox, jackrabbit, cottontail rabbit, raccoon, muskrat, sharp-tailed grouse, ring-tail pheasant, geese, ducks, and ground squirrel	MN
Central Irregular Plains	White-tailed deer, badger, raccoon, skunk, muskrat, cottontail rabbit, mink, Canada geese, bobwhite quail, western meadowlark, ring-neck pheasant	IA, MO
Western Corn Belt Plains	White-tailed deer, beaver, raccoon, red-tailed hawk, barn owl, bobwhite quail, western meadowlark, Canada goose, pheasant, gray partridge, mallard, teal, Great Plains toad	MN, WI, IA, MO
Southeastern Wisconsin Till Plains	White-tailed deer, red fox, coyote, raccoon, red squirrel, gray squirrel, wild turkey, Canada goose, sandhill crane	WI, IL
Central Corn Belt Plains	White-tailed deer, coyote, bobcat, meadow vole, Canada goose, mallard duck, black-capped chickadee, upland sandpiper, Illinois mud turtle, and Illinois chorus frog	WI, IL, IN
Eastern Corn Belt Plains	White-tailed deer, coyote, red fox, gray fox, big eared bat (in IN only), white-footed mouse, cottontail rabbit, eastern mole, indigo bunting, eastern bluebird, Canada warbler, American redstart, tree sparrow	MI, IN, OH
Huron/Erie Lake Plains	White-tailed deer, raccoon, woodchuck, downy woodpecker, green-backed heron, wood duck, snapping turtle, northern water snake	MI, IN, OH
Mississippi Alluvial Plain	White-tailed deer, black bear, bobcat, gray fox, raccoon, swamp rabbit, migratory waterfowl, wild turkey, cormorants, egrets, herons, mourning dove, wood thrush, yellow-throated vireo. Major bird migration corridor due to traditional use along Mississippi River Valley.	MO, IL
Mississippi Valley Loess Plains	White-tailed deer, red fox, raccoon, weasel, gray squirrel, wood thrush, Carolina wren, bobwhite quail, mourning dove, wild turkey	MO

Sources: U.S. Environmental Protection Agency 2013; Commission for Environmental Cooperation 2006, 2011.
IL=Illinois; IN=Indiana; IA=Iowa; MI=Michigan; MN=Minnesota; MO=Missouri; OH=Ohio; WI=Wisconsin.
* List includes some Federal and state-listed species.

Migratory Birds

The regulatory definition of a migratory bird is any individual species or family of birds that crosses between Canada, United States, or Mexico borders at some point during their annual life cycle to live or reproduce (U.S. Fish and Wildlife Service 2015d). As described in Section 1.4.1.1, *Migratory Bird Treaty Act*, the MBTA implements four treaties that prohibit take, possession, transportation, and importation of all migratory, native birds (plus their eggs and active nests) occurring in the wild in the U.S. except for house sparrow, European starling, rock pigeon, any recently listed unprotected species in the *Federal Register*, and non-migratory upland game birds, except when specifically authorized by the Service. Many of these migratory birds are also protected by endangered species legislation at Federal and state levels, have been identified in State Wildlife Action Plans, or identified as Birds of Conservation Concern (*i.e.,* a species likely to become a candidate for listing under the ESA without further conservation action).

Migratory Birds in Study Area

The study area supports hundreds of migratory bird species. Migration through the study area generally begins in March with the movement of waterfowl, waterbirds, songbirds, raptors, and other bird species that overwinter in the southern United States and adjacent Mexico. In late April and May, the neotropical migrants that overwinter in Central and South America and the Caribbean islands arrive, along with shorebirds and the last of the raptor species. After the June-July breeding period, species migration reverses, with shorebirds among the earliest of migrants. September is the peak of the small perching bird migration, with raptors and waterfowl continuing into November.

Many migratory birds, particularly waterfowl and shorebirds, concentrate in “flyways” or migration corridors. All states in the study area are in the Mississippi Flyway. The main migration routes are along the Mississippi River Valley and associated large tributaries, north into Canada, and also across the relatively level plains between river systems where more dispersed migration occurs. Birds from the Atlantic Flyway also migrate to and from northern Michigan, Wisconsin and Minnesota after overwintering around the Caribbean and Gulf of Mexico.

Other migratory birds, mainly songbirds, flying in conspecific or mixed flock groups, in pairs or as individuals, migrate across the broader landscape, following landmarks or other cues to move from one stopover point to the next where they may rest and feed.

The Service (2008) has delineated Birds of Conservation Concern Regions (BCRs) across the United States. These BCRs, which are identified by number and name, represent ecologically distinct regions with similar bird communities, habitats and resource management issues. BCRs in the study area are: 12 (Boreal Hardwood Transition), 13 (Lower Great Lakes/St. Lawrence Plain), 23 (Prairie Hardwood Transition), 28 (Appalachian Mountains), 24 (Central Hardwoods), 11 (Prairie Potholes), 22 (Eastern Tallgrass Prairie), 26 (Mississippi Alluvial Valley).

There are 65 Birds of Conservation Concern listed in these BCRs in the study area.

Migratory Tree Bat Species

Four migratory tree bat species are known to the study area: eastern red bat, hoary bat, Seminole bat, and silver-haired bat. Migratory tree bat species are particularly susceptible to operational impacts at wind energy facilities, depending on where wind developments are sited and how they are operated during migration seasons.

The eastern red bat ranges from the United States-Canadian border south to the Gulf Coast and west to the Front Range of the Rocky Mountains. It is abundant throughout the study area. Eastern red bats primarily roost in foliage throughout the year. During intense periods of cold weather, eastern red bats may move to the ground and roost in leaf litter. Detailed assessment of potential mortality is provided in Chapter 4. Based primarily on mortality documented at wind energy sites, the Service has begun an informal status review of the species to determine if a formal ESA status review should be initiated to assess if ESA protection is warranted.

The Seminole bat is most abundant on the Coastal Plain where it ranges from southern Pennsylvania south and west to the southern tip of Texas. Individuals have been occasionally captured along the southern border of the study area, but the species also wanders widely and individuals can be found throughout the study area, especially during late summer. Seminole bats primarily roost in foliage throughout the year. Spanish moss is also an important roosting type. During intense periods of cold weather, Seminole bats may move to the ground and roost in leaf litter.

The hoary bat ranges throughout most of North and South America, and migrates at continental scales (Cryan 2003). Mortality at wind energy sites indicates the North American sub-species is more common in the study area than previously believed. Hoary bats primarily roost in foliage throughout the year. During intense periods of cold weather, hoary bats may move to the ground and roost in leaf litter. Detailed assessment of potential mortality is provided in Chapter 4. Based primarily on mortality documented at wind energy sites, the Service has begun an informal status review of the species to determine if a formal ESA status review should be initiated to assess if ESA protection is warranted.

The silver-haired bat ranges from the southeastern corner of Alaska south and east to southern Georgia. The species summers in the north portion of the study area and moves to hibernation areas within the southern states. Silver-haired bats primarily form summer colonies in hollow trees. Bark crevices are used extensively during migration. Hibernacula are poorly known, although caves, buildings, and hollow trees have all been used. Detailed assessment of potential mortality is provided in Chapter 4. Based primarily on mortality documented at wind energy sites, the Service has begun an informal status review of the species to determine if a formal ESA status review should be initiated to assess if ESA protection is warranted.

Arnett and Bearwald (2013), using data from the U.S. and Canada combined, estimated that hoary bats account for 38 percent of bat fatalities, eastern red bats 22 percent, and silver-haired bats 18 percent. As such, this group of bats account for much of the mortality at wind energy facilities.

3.1.2.5 Other Fish and Aquatic Resources

Aquatic habitats that support fish and other aquatic resources, including macroinvertebrates, in the study area include rivers, streams, lakes, and ponds. Section 3.2.2.1, *Surface Waters*, summarizes the extent of these habitats and general conditions (e.g., water quality) in the study area. High quality aquatic habitats identified in the MGIN model (e.g., aquatic core and aquatic corridors) likely support a greater diversity of these animals as well as those most sensitive to pollution and habitat alteration (See Table 3.1-8). In addition, semi-aquatic and terrestrial animals, such as beaver and otter, wading birds, waterfowl, amphibians, and some snakes, use these habitats during portions of their life cycle or as a key resource.

The study area hosts a wide variety of aquatic resources, including the Laurentian Great Lakes drainage and a part of the Mississippi River basin. Accordingly, a diverse array of fish and aquatic

macroinvertebrates occur throughout the study area. Many major taxonomic groupings of fish and invertebrates have some freshwater representatives, and many occur within the study area. Fish and macroinvertebrate species representative of the study area are presented by Level III Terrestrial Ecoregions in Table 3.1-11.

Table 3.1-11. Fish and Macroinvertebrate Species Representative of the Study Area by Ecoregion

Ecoregion Name	Common and Typical Fish Species*	State
Northern Minnesota Wetlands	lake trout, cisco, squaregilled mayflies, flat-headed mayflies, pea clams	MN
Northern Lakes and Forests	lake trout, cisco, salmon, rock bass, yellow perch, muskellunge, walleye, brook trout, spiny crawler mayflies, black flies, non-biting midges	MN, WI, MI
North Central Hardwood Forests	northern pike, walleye, carp, bluegill, green sunfish, non-biting midges, scud, detritus worms	MN, WI, MI
Driftless Area	northern pike, walleye, and largemouth bass, smallmouth bass, black flies, detritus worms, water mites	MN, WI, IA, IL
Southern Michigan/ Northern Indiana Drift Plains	northern pike, walleye, salmon, steelhead, brown trout, creek chub, sand shiner, green sunfish, Johnny darter, central stoneroller, fathead minnow, white sucker, fantail darter, common carp	MI, IN
Erie Drift Plain	white crappie (calico bass), bluegill, pumpkinseed sunfish, yellow perch, bullhead, common carp, channel catfish, net-spinning caddisflies, non-biting midges, riffle beetles	OH
Eastern Great Lakes Lowlands	lake trout, coho, salmon, brown trout, sturgeon, muskellunge, smallmouth bass, walleye, non-biting midges, net-spinning caddisflies, riffle beetles	OH
Western Allegheny Plateau	river redhorse, common carp, smallmouth bass, walleye, white crappie (calico bass), sauger, channel catfish, freshwater drum, water mites, non-biting midges, net-spinning caddisflies	OH
Interior Plateau	blackspot shiner, northern cavefish, smallmouth bass, channel catfish, white crappie (calico bass), paddlefish, sauger, striped bass, walleye, white bass, yellow bass, various darters, detritus worms, non-biting midges, small minnow mayflies	IL, IN, OH
Interior River Valleys and Hills	paddlefish, various darters, bluegill, blue catfish, flathead catfish, channel catfish, common carp, freshwater drum, red-ear sunfish, smallmouth bass, spotted bass, net-spinning caddisflies, non-biting midges, small minnow mayflies	IA, MO, IL, IN
Ozark Highlands	Ozark cavefish, smallmouth bass, white bass, yellow bass, flat-headed mayflies, water mites, slate drakes	MO
Northern Glaciated Plains	Largemouth bass, smallmouth bass, walleye, paddlefish, Asian carp, channel catfish, flathead catfish, shovelnose sturgeon, walleye, net-spinning caddisflies, black flies, detritus worms	MN
Lake Agassiz Plain	perch, walleye, sturgeon, channel catfish, smallmouth bass, sauger, walleye, northern pike, common carp, stonecat, madtom, net-spinning caddisflies, small minnow mayflies, dance flies	MN

Ecoregion Name	Common and Typical Fish Species*	State
Central Irregular Plains	common carp, creek chub, bluntnose minnow, central stoneroller, emerald shiner, northern hogsucker, red shiner, sand shiner, fantail darter, Johnny darter, net-spinning caddisflies,, non-biting midges, riffle beetles	IA, MO
Western Corn Belt Plains	walleye, northern pike, bluegill, creek chub, sand shiner, green sunfish, Johnny darter, central stoneroller, fathead minnow, white sucker, fantail darter, common carp, non-biting midges, net-spinning caddisflies, detritus worms	MN, WI, IA, MO
Southeastern Wisconsin Till Plains	perch, northern pike, and brook trout, walleye, northern pike, bluegill, creek chub, green sunfish, Johnny darter, central stoneroller, fathead minnow, white sucker, fantail darter, common carp, salmon, steelhead, brown trout, Net-spinning caddisflies, freshwater isopods, black flies	WI, IL
Central Corn Belt Plains	common carp, creek chub, bluntnose minnow, central stoneroller, emerald shiner, northern hogsucker, red shiner, sand shiner, fantail darter, Johnny darter, detritus worms, net-spinning caddisflies, riffle beetles	WI, IL, IN
Eastern Corn Belt Plains	bluebreast darter, redside dace, creek chub, sand shiner, white sucker, redhorse, yellow bullhead, smallmouth bass, orange-spotted sunfish, green sunfish, greenside darter, logperch darter, net-spinning caddisflies, non-biting midges, riffle beetles	MI, IN, OH
Huron/Erie Lake Plains	flathead catfish, greater redhorse, creek chub, striped shiner, smallmouth bass, walleye, pugnose shiner, stonecat, net-spinning caddisflies, small minnow mayflies, non-biting midges	MI, IN, OH
Mississippi Alluvial Plain	alligator gar, pallid sturgeon, catfish, bluegill, sunfish, common carp, blue catfish, channel catfish, bowfin, freshwater drum, bullhead, river quillback, roundworms, freshwater amphipods, detritus worms	MO, IL
Mississippi Valley Loess Plains	bayou darter, striped bass, catfish, largemouth bass, crappie, bream, detritus worms, non-biting midges, net-spinning caddisflies	MO

Sources: U.S. Environmental Protection Agency 2013; Commission for Environmental Cooperation 2006, 2011; U.S. Geological Survey 2015.

IL=Illinois; IN=Indiana; IA=Iowa; MI=Michigan; MN=Minnesota; MO=Missouri; OH=Ohio; WI=Wisconsin.

* List includes some Federal and state-listed species, as well as some exotic, introduced species.

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3.2 Water Resources

This section describes water resources (e.g., surface waters, floodplains, and wetlands) in the study area.

3.2.1 Study Area and Approach

The water resources study area is concurrent with the Plan Area.

3.2.1.1 Surface Waters

Existing surface water conditions in the study area are described and summarized using several geospatial and tabular resources. The area of watershed resource regions and subregions[18] within the study area was determined by overlying the United States Geological Survey's (USGS) Watershed Boundary Dataset (U.S. Geological Survey 2013) with the study area boundary in a geographic information system (GIS). The extent of surface water features within the study area was determined in GIS by overlying the National Hydrography Dataset (NHD)(U.S. Environmental Protection Agency 2012; U.S. Geological Survey 2012) with the study area boundary. The NHD maps the surface water drainage network of the United States and includes streams, rivers, canals, ponds, lakes, reservoirs, and coastlines. The GIS analysis used the NHD to generate the length of streams and rivers and acres of waterbodies (ponds, lakes, reservoirs) in the study area, tabulated and summarized by watershed resource region and state. Major rivers and major waterbodies were also identified in each watershed resource region using additional NHD attributes. Major rivers were defined as rivers with a Strahler (1957) stream order of seven or greater, and major waterbodies were defined as waterbodies (e.g., reservoirs, ponds, and lakes) with an area larger than 24,710 acres (100 square kilometers).

Surface water quality in the study area is described using the EPA's state-submitted Clean Water Act (CWA) 305(b)[19] surface waters report and the 303(d)[20] list of impaired waters (U.S. Environmental Protection Agency 2015a). The CWA requires all states to assess and describe the quality of its waters in a report called the 305(b) report. In this report, states assign designated uses (e.g., fish consumption, public water supply) to all surface waters within the state. For surface waters where current pollution controls are not sufficient to maintain relevant water quality standards for designated uses, states must designate these waters as non-supporting and list them as impaired on the 303(d) list for the state. To address surface water quality in the study area, the 303(d) and 305(b) streams and waterbodies were summarized by linear miles (streams and rivers) and acres (waterbodies) by state and the watershed resource regions.

3.2.1.2 Floodplains

Floodplains in the study area are described using two GIS data sources: Federal Emergency Management Agency (FEMA) floodplain mapping data (Federal Emergency Management Agency

[18] Watershed resource regions and subregions are also known as Hydrologic Unit Codes (HUCs). HUCs are part of a tiered system (identified by a number) that describes and divides surface drainage in the United States. HUCs increase by two digits for each increasingly smaller hydrologic subdivision.

[19] 33 U.S.C. § 1315(b)

[20] 33 U.S.C. § 1313(d)

2015) and Natural Resources Conservation Service (NRCS) soil data (Natural Resource Conservation Service 2015). FEMA develops Flood Insurance Rate Maps, which are the official maps on which FEMA delineates special flood hazard areas for regulatory purposes under the National Flood Insurance Program. Special flood hazard areas are also known as *100-year floodplains*, or areas that have a 1-percent annual chance of flooding.

Because not all communities (e.g., cities and counties) participate in the National Flood Insurance Program, and because not all floodplains contain insurable structures, the FEMA floodplain mapping data is not comprehensive of all floodplains. For this reason, NRCS soil data is also used in this section to estimate the amount of flood-prone soils in the study area. Soils with the following NRCS flood frequency classifications were selected to estimate the extent of floodplains in the study area: rare, occasional, frequent, and very frequent (Natural Resource Conservation Service 2013).

- *Rare flooding* is unlikely but possible under unusual weather conditions; there is a 1- to 5-percent chance of flooding in any year or nearly 1 to 5 times in 100 years.
- *Occasional flooding* is expected infrequently under usual weather conditions; there is a 5- to 50-percent chance of flooding in any year or 5 to 50 times in 100 years.
- *Frequent flooding* is likely to occur often under usual weather conditions; there is more than a 50-percent chance of flooding in any year (*i.e.,* more than 50 times in 100 years), but less than a 50-percent chance of flooding in all months in any year.
- *Very frequent flooding* is likely to occur very often under usual weather conditions; there is more than a 50-percent chance of flooding in all months of any year.

The FEMA and NRCS GIS data were overlain with the study area to quantify and describe floodplains by state.

3.2.1.3 Wetlands

Wetlands in the study area are described using the Service National Wetlands Inventory (NWI) GIS data (U.S. Fish and Wildlife Service 2015). The NWI classifies wetlands using the Cowardin *et al.* (1979) wetland classification system. This classification system covers all wetlands and deep-water habitats, including wetlands, streams, and other non-wetland surface waters (e.g., ponds and lakes). The NWI data were overlain with the study area to quantify and describe wetlands and deep-water habitats by state.

3.2.2 Existing Conditions

The following sections discuss the existing conditions for surface waters, floodplains, and wetlands in the study area.

3.2.2.1 Surface Waters

Hydrology and Watershed Information

The study area includes a portion of seven watershed resource regions (Figure 3.2-1) and 46 subregions (Table 3.2-1). Approximately 511,486 miles of streams and rivers, nearly 5.85 million acres of waterbodies (ponds, lakes, and reservoirs), and 1,327 miles of coastline are found within the study area. The following provides information on each of the seven watershed resource regions in the study area.

- **The Great Lakes Region** is comprised of over 152 million acres and spans seven states: Illinois, Indiana, Michigan, Minnesota, New York, Ohio, and Wisconsin. This region hosts a diverse array of aquatic surface waters, including the largest freshwater system on earth: the Laurentian Great Lakes. All water in this area drains into the Great Lakes, unless anthropogenically altered (e.g., canal) to drain elsewhere (U.S. Geological Survey 2007). The region within the study area contains over 94,663 miles of linear streams and rivers, 1.3 million acres of waterbodies, and 1,327 miles of coastline (Table 3.2-2). Major rivers within the region include: the Detroit, Maumee, and Saginaw rivers. Major waterbodies within the region include: Duck Lake, Lake Erie, Lake Huron, Lake Michigan, Lake St. Clair, Lake Superior, Lake Ontario, and Lake Winnebago.

  Portions of 12 Great Lakes subregions are within the study area (Table 3.2-1). The largest of these subregions (by area within the study area) is Northwestern Lake Michigan that encompasses the western portion of the Lake Michigan drainage, west of the Little Calumet-Galien River system. The smallest is the Lake Erie Subregion that encompasses the Lake Erie drainage between the Vermilion and Huron drainage (U.S. Geological Survey 2007).

- **The Ohio Region** covers over 104 million acres and spans 11 states: Illinois, Indiana, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The major hydrologic feature of this region is the Ohio River, which spans from Pittsburgh, Pennsylvania where the Allegheny and Monongahela Rivers combine to form the Ohio River (Kammerer 1990; U.S. Geological Survey 2007). From Pittsburgh, the Ohio River travels 981 miles across six states to where it meets the Mississippi River near Cairo, Illinois. This region within the study area contains over 77,869 miles of linear streams and rivers and 281,340 acres of waterbodies (Table 3.2-2). Major rivers within the region include: Great Miami River, Little Wabash River, Muskingum River, Ohio River, Wabash River, and White River. Major waterbodies within the region include Bards Lake, Dale Hollow Lake, and Lake Cumberland.

  Portions of seven Ohio Region subregions are within the study area (Table 3.2-1). The largest of these subregions (by area within the study area) is the Wabash, which contains the Wabash River basin, excluding the Patoka and White river systems (U.S. Geological Survey 2007).

- **The Upper Mississippi Region** covers over 121 acres, and spans nine states: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, North Dakota, South Dakota, and Wisconsin. This region is defined as the drainage of the Mississippi River above the confluence of the Ohio River, and excluding the Missouri River Basin (U.S. Geological Survey 2007). The major hydrologic resource of this region is the Upper Mississippi River, which originates from Lake Itasca in northern Minnesota and travels about 1,300 miles to meet the Ohio River near Cairo, Illinois (Kammerer 1990). The region within the study area contains over 211,634 miles of linear streams and rivers and 2.4 million acres of waterbodies (Table 3.2-2). Major rivers within the region include:

Chippewa, Des Moines, Illinois, Iowa, Kaskaskia, Meramec, Minnesota, Mississippi, Pecatonica, Rock, and Sangamon rivers. Major waterbodies within the region include: Leech, Mills Lacs, Peoria, and Sugar lakes.

Portions of 14 Upper Mississippi Region subregions are within the study area (Table 3.2-1). The largest of these (by area within the study area) is the Upper Mississippi-Iowa-Skunk-Wapsipinicon, which includes the Mississippi River Basin below Lock and Dam 13 to where the Des Moines River Basin meets the Mississippi (excluding the Rock River Basin)(U.S. Geological Survey 2007).

- **The Lower Mississippi Region** covers over 70.76 million acres and spans six states: Arkansas, Illinois, Kentucky, Louisiana, Mississippi, and Tennessee. This region is defined as the Mississippi River drainage below the confluence of the Ohio River and excluding the Arkansas, Red, and White river basins (U.S. Geological Survey 2007). The major hydrologic resource of this region is the Lower Mississippi River, which flows just under 1,000 miles from the confluence with Ohio to the Gulf of Mexico (Kammerer 1990). The region within the study area contains over 211,634 miles of linear streams and rivers and 2.4 million acres of waterbodies (Table 3.2-2). The Mississippi River is the major hydrological feature for the region within the study area; there are no other major rivers or major waterbodies.

  Portions of two Lower Mississippi Region subregions are within the study area (Table 3.2-1). The largest of these (by area within the study area) is the Lower Mississippi-St. Francis Subregion, which includes the Mississippi River Basin, along the east bank, from the Horn Lake Creek system to the Arkansas and White river basins (U.S. Geological Survey 2007).

- **The Souris-Red-Rainy Region** covers over 60.6 million acres and spans portions of Minnesota, North Dakota, and South Dakota. The drainage, within the United States, is defined as those of the Lake of the Woods and the Rainy, Red, and Souris River systems that eventually flow to Lake Winnipeg and the Hudson Bay. The region within the study area contains over 22,700 miles of linear streams and rivers and 1.4 million acres of waterbodies (Table 3.2-2). The only major river in the study area is the Red River of the North, which flows between Minnesota and North Dakota. Major waterbodies in the study area include: Kabetogama Lake, Lake of the Woods, Rainy Lake, Upper Red Lake, and Vermillion Lake.

  Portions of two Souris-Red-Rainy Region subregions are within the study area: the Red and Rainy subregions (Table 3.2-1). The Red River subregion is an entirely closed river basin that includes Devils Lake. The subregion spans over Minnesota, North Dakota, and South Dakota. The Red River originates at the confluence of the Bois de Sioux and Otter Tail rivers. The Rainy subregion includes the Rainy River Basin and the Lake of the Woods drainage and is contained within Minnesota.

- **The Missouri Region** covers over 333 million acres and spans nine states: Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, North Dakota, South Dakota, and Wyoming. The region is defined as the Missouri River Basin, the Saskatchewan River Basin, and several other small, closed basins. This region hosts the Missouri River, the longest river in North America that begins in the Rocky Mountains in western Montana and travels 2,540 miles to the Mississippi River (Kammerer 1990). The region within the study area contains over 77,150 miles of linear streams and rivers and 270,766 acres of waterbodies (Table 3.2-2). Major rivers within the study area portion of the region include: Grand, Lamine, Missouri, and Osage rivers. Major waterbodies include: Lake of the Ozarks and Stockton Lake.

Portions of seven Missouri Region subregions are within the study area (Table 3.2-1). The largest of these (by area within the study area) is the Gasconade-Osage Subregion, which contains the Gascondade and Osage river systems and spans over Kansas and Missouri (U.S. Geological Survey 2007).

- **The Arkansas-White-Red Region** covers almost 159 million acres and includes all of Oklahoma and portions of Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, and Texas. The region within the study area is defined as the drainage of the Arkansas, White, and Red river basins. The largest of these basins is Arkansas, which includes the Arkansas River that flows approximately 1,469 miles from Colorado to the Mississippi River near Napoleon, Arkansas (Kammerer 1990). The region within the study area contains over 19,509 miles of linear streams and rivers and 63,068 acres of waterbodies (Table 3.2-2). Within the study area, the White River is the only major river.

  Portions of two Arkansas-White-Red Region subregions are within the study area: Upper White and Neosho-Verdigris (Table 3.2-1). The Upper White subregion includes the White and the Little Red river basins and spans over Arkansas and Missouri. The Neosho-Verdigris Subregion contains both the Neosho and Verigris river basins and spans over Arkansas, Kansas, Missouri, and Oklahoma.

Table 3.2-1. Summary of Regional and Subregional Watersheds within the Study Area

Subregion HUC Code	Subregional Watershed Name	Subregional Watershed Acres in Study Area	Regional Watershed Name	Percent of Study Area by Regional Watershed
0401	Western Lake Superior	5,870,994	Great Lakes Region	21.03
0402	Southern Lake Superior-Lake Superior	4,923,787		
0403	Northwestern Lake Michigan	11,975,178		
0404	Southwestern Lake Michigan	1,270,912		
0405	Southeastern Lake Michigan	8,274,658		
0406	Northeastern Lake Michigan-Lake Michigan	7,197,317		
0407	Northwestern Lake Huron	4,294,353		
0408	Southwestern Lake Huron-Lake Huron	5,864,754		
0409	St. Clair-Detroit	2,377,114		
0410	Western Lake Erie	7,609,864		
0411	Southern Lake Erie	1,944,297		
0412	Lake Erie	40,114		

Subregion HUC Code	Subregional Watershed Name	Subregional Watershed Acres in Study Area	Regional Watershed Name	Percent of Study Area by Regional Watershed
0503	Upper Ohio	3,623,385	Ohio Region	15.35
0504	Muskingum	5,152,003		
0506	Scioto	4,167,859		
0508	Great Miami	3,434,834		
0509	Middle Ohio	3,786,993		
0512	Wabash	21,091,306		
0514	Lower Ohio	3,743,287		
0701	Mississippi Headwaters	12,870,868	Upper Mississippi Region	41.12
0702	Minnesota	9,808,971		
0703	St. Croix	4,940,588		
0704	Upper Mississippi-Black-Root	6,887,447		
0705	Chippewa	6,104,264		
0706	Upper Mississippi-Maquoketa-Plum	5,499,711		
0707	Wisconsin	7,637,264		
0708	Upper Mississippi-Iowa-Skunk-Wapsipinicon	14,678,737		
0709	Rock	6,987,134		
0710	Des Moines	9,251,675		
0711	Upper Mississippi-Salt	6,451,992		
0712	Upper Illinois	6,995,491		
0713	Lower Illinois	11,454,264		
0714	Upper Mississippi-Kaskaskia-Meramec	10,937,368		
0801	Lower Mississippi-Hatchie	105,375	Lower Mississippi Region	1.07
0802	Lower Mississippi-St. Francis	3,016,234		
0902	Red	11,309,528	Souris-Red-Rainy Region	6.33
0903	Rainy	7,231,101		
1017	Missouri-Big Sioux	1,811,548	Missouri Region	12.16
1023	Missouri-Little Sioux	5,140,899		
1024	Missouri-Nishnabotna	5,979,234		
1027	Kansas	4,565		
1028	Chariton-Grand	7,013,408		
1029	Gasconade-Osage	9,158,873		
1030	Lower Missouri	6,520,434		
1101	Upper White	6,790,624	Arkansas-White-Red Region	2.95
1107	Neosho-Verdigris	1,862,462		

Source: U.S. Geological Survey 2013.

Table 3.2-2. Linear Distances of Streams and Rivers and Areas of Waterbodies in the Study Area

Water Resource Region by State	Linear Distance of Streams and River (Miles)	Area of Waterbodies (Acres)	Linear Distance of Coastline (Miles)
Great Lakes			
Illinois	45	1,765	33
Indiana	3,317	29,007	13
Michigan	52,020	808,860	831
Minnesota	5,264	146,108	99
Ohio	17,578	30,271	95
Wisconsin	16,439	322,830	256
Ohio			
Illinois	14,027	25,065	–
Indiana	23,809	113,459	–
Ohio	40,033	142,816	–
Upper Mississippi			
Illinois	56,750	266,813	–
Indiana	3,559	12,495	–
Iowa	48,204	84,366	–
Michigan	6	3,869	–
Minnesota	40,358	1,397,531	–
Missouri	23,019	44,943	–
Wisconsin	39,738	665,181	–
Lower Mississippi			
Missouri	7,961	14,677	–
Souris-Red-Rainy			
Minnesota	22,700	1,403,366	–
Missouri			
Iowa	22,848	51,179	–
Minnesota	2,668	7,251	–
Missouri	51,634	212,336	–
Arkansas-White-Red			
Missouri	19,509	63,068	–

Source: U.S. Environmental Protection Agency and U.S. Geological Survey 2012.

Water Quality

Designated water use of streams (Table 3.2-3) and waterbodies (Table 3.2-4) vary widely between water resource regions and states in the study area. The most common forms of designated use of streams and waterbodies in the study area are fish, shellfish, and wildlife protection and propagation; recreation; aquatic life harvesting; and public water supply.

Table 3.2-5 summarizes the total linear distances of rivers and streams and areas of waterbodies that are listed as CWA 303(d) impaired for each watershed resource region and state. Causes for water quality impairment in the watershed resource regions across the study area vary, but the most frequent causes for listing streams impaired under Section 303(d) of the CWA are polychlorinated biphenyls (PCBs), pathogens, organic enrichment/oxygen depletion, habitat alterations, nutrients, sediment, mercury, flow alterations, metals other than mercury, and unknown cause (Table 3.2-6). Similarly, the most frequent causes for listing waterbodies as impaired in the study area under CWA Section 303(d) are nutrients, mercury, PCBs, organic enrichment/oxygen depletion, sediment, algal growth, pesticides, turbidity, dioxins, and habitat alterations (Table 3.2-7).

The following passages summarize designated uses and causes of impairment by state within the study area.

- **Illinois**: Designated uses of streams and waterbodies include: aesthetic value; agriculture; aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; industry; public water supply; and recreation (Tables 3.2-4 and 3.2-5). In total, over 7,672 miles of stream and 137,442 acres of waterbodies in Illinois in the study area are listed on the CWA 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: nutrients; metals other than mercury; organic enrichment/oxygen depletion; PCBs; and habitat alterations. Major sources of impairment in waterbodies of the state include: nutrients, algal growth, turbidity, metals other than mercury, and PCBs (U.S. Environmental Protection Agency 2015a, 2015b).
- **Indiana**: Designated uses of streams and waterbodies include: aesthetic value; aquatic life harvesting; exceptional recreational or ecological significance; fish, shellfish, and wildlife protection and propagation; public water supply; and recreation (Tables 3.2-4 and 3.2-5). In total, over 9,223 miles of stream and 72,952 acres of waterbodies in Indiana in the study area are listed on the 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: pathogens; PCBs; unknown cause (impaired biota); mercury; and salinity, total dissolved solids, chlorides, and sulfates. Major sources of impairment in waterbodies of the state include: PCBs; mercury; algal growth; taste, color, and odor; and nutrients (impaired biota) (U.S. Environmental Protection Agency 2015a, 2015b).
- **Iowa**: Designated uses of streams and waterbodies include: aesthetic value; agriculture; aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; public water supply; and recreation (Tables 3.2-4 and 3.2-5). In total, over 4,672 miles of stream and 54,848 acres of waterbodies are listed on the 303(d) list of impaired waters in Iowa in the study area (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: pathogens; unknown cause (impaired biota); unknown cause (fish kills); metals other than mercury; and mercury. Major sources of impairment in waterbodies of the state include: turbidity; pathogens; algal growth; pH, acidity, and caustic conditions; and mercury (U.S. Environmental Protection Agency 2015a, 2015b).
- **Michigan**: Designated uses of streams and waterbodies include: agriculture; aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; industrial; navigation; public water supply; and recreation (Tables 3.2-3 and 3.2-4). In total, over 33,904 miles of stream and 331,265 acres of waterbodies in Michigan in the study area are listed on the 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: PCBs; mercury; dioxins; organic enrichment and oxygen depletion; and pathogens.

Major sources of impairment in waterbodies of the state include: mercury, PCBs, pesticides, dioxins, and nutrients (U.S. Environmental Protection Agency 2015a, 2015b).

- **Minnesota**: Designated uses of streams and waterbodies include: aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; limited resource value; and public water supply (Tables 3.2-3 and 3.2-4). In total, over 7,759 miles of stream and 677,988 acres of waterbodies in Minnesota in the study area are listed on the 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: turbidity; unknown cause (impaired biota); pathogens; PCBs; and organic enrichment/oxygen depletion. Major sources of impairment in waterbodies of the state include: nutrients, mercury, PCBs, pesticides, and algal growth (U.S. Environmental Protection Agency 2015a, 2015b).
- **Missouri**: Designated uses of streams and waterbodies include: aesthetic value; agriculture; aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; industry; public water supply; and recreation (Tables 3.2-3 and 3.2-4). In total, over 4,281 miles of stream and 65,917 acres of waterbodies in Missouri in the study area are listed on the 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: pathogens; organic enrichment and oxygen depletion; mercury; metals other than mercury; and unknown cause (impaired biota). Major sources of impairment in waterbodies of the state include: nutrients; algal growth; mercury; pathogens; and organic enrichment/oxygen depletion (U.S. Environmental Protection Agency 2015a, 2015b).
- **Ohio**: Designated uses of streams and waterbodies include: aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; public water supply; and recreation (Tables 3.2-3 and 3.2-4). In total, over 44,667 miles of stream and 124,413 acres of waterbodies in Ohio in the study area are listed on the 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: habitat alterations, sediment, nutrients, pathogens, and organic enrichment and oxygen depletion. Major sources of impairment in waterbodies of the state include: habitat alterations, PCBs, organic enrichment and oxygen depletion, sediment, and nutrients (U.S. Environmental Protection Agency 2015a, 2015b).
- **Wisconsin**: Designated uses of streams and waterbodies include: agricultural; aquatic life harvesting; fish, shellfish, and wildlife protection and propagation; industry; navigation; public water supply; and recreation (Tables 3.2-3 and 3.2-4). In total, over 3,219 miles of stream and 424,203 acres of waterbodies in Wisconsin in the study area are listed on the 303(d) list of impaired waters (Tables 3.2-6 and 3.2-7). Major sources of impairment in streams of the state include: PCBs, mercury, sediment, habitat alterations, and organic enrichment and oxygen depletion. Major sources of impairment in waterbodies of the state include: nutrients, mercury, PCBs, organic enrichment and oxygen depletion, and sediment (U.S. Environmental Protection Agency 2015a, 2015b).

Table 3.2-3. Designated Uses of Streams and Rivers within the Study Area by Water Resource Region and State (in Miles)

Water Resource Region by State	Aesthetic Value	Agriculture	Aquatic Life Harvesting	Exceptional Recreation or Ecological Significance	Fish, Shellfish and Wildlife Protection and Propagation	Industry	Other*	Public Water Supply	Recreation
Great Lakes									
Illinois	32	–	32	–	32	–	–	–	64
Indiana	–	–	1,569	–	1,569	–	–	4	1,569
Michigan	–	52,666	52,665	–	157,997	52,666	52,666†	473	105,332
Minnesota	–	–	413	–	825	–	–	159	–
Ohio	–	–	16,221	–	16,221	–	–	16,221	16,221
Wisconsin	–	5	15	–	4,291	5	5†	8,514	4,267
Ohio									
Illinois	3,058	–	3,063	–	3,063	–	–	289	6,090
Indiana	21	–	16,607	27	16,598	–	–	107	16,628
Ohio	–	–	35,168	–	35,168	–	–	35,168	35,168
Upper Mississippi									
Illinois	12,784	75	12,990	–	12,887	51	–	928	25,223
Indiana	–	–	2,768	–	2,768	–	–	–	2,828
Iowa	34	–	3,712	–	7,326	–	–	224	7,677
Minnesota	–	–	9,574	–	19,135	–	94‡	492	–
Missouri	24	3,267	4,265	–	569	620	–	981	2,581
Wisconsin	–	–	36	–	7,072	–	–	14,026	7,025
Lower Mississippi									
Missouri	–	1,186	1,353	–	142	101	–	101	798
Souris-Red-Rainy									
Minnesota	–	–	3,100	–	6,175	–	–	585	–

Water Resource Region by State	Aesthetic Value	Agriculture	Aquatic Life Harvesting	Exceptional Recreation or Ecological Significance	Fish, Shellfish and Wildlife Protection and Propagation	Industry	Other*	Public Water Supply	Recreation
Missouri									
Iowa	–	–	1,027	–	2,829	–	–	79	2,794
Minnesota	–	–	189	–	378	–	–	–	–
Missouri	–	6,684	7,977	–	816	567	–	1,765	4,852
Arkansas-White-Red									
Missouri	–	2,665	3,031	–	1,171	191	–	154	1,765
Total	**15,953**	**66,548**	**175,776**	**27**	**297,035**	**54,202**	**52,765**	**80,268**	**240,883**

Source: U.S. Environmental Protection Agency 2015b.
* Streams listed with an "Other" designated use refer to state designated uses that do not fit into EPA parent uses categories.
† State designated use="Navigation."
‡ State designated use ="Limited Resource Value" (*i.e.,* waters not meeting minimal aquatic life uses).

Table 3.2-4. Designated Uses of Waterbodies (Lakes, Ponds, and Reservoirs) in Acres within the Study Area According to Section 305(b) Reports

Water Resource Region by State	Aesthetic Value	Agriculture	Aquatic Life Harvesting	Exceptional Recreation or Ecological Significance	Fish, Shellfish and Wildlife Protection and Propagation	Industry	Other*	Public Water Supply	Recreation
Great Lakes									
Illinois	6,543	–	7,226	–	7,226	–	–	–	13,769
Indiana	–	–	16,615	–	14,899	–	–	383	14,899
Michigan	–	851,171	851,102	–	2,553,513	851,171	851,171 †	414	1,702,342
Minnesota	–	–	96,308	–	102,023	–	–	51	
Ohio	–	–	30,230	–	28,808	–	–	28,808	28,808
Wisconsin	–	2,924	2,924	–	122,199	2,924	2,924†	226,852	119,275
Ohio									
Illinois	11,492	–	11,492	–	11,492	–	–	5,456	22,983
Indiana	–	–	58,126	18	58,117	–	–	24,856	58,126
Ohio	–	–	111,570	–	92,498	–	–	92,523	92,498
Upper Mississippi									
Illinois	130,730	–	130,730	–	130,730	–	–	61,124	261,444
Indiana	–	–	6,053	–	6,053	–	–	88	6,071
Iowa	–	–	49,754	–	50,131	–	–	6,065	41,068
Michigan	–	1,569	1,569	–	4,706	1,569	1,569†	–	3,137
Minnesota	–	–	903,621	–	906,730	–	–	–	–
Missouri	–	20,426	39,922	–	86	30	–	36	87,152
Wisconsin	–	–	–	–	123,476	–	–	237,725	102,043
Lower Mississippi									
Missouri	–	319	–	–	–	–	–	–	50

Water Resource Region by State	Aesthetic Value	Agriculture	Aquatic Life Harvesting	Exceptional Recreation or Ecological Significance	Fish, Shellfish and Wildlife Protection and Propagation	Industry	Other*	Public Water Supply	Recreation
Souris-Red-Rainy									
Minnesota	–	–	714,855	–	611,426	–	–	–	–
Missouri									
Iowa		–	37,602	–	37,885	–	–	12,199	32,054
Minnesota	–	–	2,701	–	2,701	–	–	–	–
Missouri	–	155,960	279,148	–	9	4,167	–	93,839	155,813
Arkansas-White-Red									
Missouri	–	55,861	110,905	–	12,482	59	–	2,026	55,566
Total	**148,765**	**1,088,294**	**3,816,941**	**18**	**5,574,571**	**859,920**	**855,664**	**1,298,138**	**2,991,340**

Source: U.S. Environmental Protection Agency 2015b.
* Waterbodies listed with an "Other" designated use refer to state designated uses that do not fit into EPA parent uses categories.
† State designated use="Navigation."

Table 3.2-5. Summary of CWA 303(d) Impaired Surface Waters by Watershed Resource Region

Water Resource Region by State	Total Length (Miles) of Impaired Streams and Rivers	Total Area (Acres) of Impaired Waterbodies
Great Lakes		
Illinois	16	1,126
Indiana	967	13,056
Michigan	33,904	331,265
Minnesota	266	28,177
Ohio	14,006	23,580
Wisconsin	1,280	209,640

Water Resource Region by State	Total Length (Miles) of Impaired Streams and Rivers	Total Area (Acres) of Impaired Waterbodies
Ohio		
Illinois	1,567	10,233
Indiana	7,419	55,641
Ohio	30,661	100,832
Upper Mississippi		
Illinois	6,089	126,084
Indiana	837	4,255
Iowa	3,231	30,262
Minnesota	5,522	179,353
Missouri	835	18,141
Wisconsin	1,939	214,564
Lower Mississippi		
Missouri	126	–
Souris-Red-Rainy		
Minnesota	1,853	468,929
Missouri		
Iowa	1,442	24,586
Minnesota	117	1,529
Missouri	2,445	4,642
Arkansas-White-Red		
Missouri	874	43,135
Total	**115,397**	**1,889,028**

Source: U.S. Environmental Protection Agency 2015a.

Note: Totals reflect sum of waterbodies with impairment (*i.e.,* each waterbody is only counted once no matter how many impairment causes). Therefore, totals derived from Tables 3.2-6 and 3.2-7 may be higher than information presented in this table.

Table 3.2-6. CWA 303(d) Impaired Streams and Rivers in the Study Area (in Linear Miles)

Impairment Cause	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Study Area Total
Algal Growth	253	39	8	260	–	2	227	–	789
Ammonia	87	20	7	193	70	105	5,688	18	6,188
Cause Unknown	277	–	–	63	–	65	8,319	11	8,735
Cause Unknown – Fish Kills	72	–	648	11	–	–	179	8	918
Cause Unknown – Impaired Biota	–	1,766	1,765	–	2,404	294	–	–	6,229
Chlorine	–	–	–	–	–	–	237	–	237
Dioxins	4	<1	–	3,050	2	–	<1	1	3,057
Fish Consumption Advisory	–	–	9	–	–	<1	1,058	4	1,071
Flow Alterations	474	–	–	141	–	–	15,332	–	15,947
Habitat Alternations	2,163	–	–	27	–	5	22,439	836	25,470
Mercury	902	1,426	275	14,107	1,032	696	3,011	1,136	22,585
Metals (not including Mercury)	2,784	45	289	181	–	660	7,164	108	11,231
Nuisance Exotic Species	25	–	–	–	–	–	283	–	308
Nuisance Native Species	25	–	–	19	–	–	–	–	44
Nutrients	3,518	396	14	626	–	9	20,118	643	25,324
Oil and Grease	25	12	–	87	–	–	1,685	10	1,819
Organic Enrichment/Oxygen Depletion	2,580	412	127	1,647	1,024	936	19,819	733	27,278
Other Cause*	–	–	14†	–	32‡	–	5,786††	2‡‡	5,834
Pathogens	2,162	5,463	2,651	836	2,033	2,260	20,080	52	35,537
Pesticides	849	6	–	162	19	2	844	4	1,886

Impairment Cause	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Study Area Total
pH/Acidity/Caustic Conditions	778	58	1	–	121	31	2,637	11	3,637
Polychlorinated Biphenyls	2,525	2,956	62	51,156	1,188	18	17,906	1,857	77,668
Radiation	34		–	–	–	–	207	–	241
Salinity/Total Dissolve Solids/Chlorides/ Sulfates	1,396	516	4	37	91	124	2,418	–	4,586
Sediment	1,984	22	–	675	–	38	20,757	987	24,463
Taste, Color, and Odor	–	–	–	–	–	–	195	–	195
Temperature	–	–	–	51	12	33	1,218	168	1,482
Total Toxics	–	–	–	–	–	–	3,510	157	3,667
Toxic Inorganics	83	83	–	–	–	–	152	–	318
Toxic Organics	74	–	2	–	83	–	3,222	30	3,411
Turbidity	1,491	–	8	13	4,468	2	1,536	10	7,528

Source: U.S. Environmental Protection Agency 2015a.
* Other causes are state listed causes that do not fit within EPA parent causes.
† State designated use = “Wastewater.”
‡ State designated use = “Lack of a Coldwater Assemblage.”
†† State designated use = “Natural Limits.”
‡‡ State designated use = “Wildlife.”

Table 3.2-7. CWA 303(d) Impaired Waterbodies (Lakes, Ponds, and Reservoirs) in the Study Area (in Acres)

Impairment Cause	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Study Area Total
Algal Growth	82,711	16,366	10,680	3,737	4,889	42,580	280	–	161,243
Ammonia	1,849	–	–	–	–	6	12,958	–	14,813
Cause Unknown	924	–	–	–	–	–	17,141	–	18,065
Cause Unknown – Fish Kills	–	–	274	–	–	–	686	40	1,000
Cause Unknown – Impaired Biota	–	4,641	570	–	115	–	–	–	5,326
Chlorine	–	–	–	–	–	–	261	–	261
Dioxins	–	–	–	59,429	2,050	–	–	40,260	101,739
Fish Consumption Advisory	–	–	–	–	–	–	4,136	–	4,136
Flow Alterations	248	–	–	–	–	–	37,210	–	37,458
Habitat Alterations	12,511	–	–	–	–	–	63,644	12,892	89,047
Mercury	29,296	37,272	974	284,413	223,921	23,607	3,461	362,534	965,478
Metals (Other than Mercury)	57,339	–	–	–	–	3	14,956	26	72,324
Nuisance Exotic Species	8,012	–	–	–	–	–	39	–	8,051
Nuisance Native Species	13,003	–	–	–	–	–	–	–	13,003
Nutrients	125,078	6,359	–	10,194	454,007	84,073	45,824	531,869	1,257,404
Oil and Grease	29	–	–	–	–	–	3,152		3,181
Organic Enrichment/Oxygen Depletion	30,109	17	212	–	6	88	50,142	219,675	300,249
Other Cause*	–	–	–	–	–	–	16,821†	–	16,821
Pathogens	646	1,726	25,860	6,469	1,230	209	44,432	584	81,156
Pesticides	13,225	–	–	78,209	6,150	37	1,652	7,254	106,527

Impairment Cause	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Study Area Total
pH/Acidity/Caustic Conditions	9,243	–	1,428	–	–	–	3,833	24,504	39,008
Polychlorinated Biphenyles	45,518	48,743	198	214,801	14,359	–	58,667	246,823	629,109
Radiation	–	–	–	–	–	–	651	–	651
Salinity/Total Dissolved Solids/Chlorides/ Sulfates	1,157	44	–	–	–	60	3,864	–	5,125
Sediment	40,045	5	–	–	–	–	46,072	181,418	267,540
Taste, Color, and Odor	–	16,361	–	–	–	–	248	–	16,609
Temperature	–	–	–	–	–	–	2,130	12	2,142
Total Toxics	–	–	–	–	–	–	5,928	1,094	7,022
Total Inorganics	–	–	–	–	–	–	322	–	322
Toxic Organics	8,439	–	–	–	1,868	–	9,175	15	19,497
Turbidity	58,104	–	26,971	–	312	–	19,430	–	104,817

Source: U.S. Environmental Protection Agency 2015a.
* Other causes are state listed causes that do not fit within EPA parent causes.
† State designated use="Natural Limits."

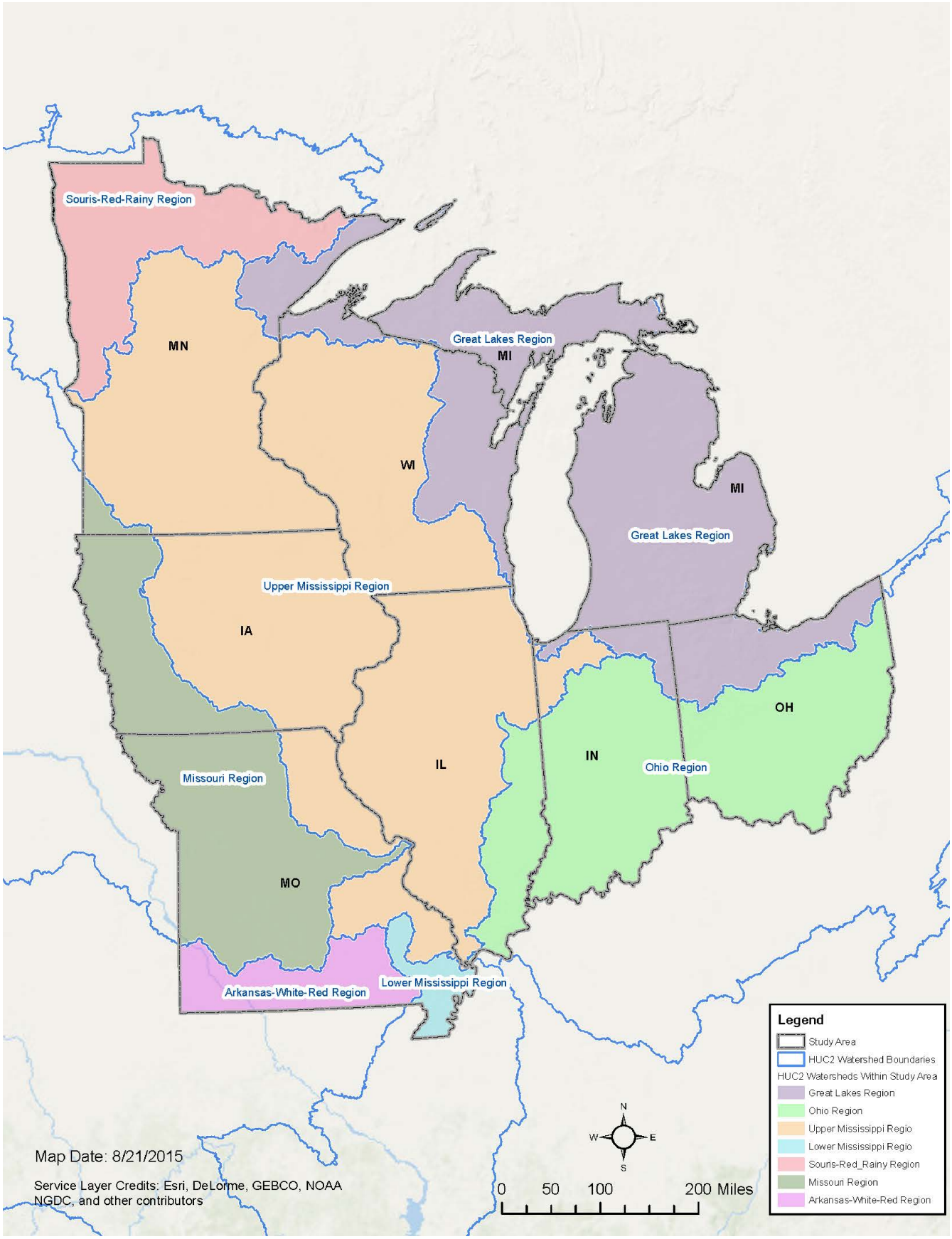

Figure 3.2-1
Watershed Resource Regions (2-digit Hydrologic Unit Code) within the Study Area
Midwest Wind Energy Multi-Species HCP EIS

3.2.2.2 Floodplains

Floodplains are defined as any land area susceptible to being inundated by waters from any source (44 CFR Part 59), and are often associated with surface waters and wetlands. Floodplains are valued for their natural flood and erosion control, enhancement of biological productivity, and socioeconomic benefits and functions. For human communities, however, floodplains can be considered a hazard area because buildings, structures, and properties located in floodplains can be inundated and damaged during floods.

Floodplains that are relatively undisturbed (or have been restored to a nearly natural state) provide a wide range of benefits to both human and natural systems. The Federal Interagency Floodplain Management Task Force (1994) groups these potential benefits into three categories—water resources, biological resources, and societal resources—labeled according to the primary recipient of the benefit or its relationship to a larger system (Table 3.2-8).

Table 3.2-8. Potential Benefits of Floodplains

Water Resources		
Natural Flood & Erosion Control • Provide flood storage and conveyance • Reduce flood velocities • Reduce flood peaks • Reduce sedimentation	*Water Quality Maintenance* • Filter nutrients and impurities from runoff • Process organic wastes • Moderate temperature fluctuations	*Groundwater Recharge* • Promote infiltration and aquifer recharge • Reduce frequency and duration of low surface flows
Biological Resources		
Biological Productivity • Support high rate of plant growth • Maintain biodiversity • Maintain integrity of ecosystem	*Fish and Wildlife Habitat* • Provide breeding and feeding grounds • Create and enhance waterfowl habitat • Protect habitats for rare and endangered species	
Societal Resources		
Harvest of Wild & Cultivated Products • Enhance agricultural lands • Provide sites for aquaculture • Restore and enhance forest lands	*Recreational Opportunities* • Provide areas for active and passive uses • Provide open space • Provide aesthetic pleasure	*Areas for Scientific Study and Outdoor Education* • Contain cultural resources (historic and archaeological sites) • Provide opportunities for environmental and other studies
Source: Federal Interagency Management Task Force 1994.		

FEMA has mapped approximately 20.9 million acres of 100-year floodplains in the study area (Table 3.2-9). Missouri and Wisconsin contain the most FEMA-mapped floodplain, and Minnesota has the least amount.

Table 3.2-9. Amount of FEMA Mapped 100-year Floodplain in the Study Area by State

State	Amount (acres)
Illinois	3,364,654
Indiana	2,165,142
Iowa	2,445,937
Michigan	1,431,489
Minnesota	1,042,011
Missouri	4,045,955
Ohio	1,767,753
Wisconsin	3,125,874
Total	**19,388,815**

Source: Federal Emergency Management Agency 2015.

According to the NRCS soils data, there are approximately 28.7 million acres of flood-prone soils in the study area (see Table 3.2-10). Missouri contains the most acreage of flood-prone soils, and Michigan has the least amount.

Table 3.2-10. Amount of NRCS Flood-Prone Soils in the Study Area by State[a]

State	Amount (acres)
Illinois	4,791,617
Indiana	2,296,770
Iowa	5,575,894
Michigan	891,311
Minnesota	1,754,344
Missouri	8,613,421
Ohio	1,676,524
Wisconsin	3,112,384
Total	**28,712,265**

Source: Natural Resources Conservation Service 2015.

[a] The data includes soils with the following flood frequency classes: very frequent, frequent, common, occasional, and rare. Soil data is not available for Pine County (Minnesota), Crow Wing County (Minnesota), and a large portion of the Superior National Forest (Minnesota).

3.2.2.3 Wetlands

Wetlands are important features in the landscape that provide numerous beneficial services for people and for fish and wildlife. Some of these services, or functions, include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, producing aesthetic value, insuring biological productivity, filtering pollutant loads, and maintaining surface water flow during dry periods. Functions are the result of the inherent and unique natural characteristics of wetlands.

Wetland functions can also reflect a measurable value to society. For example, a value can be determined by the revenue generated from the sale of fish that depend on the wetland, by the tourist dollars associated with the wetland, or by public support for protecting fish and wildlife. Although large-scale benefits of functions can be valued, determining the value of an individual wetland is difficult because wetlands differ widely and do not all perform the same functions or perform functions equally well (U.S. Environmental Protection Agency 2001).

Wetland Systems

The NWI was established by the Service to conduct a nationwide inventory of wetlands to provide information on the distribution and type of wetlands and to aid in conservation efforts. To do this, the NWI developed a wetland classification system (Cowardin *et al.* 1979) that is now the Federal standard for classifying wetlands (adopted by the Federal Geographic Data Committee).

The Cowardin classification system groups wetlands using *system* and *class* descriptors. The term *system* refers to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors. The *class* describes the general appearance of the habitat in terms of either the dominant vegetation life form or the substrate type. When more than 30 percent of the substrate is covered by vegetation, a vegetation class is used (e.g., emergent). When less than 30 percent of the substrate is covered by vegetation, a substrate class is used (e.g., unconsolidated bottom). Following is a description of the three wetland systems and the main wetland classes that occur in the study area.

Palustrine

The palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Most inland wetlands fall into the palustrine system. Classes in the palustrine system include the following.

- **Emergent wetlands** are characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.
- **Forested wetlands** are characterized by woody vegetation that is 20 feet (6 meters) tall or taller.
- **Scrub-shrub wetlands** are dominated by woody vegetation less than 20 feet (6 meters) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.
- **Unconsolidated bottom** includes all wetlands and deepwater habitats with at least 25 percent cover of particles smaller than stones (less than 2 to 3 inches [6 to 7 centimeters]), and a vegetative cover less than 30 percent.

- **Aquatic bed** includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.
- **Unconsolidated shore** includes all wetland habitats having two characteristics: (1) unconsolidated substrates with less than 75 percent areal cover of stones, boulders, or bedrock and; (2) less than 30 percent areal cover of vegetation. Landforms such as beaches, bars, and flats are included in this class.

Lacustrine

The lacustrine system includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30 percent areal coverage; and (3) total area exceeds 20 acres (8 hectares). Similar wetland and deepwater habitats totaling less than 20 acres (8 hectares) are also included in this system when an active wave-formed or bedrock shoreline feature makes up all or part of the boundary or when the depth in the deepest part of the basin exceeds 6.6 feet (2 meters) at low water.

Riverine

The riverine system includes all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water or which forms a connecting link between two bodies of standing water. Upland islands or palustrine wetlands may occur in the channel, but they are not part of the Riverine System.

Wetlands in the Study Area

The NWI data tends to err by omission, meaning that many wetlands are unmapped (*i.e.,* there are many wetlands that exist that do not appear on the NWI maps). Additionally, wetlands mapped on the NWI maps were not field-verified by the Service, meaning that wetland scientists did not conduct field work to determine if the location and extent of the mapped wetlands of the NWI were accurate or fully inclusive of all of the nation's wetlands.

Based on NWI data, there are approximately 51 million acres of wetlands and deep-water habitats in the study area (see Table 3.2-11). Michigan contains the most acreage of wetlands and deep-water habitats (due to the number and size of lakes). Ohio has the least acreage of wetlands and deep-water habitats. Freshwater forested and scrub-shrub wetlands comprise the majority of wetlands in the study area.

Table 3.2-11. Wetlands and Deep-water Habitats in the Study Area by State

	Acres of Wetland Type								
Wetland Type[a]	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Total
Freshwater Emergent Wetland	198,137	148,046	207,497	647,215	2,904,945	262,600	112,403	1,074,286	5,555,129
Freshwater Forested/Shrub Wetland	806,235	554,466	367,217	5,983,641	7,219,276	753,985	395,991	4,407,537	20,488,348
Freshwater Pond	143,726	146,611	115,082	165,672	233,603	264,745	139,454	119,048	1,327,941
Lake	370,876	160,008	159,026	17,880,977	2,723,179	318,040	171,604	864,568	22,648,278
Riverine	132,595	69,901	171,323	85,064	155,774	233,047	95,332	250,914	1,193,950
Other	590	0	114	19,991	352	2,846	0	41,348	65,241
Total	**1,652,159**	**1,079,032**	**1,020,259**	**24,782,560**	**13,237,129**	**1,835,263**	**914,784**	**6,757,701**	**51,278,887**

Source: U.S. Fish and Wildlife Service 2015.

[a] "Freshwater Emergent Wetland" includes wetlands in the emergent class of the palustrine system (e.g., herbaceous marsh, fen, swale, or wet meadow); "Freshwater Forested/Shrub Wetland" includes wetlands in the forested and scrub-shrub classes of the palustrine system (e.g., forested swamp or shrub bog); "Freshwater Pond" includes wetlands (ponds) in the unconsolidated bottom, rock bottom, aquatic bed, and unconsolidated shore classes of the palustrine system; "Lake" includes wetlands and deep-water habitats in the lacustrine system; "Riverine" includes wetlands and deep-water habitats in the riverine system. "Other" includes miscellaneous wetlands in the palustrine system (e.g., farmed wetlands).

Wetland vegetation within the study area varies by wetland type. Common vegetation associated with freshwater emergent, scrub-shrub, and forested wetlands is shown in Table 3.2-12.

Table 3.2-12. Common Wetland Vegetation in the Study Area by Wetland Type

Wetland Type	Vegetation
Freshwater emergent wetland	cattails (*Typha* spp.), sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), common reed (*Phragmites australis*), bur-reed (*Sparganium eurycarpum*), wild rice (*Zizania aquatica*), saw grass (*Cladium jamaicense*), manna grasses (*Glyceria* spp.), smartweeds (*Polygonum* spp.), arrowheads (*Sagittaria* spp.)
Freshwater scrub-shrub wetland	buttonbush (*Cephalanthus occidentalis*), willows (*Salix* spp.), red osier dogwood (*Cornus stolonifera*), alders (*Alnus* spp.), honeycup (*Zenobia pulverulenta*), spirea (*Spiraea douglasii*), bog birch (*Betula pumila*)
Freshwater forested wetland	red maple (*Acer rubrum*), black spruce (*Picea mariana*), American elm (*Ulmus americana*), ashes (*Fraxinus pennsylvanica* and *F. nigra*), black gum (*Nyssa sylvatica*), swamp white oak (*Quercus bicolor*), basket oak (*Q. michauxii*), bald cypress (*Taxodium distichum*)

Source: Cowardin *et al.* 1979.

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3.3 Geology and Soils

This section describes geology and soil resources in the study area, including surface soils and rock, landslide potential, seismic risk, and karst conditions.

3.3.1 Study Area and Approach

The study area for geology and soils is concurrent with the Plan Area. The following data are used in this section to characterize existing geologic and soil conditions within the study area:

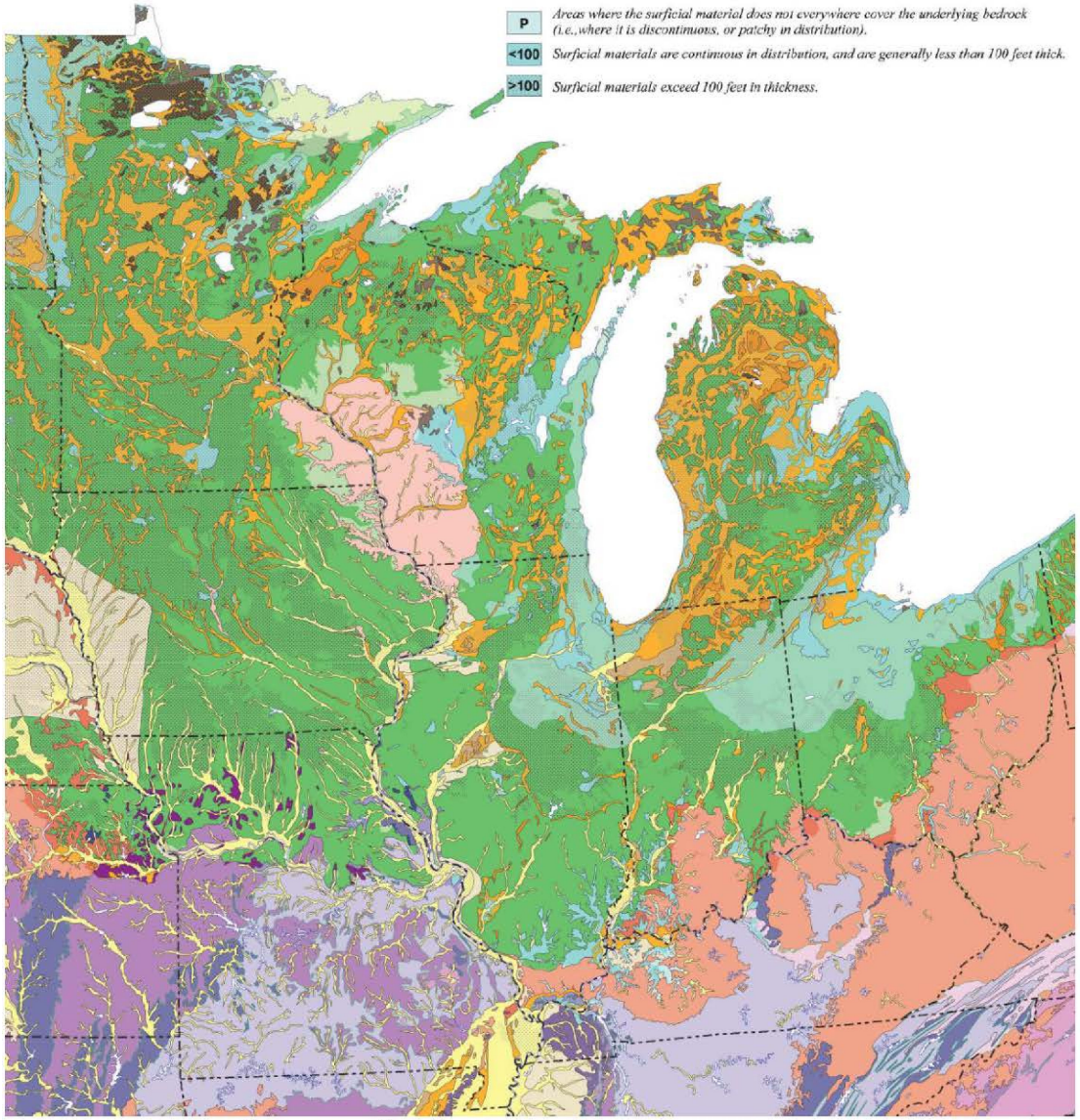
- The Geologic Map of Surface Materials (U.S. Geological Survey 2004a) is used to portray the distribution of soils and limited areas of exposed bedrock throughout the study area.
- The Landslide Overview Map of the Conterminous United States (U.S. Geological Survey 1978) is used to assess the potential for slope failures in the study area.
- The U.S. Geological Survey National Seismic Hazards Map (U.S. Geological Survey 2014a) is used to assess the potential for seismic risk in the study area.
- The U.S. Geological Survey Digital Engineering Aspects of Karst Map (U.S. Geological Survey 2004b) is used to identify areas where the solution cavities occur in the study area.
- Natural Resources Conservation Service Soil Region Maps (Natural Resources Conservation Service 2006a; Natural Resources Conservation Service 2006b) are used to characterize soil types in the study area.

3.3.2 Existing Conditions

Most of the study area is overlain by thick soil deposits in excess of 100 feet, with the exception of the Ozark Plateau of southern Missouri, which has thinner overburden and exposed bedrock. The existing conditions described in the sections below capture the scale of geologic features that contribute to the stability of the ground surface, such as geology, slope stability, seismic risk, and karst formations and that influence habitat development, such as soil types.

3.3.2.1 Geology

The study area encompasses a variety of geologic conditions and landforms. The vast center of the study area is composed of a broad glacial plain covered with loamy (silty) glacial till often over 100 feet thick. A more clayey glacial till is found along the borders of the Great Lakes. The eastern edge of a glacial lake plain with remnants of gravelly beaches forms the northwestern border of Minnesota. More relief and steeper slopes are prevalent on the southern edges of the study area along the borders of Illinois, Indiana, and Ohio and on the Ozark Plateau of southern Missouri. Both of these areas are known for karst features due to the underlying limestone and dolomite bedrock. Loess deposits are present in the extreme southeastern tip of Missouri. The *Geologic Map of Surface Materials,* Figure 3.3-1 shows the distribution of surface geological materials throughout the study area (U.S. Geological Survey 2004a).



Glacial till sediments (late Wisconsinan to pre-Illinoian) -- unsorted material ranging in grain size from clay to boulders, deposited by glacial ice. Includes minor areas of ice-contact and lake sediment. Areas of predominantly clayey, loamy (silty), and sandy till are shown separately on the map. These sediments, and any underlying sediments, commonly form a continuous cover on underlying rocks and may exceed 100 ft in thickness, especially in areas that were occupied by numerous glacial ice lobes (for example, central Michigan, northeastern South Dakota). However, in some areas that are mountainous or near the glacial margin, these sediments are patchy in distribution and bedrock commonly is exposed at land surface.

Predominantly clayey till. Mapped mostly in lowlands near the Great Lakes.

Predominantly loamy (silty) till, or tills of various textures.

Proglacial sediments (late Wisconsinan to pre-Illinoian) -- fine- to coarse-grained sediment derived from material eroded and transported by glaciers. As the ice melted, this material was transported and deposited by glacially-fed streams.

Generally fine-grained sediment melted from glaciers and deposited in lakes and marine environments. In the eastern U.S., these lakes are commonly small and related to ice and sediment damming of waters near the margin of the continental glaciers. In the western U.S., these lakes may be considerably larger (e.g., Lake Missoula in western Montana). Includes some areas of glacial till and well-sorted glaciofluvial sediment. These sediments, and any underlying sediments, commonly form a continuous cover on underlying rocks and may exceed 100 ft in thickness.

Generally coarse-grained sediment mostly deposited in terraces, river floodplains, buried valleys, and as sheet deposits during intervals when glacial ice was melting. In the northwest U.S., includes coarse-grained flood sediments from the breaching of glacial Lake Missoula. Includes fine-grained deposits, especially in slackwater areas. In places, interfingers with alluvial sediments. These sediments, and any underlying sediments, commonly form a continuous cover on underlying rocks and may exceed 100 ft in thickness. Common in glaciated region and the Pacific Northwest.

Mass-movement sediments (Holocene to Tertiary) -- poorly sorted and stratified sediment ranging from clay to boulders in size; may contain organic material. Formed by weathering and breakdown of underlying rock in areas of steep to moderate slopes. The weathered and broken material has undergone some downslope transport and has been deposited as colluvium, landslides, talus, and rock avalanches. In places, this map unit includes the following: residual materials, especially on lower slopes; alluvial sediments; and fine-grained eolian sediments (loess) overlying the colluvium.

Mostly colluvial sediments.

Colluvial and alluvial sediments.

Alluvial sediments (Holocene to Pliocene) -- clay- to gravel-sized sediment, with minor coarser materials, generally moderate- to well-bedded, deposited by perennial and intermittent streams and rivers and by sheetwash flow on uplands. Locally includes associated lake and estuarine sediments. Along perennial streams and rivers, relatively well-sorted sediment underlies floodplains, natural levees, and alluvial terraces that parallel modern or former drainage courses. Alluvial sediments within the glaciated area commonly overlie or are mixed with sediment deposited by water that flowed from the glaciers (see "Glaciofluvial ice-contact sediments", below). On steeper slopes and especially in the arid western U.S., relatively poorly sorted sediment (including debris-flow and debris-avalanche material) underlies alluvial fans and fan piedmonts deposited by intermittent streams. These materials generally form a continuous cover less than 100 feet thick. However in many places, notably in the Mississippi River Valley, in the glaciated area, on the uplands near the Platte River in Nebraska, and in fault bounded valleys of the western U.S., these sediments may greatly exceed 100 ft in thickness.

Organic sediments (Holocene to late Pleistocene) -- organic-rich muck and peat deposited in poorly drained and swampy areas. These sediments, and any underlying sediments, are generally less than 100 ft thick, forming a continuous cover on underlying rocks. Mapped in the glaciated region and the coastal margins of the Atlantic and Gulf Coast; areas >100 ft thick are found in the glaciated region, but much of that thickness is composed of the underlying glacially-deposited sediment.

Residual materials (Holocene to Tertiary) -- these materials formed by the partial chemical dissolution and physical disintegration of bedrock; they include the modern soil profile and extend downward to unweathered rock. Depending on the source rock, these materials can be generally fine- to coarse-grained, and commonly are poorly sorted. Unlike mass-movement sediments, these materials were not transported. In places, this map unit includes alluvial and colluvial sediments. This material is generally less than 10 ft (3m) thick and, in many places, is patchy in distribution. Particularly in mountainous areas, exposed rock can more commonly be found than residual material.

Residual materials developed in sedimentary rocks.

Source: U.S. Geological Survey 2004a

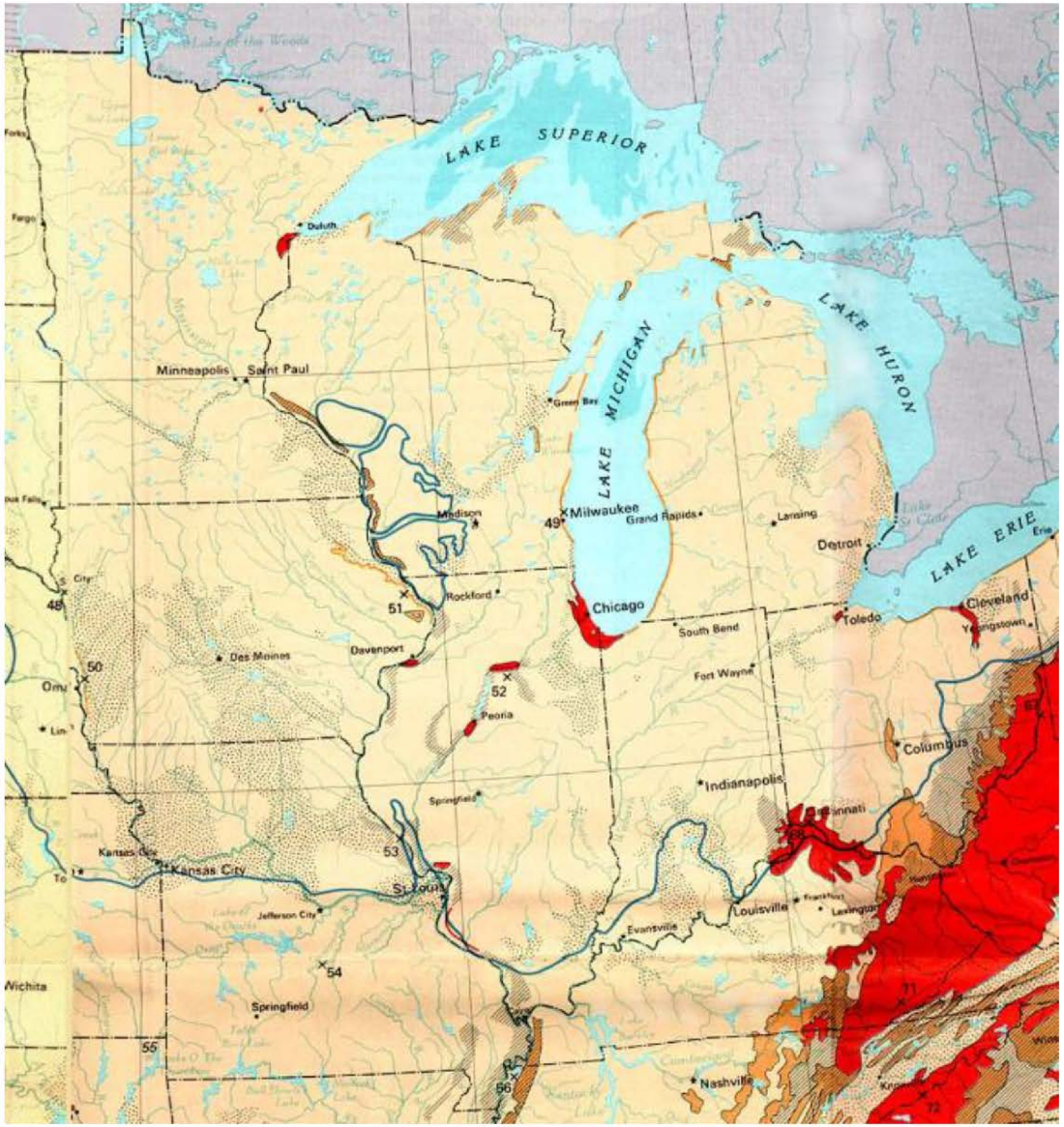
Figure 3.3-1
Geologic Map of Surface Materials
Midwest Wind Energy Multi-Species HCP EIS

3.3.2.2 Landslides

The Figure 3.3-2, *Landslide Incidence and Susceptibility,* illustrates these features throughout the study area (U.S. Geological Survey 1978). Landslide susceptibility indicates where landslides are likely to occur, as opposed to landslide incidence, which shows where they have occurred.

Most of the study area has a low incidence of landslides, meaning that less than 1.5 percent of the indicated area has experienced any known landslides. Areas of moderate landslide incidence (*i.e.,* involving 1.5 to 15 percent of the indicated area) are limited to the southern border of Ohio; a small sliver along or near the Mississippi River between St. Paul, Minnesota and Davenport, Iowa; and areas of shoreline around the Great Lakes. Areas of high landslide incidence (*i.e.,* involving over 15 percent of the indicated area) are found at the western tip of Lake Superior near Duluth, Minnesota; at the southern tip of Lake Michigan near Chicago, Illinois; along the Ohio River on the southern boundaries of Ohio and Indiana; and in a few isolated locations near Peoria, Illinois, and Cleveland, Ohio.

Landslide susceptibility is characterized as high along the southern Ohio border, in the southeast corner of Indiana, at a few locations along the Mississippi River, and along the southern shore of Lake Superior. Moderate landslide susceptibility has been determined in southern Iowa and northern Missouri, in southern Indiana, and at a few other locations along rivers or near lake shores. The vast majority of the study area has a low susceptibility to landslides because of its gentle topography.



LANDSLIDE INCIDENCE

High (More than 15% of area involved)

Moderate (15%–1.5% of area involved)

Low (Less than 1.5% of area involved)

LANDSLIDE SUSCEPTIBILITY

High

Moderate

Susceptibility not indicated where same as or lower than incidence

Source: U.S. Geological Survey 1978

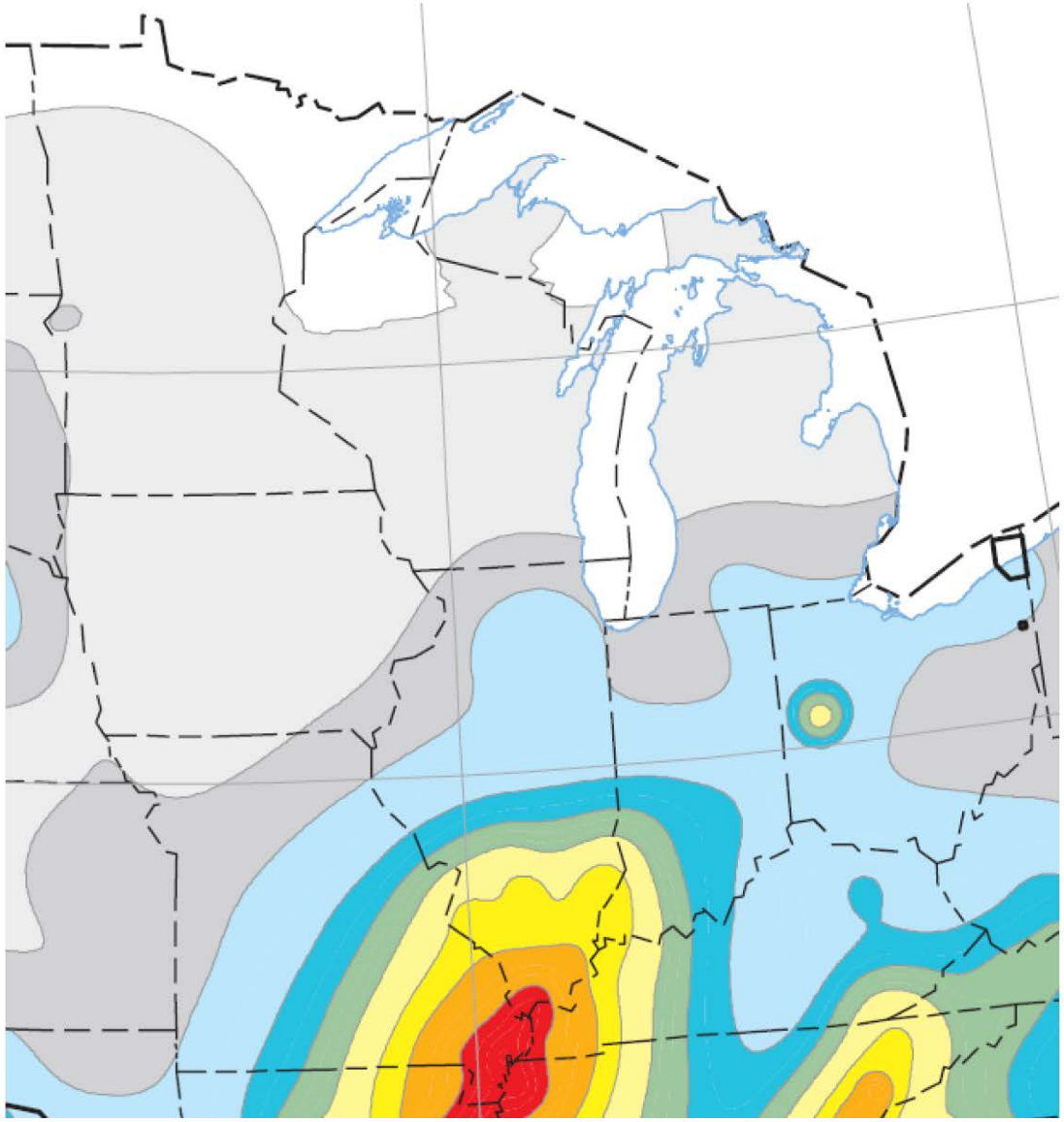
Figure 3.3-2
Landslide Incidence and Susceptibility
Midwest Wind Energy Multi-Species HCP EIS

3.3.2.3 Seismic Risk

The map entitled *Seismic Risk,* Figure 3.3-3 shows the seismic risk (*i.e.,* risk of earthquake) throughout the study area, shown as the peak ground accelerations that have a 2-percent probability of exceedance in a 50-year period (U.S. Geological Survey 2014a).

The entire areas of the four northernmost states—Minnesota, Wisconsin, Iowa, and Michigan (except for a small area at the base of the peninsula)—have no more than a 2-percent probability of exceeding a peak acceleration of 0.1 of standard gravity (g). An acceleration of 0.1g would be perceived as strong shaking but would not be expected to cause more than light damage. It corresponds roughly to an earthquake of Intensity VI (Strong) on the Modified Mercalli Intensity scale, which ranges from Intensity I (Not Felt) to Intensity X (Extreme). Near the epicenter of a quake, this level of acceleration or intensity corresponds to an earthquake of about magnitude 5.0.

As one approaches the area where Missouri, Indiana, Kentucky, Tennessee, and Arkansas nearly converge, the peak ground acceleration expected with a 2-percent probability in 50 years increases to over 0.8g. This represents a major earthquake of about Intensity IX (Violent). It would be felt as violent shaking and cause heavy damage. Near the epicenter of a quake, this level of acceleration or intensity corresponds to an earthquake of about magnitude 6.9.



EXPLANATION

Peak acceleration, expressed as a fraction of standard gravity (g)

- 0.8
- 0.4
- 0.3
- 0.2
- 0.14
- 0.1
- 0.06
- 0.04
- 0.02
- 0

The contours show the peak ground acceleration that has a 2-percent chance of being exceeded in a 50-year period.

Source: U.S. Geological Survey 2014

Figure 3.3-3
Seismic Risk
Midwest Wind Energy Multi-Species HCP EIS

3.3.2.4 Karst Conditions

Karstic conditions in the study area result from the formation of solution cavities in carbonate rock such as limestone or dolomite. The slow processes of solution and erosion create sinkholes, caverns, and tunnels, which can extend over a hundred miles in length. These voids can create complicated groundwater regimes and cause collapses at the ground surface.

Within the study area, moderate karstic conditions (features less than 1,000 feet long or 50 feet deep) are found along the western shore of Lake Michigan; in northeastern Iowa, southwestern Wisconsin, and southeastern Minnesota; in eastern Indiana and western Ohio; along the Mississippi River between Missouri and Illinois; and in southern Missouri (Figure 3.3-4). More dramatic karstic conditions (features more than 1,000 feet long and 50 feet to 250 feet deep) are also found in southern Missouri as well as in small areas in southern Indiana, and the northern part of the lower Michigan peninsula. *Karst Conditions,* Figure 3.3-4, shows the areas where karst conditions occur or are likely to occur (U.S. Geological Survey 2004b).

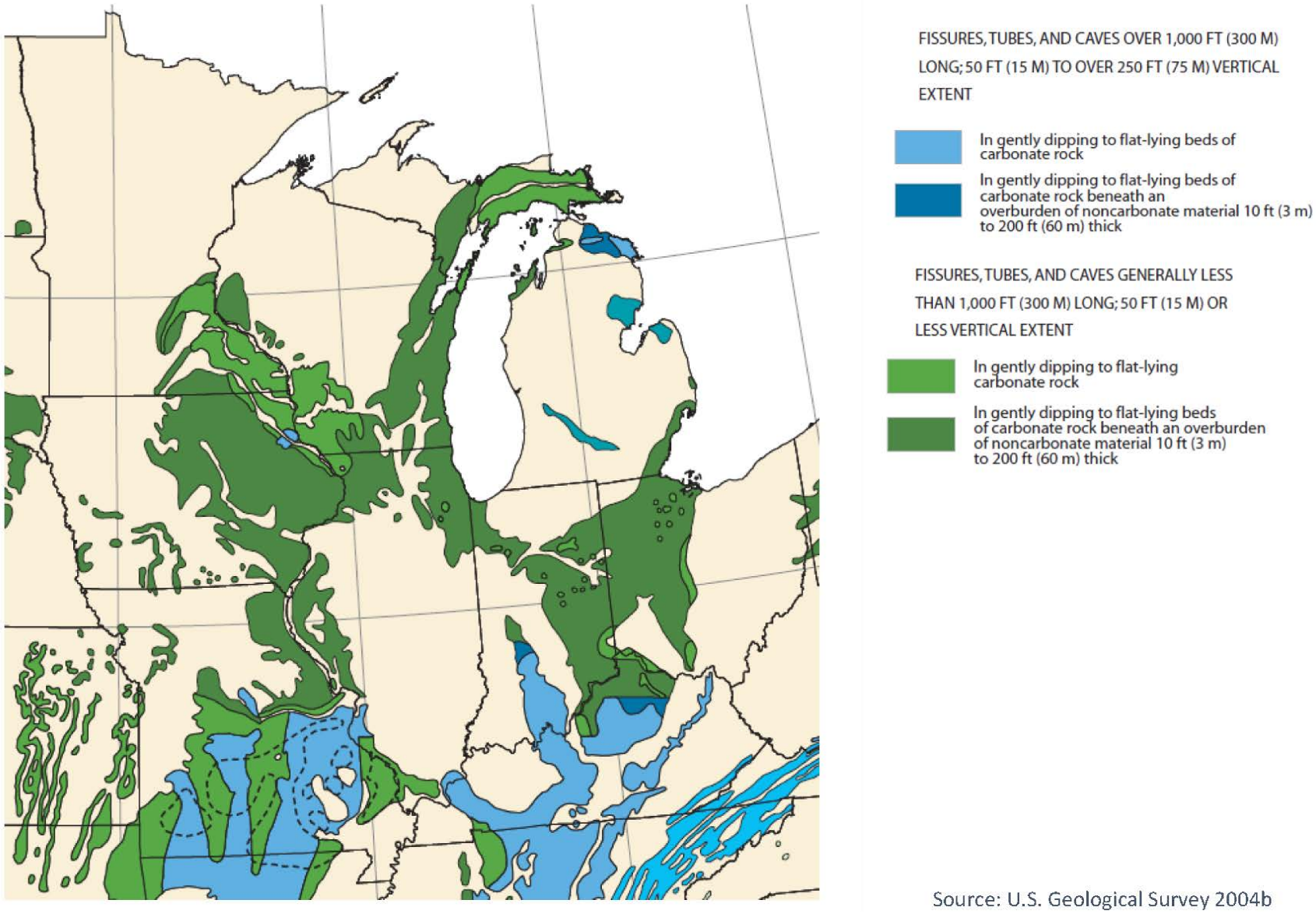


Figure 3.3-4
Karst Conditions
Midwest Wind Energy Multi-Species HCP EIS

3.3.2.5 Soils

Soil conditions in the study area are characterized in this section using the soil orders and Land Resource Regions (LRRs) developed by the Natural Resources Conservation Service (Natural Resources Conservation Service 2006a).

Soil orders are the highest level of taxonomic grouping in the Natural Resources Conservation Service soil classification system. Subordinate levels include suborder, great group, subgroup, family, and series. Table 3.3-1 contains brief descriptions of the soil orders.

Table 3.3-1. Brief Description of the Soil Orders

Soil Order	Description
Alfisols	Naturally fertile soils with high base saturation and a clay-enriched subsoil horizon
Andisols	Relatively young soils, mostly of volcanic origin, that are characterized by unique minerals with poorly organized crystalline structure
Aridisols	Dry soils of deserts
Entisols	Young soils with little or no profile development
Gelisols	Very cold soils with permafrost in the subsoil
Histosols	Soils that formed in decaying organic material
Inceptisols	Youthful soils with a weak, but noticeable, degree of profile development
Mollisols	Very dark-colored, naturally very fertile soils of grasslands
Oxisols	Highly weathered tropical soils with low natural fertility
Spodosols	Acid soils with low fertility and accumulations of organic matter and iron and aluminum oxides in the subsoil
Ultisols	Soils with low base status and a clay-enriched subsoil
Vertisols	Very clayey soils that shrink and crack when dry and expand when wet
Source: Natural Resources Conservation Service 2015.	

The dominant soil orders within the study area include alfisols and mollisols (Figure 3.3-5). Among the areas with alfisols, the predominant suborder is udalfs, found in humid regions with abundant rainfall, with the remaining being of suborder aqualfs, which are wet alfisols. Similarly, the mollisols in the study area are almost exclusively either wet mollisols known as aquolls or udolls, which are mollisols found in humid regions with abundant rainfall.

The ultisols in the study area are exclusively of the suborder udults, which are ultisols found in humid regions with abundant rainfall. Similarly, the inceptisols are either suborders aquepts (wet) or udepts (found in humid regions with abundant rainfall). The histosol suborders hemists and saprists are also characterized as wet soils. The entisols are largely suborder psamments, which are dominated by sandy textures. The spodosols found in the coniferous forests of northern Minnesota, Wisconsin, and Michigan are relatively free-draining soils with high aluminum and iron content.

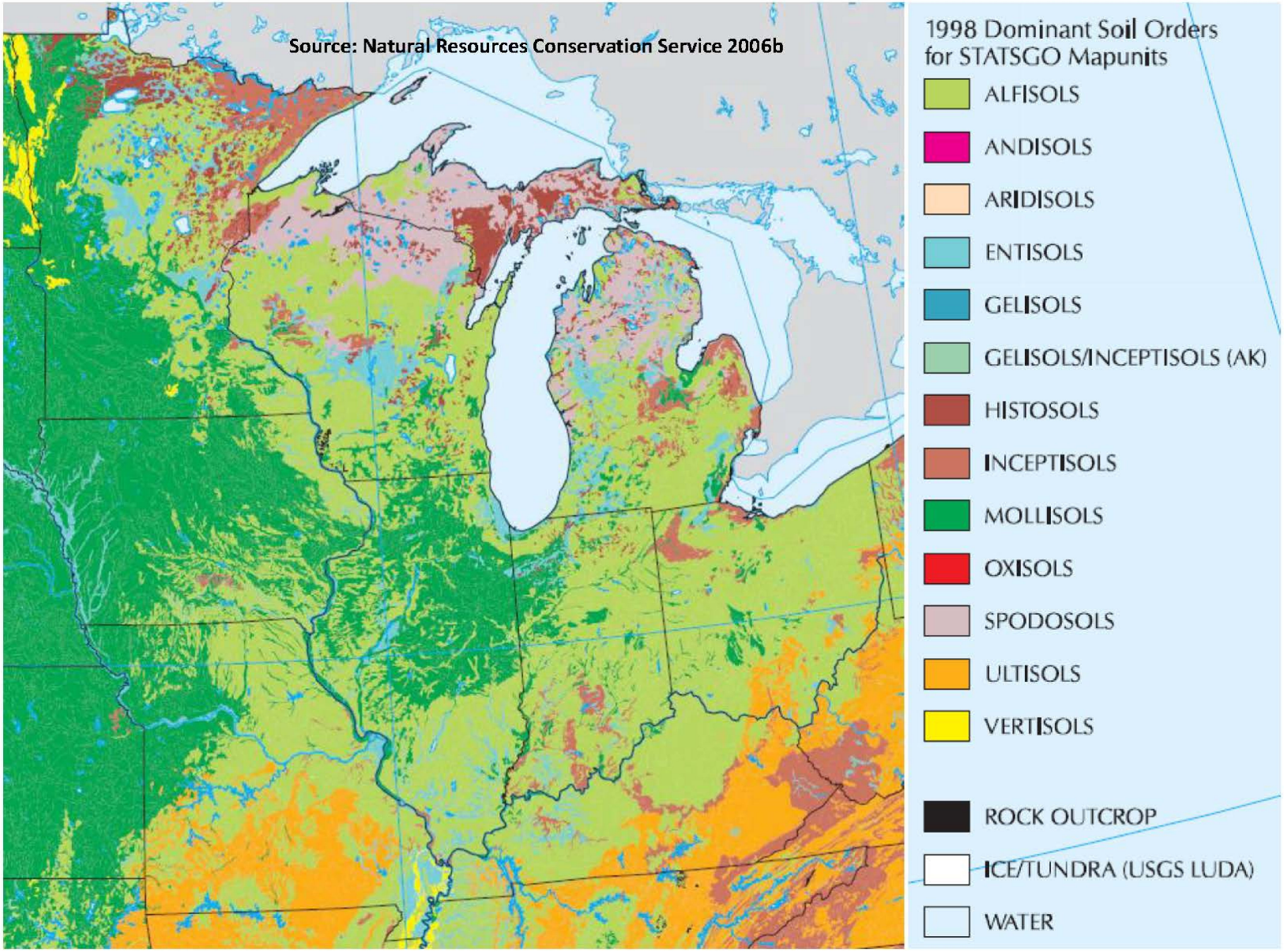


Figure 3.3-5
Dominant Soil Orders in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

Eight LRRs cover the study area (Figure 3.3-6). Each of the eight is designated by a letter as described in Table 3.3-2. LRRs are composed of smaller units called Major Land Resource Areas (MLRAs). Table 3.3-2 presents the land areas of each LRR within each state. As the map in Figure 3.3-6 demonstrates, nearly all (95.6 percent) of the study area consists of land within LRRs K, L, M, and N. The four remaining LRRs combined comprise less than 5 percent of the study area and exist only around the edges where the LRR boundaries and state lines do not coincide.

Table 3.3-2. Areas by State within Each Land Resource Region (in square miles)

State	LRR[1,2] F	LRR K	LRR L	LRR M	LRR N	LRR O	LRR P	LRR R	State Totals
Illinois	–	2,376	457	50,841	2,364	–	265	–	56,303
Indiana	–	–	3,657	25,421	7,092	–	–	–	36,170
Iowa	–	–	–	56,490	–	–	–	–	56,490
Michigan	–	28,506	26,972	2,825	–	–	–	–	58,302
Minnesota	9,291	43,947	–	31,070	–	–	–	–	84,307
Missouri	–	–	–	36,719	30,734	3,547	530	–	71,529
Ohio	–	–	4,572	16,947	14,185	–	–	6,643	42,347
Wisconsin	–	43,947	–	11,298	–	–	–	–	55,245
Area by LRR	9,291	118,775	35,658	231,609	54,375	3,547	796	6,643	460,694
%[3] of Total Study Area	**2.0**	**25.8**	**7.7**	**50.3**	**11.8**	**0.8**	**0.2**	**1.4**	**100.0**

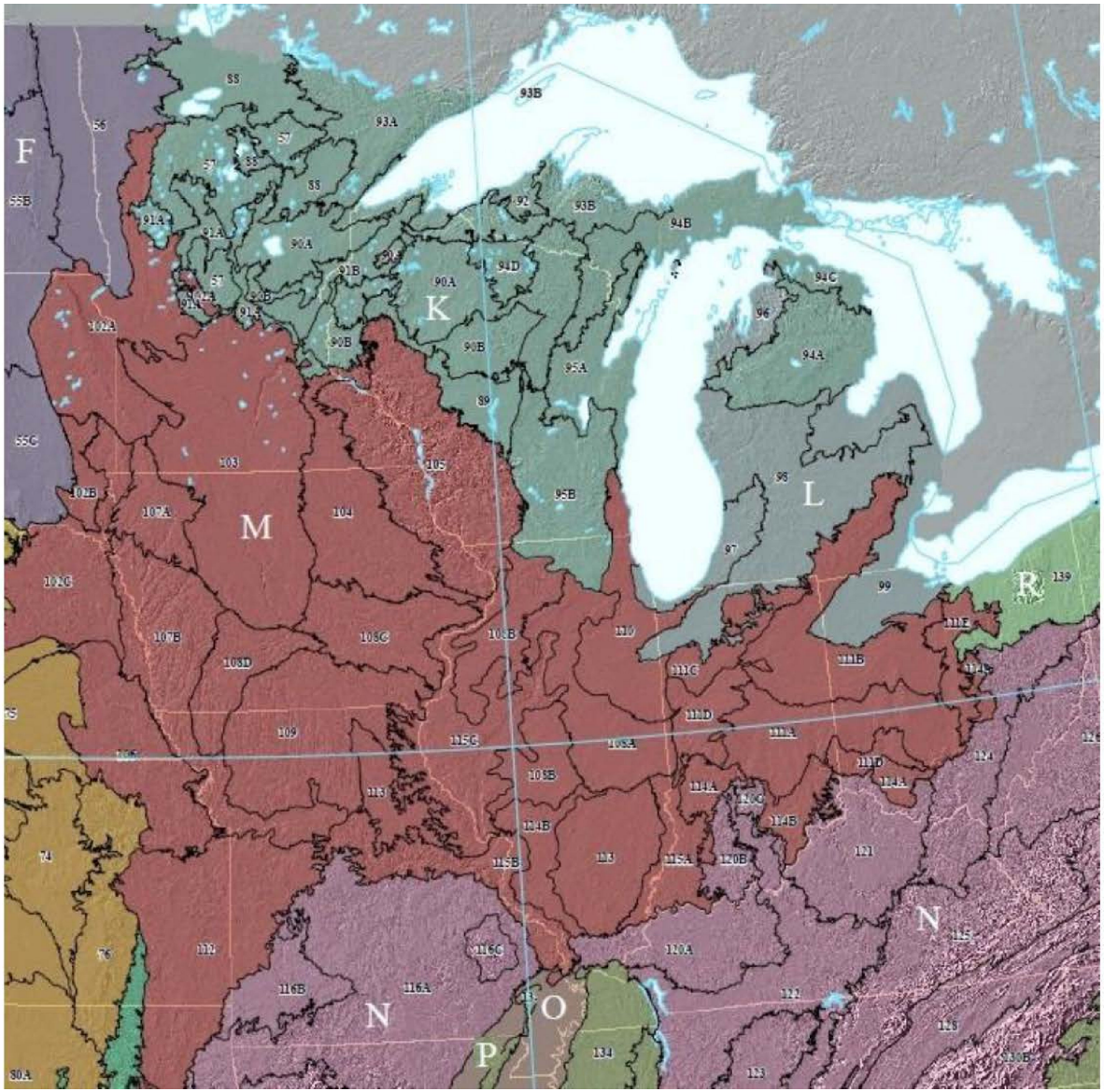
Source: Natural Resources Conservation Service 2006a.
[1] LRR = Land Resource Region.
[2] Unit of measure for all areas is square miles.
[3] % = percent.

The Northern Lake States Forest and Forage Region (LRR K) comprises about 26 percent of the study area and lies in the Central Lowland areas south and west of the western Great Lakes (*i.e.,* in upper Minnesota, Wisconsin, and Michigan). The region is glaciated and contains numerous lakes and wetlands. The topography is characterized by nearly level ground and gently undulating slopes in areas of glacial lake deposits, gentle to rolling hills on till plains and ground moraines, and occasional steeper slopes or valley sidewalls and escarpments at lake edges. The study area soils within this LRR are predominantly alfisols and spodosols with lesser areas of entisols, inceptisols, and histosols.

The Lake States Fruit, Truck Crop, and Dairy Region (LRR L) covers about 8 percent of the study area, primarily in the southern two-thirds of the lower Michigan peninsula. Most of the land in this LRR forms a nearly level to gently sloping glaciated plain. The study area soils within this LRR are predominantly alfisols.

Over half of the study area is in the Central Feed Grains and Livestock Region (LRR M). The region covers southern Minnesota, all of Iowa, most of Illinois and Indiana, northern Missouri, western Ohio, and a small part of the lower Michigan peninsula. This area is predominantly a nearly level to gently sloping, glaciated plain dissected by erosion into irregular valleys and hills. The study area soils within this LRR are predominantly alfisols and mollisols.

The East and Central Farming and Forest Region (LRR N) makes up about 12 percent of the study area and is found along the southern edges of Missouri, Illinois, Indiana, and Ohio. East of the Mississippi River, undulating hills along the Kentucky border are underlain by level-bedded limestone. West of the Mississippi River, the land is a dissected plateau underlain by limestone, sandstone, and shale bedrock with a small area of exposed igneous rocks in southeast Missouri. The study area soils within this LRR are predominantly alfisols and ultisols.



F—Northern Great Plains Spring Wheat Region
(1 of 9 MLRAs)

K—Northern Lake States Forest and Forage Region
(16 of 16 MLRAs)

L—Lake States Fruit, Truck Crop, and Dairy Region
(4 of 5 MLRAs)

M—Central Feed Grains and Livestock Region
(23 of 26 MLRAs)

N—East and Central Farming and Forest Region
(10 of 21 MLRAs)

O—Mississippi Delta Cotton and Feed Grains Region
(1 of 4 MLRAs)

P—South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region
(1 of 8 MLRAs)

R—Northeastern Forage and Forest Region
(1 of 9 MLRAs)

Source: Natural Resources Conservation Service 2006a

Figure 3.3-6
Land Resource Regions
Midwest Wind Energy Multi-Species HCP EIS

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3.4 Climate Change

This section describes the existing climate conditions in the study area. Climate is influenced by variations in latitude, elevation, topographic features, and moisture levels, including effects of surface water bodies.

3.4.1 Study Area and Approach

The study area for climate and climate change encompasses the Plan Area but is described in the context of the influence of regional and global meteorology and climatic trends. Climate is characterized in this section by describing climate trends and projections globally and for the Midwest U.S. over a 45-year planning horizon, which is equivalent to the proposed term of the MSHCP.

3.4.2 Existing Conditions

3.4.2.1 Greenhouse Gases and Global Climate

Earth absorbs heat energy from the sun and returns most of this heat to space as terrestrial infrared radiation. Greenhouse gases (GHGs) trap heat in the lower atmosphere (the atmosphere extending from Earth's surface to approximately 4 to 12 miles above the surface) by absorbing heat energy emitted by Earth's surface and lower atmosphere, and reradiating much of it back to Earth's surface, thereby causing warming. This process, known as the greenhouse effect, is responsible for maintaining surface temperatures that are warm enough to sustain life. Most GHGs, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor, and ozone, occur naturally. Human activities, particularly fossil-fuel combustion, as well as the use of several industrial gases that are GHGs, lead to the presence of increased concentrations of GHGs in the atmosphere, thereby intensifying the warming associated with the Earth's greenhouse effect.

Since the industrial revolution, when fossil fuels began to be burned in increasing quantities, concentrations of GHGs in the atmosphere have increased. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and the burning of fossil carbon fuel sources have caused CO_2 concentrations to increase by more than 40 percent, from approximately 280 parts per million (ppm) in 1750 to over 400 ppm as of July 2015 (National Oceanic and Atmospheric Administration 2015). The concentration of CH_4 is now 150 percent above pre-industrial levels (U.S. Environmental Protection Agency 2015a). The rate of change has also been increasing as more industrialization and population growth is occurring around the globe. Data from the Mauna Loa CO_2 monitor (National Oceanic and Atmospheric Administration 2015) in Hawaii documents atmospheric concentrations of CO_2 going back to 1960, at which time the average annual CO_2 concentration was recorded at approximately 317 ppm. This record shows that approximately 70 percent of the increases in atmospheric CO_2 concentration since pre-industrial times occurred within the last 54 years. The Intergovernmental Panel on Climate Change (2007) has predicted that the average global temperature rise between 1990 and 2100 could be as great as 5.8 degrees Celsius (10.4 degrees Fahrenheit [°F]), which could have substantial adverse impacts on the natural and human environments. This buildup of GHGs in the atmosphere is changing the Earth's energy balance and causing the planet to warm, which in turn affects sea levels, precipitation patterns, cloud cover, ocean temperatures and currents, ocean

acidification, polar snow and ice accumulation, and other climatic conditions. Scientists refer to this phenomenon as "global climate change."

3.4.2.2 Midwest Regional Climate

The study area is located in the Midwest Climate Region defined by the National Climatic Data Center which includes Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The Midwest regional climate is characterized by hot and humid summers with monthly mean temperatures ranging from 69°F to 88°F, followed by cold winters with monthly mean temperatures ranging from 15°F to 32°F. The annual temperature range is relatively wide because the region is distant from the seacoasts and does not experience the temperature-moderating effect of the oceans (U.S. Environmental Protection Agency 2015b; Midwestern Regional Climate Center 2015). Temperatures in the Midwest have increased from 1900 to 2010 by more than 1.5°F. Between 1950 and 2010, the average temperature increased twice as quickly as it did from 1900 to 2010; between 1980 and 2010 it increased three times as quickly. Regional projections show average temperature increases of 3.8°F by 2065 even with substantial reductions in GHG emissions (U.S. Global Change Research Program 2014).

Precipitation patterns in the Midwest show the greatest amount of rain falling in the east and rainfall declining toward the west. Annual rainfall totals range from 10 to 30 inches (Midwestern Regional Climate Center 2015). Between 2041 and 2062, rainfall in the spring season is expected to increase by 9 percent, increasing the likelihood of flooding; rainfall in the summer is expected to decrease by an average of 8 percent (U.S. Global Change Research Program 2014). Snowfall varies across the Midwest Region with less than 10 percent of total snowfall occurring in the south and more than half occurring in the north. Annual snowfall totals are greatest in the north, ranging from 42 to 150 inches, and lowest in the south, ranging from less than 6 inches up to 12 inches (Midwestern Regional Climate Center 2015).

In recent years the Great Lakes have recorded higher water temperatures and less ice cover as a result of changes in regional climate. The average annual maximum ice coverage of the Great Lakes during 2003 to 2013 was less than 43 percent compared to the 1962 to 2013 average of 52 percent. Summer surface water temperatures in Lake Huron and Lake Ontario have increased between 2.7 and 5.2°F from 1968 to 2002. Lake surface temperatures are projected to continue to rise by as much as 7°F by 2050 and 12.1°F by 2100 (U.S. Global Change Research Program 2014).

3.5 Air Quality

This section describes air quality conditions in the study area. Air quality is generally influenced by the quantities of pollutants released within and upwind of the area, and can be highly dependent upon the chemical and physical properties of the pollutants. Air quality standards and regulations limit the allowable quantities that may be emitted. The topography, weather, and land use in an area also affect how pollutants are transported and dispersed and the resulting ambient concentrations.

3.5.1 Study Area and Approach

The study area for air quality encompasses the Plan Area as well as all nonattainment and maintenance areas that overlap the Plan Area to account for construction and operation-related air emissions that may occur as a result of Covered Activities. Nonattainment and maintenance areas refer to geographic regions in which measured concentrations of air pollutants exceed the National Ambient Air Quality Standards (NAAQS) established by the EPA under the Clean Air Act. EPA designates an area as nonattainment when pollutant levels exceed the NAAQS for specific pollutants and time periods, and as attainment when pollutant levels are less than the NAAQS. EPA designates former nonattainment areas that have reduced pollutant levels below the NAAQS as maintenance areas. Existing air quality is characterized in this section by describing the NAAQS and indicating the portions of the study area where air quality is of concern, as indicated by those locations designated nonattainment or maintenance.

3.5.2 Existing Conditions

Air quality conditions are characterized by measuring ground-level ambient (outdoor) pollutant concentrations. Measured concentrations are compared to the NAAQS (Table 3.5-1). The most important measured pollutants are the “criteria” pollutants indicated in Table 3.5-1. Criteria pollutants are air contaminants that are commonly emitted from a variety of sources and include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter smaller than 10 and 2.5 microns (PM10 and PM2.5, respectively), and sulfur dioxide (SO_2). Primary standards are set at levels to protect public health, including the health of sensitive populations (such as asthmatics, children, and the elderly), with a margin of safety. Secondary standards are set to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings. States also have established ambient air quality standards which generally are the same as or similar to the NAAQS.

Table 3.5-1. National Ambient Air Quality Standards

Criteria Pollutant	Primary Standards		Secondary Standards	
	Level[a]	Averaging Time	Level[a]	Averaging Time
Carbon monoxide (CO)	9 ppm (10 mg/m^3)	8 hours[b]	None	
	35 ppm (40 mg/m^3)	1 hour[b]		
Lead (Pb)	0.15 µg/m^3	Rolling 3-month average	Same as Primary	
Nitrogen dioxide (NO_2)	0.053 ppm (100 µg/m^3)	Annual (arithmetic mean)	Same as Primary	
	0.100 ppm (188 µg/m^3)	1 hour[c]	None	
Particulate matter (PM10)	150 µg/m^3	24 hours[d]	Same as Primary	
Particulate matter (PM2.5)	12.0 µg/m^3	Annual (arithmetic mean)[e]	15.0 µg/m^3	Annual (arithmetic mean)[e]
	35 µg/m^3	24 hours[f]	Same as Primary	
Ozone (O_3)	0.075 ppm	8 hours[g]	Same as Primary	
Sulfur dioxide (SO_2)	0.075 ppm (200 µg/m^3)	1 hour[h]	0.5 ppm (1,300 µg/m^3)	3 hours[b]

Source: 40 CFR Part 50; ESRI 2015b

CFR = Code of Federal Regulations; EPA = U.S. Environmental Protection Agency; PM10 = particulate matter with a nominal aerodynamic diameter equal to or less than 10 microns; PM2.5 = particulate matter with a nominal aerodynamic diameter equal to or less than 2.5 microns.

[a] Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m3), and micrograms per cubic meter (µg/m3) of air.

[b] Not to be exceeded more than once per year.

[c] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm.

[d] Not to be exceeded more than once per year on average over 3 years.

[e] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 12.0 µg/m3 for the primary standard and 15.0 µg/m3 for the secondary standard.

[f] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3.

[g] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor in an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

[h] The 1-hour sulfur dioxide standard is attained when the 3-year average of the 99th percentile of the daily maximum 1-hour average concentrations does not exceed 0.075 ppm.

Air quality agencies for the states in the Plan Area maintain a number of monitoring stations that measure air pollutant levels. Figure 3.5-1 depicts the locations of air quality monitors for criteria pollutants in the study area. Monitors typically are located in largest numbers where air quality is of greatest concern, primarily major urban areas. Figure 3.5-2 depicts those areas designated as nonattainment and maintenance areas within the study area, and indicates that air quality in large portions of the study area is within the NAAQS. However, air quality conditions and meeting the standards are of concern in a number of regions within the study area, including the largest urban areas, as indicated by the locations of monitoring stations (Figure 3.5-1) and of nonattainment and maintenance areas (Figure 3.5-2).

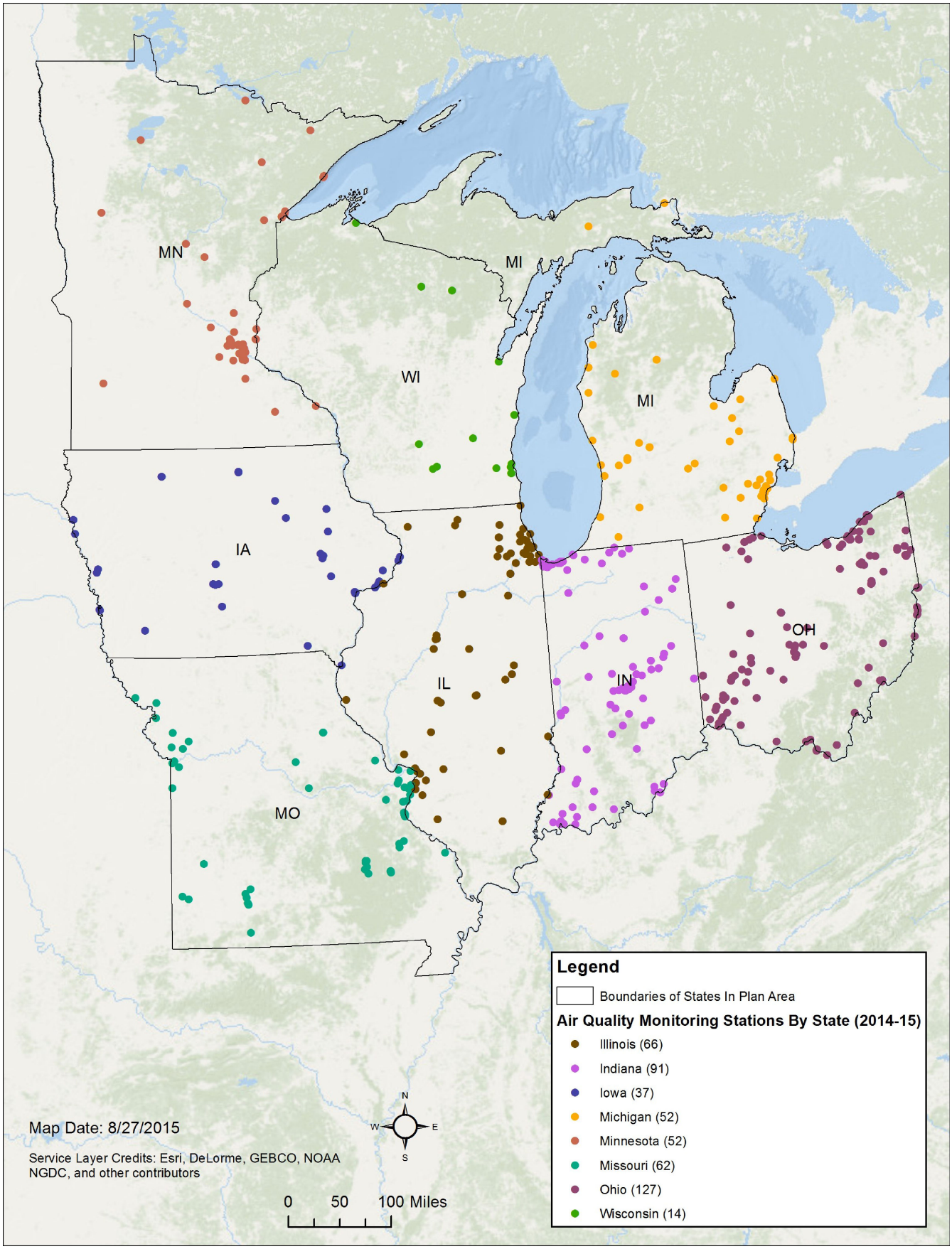

Figure 3.5-1
Air Quality Monitoring Stations in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

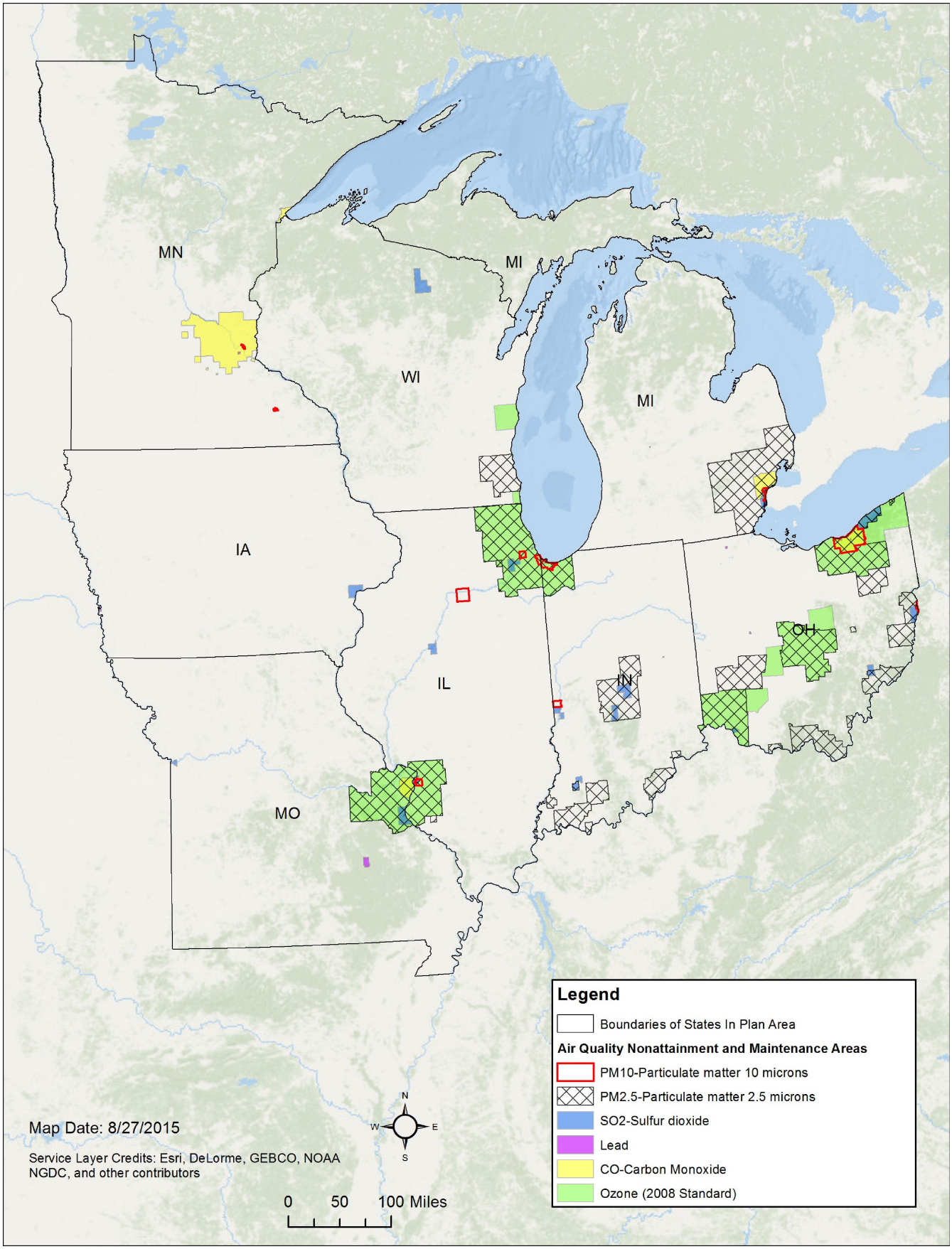

Figure 3.5-2
Air Quality Conditions in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

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3.6 Noise

This section describes the existing noise environment in the study area.

3.6.1 Study Area and Approach

The study area for noise is concurrent with the Plan Area. This section provides a general discussion of noise, ambient noise levels typical of areas with various population densities (e.g., rural and urban areas), and noise associated with WTGs. Because of the large geographic scale of the study area as well as unknown locations of WTGs, site-specific ambient noise measurements are impractical and therefore not discussed in this section.

3.6.2 Existing Conditions

3.6.2.1 Fundamentals of Acoustics

Any pressure variation that the human ear can detect is considered sound; noise is unwanted sound. Noise (and sound) can be characterized in terms of amplitude (perceived as loudness), frequency (perceived as pitch), and time pattern. The normal hearing for a healthy young person ranges in frequency from approximately 20 Hertz[21] (Hz) to 20,000 Hz (or 20 kHz). In particular, frequencies in the 20 to 200 Hz range are called "low-frequency noise," while frequencies less than 20 Hz are called "infrasound." Wind turbines emit a wide range of noise frequencies, including low and infrasound frequencies.

The human ear can detect sounds with a very wide range of pressure amplitudes. A direct application of a linear scale to the measurement of sound pressure leads to a large and unwieldy number. In addition, because of a protective mechanism of the human ear, the ear responds logarithmically rather than linearly to sound amplitude. Accordingly, it is practical to express acoustic parameters ("sound pressure level") as a logarithmic ratio of the measured value to a reference level, or "decibel" (dB). Audible sounds range from 0 dB ("threshold of hearing") to about 140 dB ("threshold of pain").

Another measure of the magnitude of sounds is "sound power level." The sound power level is a measure of the acoustic power radiated by the source. The sound power level reflects not only the power of the source but the distance from the source and the acoustical characteristics of the intervening space between the source and the receptor.[22] Sound power level is not measured directly; it is calculated from sound pressure measurements. Sound power level is used to estimate how far sound will travel and to predict the sound levels at various distances from the source. Although they use different reference levels, sound power and pressure levels are expressed in dB.

[21] The hertz (Hz) is a unit of time which measures frequency. Frequency is how often something happens. A frequency of 1 Hz means that something happens once a second. The note Middle C (the C in the middle of the piano) is 262 Hz. This means there are 262 vibrations every second, which is heard as the note Middle C, when that piano key is played.

[22] As an analogy, an electrical heater (viewed as sound power level) has a certain power rating, which is the heat that it can produce, and is independent of the surroundings. However, the temperature (viewed as sound pressure level) at a particular point away from the heater depends on many factors, for example, power rating of the heater, distance from the heater, atmospheric conditions, and proximity from reflecting surfaces.

A human's perception of noise depends on not only the dB scale but also on the frequency distribution. To reflect a human's perception of noise, "weighting" scales are used that represent a single number rather than a spectrum. For addressing wind turbine noise, three weightings scales of A, C, and G are appropriate. The A scale, denoted by dBA, gives greater emphasis to the sounds between 1 and 5 kHz and less emphasis to the lower and much higher frequencies. The A scale is reasonably correlated with a human's subjective reaction to medium-intensity (<60 dBA) and mid-to-high frequency (>100 Hz) sounds. The A scale is most widely used for the assessment of environmental and industrial noise, as well as potential occupational hearing damage and other health effects. To provide a frame of reference for typical noise levels, a whisper has a decibel level of 20 dBA; conversational speech, 60 dBA; heavy truck traffic, 80 dBA; and a rock concert, 120 dBA (Claflin 2008). The C scale is fairly flat, with a small attenuation at both low and high frequencies. This C-weighting is used particularly when evaluating very loud or very low-frequency sounds, such as artillery firing. The G scale is designed to reflect human response to infrasound, which is perceived as a mixture of auditory and tactile sensations. The relative response of the G scale falls off rapidly above 20 Hz and below 20 Hz, with a peak gain of 9 dB at 20 Hz. The practicality and the importance of using the G scale for measuring noise are controversial, and thus the G scale is not widely used to evaluate wind turbine noise.

Human responses to noise differ depending on the time of the day; for example, humans experience more annoyance from noise during nighttime hours. The day-night average sound level (DNL) is the average noise level over a 24-hour period, after the addition of 10 dB to sound levels from 10 p.m. to 7 a.m. to account for the greater sensitivity of most people to nighttime noise. DNL 55 is recognized by many Federal agencies, including the EPA, as an outdoor limit for protecting public health and welfare in residential areas. DNL 65 is considered to be the dividing line between acceptable and unacceptable noise levels in residential areas.

Individuals respond differently to various sounds. Whether the sound is desirable or not is quite subjective. Noise effects on people generally fall into three categories (Rogers *et al.* 2002):

- Subjective effects such as annoyance, nuisance, and dissatisfaction;
- Interference with activities such as speech, sleep, and learning; and
- Physiological effects such as anxiety, tinnitus, or hearing loss.

In most cases, effects resulting from the sound levels associated with environmental noise and wind turbines are limited only to the first two categories, with modern wind turbines typically producing only the first. Employees who work in industrial plants and around aircraft for a prolonged period can experience noise effects in the last category, which is the most clearly measurable health hazard.

Both objective and subjective factors can be considered when evaluating the community reaction to a noise (Miller *et al.* 1984). Objective factors include absolute level and background noise, character of noise, and temporal and seasonal factors. Subjective factors include history of previous exposure, community attitude, and type of neighborhood. The most important factor in human annoyance is the magnitude of the intruding noise relative to existing sound environments. Discrete tones (tonal noise) are more noticeable and annoying than broadband noise at the same loudness level because they stand out against the background noise. Impulsive noises such as blasting also tend to be considered particularly objectionable. High-level low-frequency noise, typical of large diesel engines in trains, ships, and power plants, is hard to muffle, spreads easily in all directions with less attenuation, and is considered more annoying than its A-weighted level would indicate. During the night, people seek quiet for relaxation and sleep, and thus usually judge an intruding noise as more

disturbing at night than during the day. In moderate climates, people spend more time outdoors and leave doors and windows open, so noises are usually more disturbing. New noises that exceed the previously existing ambient noise level become less acceptable to hearers. However, local residents are more tolerant to the noise source if it is considered important to the economic or social well-being of the community, or if they believe that the generator of the noise is responsive to community interests and is trying to resolve the noise issues. Local residents will be more inclined to complain about the noise if it does not seem suitable for its surroundings.

Human responses to changes in sound levels generally exhibit the following characteristics (Rogers *et al.* 2002):

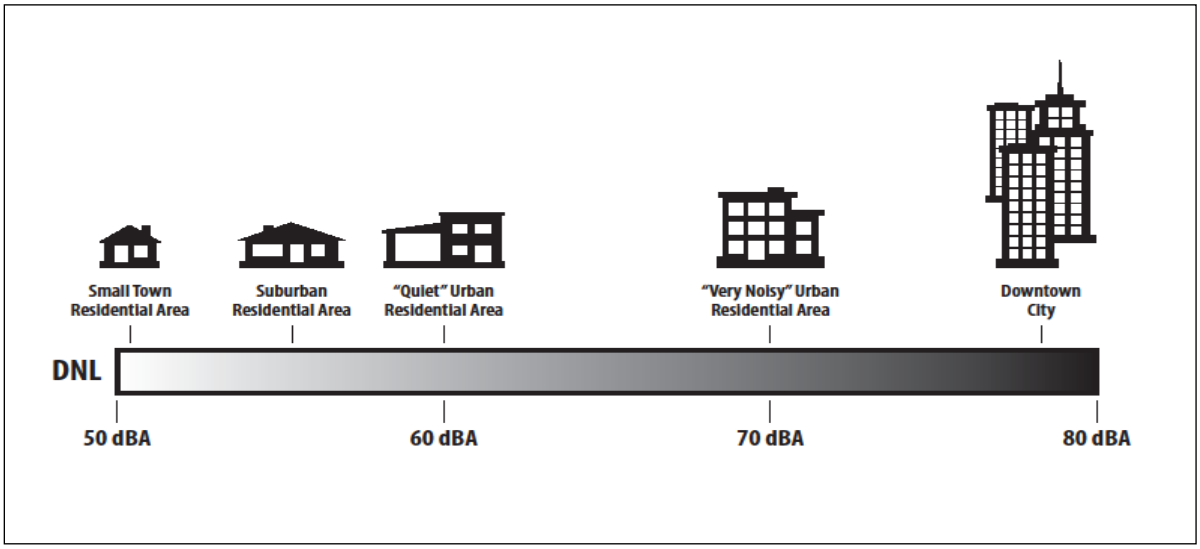
- Except under laboratory conditions, a 1-dB change in sound level is not perceptible;
- A 3-dB change in sound level (twice the sound energy) is considered barely noticeable;
- A 5-dB change in sound level (more than three times the sound energy) will typically result in a noticeable community response; and
- A 10-dB change in sound levels (10 times the sound energy), which is generally judged to be a doubling in loudness, will almost certainly cause an adverse community response.

3.6.2.2 Ambient Noise

Ambient or background noise levels represent the total amount of noise in an area and are used to compare the effects of a new noise source relative to existing conditions. Figure 3.6-1 shows ambient noise levels typical of areas with various population densities; population densities for each of the eight states is described in Section 3.12, *Socioeconomics and Environmental Justice*.

As indicated in Figure 3.6-1, ambient noise levels associated with high-density urban areas (70–80 dBA) are much higher than those associated with small residential areas (50 dBA). The addition of a new noise source (such as a WTG) to an area with high existing ambient noise levels may be masked by existing noise sources and therefore less audible than in an area with low ambient noise levels. In rural areas with low ambient noise levels, a new noise source (such as a WTG) may be audible at distances farther from the WTG than their urban counterparts, although low population densities in rural areas may result in fewer sensitive receptors potentially affected by WTG noise. Ambient noise levels and population density are therefore important parameters in characterizing the affected environment related to WTG noise.

Figure 3.6-1. Typical Day-Night Average Noise Levels



Source: U.S. Environmental Protection Agency 1974.

3.6.2.3 Wind Turbine Generator Noise Levels

Wind turbines have many noise-generating moving parts. The two main types of noise from a wind turbine are mechanical and aerodynamic. Mechanical noises include tonal (discrete) noises, while aerodynamic noise includes broadband (>100 Hz), low-frequency (20–100 Hz), and impulsive noises. The following discussion on mechanical and aerodynamic noise was extracted from Rogers *et al.* (2002) and Wagner *et al.* (1996).

Mechanical noise is associated with the rotation of mechanical and electrical components; thus, it tends to be tonal, although a broadband component exists. Mechanical noise is primarily originated by the gearbox and also by other moving parts, such as generators, yaw drives, cooling fans, and auxiliary equipment (e.g., hydraulics). Mechanical noise has a dominant energy within frequencies below 1 kHz and contains a discrete tonal component. Pure tones can be emitted at the rotational frequencies of shafts and generators and the meshing frequencies of the gears. In contrast to aerodynamic noise, mechanical noise can be avoided or highly damped through the special finishing of gear teeth, low-speed cooling fans, acoustic insulation, vibration isolators, etc. In general, mechanical noise can be viewed as an indication of poor design. In addition, the hub, rotor, and tower may act as loudspeakers, transmitting the mechanical noise and radiating it. The transmission path of the noise can be airborne (directly propagated from the component surface or interior into the air) or structure-borne (transmitted along other structural components before it is radiated into the air). Recent improvements in the mechanical design of large wind turbines and vibration damping have resulted in significantly reduced mechanical noise from both broadband and pure tones. Thus, the noise emission from modern utility-scale wind turbines is dominated by broadband aerodynamic noise. This is also due, in part, to the fact that turbine size has increased; mechanical noise does not increase with the dimensions of the turbine as rapidly as aerodynamic noise.

Aerodynamic noise from wind turbines originates mainly from the flow of air over and past the blades; therefore, the noise generally increases with rotor tip speed. It is directly linked to the production of power, and, therefore, is inevitable, although blade design can influence aerodynamic

noise characteristics. The aerodynamic noise has a broadband character and is typically the dominant part of wind turbine noise today. Broadband noise is characterized by the continuous distribution of sound pressure with frequencies greater than 100 Hz, which is caused by the interaction of wind turbine blades with atmospheric turbulence, and is also described as a characteristic "swishing" sound. The swishing sound, which many people mistakenly recognize as low-frequency noise, is amplitude-modulated blade-tip turbulence at the frequency of the passing blade tip (every 1.1 second for a newer model turbine rotating at 18 rotations per minute). Low-frequency and impulsive noise are primarily associated with downwind turbines with blades on the downwind side of the tower. Low-frequency noise in the range of 20 to 100 Hz is caused when the turbine blade encounters localized flow deficiencies due to the flow around a tower and wakes produced by the other blades. Sometimes this noise can cause structural vibration. Impulsive noise is caused by the interaction of wind turbine blades with disturbed airflow around the tower. This is characterized by short acoustic impulses or thumping sounds that vary in amplitude as a function of time. Airfoil-related noise can create a tonal component that is caused by nonlinear boundary instabilities interacting with the blade surface; vortex shedding at blunt trailing edges; or noise from flow over holes, slits, and intrusions, which can be avoided with good engineering design. Recent efforts to reduce aerodynamic noise have been made through the use of a lower tip speed ratio,[23] lower blade angle of attack, variable-speed operation, and most recently, the introduction of specially designed blade trailing edges.

At higher wind speeds, the noise from the wind can mask the noise from the turbine. However, lower background noise conditions make turbine noises more noticeable. Accordingly, fixed-speed turbines are most likely to have noticeable aerodynamic noise just above cut-in wind speeds before the wind-induced background noise increases enough to mask the noise of the turbine (Alberts 2006). Some earlier downwind wind turbines, which are rarely seen in modern utility-scale wind turbines, emit substantial levels of infrasound. Upwind turbines also emit low-frequency noise and infrasound, but their levels are below the human perception threshold. No reliable evidence exists to indicate that infrasound below the human perception threshold causes physiological and psychological effects (Rogers *et al.* 2002).

[23] The tip speed ratio is the ratio between the rotational speed of the blade tip and the actual wind speed. A higher tip speed ratio generally means a higher efficiency, but is also related to higher noise levels and a need for heavier, stronger blades.

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3.7 Visual Resources

Visual resources are all objects (human-made and natural, moving and stationary) and features (e.g., landforms and waterbodies) visible on a landscape. These resources add to or detract from the scenic quality of the landscape (*i.e.,* the visual appeal of the landscape). This section describes visual resources typical of the study area.

3.7.1 Study Area and Approach

The visual resources study area is concurrent with the Plan Area and defined to encompass an *area of visual effect* (AVE) comprised of the viewsheds that people can see in the landscape. The AVE and its viewsheds are defined by the physical constraints of the environment and the physiological limits of human sight. Physical constraints of the environment include landform, land cover, and atmospheric conditions. *Landform,* or the general topography of the viewshed, is a major factor in determining the AVE because it can limit views or provide an elevated perspective for viewers. Similarly, *land cover*, such as trees and buildings, can limit views while low-growing vegetation and the absence of structures can allow for unobscured views. *Atmospheric conditions* such as smoke, dust, fog, or precipitation can temporarily reduce visibility.

The physiological limits of human sight, or the factors that contribute to what can be seen in any given viewshed, are affected by location, proximity, and light. *Location* refers to the topographic position of the viewer relative to what is being observed (e.g., being even with, above, or below what is being observed). *Proximity*, or the location of an element in the viewshed relative to the viewer, is broken down into three distance zones: foreground (up to 0.5 mile from the viewer), middleground (0.5 mile to 3 to 5 miles from the viewer), and background (from 3 to 5 miles to infinity).

Features in the landscape are more dominant and have greater importance the closer the resource is to the viewer. Importance is reduced the further away features are from the viewer because details and features in the landscape, including project elements, become lost and comprise a smaller portion of the total landscape. In the background, the scale and color of existing landscape elements and project features blend so that only broad forms, large-scale patterns, and muted colors are evident.

Light influence also plays a large role in affecting views. During the daytime, views are more readily available relative to the nighttime, when darkness greatly reduces the ability to see details and color in the landscape without bright moonlight or artificial light sources. In addition, lighting levels change throughout the day, making color and individual forms more prominent with more light and less distinct as light decreases.

The environment's physical constraints and limits of human sight combine to provide for viewsheds that range from restrictive to expansive and AVEs that range from being smaller and more confined to larger and wider reaching. (Federal Highway Administration 2015a:4-5–4-9, 6-3–6-4; Litton 1968:3–5).

3.7.2 Existing Conditions

The AVE falls within the Central Lowlands and Superior Uplands provinces of the country. The Central Lowlands support extensive agriculture and often allow for expansive views over the flatter

landscape. Conversely, the portions of Michigan, Minnesota, and Wisconsin within the Superior Uplands have more topographic variation. This topographic variation can limit views or allow for expansive views from elevated vantages. Existing development with the AVE is generally centralized along major transportation corridors within the study area.

Table 3.7-1 identifies sensitive Federal visual resources within the AVE. In addition to Federal resources listed in this table, the Cahokia Mounds State Historic Site is a World Heritage Site located within the AVE in Illinois (UNESCO 2015). The AVE also has many visual resources that are protected at the state and local levels. These resources, which include historic sites and recreational areas, state-designated scenic byways and roadways, and wild and scenic rivers, are summarized in Table 3.7-2. Individual states also contain visual resources protected by locally based jurisdictions or conservation organizations, such as lands protected by The Nature Conservancy and shoreline areas along the Great Lakes (Minnesota, Wisconsin, Illinois, Indiana, and Michigan).

Affected viewers within the AVE broadly include private residential viewers; travelers on roadways; recreationists; and workers and patrons of commercial, industrial, civic, and institutional businesses. Generally, higher visual sensitivity is attributed to residential viewers, who have longer-term views and a higher sense of ownership of views, as well as recreational viewers, who tend to have a higher regard for and acuity to changes in the natural and built environments. Lower visual sensitivity is generally attributed to roadway commuters who tend to be focused on driving and business workers and patrons who are more focused on work activities and engaged in shopping or receiving services. Recreational roadway travelers have slightly higher sensitivities than roadway commuters because recreational roadway travelers often take routes for their scenic qualities.

Table 3.7-1. Sensitive Federal Visual Resources in the Plan Area

State	Resource Type	Resource Name
Illinois	National Heritage and Historic Sites/Areas	Lincoln Home National Historic Site
	National Lakeshores	None
	National Memorials and Monuments	Pullman National Monument
	National Parks	None
	National Scenic Areas	None
	National Trails	Trail of Tears National Historic Trail
		Mormon Pioneer National Historic Trail
	Scenic Byways/All-American Roads	Great River Road
		Historic National Road
		Historic Route 66
		Illinois River Road
		Lincoln Highway
		Meeting of the Great Rivers Scenic Route
		Ohio River Scenic Byway
	U.S. National Forests	Midewin National Tallgrass Prairie
		Shawnee National Forest
	Wild and Scenic Rivers	Vermilion Scenic River

State	Resource Type	Resource Name
	Wildlife Refuges	Chautauqua National Wildlife Refuge
		Crab Orchard National Wildlife Refuge
		Cypress Creek National Wildlife Refuge
		Emiquon National Wildlife Refuge
		Meredosia National Wildlife Refuge
		Middle Mississippi River National Wildlife Refuge
		Two Rivers National Wildlife Refuge
Indiana	National Heritage and Historic Sites/Areas	George Rogers Clark National Historic Park
	National Lakeshores	Indiana Dunes
	National Memorials and Monuments	Lincoln Boyhood National Memorial
	National Parks	None
	National Scenic Areas	None
	National Trails	None
	Scenic Byways/Roadways	Historic National Road
		Indiana's Historic Pathways
		Ohio River Scenic Byway
	U.S. National Forests	Hoosier National Forest
	Wild and Scenic Rivers	None
	Wildlife Refuges	Big Oaks National Wildlife Refuge
		Muscatatuck National Wildlife Refuge
		Patoka River National Wildlife Refuge and Wildlife Management Area
Iowa	National Heritage and Historic Sites/Areas	Herbert Hoover National Historic Site
	National Lakeshores	None
	National Memorials and Monuments	Effigy Mounds National Monument
	National Parks	None
	National Scenic Areas	None
	National Trails	Lewis and Clark National Historic Trail
		Mormon Pioneer National Historic Trail
	Scenic Byways/All-American Roads	Great River Road
		Loess Hills Scenic Byway
	U.S. National Forests	None
	Wild and Scenic Rivers	None
	Wildlife Refuges	DeSoto National Wildlife Refuge
		Driftless Area National Wildlife Refuge
		Iowa Wetland Management District
		Neal Smith National Wildlife Refuge
		Port Louisa National Wildlife Refuge
		Union Slough National Wildlife Refuge

State	Resource Type	Resource Name
Michigan	National Heritage and Historic Sites/Areas	Motor Cities National Heritage Area
		Keweenaw National Historic Park
		River Raisin National Battlefield Park
	National Lakeshores	Pictured Rocks
		Sleeping Bear Dunes
	National Memorials and Monuments	None
	National Parks	Isle Royale
	National Scenic Areas	None
	National Trails	North Country National Scenic Trail
	Scenic Byways/All-American Roads	Copper Country Trail
		River Road Scenic Byway
		Woodward Avenue (M-1) – Automotive Heritage Trail
	U.S. National Forests	Hiawatha National Forest
		Huron-Manistee National Forest
		Ottawa National Forest
	Wild and Scenic Rivers	Au Sable River
		Bear Creek
		Black River
		Carp River
		Indian River
		Manistee River
		Ontonagon River
		Paint River
		Pere Marquette River
		Pine River
		Presque Isle River
		Sturgeon River (Hiawatha and Ottawa National Forests)
		Tahquamenon River (East Branch)
		Whitefish River
		Yellow Dog River
	Wildlife Refuges	Detroit River International Wildlife Refuge
		Harbor Island National Wildlife Refuge
		Huron National Wildlife Refuge
		Kirtland's Warbler Wildlife Management Area
		Michigan Islands National Wildlife Refuge
		Michigan Wetland Management District
		Seney National Wildlife Refuge
		Shiawassee National Wildlife Refuge

State	Resource Type	Resource Name
Minnesota	National Heritage and Historic Sites/Areas	None
	National Lakeshores	None
	National Memorials and Monuments	Pipestone National Monument
		Grand Portage National Monument
	National Parks	Mississippi National River and Recreation Area
		Voyageurs National Park
	National Scenic Areas	St. Croix River National Scenic Riverway
	National Trails	North Country National Scenic Trail
	Scenic Byways/All-American Roads	Edge of the Wilderness
		Grand Rounds Scenic Byway
		Great River Road
		Gunflint Trail Scenic Byway
		Historic Bluff Country Scenic Byway
		Minnesota River Valley Scenic Byway
		North Shore Scenic Drive
		Paul Bunyan Scenic Byway
	U.S. National Forests	Chippewa National Forest
		Superior National Forest
	Wild and Scenic Rivers	St. Croix River
	Wildlife Refuges	Agassiz National Wildlife Refuge
		Big Stone National Wildlife Refuge
		Big Stone Wetland Management District
		Crane Meadows National Wildlife Refuge
		Detroit Lakes Wetland Management District
		Fergus Falls Wetland Management District
		Glacial Ridge National Wildlife Refuge
		Hamden Slough National Wildlife Refuge
		Litchfield Wetland Management District
		Mille Lacs National Wildlife Refuge
		Minnesota Valley National Wildlife Refuge
		Minnesota Valley Wetland Management District
		Morris Wetland Management District
		Northern Tallgrass Prairie National Wildlife Refuge
		Rice Lake National Wildlife Refuge
		Rydell National Wildlife Refuge
		Sherburne National Wildlife Refuge
		Tamarac National Wildlife Refuge
		Tamarac Wetland Management District

State	Resource Type	Resource Name
		Upper Mississippi River National Wildlife and Fish Refuge
		Windom Wetland Management District
Missouri	National Heritage and Historic Sites/Areas	Harry S. Truman National Historic Site
		Ulysses S. Grant National Historic Site
		Wilson's Creek National Battlefield
	National Lakeshores	None
	National Memorials and Monuments	George Washington Carver National Monument
		Jefferson National Expansion Memorial
	National Parks	None
	National Scenic Areas	Ozark National Scenic Riverways (Current and Jacks Fork Rivers)
	National Trails	California National Historic Trail
		Lewis and Clark National Historic Trail
		Oregon National Historic Trail
		Pony Express National Historic Trail
		Santa Fe National Historic Trail
		Trail of Tears National Historic Trail
	Scenic Byways/All-American Roads	Crowley's Ridge Parkway
		Great River Road
	U.S. National Forests	Mark Twain National Forest
	Wild and Scenic Rivers	Eleven Point River
	Wildlife Refuges	Big Muddy National Fish and Wildlife Refuge
		Clarence Cannon National Wildlife Refuge
		Great River National Wildlife Refuge
		Mingo National Wildlife Refuge
		Ozark Cavefish National Wildlife Refuge
		Pilot Knob National Wildlife Refuge
		Squaw Creek National Wildlife Refuge
		Swan Lake National Wildlife Refuge
Ohio	National Heritage and Historic Sites/Areas	Dayton Aviation Heritage National Historic Park
		Fallen Timbers Battlefield and Fort Miamis National Historic Site
		First Ladies National Historic Site
		Hopewell Culture National Historic Site
		James A. Garfield National Historic Site
		National Aviation National Heritage Area
		William Howard Taft National Historic Site
	National Lakeshores	None
	National Memorials and Monuments	Charles Young Buffalo Soldiers National Monument
		David Berger National Memorial

State	Resource Type	Resource Name
		Perry's Victory and International Peace National Memorial
	National Parks	Cuyahoga Valley National Park
	National Scenic Areas	None
	National Trails	North Country National Scenic Trail
	Scenic Byways/All-American Roads	Amish Country Byway
		Historic National Road
		Lake Erie Coastal Ohio Trail
		Ohio & Erie Canalway
		Ohio River Scenic Byway
	U.S. National Forests	Wayne National Forest
	Wild and Scenic Rivers	Big and Little Darby Creeks
		Little Beaver Creek
		Little Miami River
	Wildlife Refuges	Cedar Point National Wildlife Refuge
		Ottawa National Wildlife Refuge
		West Sister Island National Wildlife Refuge
Wisconsin	National Heritage and Historic Sites/Areas	None
	National Lakeshores	Apostle Islands
	National Memorials and Monuments	None
	National Parks	None
	National Scenic Areas	St. Croix River National Scenic Riverway
	National Trails	Ice Age National Scenic Trail
		North Country National Scenic Trail
	Scenic Byways/All-American Roads	Great River Road
	U.S. National Forests	Chequamegon-Nicolet National Forest
	Wild and Scenic Rivers	St. Croix River
		Wolf River
	Wildlife Refuges	Fox River National Wildlife Refuge
		Gravel Island National Wildlife Refuge
		Green Bay National Wildlife Refuge
		Horicon National Wildlife Refuge
		Leopold Wetland Management District
		Necedah National Wildlife Refuge
		St. Croix Wetland Management District
		Trempealeau National Wildlife Refuge
		Whittlesey Creek National Wildlife Refuge

Sources: Federal Highway Administration 2015b; National Park Service 2015a–2015h; National Wild and Scenic Rivers System 2015a–2015h; U.S. Department of Agriculture Forest Service 2015; U.S. Fish and Wildlife Service 2015.

Table 3.7-2. Sensitive State Visual Resources in the Plan Area

State	Resource Type	Summary/Resource Name[1]
Illinois	Historic Sites/Areas	56 historic sites and memorials
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	6 forests, 563 preserves/refuges, 140 parks, and over 270 trails covering more than 700 miles
	Scenic Byways/Roadways	None
	Wild and Scenic Rivers	Vermilion Scenic River
Indiana	Historic Sites/Areas	Close to 600 historical markers/sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	12 forests, over 250 preserves/refuges, 37 parks/recreation areas, and 1,200 miles of trails
	Scenic Byways/Roadways	Indiana Historic Pathways
	Wild and Scenic Rivers	Cedar Creek
		Wildcat Creek
		Blue River
Iowa	Historic Sites/Areas	8 historic sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	10 forests, 95 preserves/refuges, 77 parks/recreation areas, and over 270 trails covering more than 700 miles
	Scenic Byways/Roadways	Delaware Crossing Scenic Byway
		Driftless Area Scenic Byway
		Glacial Trail Scenic Byway
		Grant Wood Scenic Byway
		Historic Hills Scenic Byway
		Iowa Valley Scenic Byway
		Lincoln Highway Scenic Byway
		River Bluffs Scenic Byway
		Western Skies Scenic Byway
	Wild and Scenic Rivers	Boone River
		Little Sioux River
		Middle Raccoon River
		Upper Iowa River
		Wapsipinicon River

State	Resource Type	Summary/Resource Name[1]
Michigan	Historic Sites/Areas	427 historic sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	16 forests, 46 natural areas, 106 parks/recreation areas, and 292 trails
	Scenic Byways/Roadways	Center Avenue Heritage Route/Bay City Historic Route
		Chief Noonday Recreational Heritage Route
		Copper Country Trail Scenic Heritage Route
		Huron Shores Recreational Heritage Route
		I-69 Recreational Heritage Route
		Iron County Heritage Trail
		Leelanau Scenic Heritage Route
		M-119 Tunnel of Trees Scenic Heritage Route
		Marshall's Territorial Road Historic Heritage Route
		Monroe Street Heritage Route
		Old Mission Peninsula Scenic Heritage Route
		Pathway to Family Fun Recreational Heritage Route
		Proposed North Huron (M-134) Recreational Heritage Route
		Tahquamenon Scenic Byway
		U.P. Hidden Coast Recreational Heritage Route
		US-12 Heritage Trail
		Woodward Avenue Recreational Heritage Route
	Natural Rivers	AuSable River
		Betsie River
		Boardman River
		Flat River
		Fox River
		Huron River
		Jordan River
		Lower Kalamazoo River
		Pere Marquette River
		Pigeon River
		Pine River
		Rifle River
		Rogue River
		Two Hearted River
		Upper Manistee River
		White

State	Resource Type	Summary/Resource Name[1]
Minnesota	Historic Sites/Areas	26 historic sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	58 forests, 161 natural areas, 1,440 wildlife areas, 76 parks/recreation areas, and 24 trails covering more than 1,360 miles
	Scenic Byways/Roadways	Apple Blossom Drive
		Avenue of Pines
		Edge of the Wilderness
		Glacial Ridge Trail
		Grand Rounds Scenic Byway
		Great River Road
		Gunflint Trail Scenic Byway
		Historic Bluff Country Scenic Byway
		Historic Highway 75 "King of Trails"
		Ladyslipper Scenic Byway
		Lake Country Scenic Byway
		Minneapolis Grand Rounds Scenic Byway
		Minnesota River Valley Scenic Byway
		North Shore Scenic Drive
		Otter Trail Scenic Byway
		Paul Bunyan Scenic Byway
		Saint Croix Scenic Byway
		Shooting Star Scenic Byway
		Skyline Parkway
		Superior National Forest Scenic Byway
		Veterans Evergreen Memorial Drive
		Waters of the Dancing Sky Scenic Byway
	Wild and Scenic Rivers	Cannon River
		Kettle River
		Minnesota River
		Mississippi River
		North Fork – Crow River
		Rum River
Missouri	Historic Sites/Areas	36 historic sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	38 natural areas, 11 wildlife areas, 54 parks/recreation areas, and nearly 1,000 miles of trails
	Scenic Byways/Roadways	Crowley's Ridge Parkway
		Great River Road
	Wild and Scenic Rivers	None

State	Resource Type	Summary/Resource Name[1]
Ohio	Historic Sites/Areas	57 historic sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	21 forests, 37 preserves/refuges, 77 parks/recreation areas, and over 270 trails covering more than 700 miles
	Scenic Byways/Roadways	Accommodation Line Scenic Byway
		Big Darby Plains Scenic Byway
		Drovers' Trail Scenic Byway
		Gateway to Amish Country
		Heritage Corridors of Bath
		Hocking Hills Scenic Byway
		Jefferson County Scenic Byway
		Jefferson Township Scenic Byway
		Land of the Cross-Tipped Churches
		Lincoln Highway Historic Byway
		Lower Valley Pike Scenic Byway
		Maumee Valley Scenic Byway
		Miami and Erie Canal Scenic Byway
		Morgan County Scenic Byway
		North Ridge Scenic Byway
		Old Mill Stream Scenic Byway
		Presidential Pathways Scenic Byway
		Scenic Olentangy Heritage Corridor
		Scenic Scioto Heritage Trail
		Tappan-Moravian Trail Scenic Byway
		Wally Road Scenic Byway
		Welsh Scenic Byway
	Wild and Scenic Rivers	Ashtabula River
		Chagrin River
		Conneaut Creek
		Darby Creeks, Big and Little
		Grand River
		Kokosing River
		Little Beaver Creek
		Little Miami River
		Maumee River
		Mohican River
		Olentangy River
		Sandusky River
		Stillwater/Greenville River
		Upper Cuyahoga River

State	Resource Type	Summary/Resource Name[1]
Wisconsin	Historic Sites/Areas	11 historic sites
	Forests, Nature Preserves/Wildlife Refuges, Parks/Recreational Areas, and Trails	9 forests, 673 natural areas, 202 wildlife areas, 47 parks/recreation areas, and 41 trails
	Scenic Byways/Roadways	Great River Road
		Lower Wisconsin River Road
		Door County Coastal Byway
		Wisconsin Lake Superior Scenic Byway
	Wild and Scenic Rivers/Scenic Waterways	Chippewa Flowage
		Lower Wisconsin State Riverway
		Pike Wild River
		Pine-Popple Wild River
		Totagatic Wild River
		Turtle-Flambeau Scenic Waters Area
		Willow Flowage Scenic Waters Area

Sources: Illinois Department of Natural Resources 2015a–2015c; Illinois Historic Preservation Agency 2015; Indiana Historic Bureau 2015; Indiana Department of Natural Resources 2015a–2015e; Iowa Department of Natural Resources 2015a–2015d; Iowa Natural Heritage Foundation 2015; State Historical Society of Iowa 2015; Iowa Department of Transportation 2015; Pure Michigan 2015; Michigan Department of Natural Resources 2015a–2015d; Michigan Highways 2015; Minnesota Historical Society 2015; Minnesota Department of Natural Resources 2015a–2015f; Minnesota Department of Transportation 2015a; Missouri Department of Natural Resources 2015a–2015d; Missouri State Parks 2015; Ohio Department of Natural Resources Division of Forestry 2015; Ohio Department of Natural Resources Division of Natural Areas and Preserves 2015; Ohio Department of Natural Resources Division of Ohio State Parks 2015; Ohio Department of Natural Resources Division of Watercraft 2015; Ohio Department of Transportation 2015; Ohio History Connection 2015; Wisconsin Department of Natural Resources 2015a–2015f; Wisconsin Department of Transportation 2015; Wisconsin Scenic Byways program 2015; Wisconsin Historical Society 2015.

[1] Resources listed here that are included in Table 3.7-1 are protected under both Federal and state laws.

3.7.2.1 Shadow Flicker

The impact analysis in Section 4.7, *Visual Resources*, will consider the potential effects of shadow flicker from wind energy operations in the study area. The following generally describes the phenomenon of shadow flicker, and how it may be perceived under different circumstances.

Shadow flicker is caused when sun- or moonlight shines on rotating wind turbine blades, casting intermittent shadows of the rotating blades to create regularly spaced intervals of light and dark that result in a flickering effect. While shadow flicker can be seen outside, it is more pronounced indoors where the shadows enter through a window or door opening and are confined within a walled room.

The magnitude of the shadow flicker effect depends on the position and height of the turbine, relative to a sensitive receptor. The position and height of the sun, wind speed and direction, and weather conditions also affect the severity of shadow flicker. For example, the position and height of the sun (which change throughout the day and seasonally) affect the sun angle, with lower sun angles (typical of the morning and evening hours and winter months) casting longer shadows and higher sun angles (typical of midday and summer months) casting shorter shadows. Wind speed and

direction affect how quickly the turbine spins, which in turn affects the duration of each flicker; higher wind speeds result in a faster flicker and lower wind speeds create a slower flickering effect. Wind direction affects the direction the turbine is facing and if the shadow is cast from a smaller or larger surface area. Weather conditions affect how prominent the shadow flicker may be, with flickering less pronounced on cloudy days and more pronounced on sunny days.

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3.8 Transportation

This section describes the general transportation infrastructure in the study area including highways, roads, railroads, and airports as well as the current levels and trends of freight transportation in the study area.

3.8.1 Study Area and Approach

The study area for transportation is concurrent with the Plan Area. Transportation infrastructure is described from state transportation statistics provided by the Department of Transportation. Data on current freight levels and trends are from the Department of Transportation Freight Analysis Framework tool.

3.8.2 Existing Conditions

Surface transportation in the study area is provided by a network of primary, secondary, and local roads and railroads. There are approximately 937,000 miles of public roads in the study area, including interstate highways, arterials, collector, and local roads (Table 3.8-1). Major east-west U.S. Interstates in the study area include Interstate (I) 2, I-28, I-64, I-70, I-80, I-90, and I-94. Major north-south U.S. Interstates in the study area include I-35, I-43, I-53, I-55, I-61, I-75, and I-77. The study area also contains a total of 35,917 miles of railroads, ranging from 3,385 miles in Wisconsin to 7,027 miles in Illinois. In addition, the study area has approximately 3,900 miles of inland waterways and 4,105 airports and heliports (Table 3.8-1).

Table 3.8-2 shows estimates for the current and future (2040) freight transportation in the study area by state and mode of transportation. Approximately two-thirds of total freight transportation in the study area is done by truck. The states with the most freight originating within the state or destined to the state, including intra-state transportation, are Illinois and Ohio. The states with the least freight transportation by weight are Wisconsin and Iowa. The Department of Transportation forecast expects air freight transportation to grow at a faster rate than freight transportation by other modes.

The Federal government imposes maximum weight, length, and width standards on interstate highways and other highways formerly classified as Primary System routes. States often set their own standards for commercial vehicle weight on other roads (Department of Transportation 2003). States may issue permits for oversize and overweight vehicles.

Table 3.8-1. Transportation Infrastructure in the Study Area by State, 2012

Type of Infrastructure	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Grand Total
Public Roads (miles)	144,337	97,289	114,438	122,051	138,833	131,978	123,281	115,094	987,301
Freight Railroads (miles, all classes)[a]	7,027	4,273	3,855	3,632	4,449	3,958	5,338	3,385	35,917
Inland Waterways (miles)[b]	1,100	350	490	0	260	1,030	440	230	3,900
Airports (number)[c]	715	545	280	452	442	478	659	534	4,105

Source: Department of Transportation 2014.

[a] Data for railroad miles is for 2011.

[b] Does not include channels in the Great Lakes.

[c] Includes public and private airports, heliports, and seaplane bases.

Table 3.8-2. Total Freight in the Study Area by State and Mode of Transportation, Thousands of Tons[a]

Mode of Transportation	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Grand Total
2015 Forecast									
Air[b]	887.4	74.9	33.3	106.3	74.6	52.2	398.4	74.0	1,701.1
Rail	200,070.0	113,032.2	77,056.7	116,726.4	151,759.9	103,754.5	119,684.8	117,543.1	999,627.6
Truck	780,880.2	548,239.0	418,304.1	488,963.1	416,421.4	445,702.0	677,616.3	346,645.6	4,122,771.6
Water	85,288.4	9,404.5	8,052.8	33,120.5	28,171.3	80,549.1	26,650.1	2,210.1	273,446.9
Other[c]	242,648.9	96,843.4	24,722.7	103,477.4	142,516.1	57,570.0	138,029.6	35,363.9	841,172.2
2040 Forecast									
Air[b]	2,554.9	179.9	90.3	263.1	198.6	135.9	1,205.0	157.7	4,785.3
Rail	264,060.9	118,718.6	98,679.5	183,376.4	241,498.4	117,581.1	133,098.7	164,051.5	1,321,065.1
Truck	1,060,327.3	755,435.7	685,745.1	803,255.4	641,247.6	644,277.8	1,040,488.2	469,907.4	6,100,684.4
Water	131,641.3	12,103.8	10,042.2	62,739.2	47,498.1	102,746.2	26,550.5	3,399.5	396,720.8
Other[c]	318,493.8	105,546.3	30,100.7	148,843.8	180,539.1	75,311.0	168,033.5	41,340.8	1,068,209.0

Source: Department of Transportation 2007.

[a] Includes freight with origin or destination in the states shown, including freight within the state.

[b] Includes truck-air.

[c] Includes pipeline transportation, multiple modes, mail, other and unknown.

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3.9 Land Resources

This section describes the land ownership and use in the study area, including a description of areas and programs with potential restrictions on development.

3.9.1 Study Area and Approach

The study area for land resources is concurrent with the Plan Area. The descriptions of land ownership and uses in the study area are based on publicly available data from the USGS, Multi-Resolution Land Characteristics Consortium, NRCS, National Conservation Easement Database, U.S. Census Bureau, U.S. Forest Service (Forest Service), the Service, and state sources. Data are typically presented by state and for the entire study area.

3.9.2 Existing Conditions

The existing environmental conditions related to land use in the study area are described below.

3.9.2.1 Land Ownership

Almost 90 percent of the land in the study area is privately owned (Table 3.9-1). At a state level, the share of lands that are privately owned ranges from 74.8 percent in Minnesota to 98.6 percent in Iowa.

The state where the Federal government owns the most land is Michigan (8.8 percent). Of the Federal lands in the study area, the Forest Service manages 74.3 percent, followed by the Service (10.8 percent), the Department of Defense (9.5 percent) and the National Park Service (5.1 percent) (Table 3.9-1, percentages calculated from absolute acreages).

State lands are more prevalent in Minnesota (17 percent), followed by Michigan (13 percent). In Minnesota and Michigan, most state lands are forest resources (Minnesota Legislative 2002; Michigan Department of Natural Resources 2015).

Figure 3.9-1 shows a map of land ownership in the study area.

3.9.2.2 Land Use

Table 3.9-2 shows the current uses of land in the study area. Approximately half of the land area is used for agriculture and livestock. Within the study area, Iowa supports the greatest acreage of land in agricultural uses (77.3 percent); Michigan supports the lowest acreage (25.5 acres). Other land uses include open water (2.6 percent), developed (8.7 percent), and other or undeveloped land uses (38.9 percent), which includes forest land, wetlands, shrub and grasslands and a few acres with no data. The greatest share of undeveloped land is found in Michigan (61.7 percent) and lowest is found in Illinois (18.8 percent) (Table 3.9-2).

Table 3.9-1. Land Ownership in the Study Area by State, Acres

	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Grand Total
Federal Land	**539,626**	**463,112**	**169,891**	**3,279,053**	**4,424,956**	**2,012,894**	**334,099**	**1,970,831**	**13,194,462**
BLM					36,001			3	36,004
DOD	108,644	233,889	87,528	19,189	274,774	372,651	71,083	79,293	1,247,052
FS	313,756	199,137		2,871,814	3,162,006	1,492,726	238,547	1,530,020	9,808,006
FWS	112,470	15,336	79,712	130,942	747,966	82,940	3,516	252,594	1,425,476
NOAA				3,789					3,789
NPS	13	14,750	2,631	253,309	203,614	64,576	20,953	108,921	668,768
NRCS			20						20
Other	4,742			10	595				5,347
State	**444,943**	**391,866**	**350,213**	**4,842,198**	**9,188,983**	**932,484**	**572,766**	**1,511,928**	**18,235,381**
Private	**35,072,736**	**22,304,280**	**35,493,623**	**29,203,203**	**40,392,863**	**41,668,169**	**25,507,422**	**32,437,605**	**262,079,902**
Grand Total	**36,057,305**	**23,159,258**	**36,013,728**	**37,324,453**	**54,006,802**	**44,613,547**	**26,414,288**	**35,920,364**	**293,509,745**
Percent Federal	1.5%	2.0%	0.5%	8.8%	8.2%	4.5%	1.3%	5.5%	4.5%
Percent State	1.2%	1.7%	1.0%	13.0%	17.0%	2.1%	2.2%	4.2%	6.2%
Percent Private	97.3%	96.3%	98.6%	78.2%	74.8%	93.4%	96.6%	90.3%	89.3%

Source: U.S. Geological Survey 2012[24]
BLM = Bureau of Land Management.
DOD = Department of Defense.
FS = U.S. Forest Service.
FWS = U.S. Fish and Wildlife Service.
NOAA = National Oceanic and Atmospheric Administration.
NPS = National Park Service.
NRCS = Natural Resources Conservation Service.

[24] The USGS Protected Areas Database collects data on all lands owned by the Federal and state governments, including lands with no known mandate for protection (U.S. Geological Survey 2015)

Table 3.9-2. Land Use in the Study Area by State, Percent of State Land Area

	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Grand Total
Open Water	1.7	1.1	1.0	2.6	5.7	1.4	1.1	3.4	2.6
Developed	11.7	10.7	7.4	10.3	5.4	6.9	14.5	7.2	8.7
Pasture, Hay and Cultivated Crops	67.8	61.3	77.3	25.5	42.1	49.9	49.4	35.5	49.9
Other/Undeveloped[a]	18.8	26.9	14.4	61.7	46.8	41.7	35.0	53.9	38.9

Source: Multi-Resolution Land Characteristics Consortium 2011.

[a] Includes forest land, wetlands, shrub and grasslands and a few acres with no data (in Michigan and Minnesota), mostly on the Great Lakes.

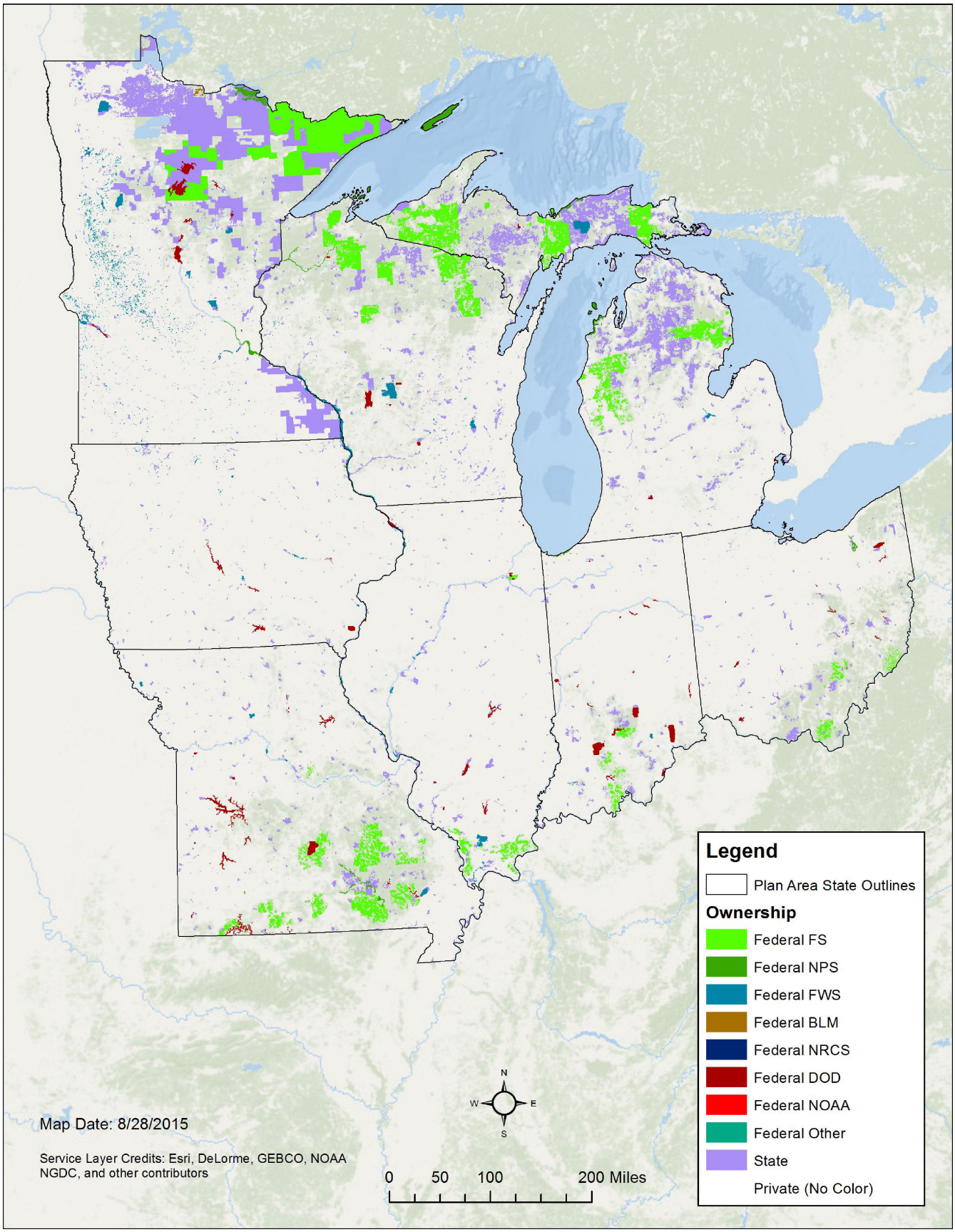

Figure 3.9-1
Land Ownership in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

Important Farmland

The Farmland Protection Policy Act of 1981 (7 U.S.C. §§ 4201 – 4209) requires that Federal agencies and programs minimize conversion of farmland to nonagricultural uses (Natural Resources Conservation Service 2013). This includes *prime farmland* (most suitable for production of food, as determined by NRCS); *unique farmland* (land used for production of specific high-value crops), and *farmland of state or local importance* (other land capable of producing crops) (Natural Resources Conservation Service 2015a).

As summarized in Table 3.9-3, Illinois has the most prime farmland in the study area, followed by Minnesota and Iowa. Illinois is also the state with the greatest share of its lands considered prime farmland, followed by Indiana. Iowa has the greatest acreage of farmland of state or local importance (Table 3.9-3). Figure 3.9-2 shows the location of important farmland in the study area.

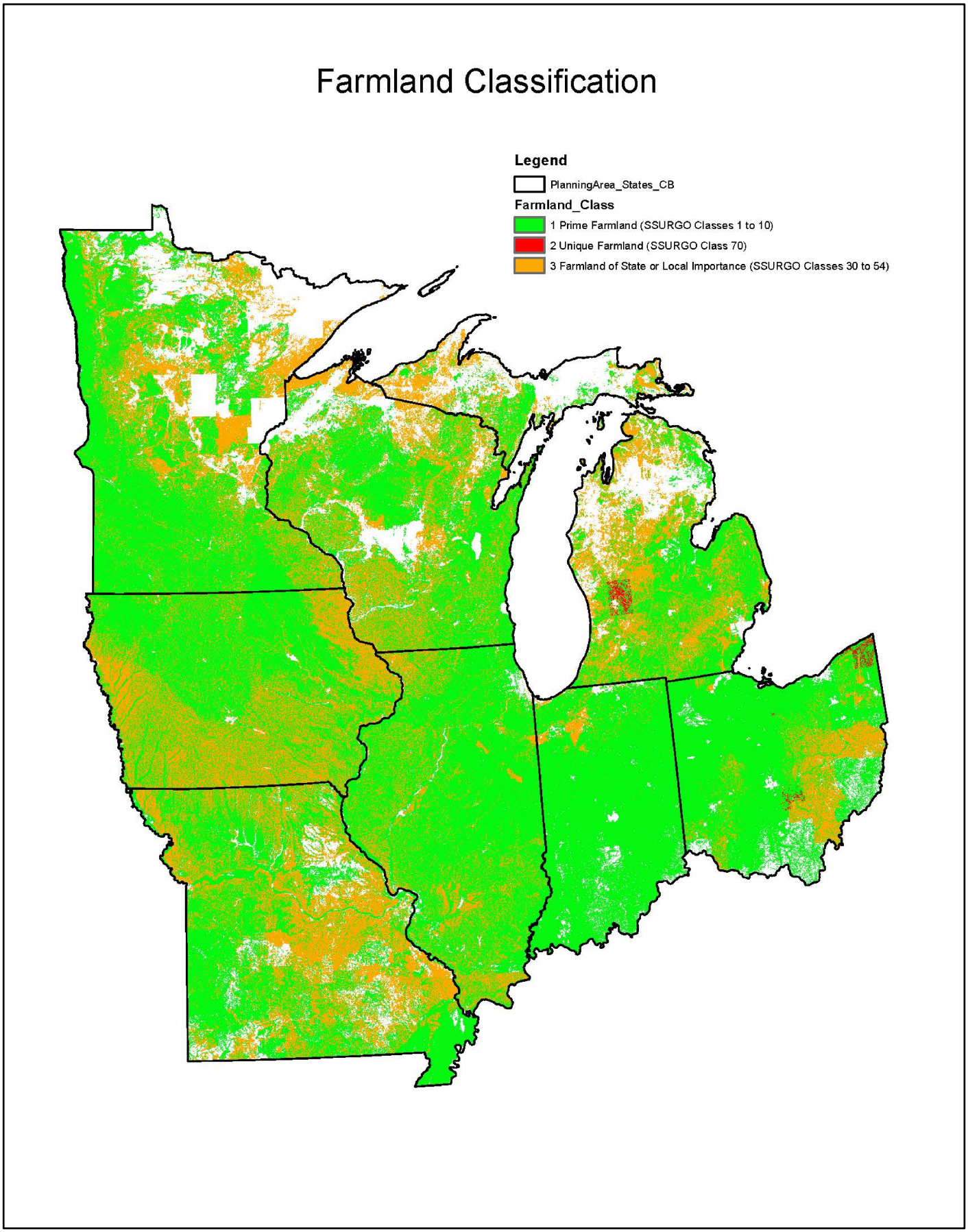

Figure 3.9-2
Important Farmland in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

Coastal Resources

The Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451- 1466) established the basis for protecting, restoring and responsibly developing coastal communities and resources throughout the United States. All states in the study area, with the exception of Missouri, participate in a federally approved Coastal Management Program, where they collaborate with Federal government to achieve the goals of the Coastal Zone Management Act.

Figure 3.9-3 shows the coastal zone boundaries for states in the study area. In Wisconsin, the coastal zone includes the 15 counties on the lakes Superior, Michigan or on Green Bay. In Indiana, the coastal zone reaches 17 miles from the shoreline at its widest point (National Oceanic and Atmospheric Administration 2012).

Figure 3.9-3
Coastal Zone Boundaries in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

Land Use Management

Land use in the study area is governed at the Federal, state and local levels. Federal agencies (e.g., Forest Service, Bureau of Land Management) typically use land use or management plans to guide use of resources in the areas they are responsible for. Resources are managed, in part, by granting permits, licenses and rights-of-way for recreational use, livestock grazing, mineral exploration, and development of renewable energy projects, among other activities. States develop management plans for state owned lands and often engage in coordination with local governments to develop and monitor local government planning efforts for consistency with state policy. Local land use planning typically include county comprehensive plans and zoning ordinances.

Under all land ownerships and uses, conservation easements can be used to create legally enforceable conservation obligations tied to specific property. Conservation easements are established between a landowner and a government agency or a land trust, and typically apply in perpetuity to a property. Approximately 0.5 percent of the land in the study area are under conservation easements, with the greatest percentages in Minnesota, Michigan and Wisconsin (Table 3.9-4).

Table 3.9-3. Important Farmland in the Study Area by State, Acres and Percent of State Land Area

Farmland Class	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Grand Total
Prime Farmland (Acres)	24,516,649	15,118,254	20,162,237	10,441,559	22,496,269	14,109,453	14,895,667	12,863,239	134,603,326
Unique Farmland (Acres)				158,812			211,963		370,775
Farmland of State or Local Importance (Acres)	5,461,024	469,328	12,253,654	6,586,672	6,629,419	8,386,601	2,621,111	5,664,715	48,072,524
Prime Farmland (Percent of State Land Area)	68.0	65.3	56.0	28.0	41.7	31.6	56.4	35.8	45.9
Unique Farmland (Percent of State Land Area)	0.0	0.0	0.0	0.4	0.0	0.0	0.8	0.0	0.1
Farmland of State or Local Importance (Percent of State Land Area)	15.1	2.0	34.0	17.6	12.3	18.8	9.9	15.8	16.4

Source: Natural Resources Conservation Service 2015b.

Table 3.9-4. Conservation Easements in the Study Area by State, Acres and Percent of State Land Area[a, b]

State	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Grand Total
Acres	150,022	27,690	13,484	239,178	727,908	34,233	90,289	200,706	1,483,510
Percent of State Land Area	0.42	0.12	0.04	0.64	1.35	0.08	0.34	0.56	0.51

Source: National Conservation Easement Database 2015.

[a] National Conservation Easement Database estimates completeness of estimates varies by state and whether easements are privately or publicly held.

[b] Percentages calculated comparing with State Land Area per U.S. Geological Survey 2012a.

3.9.2.3 Recreation

Federal lands in the study area are largely used for recreation. The largest Federal landholder is the Forest Service (Table 3.9-1). Table 3.9-5 shows national forests in the study area and their latest visitation data. Michigan and Minnesota receive the most visits to national forests for recreational purposes. Recreational activities available on national forests in the study area include bicycling, camping, fishing, hiking, horse riding, hunting, nature viewing, off-highway vehicle riding, picnicking, rockhounding, scenic driving and water and winter sports.

Table 3.9-5. Annual Visits to National Forests by State

	National Forests	Annual Visits[a]
Illinois	Midewin National Tallgrass Prairie, Shawnee NF	406
Indiana	Hoosier NF	NA
Iowa	–	NA
Michigan	Hiawatha NF, Huron-Manistee NF, Ottawa NF	2,426
Minnesota	Chippewa NF, Superior NF	1,711
Missouri	Mark Twain NF	801
Ohio	Wayne NF	NA
Wisconsin	Chequamegon-Nicolet NF	589
Grand Total Plan Area		**5933**

Source: U.S. Forest Service 2013.
NA = not available
NF = National Forest
[a] A visit consists of an entry of one person to a national forest for recreational purposes for an unspecified period of time.

Other Federal lands used for recreational purposes in the study area include lands managed by the Service, the National Park Service, and the Bureau of Land Management.

State lands are also important outdoor recreational areas in the study area. Table 3.9-6 shows estimates of annual visitors to state parks and recreational areas, as reported by state park directors.

Table 3.9-6. Estimated Annual Visitors to State Parks and Recreational Areas by State, 2010

	Visitors (thousands)[a]
Illinois	42,294
Indiana	15,846
Iowa	14,374
Michigan	21,167
Minnesota	8,922
Missouri	16,215
Ohio	53,814
Wisconsin	14,470
Grand Total Plan Area	**187,102**

Source: U.S. Census Bureau 2012.

[a] Numbers as reported by state park directors. In some states, park agencies have forests and fish and wildlife areas under their control, in others only state parks.

The latest Service survey of fishing, hunting and wildlife associated recreation provides a broad view of these activities in the study area. Approximately 45 percent of the population 16 years of age and older in the study area fish, hunt or participate in a wildlife watching recreational activity (Table 3.9-7).

Table 3.9-7. Annual Participation in Wildlife-Related Recreation by State

	Total Participants 16 years and Older		Anglers and Hunters		Wildlife Watching	
	Number (thousands)	Percent of Population	Number (thousands)	Percent of Population	Number (thousands)	Percent of Population
Illinois	3,493	35	1,487	15	2,784	28
Indiana	2,131	43	842	17	1,681	34
Iowa	1,097	46	586	25	780	33
Michigan	3,709	48	1,636	21	3,067	39
Minnesota	2,107	51	1,400	34	1,498	36
Missouri	2,105	45	1,001	21	1,645	35
Ohio	4,078	45	1,603	18	3,155	35
Wisconsin	2,499	56	1,198	27	2,152	48
Grand Total Plan Area	21,219	45	9,753	21	16,762	35

Source: U.S. Fish and Wildlife Service 2011.

3.10 Public Services and Utilities

This section describes the availability of public services in the study area, with emphasis on electricity, communications, water and sewage, and emergency services.

3.10.1 Study Area and Approach

The study area for public services and utilities is concurrent with the Plan Area. Information in this section is qualitatively described from Federal government sources and the North American Electric Reliability Corporation, with emphasis on the availability of public services in rural areas; entities responsible for providing public services in those areas; and services most likely of demand during construction, operations and maintenance, and decommissioning of wind energy infrastructure.

3.10.2 Existing Conditions

Private and public companies and utilities provide public services in the study area, including electricity, communications, water and sewage, and emergency services. Federal and state regulatory agencies oversee the provision of these services.

3.10.2.1 Electricity

The study area is part of the eastern interconnection electrical grid of power generation, transmission, and distribution. The North American Electric Reliability Corporation anticipates demand for electricity in the eastern interconnection to grow at an annual rate of up to 1.02 percent between 2015 and 2024, or approximately 9.6 percent over the nine year period (North American Electric Reliability Corporation 2014).

The study area's current electric generation capability is 205,588 megawatts (MW) annually, with Illinois generating the most electricity and Minnesota the least. Coal and natural gas are the sources of approximately 75 percent of the energy generation capacity in the study area, with wind energy adding important shares of the total in Iowa and Minnesota (Table 3.10-1).

There are 599 power utilities operating in the study area, including municipal utilities, cooperatives, and investor owned utilities. Approximately 24 percent of the wind energy in the study area is generated by electric utilities; independent power producers generate the remaining wind energy (Table 3.10-1).

Table 3.10-1. Selected Electric Industry Data by State, 2013

	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Plan Area
Total electric industry capability (MW)	**44,950**	**27,196**	**15,929**	**30,129**	**15,758**	**21,801**	**32,481**	**17,344**	**205,588**
Coal	15,498	18,648	6,562	10,947	4,822	12,333	18,895	8,151	95,856
Hydroelectric	34	60	145	331	184	570	102	385	1,811
Natural gas	13,355	5,600	2,511	10,942	4,970	5,432	9,525	6,174	58,509
Nuclear	11,578	0	601	3,929	1,673	1,194	2,134	1,198	22,307
Petroleum	683	542	1,047	590	806	1,146	987	704	6,505
Wind[a]	3,525	1,540	5,047	1,080	2,844	459	424	329	15,248
Other[b]	277	806	16	2,310	459	667	414	403	5,352
Number of power utilities	**40**	**64**	**89**	**46**	**114**	**79**	**79**	**88**	**599**
Investor owned	3	4	3	4	4	5	20	12	55
Municipal	13	22	49	24	62	27	28	52	277
Cooperative	20	37	37	10	43	46	24	22	239
Other[c]	4	1		8	5	1	7	2	28
Share of wind energy generated by electric utilities[d]	**3.4%**	**0.0%**	**51.3%**	**31.9%**	**20.9%**	**0.0%**	**1.7%**	**36.8%**	**24.7%**

Sources: Energy Information Administration 2013a; 2013b.

MW = megawatts.

[a] The total MW of wind energy capacity in the study area reflect Energy Information Administration estimates provided in 2013. As part of the MSHCP development process, and to support their application for an Incidental Take Permit, the American Wind Energy Association has provided the Service with refined estimates of the anticipated installed wind energy capacity that will be available on the landscape by the end of 2015. This capacity is reflected as 18,004 MW, and is the metric used to consider potential impacts in this environmental impact statement. For the purposes of this table, however, current (2013) Energy Information Administration data are used.

[b] Includes solar, wood, pumped storage, other gas, other biomass, and other.

[c] Includes wholesale and retail power marketers, state utilities, transmission utilities, and political subdivisions.

[d] As opposed to independent power producers and combined heat and power plants.

3.10.2.2 Communications

Communication services in the study area include radio and television broadcasting; telecommunication services, such as telephone service; and the provision of access to higher capacity and faster transmission services such as cable, fiber, wireless, satellite, and broadband over powerline services. The communications industry is largely private and overseen by the Federal Communications Commission and state public utility regulators.

Access to communications services tends to be more limited in rural areas where distances may reduce incentives for private sector companies to provide services. A Federal Communications Commission outreach program targets areas of the United States typically underserved by communications services to create greater incentives for private investments. Areas identified by this program in need of greater services that are within the study area include tribal areas, southern portions of Missouri and Illinois and southeastern portions of Ohio (Appalachian region) (Federal Communications Commission 2006).

3.10.2.3 Water and Sewage

There are approximately 9,834 community water systems providing water in the study area and an additional 39,383 transient or seasonal water systems (U.S. Environmental Protection Agency 2013). Water service providers are regulated by the EPA and state health and environmental agencies.

There are approximately 809 sewage treatment facilities in the study area (U.S. Census Bureau 2012).

3.10.2.4 Emergency Services

Emergency services in the study area include fire protection, law enforcement, and medical services. There are approximately 6,974 fire departments in the study area, with the largest number located in Ohio and Illinois. Approximately 88 percent of the fire departments are staffed completely or mostly by volunteer fire fighters. There are 4,706 law enforcement agencies in the study area, including state and local agencies, with the greatest number located in Illinois and Ohio. These law enforcement agencies are staffed by approximately 203,466 police officers. There are 1,577 hospitals in the study area with over 1.3 million paid employees (Table 3.10-2).

Table 3.10-2. Emergency Services in the Study Area

	Fire Departments[a]		Law Enforcement Agencies[b]		Hospitals	
	Number	Volunteer or Mostly Volunteer	Number	Personnel	Number	Paid Employees
Illinois	1,103	81.5%	877	52,848	241	248,371
Indiana	762	88.7%	482	19,940	173	133,995
Iowa	731	95.9%	392	8,896	147	67,573
Michigan	962	86.9%	571	26,395	214	207,666
Minnesota	726	97.3%	448	15,458	160	124,701
Missouri	772	85.6%	576	22,484	168	136,855
Ohio	1,143	83.1%	831	37,295	259	271,524
Wisconsin	775	92.6%	529	20,150	155	109,511
Grand Total Plan Area	**6,974**	**88.1%**	**4,706**	**203,466**	**1,517**	**1,300,196**

Sources: Federal Emergency Management Agency 2015; U.S. Department of Justice 2011; United States Census Bureau 2013.

[a] Registered fire departments (estimated 90 percent of total).

[b] State and local.

3.11 Public Health and Safety

This section identifies the public health and safety issues in the study area, including activities typical of the wind industry that can result in public health or safety hazards.

3.11.1 Study Area and Approach

The public health and safety study area is concurrent with the Plan Area. This section qualitatively describes public health and safety issues as they pertain to the construction, operation, and decommissioning activities of wind energy facilities. The background information on these types of public safety concerns is based on information from scientific studies and data generated from wind energy projects currently operating in the United States.

3.11.2 Existing Conditions

Construction, operation, and decommissioning activities associated with wind energy facilities can generate public health and safety concerns. Public safety concerns associated with wind projects are largely related to potential injury or death associated with falling overhead objects. In particular, examples of such safety concerns include structural failure, ice shedding, lightning strikes, stray voltage, and fires. Another public safety concern related to wind projects is Wind Turbine Syndrome. Most of the safety issues described in this section are related to turbine operation or failure of one or more turbine components; however, issues pertaining to the construction and decommissioning of wind energy facilities are also briefly discussed. For a description of infrasound, please refer to Section 3.6, *Noise*. For a description of turbine flicker, please refer to Section 3.7, *Visual Resources*.

3.11.2.1 Construction

Public health and safety issues arising from wind energy facility construction are those typically associated with the construction of tall structures. Construction-related safety issues include the potential for injuries to workers resulting from falls from tall structures; falls into open excavations; accidents associated with movement of construction vehicles, equipment, and materials (e.g., where a worker is struck by heavy equipment, or caught/compressed between two structures); and electrocution. Specifically, during construction activities, workers may be situated at high elevations to access individual turbine sections for welding/fitting, electrical line installation, and/or installation of testing equipment. While at these high elevations, workers may be exposed to high winds, increasing potential fall hazards. Members of the public may also be exposed to some of these issues due to general construction site hazards and the siting of industrial equipment in potentially accessible areas (Occupational Safety & Health Administration 2015).

3.11.2.2 Operation

Public health and safety issues associated with the operation of a wind energy facility are largely related to potential injury or death from overhead objects falling. General public health and safety issues discussed in this section include structural failure (e.g., turbine collapse, blade shear), ice shedding, lightning strikes, stray voltage, and fire and fuels. According to the American Planning Association *Planning for Wind Energy*, the probability of injury or property damage from any of

these events is extremely small, and the residual risk can be minimized with the implementation of reasonable setback distances (American Planning Association 2011).

Structural Failure

Wind energy facility components are subject to failure, including turbine collapse, resulting from normal wear and tear, manufacturing issues, and unplanned stress(American Planning Association 2011). Blade shear occurs when a rotor blade is dropped or thrown from the nacelle. Wind turbine blades can break due to improper design, improper manufacturing or installation, wind gusts that exceed the design load of the wind turbine, or lightning (New York State Energy Research and Development Authority 2005). Additionally, broken blade pieces can be thrown from the wind turbine, with the mass, shape, speed, orientation, and prevailing wind speed determining the distance the broken pieces are thrown. Most instances of blade failure and wind turbine tower collapse were reported during the early years of the wind industry and were often attributed to human error in interfacing with the control system, poor or improper maintenance, blade strikes, or rotor overspeed (New York State Energy Research and Development Authority 2005).

Ice Shedding

Ice can accumulate on the blades, nacelle, and wind turbine tower during extreme cold-weather conditions (New York State Energy Research and Development Authority 2005). Two types of ice formation can occur on wind turbines: rime ice and glaze ice. Rime ice occurs when super cooled liquid water droplets from clouds or fog are transported by the wind, hit the surface of the wind turbine, and freeze immediately. Glaze ice, which is a smooth, transparent, and homogenous ice layer is caused by freezing rain, freezing drizzle, or wet in-cloud icing (International Energy Agency 2011). Ice shedding, or ice throw, refers to the phenomenon that can occur when ice accumulates on rotor blades and subsequently breaks free and falls to the ground. Gravity and mechanical forces of rotating blades can cause ice that has accumulated to shed from a turbine (Giguere 2006). This falling ice may result in injury to site workers, the general public, or damage to structures and vehicles (Giguere 2006). Additionally, ice fragments may be propelled by rotating turbine blades in a process called ice throwing. The distance traveled by the ice depends on the blade's position and location when the ice breaks off, the blade's rotational rate, the mass and shape of the ice (e.g., spherical, flat, smooth), and the prevailing wind speed (New York State Energy Research and Development Authority 2005).

Lightning Strikes

Wind turbines are susceptible to lightning strikes due to their height, metal composition, and location in open areas. Electrical currents associated with lightning can cause severe damage to the structural materials of the blade and can result in significant repair costs and wind turbine downtime (Garolera *et al.* 2015). All modern wind turbines include lightning protection systems designed to prevent catastrophic blade failure.

Stray Voltage

Wind energy facilities may generate stray voltage, which is a low-level electrical current that results primarily from an improperly grounded electrical distribution system. Stray voltage is a small voltage (less than 10 volts as defined by the U.S. Department of Agriculture) that can be measured between two possible contact points. When these two points are connected together by an object,

such as a person, a current will flow, and the person may feel a mild tingling sensation or experience an electrical shock (Pacific Gas and Electric Company 2007). Stray voltage may result from damaged, corroded, or poorly connected wiring or damaged insulation. The generation of stray voltage is based on factors such as operating voltage, geometry, shielding, rock/soil electrical resistivity, and proximity to ungrounded or poorly grounded metal objects.

Fuels and Fire

Fire risks associated with wind energy development projects are similar to those associated with other industrial facilities. Wind turbines contain relatively few flammable components. However, electrical generating equipment and cables, along with storage and use of various oils (including diesel fuels, lubricating oils, and hydraulic fluids), can create the potential for fire emergencies in wind turbines or substations, staging areas, and operations buildings. Additionally, lightning strikes are occasionally the cause of fires at wind energy facilities. A turbine fire is typically allowed to burn itself out while a safety area is maintained around the turbine and power to the affected turbine is disconnected (New York State Energy Research and Development Authority 2005). Fire emergencies at wind energy facilities may result in injuries to, or fatalities of, workers or members of the general public.

Wind Turbine Syndrome

Wind turbine syndrome, which is not currently a recognized medical diagnosis, is a term used to identify the suite of symptoms reportedly experienced by people who live near wind turbines. Symptoms included sleep disturbances, headaches, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, concentration and memory problems, and panic episodes. It has been suggested that these symptoms are related to infrasound emitted from the operation of wind turbines.

3.11.2.3 Decommissioning

Similar to construction, public health and safety issues arising from wind energy facility decommissioning are those typically associated with the deconstruction of tall structures. Decommissioning-related safety issues include the potential for injuries to workers resulting from falls from tall structures while dismantling and removing turbines; accidents associated with movement of construction vehicles, equipment, and materials, and electrocution while removing connector/interconnector lines and substations. Members of the public may also be exposed to some of these concerns due to general site hazards and the siting of industrial equipment in potentially accessible areas.

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3.12 Socioeconomics and Environmental Justice

This section describes socioeconomic and environmental justice conditions in the study area, including population, housing, labor force, output and earnings, and minority and low-income populations.

3.12.1 Study Area and Approach

The study area for the socioeconomics and environmental justice analyses, is concurrent with the Plan Area. Sources of data used in this section are derived from the U.S. Census Bureau, Bureau of Labor Statistics, Bureau of Economic Analysis, Department of Energy, National Renewable Energy Laboratory and state governments.

3.12.2 Existing Conditions

3.12.2.1 Population

Table 3.12-1 shows the 2010 population by state in the study area, as well as the estimated population through 2060. The most populous state in the study area is Illinois and the least populous is Iowa. Wisconsin and Minnesota have the highest estimated future growth. The two most populous states, Illinois and Ohio, are expected to have the lowest growth rate. Population density varies considerably within each state but the highest state population density is that of Ohio and the lowest that of Minnesota.

Table 3.12-1. Population in the Study Area, 2010–2060

State	2010	2020[a]	2030[a]	2060[b]	Population Density 2010 (per square mile)
Illinois	12,830,632	13,236,720	13,432,892	14,039,025	231
Indiana	6,843,802	6,852,121	7,143,795	8,095,448	181
Iowa	3,046,355	3,172,237	3,328,308	3,844,122	55
Michigan	9,883,640	10,695,993	10,694,172	10,688,711	175
Minnesota	5,303,925	5,687,161	5,974,304	6,925,684	67
Missouri	5,988,927	6,389,850	6,747,762	7,946,338	87
Ohio	11,536,504	11,574,870	11,615,100	11,736,631	282
Wisconsin	5,686,986	6,005,080	6,375,910	7,631,542	105
Grand Total	**61,120,771**	**63,614,032**	**65,312,243**	**75,012,590**	**136**

Sources: U.S. Census Bureau 2005, 2010, 2012a; StatsIndiana 2012; Iowa State Data Center 2009; Minnesota State Demographic Center 2015; Missouri Office of the Administration 2008; Ohio Development Services Agency 2013; Wisconsin Department of Administration 2013.

[a] Population estimates to 2020 and 2030 from state sources or from U.S. Census Bureau 2005, if not available.

[b] Population projections to 2060 use the same annual growth rate for the 2020–2030 period estimates.

3.12.2.2 Housing

Housing in the study area is shown in Table 3.12-2. Vacancy rates increased between 2005 and 2011 but generally decreased between 2011 and 2013 (U.S. Census Bureau 2013a, not shown in table). As of 2013, the overall vacancy rate in the study area (11.7 percent) was slightly below the U.S. average (12.4 percent); however, the vacancy rate was higher in some states (Michigan, Missouri and Wisconsin) than the U.S. average.

Table 3.12-2. Housing in the Study Area, 2013

State	Total	Occupied	Vacant	Vacancy Rate
Illinois	5,289,653	4,783,421	506,232	9.6%
Indiana	2,809,640	2,498,395	311,245	11.1%
Iowa	1,349,607	1,236,209	113,398	8.4%
Michigan	4,525,266	3,832,466	692,800	15.3%
Minnesota	2,368,754	2,119,954	248,800	10.5%
Missouri	2,719,109	2,362,853	356,256	13.1%
Ohio	5,124,126	4,564,745	559,381	10.9%
Wisconsin	2,633,420	2,289,424	343,996	13.1%
Total	**26,819,575**	**23,687,467**	**3,132,108**	**11.7%**
United States	132,808,137	116,291,033	16,517,104	12.4%

Source: U.S. Census Bureau 2013a.

3.12.2.3 Labor Force

The study area labor force is shown in Table 3.12-3. Unemployment rates vary considerably over time and are not possible to estimate reliably over a longer (e.g., 45-year) planning horizon. The average unemployment rate in the United States over the 50-year period between 1966 and 2014 was 6.1 percent (Bureau of Labor Statistics 2015a).

Table 3.12-3. Labor Force in the Study Area by State, 2014 Annual Average

State	Labor Force (thousands)	Employed (thousands)	Unemployed (thousands)	Unemployment Rate (percent)
Illinois	6,513	6,056	457	7.0
Indiana	3,237	3,041	196	6.1
Iowa	1,709	1,630	79	4.6
Michigan	4,749	4,406	343	7.2
Minnesota	2,971	2,853	119	4.0
Missouri	3,049	2,855	194	6.4
Ohio	5,708	5,390	318	5.6
Wisconsin	3,091	2,918	174	5.6
Total	**31,027**	**29,149**	**1,880**	**6.1**

Source: Bureau of Labor Statistics 2015a.

3.12.2.4 Output and Earnings

The study area generates approximately 18 percent of the gross domestic product of the country, with the largest economies being those of Illinois and Ohio. With the exceptions of Iowa and Minnesota, however, in recent years states in the study area have grown at annual rates below the U.S. average. Per capita income is slightly below U.S average, with the highest per capita income in the study area found in Minnesota and the lowest in Indiana. The study area as a whole obtains a larger share of its labor earnings from farming than the U.S. average, with the highest reliance on farm labor earnings being in Iowa, followed by Wisconsin (Table 3.12-4).

Table 3.12-4. Gross Domestic Product Personal Income in the Study Area by State, 2014

State	GDP (2014 $ millions)	Real GDP Growth (1997-2014)	Personal Income (2014 $ thousands)	Personal Income Per Capita (2014 $)	Source of Labor Earnings		
					Farm	Private Non-Farm	Government
Illinois	$745,875	1.2%	$619,808,386	$48,120	1.1%	84.9%	13.9%
Indiana	$317,840	1.6%	$260,133,424	$39,433	1.5%	85.3%	13.2%
Iowa	$170,613	2.1%	$140,177,207	$45,115	5.6%	79.1%	15.3%
Michigan	$451,516	0.5%	$401,900,691	$40,556	0.7%	84.8%	14.6%
Minnesota	$316,204	2.1%	$265,823,647	$48,711	1.3%	85.6%	13.0%
Missouri	$284,462	1.0%	$252,324,559	$41,613	1.0%	83.3%	15.8%
Ohio	$583,261	1.0%	$493,577,693	$42,571	0.4%	84.6%	15.0%
Wisconsin	$292,891	1.6%	$256,699,203	$44,585	2.1%	82.6%	15.4%
Total	**$3,162,662**	**1.2%**	**$2,690,444,810**	**$43,842**	**1.3%**	**84.3%**	**14.4%**
United States	$17,316,314	2.1%	$14,708,582,165	$46,129	0.9%	82.5%	16.5%

Source: Bureau of Economic Analysis 2014.
% = percent

Existing wind energy facilities have an economic value to the study area. In addition to providing energy, they support local employment and earnings and add value to local economies. Table 3.12-5 provides estimates of the economic contribution of currently installed wind energy capacity in the study area. Estimates were obtained using the National Renewable Energy Laboratory (NREL) Jobs and Economic Development Impact models for each state separately and inputting estimated current installed capacity, as provided by the U.S. Department of Energy (2015). The NREL Jobs and Economic Development Impact models were developed with industry input and are updated regularly. The NREL estimates assume 2,000-kilowatt (kW) turbines and operation and maintenance costs of $20 per kW in 2013 dollars. Table 3.12-5 also shows estimates for annual lease payments assuming payments of $6,000 per kW, also in 2013 dollars. The resulting estimates shown in Table 3.12-5 were updated to 2014 dollar values to allow comparison with values in Table 3.12-4 (using Bureau of Labor Statistics 2015b). Jobs are shown in Full-Time Equivalents[25].

[25] Full-time equivalent jobs corresponds to a full-time job held during 1 year. Full Time Equivalent jobs are not directly comparable with the jobs reported by the Bureau of Labor Statistics (such as those shown in Table 3.12-3) which may be full-time or part-time jobs.

Table 3.12-5. Contribution of Operations of Existing Installed Wind Energy Capacity in the Study Area

			Annual Estimated Impacts of Operations		
	Installed Capacity (MW) as of 2015[a]	Annual Land Lease Payment Estimates, 2014 $)	Value Added (millions of 2014 $)	FTE Jobs	Labor Earnings (millions of 2014 $)
Illinois	3,667	$11,182,265	$90.1	587	$39.4
Indiana	1,745	$5,322,856	$59.0	337	$18.2
Iowa	5,708	$17,401,409	$101.1	845	$44.9
Michigan	1,531	$4,670,455	$59.1	334	$18.0
Minnesota	3,035	$9,255,550	$53.9	438	$27.0
Missouri	459	$1,402,356	$5.9	63	$3.6
Ohio	435	$1,329,190	$19.0	103	$5.7
Wisconsin	648	$1,975,493	$10.0	94	$5.3
Grand Total[b]	**17,228**	**$52,539,574**	**$398.1**	**2,801**	**$162.1**

Sources: Department of Energy 2015; National Renewable Energy Laboratory 2015; Bureau of Labor Statistics 2015b.

MW = megawatts.

[a] The total MW of wind energy capacity in the study area reflects Department of Energy estimates in mid-2015. As part of the MSHCP development process, and to support their application for an Incidental Take Permit, the American Wind Energy Association has provided the Service with refined estimates of the anticipated installed wind energy capacity that will be available on the landscape by the end of 2015. This capacity is reflected as 18,004 MW, and is the metric used to consider potential impacts in this Environmental Impact Statement. For the purposes of this table, however, current (2015) Department of Energy data is used.

[b] Estimated value added, jobs and earnings impacts for the study area as a whole may be underestimated, given that impacts of wind farms in one state on value added, jobs and labor earnings in neighboring states are not included.

States in the study area tend to obtain between 50 percent and 65 percent of their revenue from taxes and charges. Federal government transfers correspond to 23 percent (Illinois) to 35 percent (Missouri) of state revenues, with the remaining being mostly insurance trust revenues and utility revenue. Sales and individual income taxes are typically over 80 percent of state tax revenues. Local governments in the study area obtain between 48 percent (Michigan) and 61 percent (Missouri) of their revenues from taxes and charges, with transfers from Federal and state governments making up 29 percent (Missouri) to 45 percent (Michigan). Between 5 percent (Ohio) and over 9 percent (Missouri) of local revenues come from utilities, including electric power utilities. Revenue from electric power utilities can correspond to between one third and two thirds of total utility revenue. The main source of tax revenues for local governments is property tax, which generates between 59 percent (Missouri) and 94 percent (Wisconsin) of total tax revenues for local governments in the study area. Sales and gross receipts taxes are almost 30 percent of tax revenues for local governments in Missouri (U.S. Census Bureau 2012b).

A description of the provisions of public services in the study area is included as a separate section (see Section 3.10, *Public Services and Utilities*).

3.12.2.5 Environmental Justice

Environmental justice analysis consists of assessing to what extent minority or low-income populations are disproportionately affected by high and adverse impacts. Characterization of the affected area for environmental justice analysis consists of identifying minority and low-income populations present in the study area. The term *minority* refers to members of American Indian, Asian or Pacific Islander, Black, or Hispanic groups. The term *low-income* refers to individuals that are below the poverty thresholds defined by the U.S. Census. Minority and low-income *populations* are communities where the presence of minorities or low-income people is greater than 50 percent or meaningfully greater than in a geographic area of comparison (Council on Environmental Quality 1997).

Table 3.12-6 below shows the share of the population in the study area that belongs to a minority population group or that is low-income. None of the states in the study area have more minority individuals, as a share of their total populations, than the country as a whole. Individual minority categories are more present in some states than in the country as a whole. This is the case of African Americans in Illinois and Michigan, and American Indians in Minnesota and Wisconsin. Michigan, Ohio and Missouri have a greater share of their populations in poverty than the country as a whole.

Figure 3.12-1 shows counties in the study area with the presence of minorities or individuals in poverty above the average rates of the study area. Minority and low-income populations may also exist at a smaller scale (within counties). The potential presence of minority populations in sub-county areas is typically less likely in rural areas, but may still occur (Housing Assistance Council 2012). The share of the population that is low-income is typically greater in rural areas than in urban areas (U.S. Department of Agriculture, Economic Research Service 2015).

There is some evidence that subsistence consumption of wildlife in the study area may make minority and low-income populations more vulnerable to potential environmental impacts, particularly to the extent that fish advisories may not reach minority and low-income populations to the same extent as they do others (Schroeder and Fulton 2005; Madison Environmental Justice Organization 2009; Kalkirtz *et al.* 2008).

Table 3.12-6. Minority and Low-Income Presence in the Study Area, 2013

	Total Population	Percentage of Total Population									
		White	Black or African American	Alaskan Native or American Indian	Asian	Native Hawaiian and Other Pacific Islander	Other Race	Two or More Races	Hispanic or Latino	Total Minorities	Individuals in Poverty[a]
Illinois	12,848,554	72.5%	14.4%	0.2%	4.7%	0.0%	6.0%	2.1%	16.0%	36.7%	14.1%
Indiana	6,514,861	84.6%	9.1%	0.2%	1.7%	0.0%	2.3%	2.1%	6.2%	18.9%	15.4%
Iowa	3,062,553	91.5%	3.0%	0.3%	1.8%	0.0%	1.4%	1.9%	5.1%	11.8%	12.4%
Michigan	9,886,095	79.3%	14.0%	0.6%	2.5%	0.0%	1.1%	2.5%	4.5%	23.7%	16.8%
Minnesota	5,347,740	85.6%	5.2%	1.1%	4.2%	0.0%	1.4%	2.5%	4.8%	17.4%	11.5%
Missouri	6,007,182	83.0%	11.5%	0.4%	1.6%	0.1%	1.1%	2.3%	3.7%	19.3%	15.5%
Ohio	11,549,590	82.9%	12.1%	0.2%	1.7%	0.0%	0.8%	2.2%	3.2%	19.2%	15.8%
Wisconsin	5,706,871	87.0%	6.2%	0.9%	2.3%	0.0%	1.5%	2.0%	6.1%	17.0%	13.0%
Study Area	60,923,446	81.4%	10.9%	0.4%	2.8%	0.0%	2.3%	2.2%	7.0%	22.9%	14.7%
United States	311,536,594	74.0%	12.6%	0.8%	4.9%	0.2%	4.7%	2.8%	16.6%	36.7%	15.4%

Source: U.S. Census Bureau 2013b.
% = percent
[a] Percent of population for which poverty status is determined.

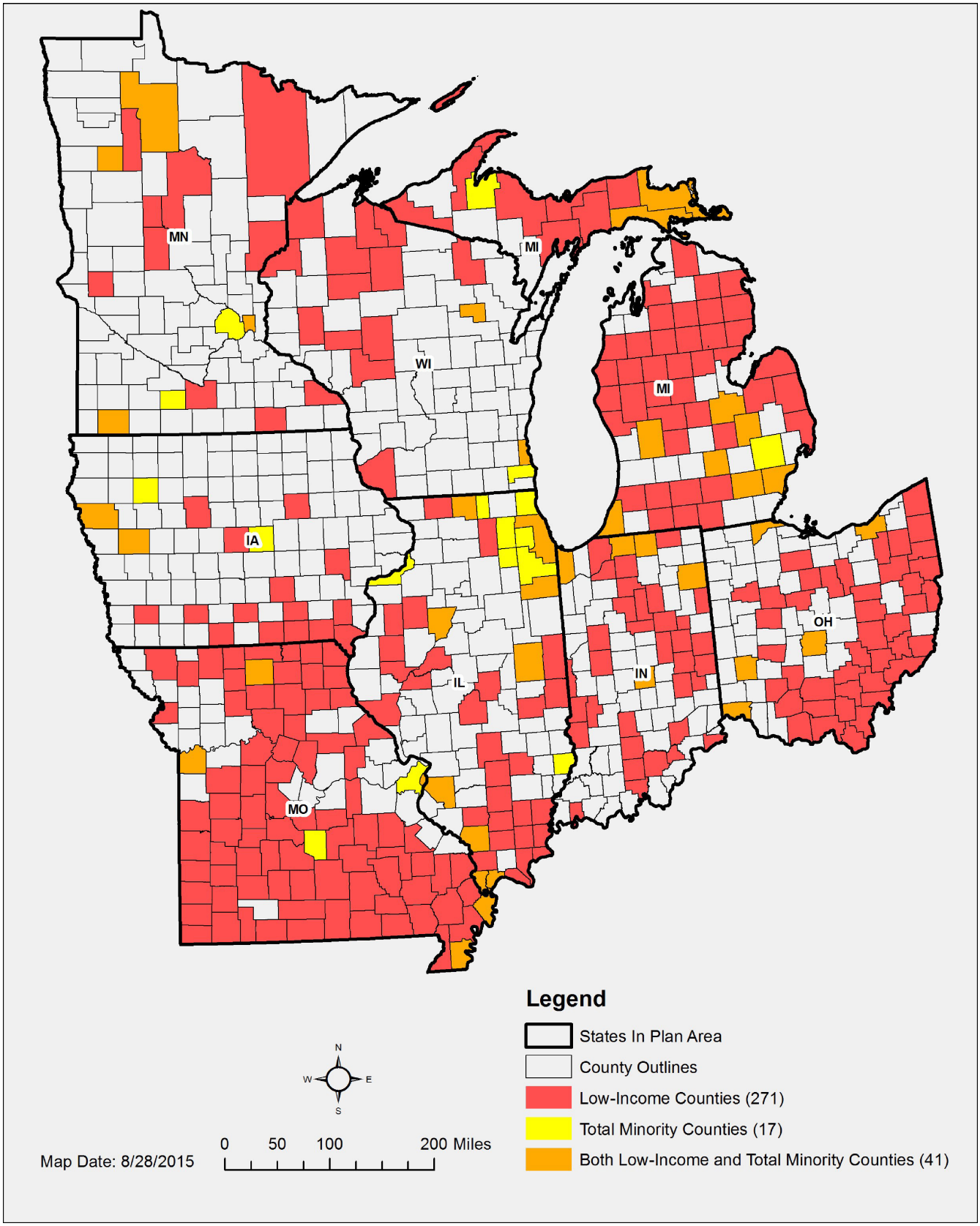

Figure 3.12-1
Total Minority and Low-Income Counties
Midwest Wind Energy Multi-Species HCP EIS

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3.13 Cultural Resources

This section describes cultural resources in the study area. Cultural resources include archaeological, historic and prehistoric resources, as well as Native American resources.

3.13.1 Study Area and Approach

The study area for cultural resources is concurrent with the Plan Area. Given the scale of the study area, this section broadly describes the cultural resources setting, the types of cultural resource that may occur, and where they are likely to occur. The cultural resources setting description is based on a review of relevant literature. Information on the type and likely location of cultural resources within the study area is derived from the National Park Service National Register of Historic Places (National Register) and National Historical Landmarks (NHL) lists, updated through July 2015.

The National Register was reviewed to identify known historic properties that occur in the study area. *Historic properties* include any prehistoric or historic buildings, structures, districts, objects and sites listed in, or eligible for listing in, the National Register. Authorized by the National Historic Preservation Act of 1966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archaeological resources. Properties are listed in the National Register if they possess integrity and meet one of the following four criteria from 36 Code of Federal Regulations (CFR) Part 60:

- A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
- B. That are associated with the lives of significant persons in the present or the past; or
- C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- D. That have yielded or may be likely to yield, information important in history or prehistory.

As of August 2015, 90,000 historic properties throughout the United States have been listed in the National Register.

The NHL list was also reviewed to identify cultural resources in the study area. National Historic Landmarks are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States. Places may be considered for NHL designation if they are of national significance and meet one of the additional criteria set forth in 36 CFR § 65.4:

1. associated with events that have made a significant contribution to, and are identified with, or that outstandingly represent, the broad national patterns of United States history and from which an understanding and appreciation of those patterns may be gained; or
2. associated importantly with the lives of persons nationally significant in the history of the United States; or
3. represent some great idea or ideal of the American people; or

4. embody the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style or method of construction, or that represent a significant, distinctive and exceptional entity whose components may lack individual distinction; or
5. composed of integral parts of the environment not sufficiently significant by reason of historical association or artistic merit to warrant individual recognition but collectively compose an entity of exceptional historical or artistic significance, or outstandingly commemorate or illustrate a way of life or culture; or
6. have yielded or may be likely to yield information of major scientific importance by revealing new cultures, or by shedding light upon periods of occupation over large areas of the United States. Such sites are those which have yielded, or which may reasonably be expected to yield, data affecting theories, concepts and ideas to a major degree.

Ordinarily, cemeteries, birthplaces, graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings and properties that have achieved significance within the past 50 years are not eligible for designation. Such properties, however, will qualify if they fall within the following categories:

1. A religious property deriving its primary national significance from architectural or artistic distinction or historical importance; or
2. A building or structure removed from its original location but which is nationally significant primarily for its architectural merit, or for association with persons or events of transcendent importance in the nation's history and the association consequential; or
3. A site of a building or structure no longer standing but the person or event associated with it is of transcendent importance in the nation's history and the association consequential; or
4. A birthplace, grave or burial if it is of a historical figure of transcendent national significance and no other appropriate site, building or structure directly associated with the productive life of that person exists; or
5. A cemetery that derives its primary national significance from graves of persons of transcendent importance, or from an exceptionally distinctive design or from an exceptionally significant event; or
6. A reconstructed building or ensemble of buildings of extraordinary national significance when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other buildings or structures with the same association have survived; or
7. A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own national historical significance; or
8. A property achieving national significance within the past 50 years if it is of extraordinary national importance.

Currently, just over 2,500 historic places have the national distinction of being on the NHL list, with all NHLs automatically listed in the National Register. The location of NHLs provide a general idea of where National Register-listed properties are most likely to be encountered in the study area. In addition, examination of the types of properties listed as NHLs in the study area may provide insight

into the type of National Register-eligible and listed properties that may be encountered more generally.

3.13.2 Existing Conditions

3.13.2.1 Cultural Resources Setting

The entire study area has been influenced by the movement and settlement of different and diverse groups of people over thousands of years. Although comprised of eight distinct states, it is important to note that the study area maintains some consistency regarding its pre-history and history. Agriculture has always been important to the people living in study area, as has the use of the many rivers, which provide for fertile lands and move people and goods. Over time, as the population of the study area shifted from pre-historic cultures to modern day, forested land has been cleared and regrown, and cities have grown up where small communities once stood.

The earliest period during which strong evidence exists for prehistoric occupations in the American Midwest is the Paleo-Indian period (12,500 – 9,500 B.P.). Paleo-Indian people are commonly characterized as small groups of highly mobile, nomadic hunters and foragers. From 9,500 B.P. to approximately 2,750 B.P., peoples of the Archaic Tradition inhabited the Midwest. Most early Archaic sites seem to represent low density, temporary encampments occurring in a variety of ecological settings. (United States Army Corps of Engineers 2007).

The majority of the study area, especially along the Ohio and Mississippi river valleys, was inhabited by the peoples of the pre-historic Woodland people (such as the Hopewell) until 1000 AD when the Mississippian culture emerged. Both societies engaged in agricultural practices, growing corn, beans and squash, as well as hunting game, such as deer, buffalo and beaver. As such, there would have been both permanent settlements and seasonal camps. The Woodland people were also known for their unique burial mounds, many of which remain *in situ* today.

The first non-Native Americans who entered this region would have encountered the Shawnee, Miami, Chippewa, Potawatomi, Osage, Sauk, Sioux, Illini tribes and confederacies, among many others, as they explored the rivers looking for goods such as fur and lumber to trade back east. Other pioneers coming from the eastern United States included those who wanted to spread the Christian faith. Early European settlements were usually small, located along a river or known trail, and often were dominated by a military installation, a religious mission, or a trading post. The French were the first to arrive to the region in the mid-1600s, but following the conclusion of the French and Indian War in 1763, the British gained control of much of the study area.

Once the Revolutionary War ended, lands in the study area reverted to possessions of the United States. Soon thereafter, in the 1780s, the Northwest Territory was formed, which included Michigan, Ohio, Indiana and Illinois, and parts of Wisconsin and Minnesota. As a result, the region became more stable for settlement and more people took advantage of their ability to claim land. Missouri, for example, was known as the "Gateway to the West" during this period of westward expansion. It was often the starting point for those heading out along the Santa Fe and Oregon trails. Forts, missions and trading posts enlarged as more people flooded into this territory, which was often the starting point for further migration to the western portion of the country.

Throughout the 1800s and into the 1900s, people from different European counties created new communities in the Northwest Territory (and later states), such as the Germans and Swedes in Minnesota. These distinct communities influenced the formation of their built environment,

including the type and style of architecture that was constructed, as well as how towns were planned. These practices and techniques are still evident throughout the study area.

3.13.2.2 National Register of Historic Places and National Historic Landmarks

There are more than 17,500 National Register-listed properties in the study area, making it impractical to identify all National Register-listed properties by type and location, either on maps or in tabular format. Accordingly, this section considers the location and type of NHLs in the study area, as depicted on Figure 3.13-1 and summarized in the Table 3.13-1.

National Historic Landmarks in the study area include civic buildings (such as state capitols, courthouses and jails), private residences, department stores and other commercial buildings, churches and temples, theaters and music halls, hotels, train stations/depots, forts and battlefields and earthworks, bridges and tunnels, farms and farmsteads, mills, mines, memorials, and water vessels, historic districts, and cemeteries (Table 3.13-1). NHLs in the study area are primarily located in larger cities, along state borders, along rivers and major roads and large waterbodies.

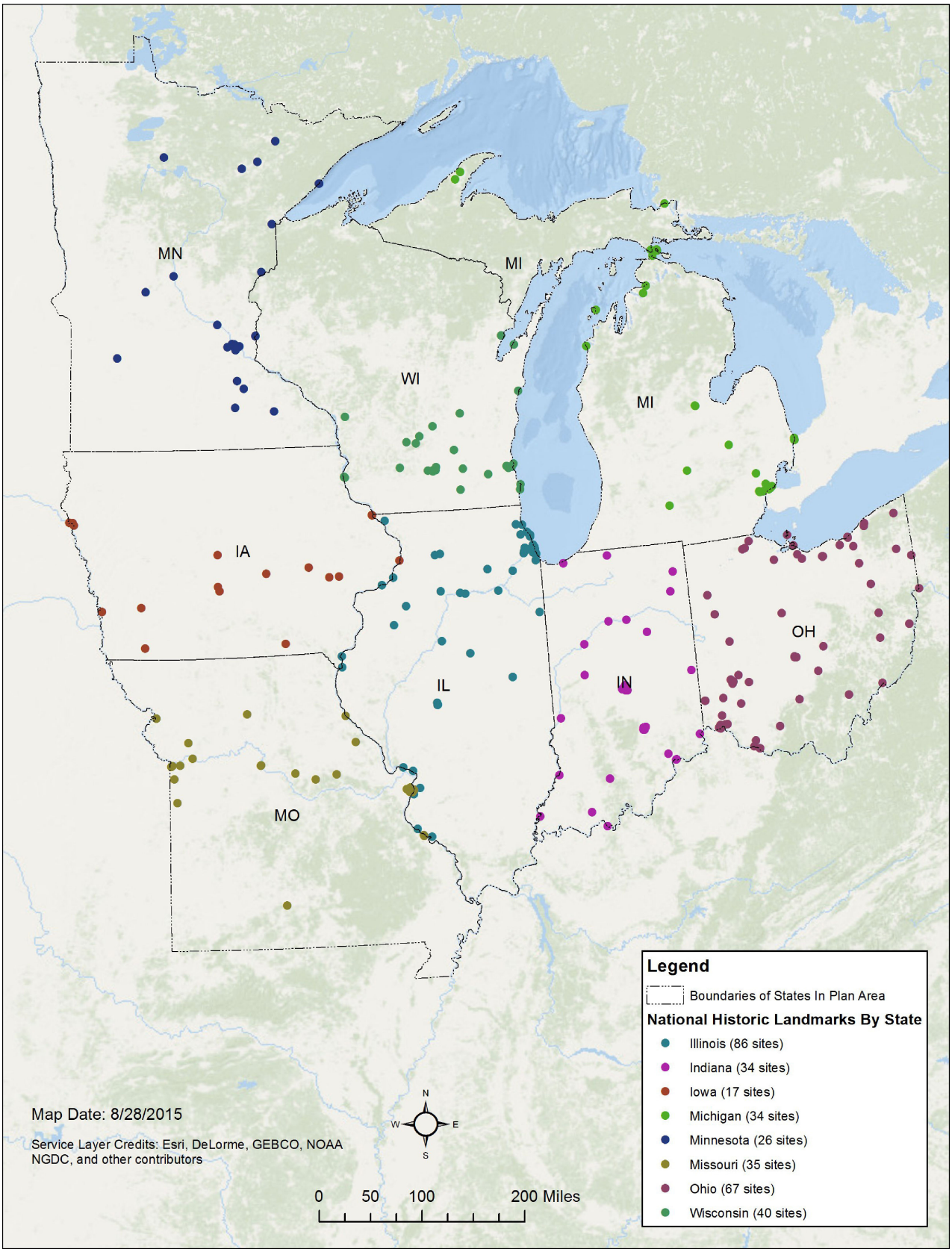

Figure 3.13-1
National Historic Landmarks in the Study Area
Midwest Wind Energy Multi-Species HCP EIS

Table 3.13-1. National Historic Landmarks in the Study Area

State	Number of National Register properties	Number of National Historic Landmarks	Most common locations of National Historic Landmarks
Illinois	1,796	86 (88)	Southwest part of the state, Chicago, along the Illinois River.
Indiana	1,820	37 (40)	Indianapolis, the Wabash River and along the southern border with Kentucky.
Iowa	2,245	25 (25)	Sioux City, Des Moines, border with Illinois and Wisconsin.
Michigan	1,840	35 (41)	Detroit, Mackinac Island and Port Huron.
Minnesota	1,662	27 (25)	Minneapolis/St. Paul, and along the Mississippi River.
Missouri	2,214	38 (37)	St. Louis, Kansas city and along the Missouri River.
Ohio	3,878	68 (72)	Cincinnati, I-75 corridor, along the northern boundary with Lake Erie and the I-77 corridor.
Wisconsin	2,288	42 (42)	Madison, Milwaukee and the lower center of the state.

Source: National Park Service 2015.

[1] Count comes from the NHL excel file downloaded on August 18, 2015: http://www.nps.gov/nhl/find/database.htm.

[2] Count comes from pdfs downloaded from the NHL website on August 25, 2015: http://www.nps.gov/nhl/find/statelists.htm.

3.13.2.3 Cultural Significance of Bald Eagle

The bald eagle is considered sacred among many Native American tribes, and is an important aspect of many cultural and religious practices. In many Native American cultures, the bald eagle is considered a messenger of God or of departed tribe members and, accordingly, treated with reverence and held in high esteem. Nesting sites are considered by some tribes as sacred or religious sites, and parts of bald eagles, including the bones and feathers, are a significant element in many religious practices (American Eagle Foundation 2015).

3.13.2.4 Native American Consultation

During the scoping period for the EIS, the Service sent email notifications to 35 Native American tribal representatives located throughout the study area. (Table 3.13-2) Tribal representatives were invited to provide comment during the scoping period, and provided a copy of both the project-specific new release and Frequently Asked Questions document. No input from tribal representatives has been received to date.

Table 3.13-2. Federally Recognized Tribes in the Study Area

State[1]	Federally Recognized Tribes
Iowa	Sac and Fox Tribe of the Mississippi in Iowa
Michigan	Bay Mills Indian Community
	Grand Traverse Band of Ottawa and Chippewa Indians
	Hannahville Indian Community
	Keweenaw Bay Indian Community
	Lac Vieux Desert Band of Lake Superior Chippewa Indians
	Little River Band of Ottawa Indians
	Little Traverse Bay Bands of Odawa Indians
	Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians of Michigan
	Nottawaseppi Huron Band of Potawatomi
	Saginaw Chippewa Indian Tribe of Michigan
	Sault Sainte Marie Tribe of Chippewa Indians
	Pokagon Band of Potawatomi Indians
Minnesota	Bois Forte Band of Lake Superior Chippewa
	Fond du Lac Band of Lake Superior Chippewa
	Grand Portage Band of Lake Superior Chippewa
	Leech Lake Band of Ojibwe
	Lower Sioux Indian Community
	Mdewakanton Sioux Indians
	Mille Lacs Band of Ojibwe
	Prairie Island Indian Community
	Red Lake Band of Chippewa Indians
	Shakopee Mdewakanton Sioux Community
	Upper Sioux Community of Minnesota
	White Earth Nation
Wisconsin	Bad River Band of Lake Superior Tribe of Chippewa Indians
	Forest County Potawatomi Community
	Ho-Chunk Nation
	Lac Courte Oreilles Band of Ojibwe
	Lac du Flambeau Band of Lake Superior Chippewa Indians
	Menominee Indian Tribe of Wisconsin
	Stockbridge-Munsee Community
	Oneida Tribe of Indians of Wisconsin
	Red Cliff Band of Lake Superior Chippewa
	St. Croix Chippewa Indians of Wisconsin
	Sokaogon Chippewa Community of Wisconsin

Source: National Conference of State Legislatures 2015.

[1] According to the National Conference of State Legislatures, no federally recognized tribes have been identified in the states of Indiana, Illinois, Missouri, and Ohio; however, tribes may be present in these states through possession of cross-border lands.

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Chapter 4
Environmental Consequences

4.0 Environmental Consequences

This chapter describes the potential environmental consequences of the alternatives considered in this Environmental Impact Statement (EIS) on the thirteen resource areas described in Chapter 3, *Affected Environment*. Each section includes a description of the resource-specific methods used to characterize the direct and indirect effects of the alternatives, an analysis of the potential effects of the alternatives, and a comparison of the effects of the action alternatives. A description of the cumulative effects of the alternatives is provided in Chapter 5, *Cumulative Effects*.

The following subsections summarize the study area, alternatives, and methodology used to complete the effects analysis in this chapter.

4.0.1 Plan Area, Covered Lands, and Study Area

As described in Section 3.0.1, *Plan Area, Covered Lands, and Study Area*, each action alternative would be implemented within an eight-state *Plan Area* that encompasses all lands under the jurisdiction of the Midwest Region of the U.S. Fish and Wildlife Service (Service), including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin (see Figure 1-1). The geographic area where incidental take authorization will be allowed under the action alternatives, referred to as *Covered Lands*, is a subset of the Plan Area and specifically excludes lands of particular importance to bat and migratory bird species, as well as a wide range of other wildlife (see Figure 1-2). The following areas are excluded from Covered Lands:

- Land within 20 miles of known sensitive bat hibernacula[26] identified by the Service and state wildlife agencies; this minimizes the potential for impacts on habitats supporting major concentrations of covered bat species;
- Land within 3 miles of the shores of the Great Lakes[27]; this minimizes the potential for impacts of wind energy development on migrant water, shorebirds, and other migratory birds;
- Land within 1 mile of the edges of major rivers supporting bird migration corridors and/or concentrations of wintering waterfowl;
- Land within floodplain areas along the Mississippi and Illinois rivers; this minimizes the potential for impacts on important bird and bat migratory corridors;
- Land near high bat concentration areas in southern Indiana and Missouri; and
- Land within bird migratory areas in Illinois and around large lakes in Minnesota.

The study area, as the term is used in this chapter, represents the area considered in completing the effects analysis, and varies by resource area. In some cases, the study area is the same as the Plan

[26] Sensitive bat hibernacula generally include Priority 1 and Priority 2 hibernacula as identified by the Service at the time the plan was developed.

[27] Offshore wind energy projects, including wind energy development on the Great Lakes, is not contemplated in (or covered under) the MSHCP or action alternatives.

Area. For other resource areas, the study area extends beyond the boundary of the Plan Area to account for potential effects on resources affected by the Covered Activities. For example, the study area for air quality encompasses the Plan Area as well as all nonattainment and maintenance areas that overlap the Plan Area to account for construction and operation-related air emissions that may occur as a result of Covered Activities. A description of the study area is provided in each resource-specific section.

4.0.2 Alternatives Evaluated

As described in Section 2.2, *Alternatives Analyzed in Detail*, this EIS considers four alternatives in detail:

- Alternative A – Proposed Multi-Species Habitat Conservation Plan (MSHCP) Alternative
- Alternative B – Reduced Permit Duration Alternative
- Alternative C – Increased Cut-In Speed Alternative
- Alternative D – No Action Alternative

These alternatives reflect a reasonable range of alternatives that meet both the requirements of the National Environmental Policy Act (NEPA) and the purpose and need of the proposed action, as described in Section 1.2.1, *Purpose and Need for Action*. These alternatives were developed by the Service, with input from the state conservation agencies responsible for managing natural resources within the Plan Area. Input provided by the public, non-governmental organizations, and other interested stakeholders during the scoping period also informed the development of alternatives.

Each of the alternatives is summarized below, with a focus on the components that are relevant to the impact analysis including some of the assumptions used in the resource-specific analyses.

4.0.2.1 Alternative A – Proposed MSHCP Alternative

Under Alternative A, incidental take permits (ITPs) or Certificates of Inclusion (COIs) will be issued for activities covered in the MSHCP, or *Covered Activities*, including the construction, operation, maintenance, decommissioning and reclamation, and repowering of existing and future land-based commercial wind energy facilities with Covered Lands (see Section 2.1.3, *Covered Activities*). Incidental take coverage will be provided for the eight Covered Species listed in Table 2-1; impacts to other federally listed species could either be avoided through siting and best management practices (BMP), or addressed through a separate and site-specific Endangered Species Act (ESA) Section 10(a)(1)(B) permitting process (see Chapter 1 for more detail on this). If impacts to other federally listed species cannot be avoided, and an applicant does not obtain a separate permit for that species, an ITP under the MSHCP to that particular, nonconforming applicant will not be issued. Alternative A also includes minimization, monitoring, reporting, and compensatory mitigation requirements as part of the conservation strategy for Covered Species. These are discussed in Chapter 2 of this document.

The proposed term of the MSHCP under Alternative A is 45 years. During the first 5 years, up to 18,004 megawatts (MW) of existing installed wind energy in Covered Lands could apply for and receive incidental take authorization under the MSHCP after review by the Service, provided they implement the avoidance, minimization, monitoring, and mitigation requirements provided in the MSHCP. An additional 33,000 MW of new commercial wind energy facilities within Covered Lands could opt-in to the MSHCP during the first 15 years of the MSHCP. Incidental take authorizations will

be issued for a period of 30 years, up to the 45 year term of the MSHCP. Chapter 7 of the MSHCP describes monitoring, adaptive management, and reporting, including how new species added to ESA will be dealt with by the MSHCP.

4.0.2.2 Alternative B – Reduced Permit Duration Alternative

Under Alternative B, new wind energy facilities in the Plan Area will have 5 years to opt-in to the MSHCP and the total term of the MSHCP will be 35 years (compared to Alternative A which allows new wind energy facilities to opt-in for 15 years and the term of the MSHCP will be 45 years). Consistent with Alternative A, existing commercial wind energy projects will still have 5 years to opt-in to the MSHCP, and incidental take authorizations (via an individual ITP or COI) will be issued for a period of 30 years to account for the operational life of most wind projects.

Because new wind energy will only have 5 years instead of 15 years to opt-in, the number of wind energy facilities that may receive incidental take authorization under Alternative B will likely be smaller than that anticipated under Alternative A. As described in more detail in Chapter 2, for the purposes of comparing alternatives, it is assumed that up to 11,000 MW of new wind energy capacity could be installed in Covered Lands and receive incidental take authorization through the MSHCP under Alternative B during the 5-year opt-in period (as compared to 33,000 MW during the 15-year opt-in period under Alternative A). The same capacity of existing wind energy facilities within Covered Lands—18,004 MW—are eligible to participate in the MSHCP under Alternative B.

Under Alternative B, the Service will only authorize incidental take for up to 11,000 MW of new wind energy capacity; however, it is possible that other wind energy infrastructure will be constructed within the Plan Area over the term of the MSHCP. This EIS assumes that an additional 22,000 MW of new wind energy capacity could be constructed in the Plan Area, for a total of 33,000 MW of total build-out capacity (consistent with Alternative D). Additional new construction under Alternative B could occur anywhere within the Plan Area, but will require either a separate ESA Section 10(a)(1)(B) permit from the Service, or avoidance of impacts to federally-listed species.

All other aspects of the MSHCP described for Alternative A will be the same for Alternative B.

4.0.2.3 Alternative C – Increased Cut-In Speed Alternative

Under Alternative C, the conservation strategy in the MSHCP will be revised to increase cut-in speeds during high risk periods for covered bats. Specifically, cut-in speeds will be increased to 5 meters per second (mps) during the spring migration period and 6.5 mps during the fall migration period (Table 2-8). In addition, cut-in speeds will be increased to 6.5 mps in the summer where the presence of covered bats has been documented, and during specified periods where turbines are located in close proximity to maternity colonies and/or swarming/staging areas as described in Table 2-8.

All other aspects of the MSHCP are the same as described under Alternative A.

4.0.2.4 Alternative D – No Action Alternative

As described in detail in Chapter 2, under Alternative D, the Service will not issue ITPs or concur with COIs for wind-related construction and operational activities under the MSHCP. Future and existing wind energy developers and operators will then continue to be required to either avoid incidental take of federally listed species and eagles through siting and operational changes, or

pursue project-specific ESA Section 10(a)(1)(B) permits and/or eagle permits, as necessary. Wind energy developers unable to avoid take of federally listed species and/or eagles, and who operate without ESA and Eagle Act permits, could be subject to enforcement action by the Service.

If wind energy developers and operators seek project-specific ITPs (not utilizing the MSHCP) under Alternative D, the minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will not be available under Alternative D, and opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service will be limited.

Under Alternative D, this EIS assumes there are 18,004 MW of installed wind energy in the Covered Lands, and up to 33,000 MW of new wind energy capacity could be developed in the Plan Area. New wind energy facilities could be constructed anywhere within the Plan Area and would not be limited to Covered Lands.

For most resource areas (with the notable exception of biological resources), the impacts under Alternative D will be generally the same as those described for Alternative A. However, because new wind energy development under Alternative D could occur anywhere within the eight-state study area (rather than limited to Covered Lands) and may not be reviewed by the Service, the location and intensity of these impacts will not be the same.

4.0.3 Methods for Assessing Direct and Indirect Effects

NEPA requires Federal agencies to consider the direct and indirect effects of their actions (40 Code of Federal Regulations [CFR] 1502.16). Direct effects are caused by the Federal action and occur at the same time and place as the action (40 CFR 1508.8(a)). Indirect effects are those that are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8(b)).

The level of detail in the analysis of direct and indirect effects is driven by the underlying action before the agency. The Federal action analyzed in this EIS is the approval of the MSHCP and the issuance of ITPs or COIs for Covered Species by the Service, pursuant to Section 10(a)(1)(B) of the ESA. This Federal action does not directly authorize the construction or operation of wind energy projects that may cause take of Covered Species; rather, an ITP from the Service provides an applicant with incidental take coverage from enforcement action under the ESA. Application for, and receipt of, other necessary construction or operation-related permits from other entities, as necessary, are a requirement of the ITP process before a project may be implemented.

Wind energy development projects within Covered Lands typically require other authorizations from other Federal, state, county and local agencies or ordinances, depending on their location (*i.e.,* which state or county they are located in) and site-specific resource constraints (e.g., the presence of sensitive habitats, proximity to sensitive noise or visual resource receptors, setbacks) (see Section 1.4.2, *State Permit and Consultation Requirements*). In this case, issuance of ITPs or COIs under the MSHCP could facilitate wind energy development by addressing one of the various statutory and regulatory requirements tied to project authorization, but will not unilaterally

approve such development (*i.e.,* other permits will be required from other entities in addition to Service authorizations).

Accordingly, the scope of the analysis in this chapter is focused principally on the potential effects that issuance of ITPs or COIs under the MSHCP will have on Covered Species, as well as any impacts associated with implementing the species avoidance, minimization, and mitigation measures provided in the MSHCP. The EIS is more detailed in its analyses of species and species habitats than for other aspects of the human environment (e.g., air quality, transportation, noise), given the direct relationship between issuance of ITPs and effects on wildlife species and their habitat. Potential impacts to other resource areas are discussed at a more programmatic level to reflect the indirect nature of the impacts of the alternatives, the geographic breadth of Covered Lands, and the lack of information on the precise location and timing of future wind energy development projects (or which existing wind energy facilities may opt into the MSHCP). In addition, the analysis of construction-related impacts is focused on new wind energy facilities rather than existing facilities, where construction impacts have already occurred and only operation of turbines and maintenance of existing facilities are ongoing.

For mitigation that is not required under the MSHCP, it is possible that mitigation measures could be developed at a later stage on a project-specific basis. Separate project-specific evaluations could be required and avoidance, minimization, and mitigation measures for projects could be identified based on those project-specific evaluations. Other agencies with authority over specific resources (such as wetlands) will likely impose requirements via required permitting on a project-specific basis as well.

As required by NEPA, the magnitude and incremental effects (qualitative or quantitative) of each alternative are disclosed and compared in this EIS. The NEPA regulations require that this evaluation discuss the context and intensity of each potential effect (40 CFR 1508.27). To provide the public with a meaningful understanding of how potential effects were considered in this EIS, each section in this chapter describes the general methods and approach by which the effects were evaluated. The methodology considered the relative magnitude of the potential direct and indirect effects of each alternative. In each resource-specific section, the impact analysis provides a conclusion determining whether the effects are anticipated to be minor (*i.e.,* minimal, negligible, or inconsequential), moderate (*i.e.,* more than minor, noticeable), or substantial (*i.e.,* more than moderate, and may rise to a level of significance). Although these criteria are subjective, they are intended to provide the public with a reference for comparing the relative effects of the four alternatives considered in this EIS.

For all of the resource areas, the action alternatives (Alternative A, B, and C), when compared to the No Action Alternative (Alternative D), either have the same impacts, or the action alternatives have the potential for lesser negative impacts and greater beneficial impacts (e.g., for biological resources). This is due to the MSHCP requirements that would be imposed on wind energy facilities taking part in the MSHCP, whether they are existing or new facilities. Because of the programmatic approach to the impact analysis and the nature of the proposed action being evaluated (implementation of the MSHCP), the majority of the impact analysis is provided under Alternative A. The other alternatives refer back to this analysis and its conclusions, and also draw comparisons to Alternative D, the No Action Alternative.

NEPA requires that an EIS describe any adverse environmental effects that cannot be avoided (42 United States Code [U.S.C.] 4332 (C)(ii)). That summary is provided in Section 6.2, *Unavoidable Adverse Effects*.

4.0.3.1 MSHCP Build-Out Model

As noted above, many of the effects analyses in this chapter are discussed at a programmatic level to reflect the indirect nature of the impacts of the alternatives, the geographic scope of Covered Lands, and the lack of specificity on where wind energy development may be located or authorized under the MSHCP. However, where possible, to provide some level of quantification of potential impacts under Alternative A, the effects analysis also considers the outputs from a predictive model developed in support of the MSHCP.[28] This predictive model—referred to as the associated wind power development potential (build-out) model—was used in the MSHCP to generate a series of realistic scenarios of how build-out of future wind energy development might be distributed across Covered Lands, considering landscape characteristics and associated wind energy development potential (e.g., distance to nearest transmission line, proximity to urban areas, wind power class). As described in Appendix B of the MSHCP, 100 randomized build-out scenarios were generated by the predictive model and used to assess potential direct and indirect impacts to Covered Species, based, in part, on species range, habitat requirements, and seasonal migration patterns.

For the effects analysis in this chapter, the 100 random outputs from the model were used, where possible, to approximate potential direct impacts to other resource areas by overlaying the model outputs with the extent of a specific mapped resource – such as wetlands and floodplains. Specifically, the model outputs were used to estimate the total acreage of specific mapped resources that new wind energy facilities will potentially encompass. After calculating the total acreage, an assumption was used that up to 5 percent of that area will be converted to turbine locations, access roads, and other associated wind-energy infrastructure. This assumption was based on estimates provided by the American Wind Energy Association (AWEA) that between 2 percent and 5 percent of total land surface (acreage for a wind energy facility) is typically converted from original land uses to turbine locations and associated infrastructure during development of new wind energy facilities (J. Anderson pers. comm.). For the purposes of this EIS, this acreage (*i.e.,* 5 percent of the MSHCP Build-Out Model output) represents the approximate area of direct impact from future wind energy development under Alternative A. Resource specific results, where applicable, are summarized in acres by state within the Plan Area.

A detailed description of the methods and specifications of the MSHCP Build-Out Model are provided in Appendix B of the MSHCP. The EIS analysis relies solely on the outputs from the MSHCP Build-Out Model; in-other words, the MSHCP Build-Out Model was not rerun specifically for the EIS analysis, and the 100 random outputs used in the MSHCP for the Covered Species assessments are the same outputs considered in this chapter. It is also important to note that the outputs from the MSHCP Build-Out Model are predictive, and should not be construed as specific development footprints. The actual implementation of future wind energy development within the Plan Area over the term of the MSHCP will vary depending on a variety of factors, and will be subject to other Federal or state permitting processes that may require avoidance of specific resources. For example, because the MSHCP Build-Out Model does not specifically account for the location of known wetland habitats, some future wind energy facilities may be sited by the model in wetland habitats. However, through various Federal and state permitting processes (e.g., Section 404 of the Clean Water Act [CWA]), it is

[28] See Chapter 4 and Appendix B of the MSHCP for more detail on the model.

anticipated that wind energy development proponents will be required to avoid wetland areas where possible, and mitigate for wetland impacts where they cannot be avoided. Accordingly, any quantification of potential impacts in this EIS derived from the MSHCP Build-Out Model should be considered representative rather than complete, and in many instances are inflated because the MSHCP Build-Out Model did not account for resource-specific constraints that will be accommodated in designing and siting individual facilities.

4.0.3.2 Consideration of Take from Collisions with Existing Turbines

This section considers the effects of the alternatives on various wildlife species, including the potential for the alternatives to result in incidental take of Covered Species (see Section 4.1.2.2), other protected bats (see Section 4.1.2.3), and migratory tree bat species (see Section 4.1.2.4) from collisions with turbines. As described below, there is some level of ongoing incidental take from the operation of existing wind turbines in the Plan Area. For the purposes of this EIS, the Service considers ongoing take from existing wind turbines the "baseline" level of take associated with Alternative D, and the level of take that is used to assess the relative effects of the action alternatives. The following assumptions are used in this section to consider the potential benefits of wind energy facilities opting into the MSHCP under Alternatives A, B, or C.

As summarized in Section 4.0.2, *Alternatives Evaluated,* under the action alternatives, existing facilities may receive incidental take authorization for Covered Species under the MSHCP provided they implement specific avoidance, minimization, monitoring, and mitigation requirements identified in the HCP designed to reduce the baseline (and future) level of take of Covered Species. Reductions in the baseline level of take will vary for individual facilities, but will generally be contingent on the size (MW) of the facility and where it is located (relative to the range of the species).

Although all of the action alternatives will allow up to 18,004 MW of existing facilities to opt-in to the MSHCP, it is unlikely they all will (*i.e.,* some facilities may not meet the eligibility standards for participation in the MSHCP, may operate under a facility-specific ITP, or may operate to avoid incidental take of federally listed species).

Similarly, the effects analysis for other biological resources considered in this section (e.g., vegetation communities) and other sections in Chapter 4 only consider full participation by existing wind energy facilities in the MSHCP because, from a resource perspective, their participation in the MSHCP, will likely represent a worst-case scenario of impacts for the purposes of the EIS analysis. For example, participation of all 18,004 MW of installed wind energy in the MSHCP will likely result in more maintenance-related impacts (e.g., dust generation, vegetation removal) under the action alternatives.

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4.1 Biological Resources

This section describes the potential impacts on biological resources in the study area for each of the alternatives.

4.1.1 Regulatory Context

4.1.1.1 Federal

- Endangered Species Act of 1973
- Bald and Golden Eagle Protection Act
- Migratory Bird Treaty Act (MBTA): The MBTA protects against the taking (intentional or incidental) of migratory species of birds, their occupied nests, and their eggs.

4.1.1.2 State

- Illinois Endangered Species Protection Act (520 ILCS/10)
- Iowa Endangered Plant and Wildlife Chapter of Iowa state code (Chapter 481B)
- Indiana Nongame and Endangered Species Conservation Chapter of Indiana state code (IC 14-22-34)
- Michigan Endangered and Threatened Species Act (M.C.L.A. 324.36501-07)
- Minnesota Statute (84.0895)
- Missouri Wildlife Code (3 CSR 10-4.111)
- Ohio Statute (1518.01-1518.05; 1531.25-1531.99)
- Wisconsin state endangered species statute (29.604)
- No state regulatory authority over non-listed species of birds, aside from hunting regulations on game birds (not applicable here). Protection measures for Species of Greatest Conservation Need, state “Special Concern” species, and Natural Heritage “tracked” species are generally voluntary by nature.
- Minnesota Noxious Weed Law (MN Statutes 18.75-18.91)
- Wisconsin Invasive Species Identification, Classification and Control Rule (Chapter 40, Wisconsin Administrative Code)
- Michigan Natural Resources and Environmental Protection Act – Prohibited and Restricted Weeds (Act 451, Act 329)
- Ohio Noxious Weeds (Chapter 901:5-37)
- Indiana Exotic and Invasive Plants (Title 14 and Title 15 of Indiana Code)
- Illinois Noxious Weed Law (Title 8, Chapter I, Subchapter F: Noxious Weeds, Part 220 Illinois Noxious Weed Law [505 Illinois Compiled Statute 100])

- Iowa Noxious Weeds and Weed Law (Chapter 317 of Iowa Code)
- Missouri Insect Pests and Weeds Law (Chapter 263 of Missouri Code)

4.1.2 Methods and Approach

The following sections discuss the approach for characterizing impacts on biological resources. Impacts are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known. Conclusions were drawn for the impacts across biological resources, using the terms established for this EIS – minor, moderate, or substantial. This was applied for consistency across the EIS; however, it should be noted that determining the severity of the impact for some resources is not possible without project specific information and will vary by species.

4.1.2.1 Vegetation Communities

The National Land Cover Data (NLCD) GIS data for the study area were overlain with the MSHCP build-out model to provide an estimate of potential vegetation impacts by state (refer to Section 4.0 for additional information regarding the build-out model). Vegetation impacts are also qualitatively described by identifying construction- and operation-related impact mechanisms of new commercial wind energy projects and associated facilities within Covered Lands. Impact mechanisms associated with mitigation activities under the MSHCP conservation strategy are also qualitatively described.

4.1.2.2 Covered Species

Covered Birds

Impacts to covered birds are qualitatively described by identifying construction- and operation-related impact mechanisms on bird breeding and migratory habitat of new commercial wind energy projects and associated facilities within Covered Lands. Impact mechanisms associated with mitigation activities for covered birds under the MSHCP conservation strategy are also qualitatively described. Impacts resulting in take of covered birds from collisions with wind turbine operations were assessed using calculations from the MSHCP.

Construction-Related Impacts

Impact to Kirtland's warbler potential breeding and nesting habitat in Covered Lands was quantified by a GIS analysis that intersected NLCD polygons of evergreen forest with the build-out model. The majority of evergreen forest in the Plan Area is comprised of upland forest types containing a significant proportion of jack pine (e.g., jack pine-red pine forest, jack pine-black spruce forest). This results in a conservative over-estimate of jack pine habitat as well as a conservative over-estimate of jack pine habitat that will be affected by wind energy facilities at full build-out. Jack pine forest is the appropriate land cover to represent potential breeding habitat of Kirtland's warbler. The analysis was done in those counties of Michigan and Wisconsin where the Service states that the species is known or potentially known to occur.

Breeding habitat for piping plover (including designated critical habitat) and interior least tern is outside of Covered Lands; therefore, there are no anticipated impacts to this habitat. Impacts to

migratory habitat for each specie were qualitatively analyzed by identifying potential migratory stopover habitat and locations (Pompei and Cuthbert 2006; Thompson *et al.* 1997; Howell and Engel 1993) and the construction impact mechanisms that could potentially affect those locations and habitat.

Operation-Related Impacts

Primary literature and data contained in the MSHCP were used to evaluate turbine collision impacts. Covered birds take data for Alternative D is taken directly from the MSHCP, which quantified bird take for existing wind energy facilities and future build-out of 33,000 MW of new wind facilities over the next 45 years without the AMMs that would be required under the MSHCP; this calculated take is considered the "baseline" level of take. The MSHCP did not quantify bird take numbers for wind energy developed under the requirements of the MSHCP because the effectiveness of AMMs at any one facility will vary depending on site-specific conditions. Because the MSHCP did not quantify take numbers that included the benefits of the AMMs, bird take is addressed qualitatively for Alternatives A, B, and C. Based on parameters contained in the MSHCP, biologists developed an estimate of the number of birds that will be killed per MW of capacity per year under baseline conditions (*i.e.,* Alternative D). This annual estimate was then multiplied by the number of MW on the landscape during a particular year based on the build-out model contained in the MSHCP. This calculated take number under baseline conditions (*i.e.,* Alternative D) is effectively a bird take cap which all other alternatives will be qualitatively evaluated against.

Kirtland's warbler's level of take during migration was calculated using the surrogate species blackpoll warbler (U.S. Fish and Wildlife Service 2007 – State Police communications tower study), a fatality rate at wind energy facilities (Erickson *et al.* 2014), and by adjusting for the average small bird fatality rate per MW in the Prairie Region (Erickson *et al.* 2014), as well as the ratio of all Kirtland's warbler to blackpoll warbler individuals. Take of piping plovers during migration was calculated by estimating the number of birds passing through Covered Lands, the number that will encounter a wind energy facility, and the number that will collide with a moving turbine blade. Census data were used to estimate that all 110 birds from the Great Lakes population and 1,865 birds from the Great Plains population migrate through Covered Lands (CITATION FOR MSHCP; Elliot-Smith *et al.* 2009). The model consisted of typical 300 MW wind energy facilities distributed proportionally across the states along the migration route. The resulting number of birds passing through wind energy facilities in the Covered Lands was multiplied by the probability of striking a moving turbine blade once inside a wind energy facility, using the Tucker (1996) model.

Other operations impacts to covered birds are qualitatively described by identifying operation-related impact mechanisms of new wind energy projects and associated facilities within Covered Lands.

Covered Bats

Construction-Related Impacts

All covered bats rely on forest habitat for foraging and roosting, as such forest loss is used to estimate loss of these habitat types. Impacts to covered bat habitats in Covered Lands was quantified by a GIS analysis that intersected NLCD polygons of forest with the build-out model within the range of each covered bat species. This analysis is summarized in Table 4-2 of the MSHCP, which includes predictions of the amount of forest suitable for use by covered bats that will be removed resulting from the permitted activities. Covered bat impacts are also qualitatively

described by identifying construction-related impact mechanisms of new commercial wind energy projects and associated facilities within Covered Lands.

Operation-Related Impacts

Primary literature and data contained in the MSHCP were used to evaluate turbine collision impacts. Bat take data for Alternative D is taken directly from the MSHCP, which quantified bat take for existing wind energy facilities and future build-out of 33,000 MW of new wind facilities over the next 45 years without the AMMs that would be required under the MSHCP; this calculated take is considered the "baseline" level of take. The MSHCP did not quantify bat take numbers for wind energy developed under the requirements of the MSHCP because the effectiveness of AMMs at any one facility will vary depending on site-specific conditions. Because the MSHCP did not quantify take numbers that included the benefits of the AMMs, bat take is addressed qualitatively for Alternatives A, B, and C. Based on parameters contained in the MSHCP, biologists developed an estimate of the number of bats that will be killed per MW of capacity per year under baseline conditions (*i.e.,* Alternative D). This annual estimate was then multiplied by the number of MW on the landscape during a particular year based on the build-out model contained in the MSHCP. This calculated take number under baseline conditions (*i.e.,* Alternative D) is effectively a bat take cap which all other alternatives will be qualitatively evaluated against.

Other operations impacts to covered bats are qualitatively described by identifying operation-related impact mechanisms of new wind energy projects and associated facilities within Covered Lands.

4.1.2.3 Other Rare, Endangered, Threatened and Candidate Species

All non-covered Federal- and state-listed species in the Plan Area were grouped into major categories (e.g., mammals, birds, reptiles) and assigned to a habitat using MGIN model habitats (forest, grassland, wetland, aquatic, unique) (The Conservation Fund 2015) within the Covered Lands (See section 3.1.2.3 *Other Rare, Endangered, Threatened, and Candidate Species*).

Potential loss of habitat for these species from wind energy development was quantified by overlaying the MSHCP build-out model on MGIN model habitats. Similarly, potential loss of critical habitat was evaluated for non-covered federally listed species by overlaying the MSHCP build-out model on critical habitat.

In addition, effects on non-covered Federal- and state-listed species were qualitatively described for construction and operations of new wind energy facilities and associated infrastructure by identifying impact mechanisms. Effects of mitigation in the Plan Area are also discussed.

Bats

The methodology to address construction- and operation-related impacts to other protected bats (Federal or state-listed species) is the same as described in Section 4.1.2.2, *Covered Species*.

For turbine collision impacts for other protected bats, mortality data and other parameters outlined in the MSHCP were used to create a clone of the model outlined by the MSHCP. This process allowed for the use of an identical approach to quantify potential impacts under Alternative D. For those species of bats whose range does not completely overlap the study area, range maps from the "Bats of" series (Boyles *et al.* 2009; Brack *et al.* 2010; Kurta 2008; Sparks *et al.* 2011; Feldhamer *et al.* 2015) were digitally overlain with the build-out model to produce an estimate of the projected

number of MW within the species range. For species with known mortality associated with White Nose Syndrome (WNS) operational mortality was reduced by the same 10 percent used in the MSHCP to address reductions in populations caused by WNS. However, the models are not spatially explicit and thus cannot identify increased mortality due to placing wind turbines in high risk areas. In these cases a general discussion of the potential risk is included based on data contained in the primary literature. Because the MSHCP did not calculate take that included the benefits of the AMMs, take for Alternatives A, B, and C are discussed qualitatively. Also, in some cases, species exist for which no prior mortality risk is known. In these cases, known behaviors were evaluated to provide an overview of risk. Relevant literature and detailed background data is included within the appropriate sections.

4.1.2.4 Other Wildlife Species

Other wildlife species are evaluated by general species groups in terms of impact mechanisms from constructing and operating wind energy facilities. The MGIN habitat GIS analysis that was used for non-covered Federal- and state-listed species was also used to quantify potential general habitat loss of other wildlife species since the MGIN habitats are generally higher quality habitats that could be associated with any wildlife. Effects on other wildlife species were also qualitatively described for construction and operations of new wind energy facilities and associated infrastructure by identifying impact mechanisms.

For turbine collision impacts for birds, mortality data and other parameters outlined in the MSHCP were used to ensure consistency between the Draft EIS and the MSHCP. Passerine birds represent 62.5 percent of all bird deaths at wind energy facilities, and 68 percent of all fatalities in the majority of the Plan Area (Erickson *et al.* 2014), and therefore are an important element of the analysis. Estimates of annual small bird fatalities at build-out were calculated for each of the eight states. Erickson *et al.'s* (2014) small bird fatality rate of 3.96 birds killed per MW per year was multiplied by the estimate of total MW build out in each state, as reported in the MSHCP. Total fatality estimates in each state under a 45 year permit duration scenario are also reported. These estimates include the first 15 years of wind energy development, which assumes linear annual wind development and assumes that build out will be reached in year 15. Total fatalities were also estimated for 30 years of operations after build out was complete.

In addition, the number of fatalities for all bird species combined was calculated in a similar way for each state, but using an extrapolated all-bird fatality rate of 5.82 birds per MW per year over the 45-year permit period. Erickson *et al.'s* (2014) analysis presents the most complete and recent fatality data for a large number of facilities, but the fatality rate is not specific to bird type in the Plan Area. For this reason a table showing percent of all fatalities by bird type is presented using Erickson *et al.*'s data. From this a general number of fatalities by bird type in the Plan Area can be estimated.

Migratory Tree Bats

The methodology to address construction- and operation-related impacts to migratory tree bats is the same as described in Section 4.1.2.2, *Covered Species*.

For turbine collision impacts for migratory tree bats, mortality data and other parameters outlined in the MSHCP were used to create a clone of the model outlined by the MSHCP. This process allowed for the use of an identical approach to evaluate Alternative D in terms of potential mortality for those species with known mortality estimates. Because the MSHCP did not calculate take that included the benefits of the AMMs, take for Alternatives A, B, and C are discussed qualitatively.

However, the models are not spatially explicit and thus cannot identify increased mortality due to placing wind turbines in high risk areas. In these cases a general discussion of the potential risk is included based on data contained in the primary literature. Relevant literature and detailed background data is included within the appropriate sections.

4.1.2.5 Other Fish and Aquatic Resources

Other fish and aquatic resources are evaluated in terms of impact mechanisms from constructing and operating wind energy facilities. Potential impacts to habitat were quantified using the MGIN habitat GIS analysis that was used for non-covered Federal- and state-listed species as described above, but with a focus on the aquatic MGIN habitats. Effects on other fish and aquatic resources were also qualitatively described for construction and operations of new wind energy facilities and associated infrastructure by identifying impact mechanisms.

4.1.3 Alternative A—Proposed MSHCP Alternative

Construction and operations-related impact mechanisms described for the installation of new wind energy facilities under Alternative A will be the same impact mechanisms for new wind energy facilities under baseline conditions (i.e., Alternative D). Those impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts under Alternative A would occur within Covered Lands, while impacts under baseline conditions (i.e., Alternative D) may vary because new wind development could occur anywhere within the Plan Area (rather than limited to Covered Lands). For the purposes of comparison with other alternatives, this EIS assumes that up to 33,000 MW of wind energy capacity could be developed in the Plan Area under baseline conditions (i.e., Alternative D), which is in addition to the 18,004 MW of existing wind energy in the Plan Area.

Covered Species impacts under Alternative A would be restricted to Covered Lands, which excludes areas of particular importance to these species (e.g., breeding habitat, migratory bird corridors, near bat hibernacula). Therefore, it is reasonable to assume that there is an overall reduced potential for impact to Covered Species under Alternative A compared to baseline conditions (i.e., Alternative D) because areas of greater sensitivity for Covered Species have been completely avoided under Alternative A. In addition, Alternative A would implement the requirements of the MSHCP across Covered Lands, which consists of a consistent conservation strategy that includes measures to avoid, minimize, and mitigate impacts; monitoring and reporting requirements; and adaptive management (see Chapter 2, *Conservation Strategy*). These requirements further reduce the risk of impact on Covered Species under Alternative A compared to baseline conditions (i.e., Alternative D) because Alternative D would not implement a consistent conservation strategy (if any at all) like Alternative A. For Other Rare, Endangered, Threatened, and Candidate Species, and Other Wildlife, it is possible that Alternative A will have less impact on these species compared to baseline conditions (i.e., Alternative D) because it is reasonable to assume that some of the components of the MSHCP conservation strategy (e.g., AMMs) that will be implemented under Alternative A will also provide benefits to some to these species compared to Alternative D. For example, lighting schemes on turbines and meteorological towers to minimize impacts to Covered Birds under Alternative A will benefit other birds that may be susceptible to collision impacts. The potential benefits of the MSHCP conservation strategy to these non-covered species would depend on the location of a proposed wind facility, the quality of the habitat present, and the species that may be in the vicinity of the wind facility.

4.1.3.1 Vegetation Communities

Construction-Related Impacts

Construction of wind energy facilities and associated infrastructure will affect vegetation by temporarily disturbing and permanently removing vegetation. Also, construction activities will compact soil, contribute to the establishment and spread of invasive weeds, and create and deposit dust, all of which will affect native plant growth. The severity of the impacts on vegetation discussed below will depend on the extent of construction of wind energy facilities and infrastructure and the abundance of the vegetation communities affected.

Temporarily Disturb and Remove Vegetation

Placement of fill material and structures for wind energy facilities and associated infrastructure will result in the permanent loss of vegetation. While it is anticipated that wind energy sites will be located in open areas, there may be some clearing or trimming of woody vegetation (shrub and forest areas) around a site or around associated infrastructure (access roads, transmission lines, etc.) for safe operations and maintenance. Any area permanently cleared of woody vegetation will permanently convert the area to nonwoody herbaceous cover. Some vegetation may be temporarily cleared and disturbed during construction to accommodate construction equipment and for staging. These areas will be restored and returned to previous conditions if they are not needed for operations or maintenance.

Table 4.1-1 summarizes potential impacts to vegetation communities by state from construction of new wind energy infrastructure under Alternative A. As described in the approach section above, these acreages were generated by overlaying NLCD data for the study area (see Section 3.1.1) with the MSHCP build-out model, which approximates where wind energy development may occur over the MSHCP permit term. Based on the GIS analysis, vegetation community impacts could be greatest in Illinois and Iowa, with the majority of impacts affecting the cultivated cropland vegetation cover class.

Decommissioning of wind energy sites could have short-term impacts on vegetation while the project infrastructure is removed. However, the reclamation process following decommissioning will result in beneficial impacts to vegetation communities. Reclamation typically includes restoring the project site to the pre-development condition or to conditions similar to those surrounding the facility. The reclamation process could result in restoring specific types of vegetation that were lost to project construction. The extent of restoring vegetation to pre-development conditions will depend on the success of the reclamation process.

Compensatory mitigation actions under the MSHCP may also result in temporary vegetation removal, if ground disturbance is required to restore or enhance habitat for Covered Species. These impacts could be greater than Alternative D, where compensatory mitigation may not be required for construction or operation of wind energy facilities within the Plan Area. Compensatory mitigation will potentially require the restoration of native vegetation.

This impact is expected to be minor.

Table 4.1-1. Potential Impacts to Vegetation Cover Classes by State (Acres)

	State								
Vegetation Cover Class	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Total
Deciduous Forest	3,620	525	647	1,847	2,195	246	619	251	9,950
Evergreen Forest	8	7	6	117	353	3	7	8	509
Mixed Forest	9	1	21	92	291	5	4	13	436
Shrub/Scrub	8	19	18	49	304	8	4	16	427
Grassland/Herbaceous	144	81	778	192	574	36	64	24	1,892
Pasture/Hay	2,317	320	1,662	1,806	1,579	702	321	562	9,268
Cultivated Crops	20,029	5,627	16,270	5,054	8,289	1,000	4,317	1,343	61,929
Woody Wetlands	141	95	90	1,226	1,517	27	42	96	3,232
Emergent Herbaceous Wetlands	17	14	134	85	880	8	8	63	1,210
Barren Land (Rock/Sand/Clay)	15	4	8	44	12	1	10	5	98
Open Water	191	43	104	207	627	18	36	293	1,520
Developed, Open Space	1,325	414	1,105	758	725	99	375	117	4,916
Developed, Low Intensity	1,066	178	258	529	184	30	188	95	2,527
Developed, Medium Intensity	275	48	71	160	71	6	58	27	716
Developed, High Intensity	82	20	17	61	20	2	25	8	237
Total	**29,247**	**7,395**	**21,190**	**12,227**	**17,620**	**2,188**	**6,080**	**2,920**	**98,867**

Constrain Plant Germination and Growth through Soil Compaction and Erosion

The movement of heavy equipment and supplies during construction could compact the soil, affecting vegetation germination and growth. Soil compaction occurs when soil particles are pressed together, reducing pore space between them. Heavily compacted soils contain few large pores and have a reduced rate of both water infiltration and drainage from the compacted layer. This occurs because large pores are the most effective in moving water through the soil when it is saturated. In addition, the exchange of gases slows down in compacted soils, causing an increase in the likelihood of aeration-related problems. Also, a compacted soil means that roots must exert greater force to penetrate the compacted layer (DeJong-Hughes *et al.* 2001). Soil compaction during construction activities will inhibit seed germination and root penetration in the soil surface and could result in bare soil or sparsely vegetated areas. Vegetation removal and soil compaction will expose soil to the erosive forces of rain and overland stormwater runoff, causing sediment to smother vegetation within and beyond project footprints, especially in areas with steep terrain. This impact is anticipated to be minor.

Contribute to the Spread of Invasive Weeds

Construction activities could introduce and increase the spread of invasive weeds in the following ways: (1) construction equipment could carry invasive weed seeds or plant parts from infested areas outside of the construction area into the construction area; (2) construction equipment could disturb existing invasive weed infestations in the study area and cause the spread of these infestations; (3) fill material containing invasive weeds could be used; and (4) seed mixtures containing invasive weed seeds could be used for re-vegetating construction staging areas. Implementing construction BMPs will minimize the potential for introducing invasive weeds to the construction area.

Invasive weeds can adversely affect vegetation communities by outcompeting native vegetation, leading to a reduction in biodiversity and degradation of habitats. Invasive weeds are often more aggressive than native vegetation, and the disturbed conditions of a construction site create an environment (e.g., bare and compact soil, disturbed surfaces) where some invasive weeds thrive. Invasive weeds that encroach beyond construction footprints could out-compete native vegetation and result in altered vegetation structure, a reduction in plant species richness, and overall disruption of the plant ecosystem.

This impact is anticipated to be minor to moderate, depending on the site conditions.

Affect Plant Growth through Dust Deposition and Accidental Spills

The operation of heavy construction equipment could generate fugitive dust from loose soil. Any accumulation of fugitive dust on vegetation could affect plant growth by inhibiting photosynthesis and reducing vegetation density and plant diversity. More tolerant native plant species could benefit from decreased competition. However, invasive weeds could colonize and disrupt the overall plant ecosystem, as discussed above. The magnitude and duration of dust exposure, tolerance of native vegetation, and aggressiveness of invasive weeds will determine vegetation response and the intensity of impacts.

Petroleum leaks and accidental spills from construction equipment are other potential sources that could affect plant growth. Accidental releases of hazardous materials could impact plant communities in the vicinity of the spill. The magnitude of impacts will depend on the type and

volume of material spilled, the location, and habitat affected. However, an uncontained spill of hazardous materials will likely be relatively small and affect a limited area because the volume of these materials that may be present at a construction location will be relatively small, and there will be no long-term storage of hazardous materials at construction locations. In addition, the implementation of required spill prevention and response plans will limit potential impacts from a spill, should one occur.

This impact is anticipated to be minor.

Operation-Related Impacts

Operation-related activities include vegetation maintenance (trimming, mowing, and herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance. These activities will include controlling vegetation around wind energy facilities and maintaining access roads and other associated project infrastructure. These activities will be infrequent and brief. Vegetation will be periodically cleared or trimmed around facilities and infrastructure, which could permanently alter vegetation (e.g., shrub vegetation that is continuously cleared for maintenance could convert to herbaceous vegetation). Maintenance activities could disturb the ground surface, require the use of herbicides, or result in petroleum leaks and spills from vehicles and equipment. Any mobilized sediment, spilled chemicals, or petroleum products could reach adjacent vegetation, affecting plant density and diversity and degrading the plant ecosystem. As noted above, implementation of required spill prevention and response plans will limit potential impacts from a spill, should one occur.

Maintenance equipment and vehicles will generate fugitive dust from loose soil and any unpaved access roads. Any accumulation of fugitive dust on vegetation could affect plant growth by inhibiting photosynthesis and reducing vegetation density and diversity. This could also allow invasive plant species to colonize, which could reduce plant species richness.

This impact is anticipated to be minor.

Decommissioning and Reclamation

Decommissioning and reclamation could have short-term impacts on vegetation similar to construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit vegetation that was affected from construction and operation. Reclamation typically includes restoring the project site to pre-construction development conditions similar to those surrounding the facility. This impact is anticipated to be a short-term minor adverse impact, but long term beneficial impact.

4.1.3.2 Covered Species

Kirtland's Warbler

Construction-Related Impacts

Habitat Loss, Fragmentation or Degradation

Wind energy facility construction will result in habitat loss, fragmentation or degradation. Construction of service roads and pads, operation of cranes, staging materials, and utility installation are the primary land-clearing activities that occur during construction of wind energy

facilities. Ancillary infrastructure requiring land clearing includes guyed and unguyed meteorological towers (met towers), electrical substations, above and below-ground power lines, and buildings for operations and maintenance.

Direct effects resulting from land clearing are the taking of nests and young during the breeding season. These effects can result in lower productivity in the year of construction, with subsequent post-construction loss of future young that might have been produced. This has the potential to affect population size if the level of activity results in productivity loss that exceeds annual population growth.

Other direct effects of land clearing are habitat loss and fragmentation, which reduces the amount and quality of habitat. Habitat loss can affect population size by reducing the area available to a species for breeding, foraging, and other life cycle needs. Fragmentation can affect population size by dividing a population into small, isolated populations which are more likely to become locally extinct due to random events and inbreeding than a large population connected to other large populations. Fragmentation also increases edge effect in the fragmented habitat. Edge effects are environmental effects that penetrate habitat from its edge and reduce the productivity of a population due to the resulting higher levels of predation and parasitism near an edge and the expansion from an edge of invasive species or unfavorable microclimate conditions that alter habitat. This can affect population size if the amount of edge reduces the amount and quality of habitat below that required to maintain a current population size at a location.

Nearly all Kirtland's warblers (98 percent) breed in the northern half of Michigan's Lower Peninsula with the remainder in Michigan's Upper Peninsula, northern Wisconsin, and southern Ontario (U.S. Fish and Wildlife Service 2012; Government Canada 2014). Overlaying the build-out model with NLCD jack pine forest indicates that one or two wind energy facilities have the potential to be developed in jack pine forest in Michigan and Wisconsin counties where Kirtland's warbler occurs. The affected area is 0.5 to 600 acres (0.2 to 243.2 hectares). While only 2 to 5 percent of this area is likely to be occupied by developed infrastructure (0.01 to 12 acres or 0.02 to 30 acres, respectively), land clearing will result in fragmentation of habitat and introduction of edge effects. This includes roads and collector lines that can be used by brown-headed cowbird to move through the jack pine forest. This nest parasite is being controlled by trapping in KWMAs. The Service continues to work on a plan that will allow for eventual delisting of the species.

The 600 acres (243.2 hectares) that may be lost or degraded by wind energy facilities over the 45-year term of the HCP is 0.3 percent of the 219,000 acres (88,628 ha) of the jack pine forest in Michigan being managed for the warbler's specific habitat requirements (U.S. Fish and Wildlife Service 2009; and see Chapter 3). Jack pine forest habitat becomes unsuitable after about 15 years of growth. In any year, new stands of jack pine forest reach a suitable age for warbler nesting, while other stands become unsuitable. The Recovery Plan goal is to maintain 38,000 acres (15,378 hectares) of suitable nesting habitat in any year (U.S. Fish and Wildlife Service 2009). The 600 acres that may be lost or degraded by wind energy facilities represents 1.6 percent of that area.

However, under Alternative A, these effects to the KWMAs in northern Lower Michigan will be avoided because new turbines will not be sited inside the KWMAs, nor to the extent possible closer than 0.5 mile away from KWMAs or any documented Kirtland's warbler breeding site (see Table 2-6). If siting within 0.5 mile cannot be avoided, avoidance measures such as timing restrictions and seasonal curtailments will be implemented. Further, construction or operations-related activities within 0.25 mile of an occupied nest site will be subject to timing constraints to

avoid impacts on any nesting Kirtland's warbler (see Table 2-6). These MSHCP avoidance and timing requirements under Alternative A will substantially reduce the risk to the species compared to Alternative D which has no avoidance or timing requirements; and therefore, wind-energy construction is expected to have a minor effect on breeding habitat of Kirtland's warbler.

Human Disturbance

Visual and noise effects from vehicles and construction equipment during land clearing may disturb birds in breeding and foraging periods, affecting health and reproductive potential. Traffic noise, for example, has been shown to reduce the density of some grassland bird species at distances of several hundred meters or more, depending on noise level (Forman *et al.* 2003). This reduces the reproductive output of a local population because not all the otherwise available habitat can be used.

These activities and effects could occur in the 600 acres of jack pine forest that could be potentially affected by wind energy development in the 45 years of the HCP term. Visual and noise effects extend beyond the boundary of a wind energy facility, suggesting the area affected is larger than 600 acres. Because wind energy facilities and associated infrastructure can be built in one calendar year, the effect will last one or two breeding seasons during the 45 years of the HCP term.

However, under Alternative A, these effects to the KWMAs in northern Lower Michigan will be avoided because new turbines will not be sited inside the KWMAs, nor to the extent possible closer than 0.5 mile away from KWMAs and any documented Kirtland's warbler breeding site (see Table 2-6). If siting within 0.5 mile cannot be avoided, avoidance measures such as timing restrictions and seasonal curtailments will be implemented. Further, construction or operation-related activities within 0.25 mile of an occupied nest site will be subject to timing constraints to avoid impacts on any nesting Kirtland's warbler (see Table 2-6). These MSHCP avoidance and timing requirements under Alternative A will substantially reduce the risk to the species compared to Alternative D which has no avoidance or timing requirements; and therefore, human disturbance associated with construction is expected to have a minor effect on Kirtland's warbler.

Encounters with Vehicles and Construction Equipment

Vehicle fatalities are a major cause of bird death (Erickson *et al.* 2005). Death is usually due to birds in flight being unable to move out of the path of an oncoming vehicle. While operating construction equipment at wind energy facilities may cause fatalities, travel speed is much slower and therefore it is much more likely that a bird's avoidance behavior will be successful. In addition, vehicles moving at slow speeds will be easily avoided by birds. Chicks may not be as skilled as adults in escaping moving vehicles and equipment, and eggs of birds encountering vehicles and equipment could be crushed.

However, under Alternative A, these effects to the KWMAs in northern Lower Michigan will be avoided because new turbines will not be sited inside the KWMAs, nor to the extent possible closer than 0.5 mile away from KWMAs and any documented Kirtland's warbler breeding site (see Table 2-6). If siting within 0.5 mile cannot be avoided, avoidance measures such as timing restrictions and seasonal curtailments will be implemented. Further, construction or operations-related activities within 0.25 mile of an occupied nest site will be subject to timing constraints to avoid impacts on any nesting Kirtland's warbler (see Table 2-6). These MSHCP avoidance and timing requirements under Alternative A will substantially reduce the risk to the species compared to

Alternative D which has no avoidance or timing requirements; and therefore, encounters with vehicles and construction equipment is expected to have a minor effect on Kirtland's warbler.

Death or Injury from Accidental Oil or Chemical Spills

Oil and chemicals are used in the construction of wind energy facilities. Spilled oil and chemicals have the potential to injure or kill birds that come in contact with these materials. The amount of oil and chemicals used to build facilities is small and, because facilities are typically constructed in upland settings, spills will nearly always come in contact with soil and vegetation, which absorb or adhere materials. In addition, spill prevention, containment, and clean-up measures will further reduce any potential impact. Oil and chemical spills will therefore not form persistent pools on the ground, or if pools form they will not extend over a large area. Consequently, the risk of a Kirtland's warbler coming in contact with oil or chemicals from a spill will be extremely low.

However, under Alternative A, these effects to the KWMAs in northern Lower Michigan will be avoided because new turbines will not be sited inside the KWMAs, nor to the extent possible closer than 0.5 mile away from KWMAs and any documented Kirtland's warbler breeding site (see Table 2-6). If siting within 0.5 mile cannot be avoided, avoidance measures such as timing restrictions and seasonal curtailments will be implemented. Further, construction or operations-related activities within 0.25 mile of an occupied nest site will be subject to timing constraints to avoid impacts on any nesting Kirtland's warbler (see Table 2-6). These MSHCP avoidance and timing requirements under Alternative A will substantially reduce the chances of a Kirtland's warbler being present at the construction site compared to Alternative D which has no avoidance and timing requirements; and therefore, death or injury from accidental oil or chemical spills is expected to have a minor effect on Kirtland's warbler.

Decommissioning and Reclamation

Decommissioning and reclamation could have short-term minor impacts on Kirtland's warbler similar to construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit the species' habitat that was affected from construction and operation. Reclamation typically includes restoring the project site to pre-construction development conditions similar to those surrounding the facility. Further, timing restrictions during certain times of the year will be placed on decommissioning activities if nests are within 0.25 mile of the site (see Table 2-6). Therefore, the effect of decommissioning and reclamation under Alternative A is expected to have a minor short-term adverse effect on Kirtland's warbler, but long-term will be beneficial.

Operation-Related Impacts

Collisions with Turbines

As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 60 Kirtland's warbler while currently-operating facilities will take another 39 Kirtland's warblers, for a total of 99 Kirtland's warblers across the 45-year permit term without AMMs and other requirements of the MSHCP conservation strategy under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs), such as changing the operational parameters of wind turbines. Avoidance and minimization of Kirtland's warbler collisions for those facilities

participating in the MSHCP under Alternative A require that turbines located within the breeding range of the species be turned off during the day in the May 1–August 15 breeding season, and at night during the spring and fall migration (March 15–May 30; August 15–October 30). In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. These MSHCP timing requirements under Alternative A would reduce the potential of Kirtland's warbler collisions with turbines compared to Alternative D which has no timing requirements. As few facilities will be built in the breeding range, however, the avoided take will not be a large proportion of the total take. Given that the take annually under Alternative D is a fraction of the population, the measures to reduce the operational curtailment during high-risk periods under Alternative A is expected to have a minor effect on the Kirtland's warbler population.

Lighting on turbine nacelles and access doors has the potential to increase collisions with moving turbine blades. FAA (2007) obstacle marking guidelines allow the perimeter of a wind energy facility to be marked with one red flashing light per 0.5 mile along a project's perimeter, and one light per mile across a project's interior. Flashing red lights greatly reduce bird fatalities at high obstacles by minimizing the attractive effect on birds of night lighting (Kerlinger *et al.* 2010). Under Alternative A red lights will be timed to flash synchronously with the briefest flash and the greatest allowable dark interval between flashes (see Table 2-5). In addition, turbines will implement other lighting schemes to reduce impacts to Kirtland's warbler, including synchronously-flashing red lights on nacelles, and use of motion- or infrared-activated, low-intensity, or cut-off lighting above tower access doors (see Table 2-5). Further, for turbines within breeding range, operational curtailment during high risk periods will be implemented during turbine operation to avoid and minimize further turbine collision risk to the Kirtland's warbler (see Table 2-6). These MSHCP requirements under Alternative A would reduce the potential of Kirtland's warbler collisions with turbines compared to Alternative D which has no lighting scheme, avoidance, or timing requirements. Given the fraction of the population taken annually under Alternative D, the measures to reduce lighting impacts under Alternative A is expected to have a minor effect on the Kirtland's warbler population.

Collisions with Meteorological Towers and Other Infrastructure

Meteorological (met) towers, electrical substations, maintenance and operations buildings, and collector lines are additional infrastructure at wind energy facilities. Birds may collide with these, causing fatalities. At a typical wind energy facility in the Plan Area, there are one or two met towers, one or two electrical substations, and one maintenance and operations building. Collector lines are buried or mounted on normal electrical poles. The number of turbines is much greater than the number of other infrastructure elements.

Guyed met towers are known to cause bird fatalities when birds strike the cables (Longcore and Gathreaux 2008). As with turbines, improper lighting at met towers and other infrastructure can attract birds and increase fatality rates. All permanent meteorological towers associated with proposed wind projects will be free standing and constructed without guy-wires, and any temporary meteorological towers with guy-wires will be removed within 1 year of initial project operations (see Table 2-5) to reduce collision risk with met towers. Further, meteorological towers will employ the same lighting scheme as described for turbines above; lighting on other infrastructure will use motion- or infrared-activated, low-intensity, or cut-off lighting; and any power or communication lines that are not buried but elevated on poles will be clearly marked following Avian Power Line Interaction Committee standards to deter bird strikes (see Table 2-5). These MSHCP requirements

under Alternative A would reduce the potential of Kirtland's warbler collisions with meteorological towers and other infrastructure compared to Alternative D which has no tower or transmission line requirements. The few met towers and other infrastructure at wind energy facilities, and the measures that will be employed to minimize collision risk with these structures, suggests that fatalities will be substantially lower than that for turbines. Therefore, collisions with meteorological towers, guy-wires, and other infrastructure under Alternative A are expected to have a minor effect on the Kirtland's warbler population.

Human Disturbance

Human disturbance during the operation of wind energy facilities includes movement of vehicles and people, repair activities at turbines and other infrastructure, turbine rotor and generator hum and vibration, and shadow flicker. Bird species known to be sensitive to visual and noise disturbances at wind energy facilities include those inhabiting grassland and scrubland (NRC 2011; Mabey and Paul 2007). Disturbance in breeding and foraging habitat causes some bird species to avoid wind energy facilities, reducing nesting densities, which may affect the productivity of the local population. As already discussed, noise can have a similar effect (Forman *et al.* 2003).

Stopover habitat for Kirtland's warbler in the Plan Area is largely within Ohio and Michigan, with fewer reports from the other states in the Plan Area. Reports of Kirtland's warbler during migration do not suggest consistency in stopover locations from year to year except near Great Lakes coastlines (U.S. Fish and Wildlife Service 2012). Given the inconsistency in year-to-year use of stopover habitat, it is speculative to assess the effect of new wind energy facility construction on stopover habitat where disturbance may affect foraging behavior. It is likely that stopover habitat which consists of residential areas, woodland, scrubland, parks, and orchards (U.S. Fish and Wildlife Service 2012) is limiting along the Kirtland's warbler's migration route.

Under Alternative A, Kirtland's warbler breeding habitat will be avoided by excluding wind energy facilities from KWMAs and from within 0.5 mile of KWMAs and other known breeding sites (see Table 2-6). This MSHCP requirement under Alternative A would reduce the potential of human disturbance on Kirtland's warbler compared to Alternative D which has no breeding site avoidance requirements. Consequently, human disturbance under Alternative A is expected to have a minor effect on the Kirtland's warbler population.

Encounters with Vehicles and Construction Equipment

Mechanisms and effects are similar to those described above for construction, but during operations, vehicles are likely to move at higher speeds than during construction. Speed is nevertheless limited due to the design and gravel surface of the pad and service road, and other road surfaces associated with other infrastructure. A speed limit of 20 miles per hour or less is usually applied to roads under the control of the wind energy operators. Trips to and from turbines and other infrastructure during operations are infrequent compared to trips occurring on public roads in the vicinity of the wind energy facility. Use of heavy equipment occurs less frequently during operations than construction, and will move at slow speeds as during construction. Given the slow speeds and infrequent trips, under Alternative A the effect of vehicles and equipment on Kirtland's warbler during operations is expected to be minor.

Conservation Strategies

Mitigation for Kirtland's warbler consists of burning jack pine forest or planting jack pine seedlings in open fields in order to create open stands of 7- to 15-year-old jack pine trees, which are appropriate habitat for nesting. This is done on a continuing basis to ensure that 38,000 acres of jack pine breeding habitat is available in the KWMAs at any one time. Mitigation also must include trapping brown-headed cowbirds to increase nesting success as measured in number of chicks fledged per nesting pair. Cowbirds lay eggs in the nests of Kirtland's warbler and other bird species, which results in the failure of the nesting pair to raise young of their own species. Rather, they raise a cowbird chick to fledging. Monitoring of singing males has been used for decades to document the increase in the population, under the assumption that singing males have mated and therefore there are two individuals for each singing male. Creating habitat, controlling cowbirds, and censusing the population are the major conservation strategies for Kirtland's warbler.

The effect of the MSHCP's mitigation and monitoring requirements under Alternative A will be beneficial to the Kirtland's warbler population compared to Alternative D which has no mitigation or monitoring requirements, although for brief periods on an intermittent basis people on foot move through breeding territories to maintain cowbird traps (and releasing other birds) and conduct population censuses. This may result in temporary disturbance of nesting and foraging behavior as birds respond to the presence of people. Most birds singing on territory quickly return to their prior behavior after brief, mild disturbances, such as people walking or working quietly nearby. Because habitat creation occurs at locations where breeding does not occur, it will not affect breeding pairs. Although mitigation and monitoring will be beneficial, the small area of habitat affected under Alternative A is expected to have a minor effect on the Kirtland's warbler population.

Piping Plover

Construction-Related Impacts

Habitat Loss, Fragmentation or Degradation

Impact mechanisms related to habitat loss, fragmentation or degradation for piping plover are the same mechanisms as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. Piping plover critical habitat in the Plan Area is outside the Covered Lands and under Alternative A no wind energy facilities will be sited near piping plover critical habitat. Other piping plover breeding habitat is located inside three miles of the Great Lakes coast (for the Great Lakes population) and inside one mile of Lake of the Woods (the only breeding location for the Northern Great Plains population in the Plan Area). The MSHCP excludes these areas from Covered Lands; therefore, Alternative A would have less potential impact on habitat loss, fragmentation or degradation compared to Alternative D which does not restrict wind energy facilities from being sited near critical habitat or breeding habitat.

A rangewide study of piping plover migratory stopover habitat identified reservoirs and constructed ponds as the primary stopover habitats, with rivers, marshes, and natural lakes comprising most of the remainder (Pompei and Cuthbert 2006). Records of piping plover sightings are distributed across the Plan Area, with the greatest concentration at the Great Lakes coast (Pompei and Cuthbert 2006). Locations of stopover habitat vary annually and on average piping plovers are present for one day. While all breeding habitat is outside the Covered Lands, stopover habitat is distributed across the Covered Lands and is not consistently used for a long duration. Co-occurrence of wind energy facilities with stopover habitat in the Covered Lands is expected to be a rare event due to the

changing use of stopover habitat by piping plovers. The effect of habitat loss under Alternative A is therefore expected to be minor.

Human Disturbance

Visual and noise effects during construction are the same described for as Kirtland's warbler under Alternative A, Section 4.1.3.2. Piping plover critical habitat and breeding habitat in the Plan Area is outside the Covered Lands, and under Alternative A no wind energy facilities will be sited near piping plover critical habitat or breeding habitat. The avoidance of piping plover habitat and critical habitat under Alternative A will reduce the risk of human disturbance impacts on piping plover compared to Alternative D, which does not restrict siting wind energy facilities near these habitats. The effect of human disturbance during construction under Alternative A is therefore expected to be minor.

Encounters with Vehicles and Construction Equipment

The impact mechanisms and effects of vehicle and construction equipment are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Piping plover critical habitat and breeding habitat in the Plan Area is outside the Covered Lands, and under Alternative A no wind energy facilities will be sited near piping plover critical habitat or breeding habitat. The avoidance of piping plover habitat and critical habitat under Alternative A will reduce the risk of vehicle and construction impacts on piping plover compared to Alternative D, which does not restrict siting wind energy facilities near these habitats. The effect of encounters with vehicles and construction equipment under Alternative A on piping plover is therefore expected to be minor.

Death or Injury from Accidental Oil or Chemical Spills

The impact mechanisms and effects of accidental oil or chemical spills are the same as described for the Kirtland's warbler under Alternative A, Section 4.1.3.2. Piping plover critical habitat and breeding habitat in the Plan Area is outside the Covered Lands, and under Alternative A no wind energy facilities will be sited near piping plover critical habitat or breeding habitat. The avoidance of piping plover habitat and critical habitat under Alternative A will reduce the risk of accidental oil or chemical spill impacts on piping plover compared to Alternative D, which does not restrict siting wind energy facilities near these habitats. The effect of accidental oil or chemical spills under Alternative A on piping plover is therefore expected to be minor.

Decommissioning and Reclamation

The mechanisms and effects of decommissioning and reclamation are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Because decommissioning and reclamation will occur at sites that originally avoided piping plover breeding habitat during construction, the potential effect of decommissioning and reclamation under Alternative A on piping plover is expected to be minor.

Operation-Related Impacts

Collisions with Turbines

The mechanism and effect of collisions with turbines are the same mechanisms as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. The impact mechanism and effects of turbine

lighting on take of piping plovers are the same as those for Kirtland's warbler under Alternative A, Section 4.1.3.2.

As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 28 piping plovers while currently-operating facilities will take another 16 piping plovers, for a total of 44 piping plovers across the 45 year term of the MSHCP without AMMs and other requirements of the MSHCP conservation strategy under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs), such as changing the operational parameters of wind turbines. Given the low percent of the piping plover population affected annually by collisions with wind turbines, and the measures that will be implemented to minimize lighting impacts, the effect of Alternative A on collisions with turbines by piping plover is not expected to change measurably from baseline conditions (*i.e.,* Alternative D). In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. Therefore, take under Alternative A are expected to be minor on the piping plover population.

Collisions with Meteorological Towers and Other Infrastructure

Mechanisms and effects of collisions with met towers and other infrastructure by piping plover during the migration period and the measures that will be implemented to reduce collisions are the same as those described for Kirtland's warbler under Alternative A, Section 4.1.3.2. These MSHCP requirements under Alternative A would reduce the potential of piping plover collisions with meteorological towers and other infrastructure compared to Alternative D which has no tower or transmission line requirements. Consequently, the effect of Alternative A on collisions with met towers by piping plover and other infrastructure is expected to be minor.

Human Disturbance

Mechanisms and effects of human disturbance on piping plover during the breeding and migration period are the same as those described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Under Alternative A new wind energy facilities will not be constructed or operated near piping plover critical habitat or other breeding habitat; Alternative D has no requirements to avoid these areas and could result in new wind energy facilities operating closer to piping plover critical habitat and other breeding habitat. Wind energy facilities may be constructed near stopover habitat, but the co-occurrence of new wind energy facilities with stopover habitat is expected to be rare. The effect of human disturbance during operations under Alternative A is expected to be minor.

Encounters with Vehicles and Construction Equipment

Mechanisms and effects of encounters with vehicles and construction equipment on piping plover are the same as those described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Under Alternative A new wind energy facilities will not be constructed or operated near piping plover critical habitat or other breeding habitat; Alternative D has no requirements to avoid these areas and could result in new wind energy facilities operating closer to piping plover critical habitat and other breeding habitat. Wind energy facilities may be constructed near stopover habitat, but the co-occurrence of new wind energy facilities with stopover habitat is expected to be rare. Under Alternative A the effect of vehicles and equipment on piping plover during operations is expected to be minor.

Conservation Strategies

Mitigation for piping plover consists primarily of protecting nesting beaches from walkers, dogs, and vehicles. Protection is accomplished by fencing the general nesting area or closing the beach. Predator control is also practiced as a mitigation measure. Predators include crows, gulls, dogs, foxes, raptors and raccoons. Both these measures have been shown to increase nesting success as measured in terms of number of chicks fledged per breeding pair. Creation of new habitat is possible but may not be as cost-effective as increasing nesting success. New habitat can be created by trapping sand in longshore currents to build new beaches, or clearing encroaching vegetation at historical nesting locations. Critical to the success of habitat creation is the presence of small cobbles and pebbles at the specific densities which plovers select as nesting sites. Nesting site characteristics are very specific and challenging to create. Monitoring is part of the conservation strategy for piping plover. A network of volunteer monitors has enabled the Service to track population trends. Mitigation for impacts to piping plover by wind energy developers could be executed with payments to a conservation fund that supports beach protection and monitoring.

The effect of mitigation and monitoring will be beneficial to the piping plover population, although for brief periods on an intermittent basis people on foot move through breeding territories to erect, maintain, and remove protective fencing and conduct population censuses. This may result in temporary disturbance of nesting and foraging behavior as birds respond to the presence of people. Most birds on territory quickly return to their prior behavior after brief, mild disturbances, such as people walking or working quietly nearby. Because habitat creation will occur at locations where breeding does not occur, it will not affect breeding pairs.

Mitigation and monitoring will be beneficial and the brief and mild disturbance under Alternative A due to the presence of people nearby is expected to have a minor effect on the piping plover population.

Interior Least Tern

Construction-Related Impacts

Habitat Loss, Fragmentation or Degradation

Impact mechanisms and effects related to habitat loss, fragmentation or degradation for interior least tern are the same mechanisms as those described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Interior least tern breeding habitat in the Plan Area is outside the Covered Lands and therefore no loss of breeding habitat of interior least tern expected; Alternative D has no requirements to avoid these areas and could result in new wind energy facilities constructed in or closer to interior least tern breeding habitats. Little is known about migration stopover habitat of interior least terns, but they appear to exhibit high site fidelity to breeding sites in large river floodplains (Sidle and Harrison 1990) and may follow large rivers to and from breeding sites during migration. Large rivers in the Plan Area are one mile outside the Covered Lands and will not be affected under Alternative A. The effect of habitat loss under Alternative A is expected to be minor.

Human Disturbance

Visual and noise mechanisms and effects during construction are the same as those described for Kirtland's warbler above under Alternative A, Section 4.1.3.2. Interior least tern habitat in the Plan Area is outside the Covered Lands. Alternative D has no requirements to avoid these habitat areas

and could result in new wind energy facilities constructed in or closer to interior least tern breeding habitats. Stopover habitat may be largely within one mile of the large rivers along which the terns migrate while feeding in aquatic habitats. Thus migratory stopover habitat for interior least tern is mostly outside the Covered Lands. The effect of human disturbance on interior least tern breeding and stopover habitat is expected to be minor.

Encounters with Vehicles and Construction Equipment

The mechanisms and effects of encounters with vehicle and construction equipment are same mechanisms as described for Kirtland's warbler under Alternative A, Section 4.1.3.2. As all breeding habitat and possibly stopover habitat in the Plan Area is outside the Covered Lands, the effect of encounters with vehicles and construction equipment under Alternative A on interior least tern is expected to be minor.

Alternative D has no requirements to avoid these habitat areas and could result in new wind energy facilities constructed in or closer to interior least tern breeding habitats.

Death or Injury from Accidental Oil or Chemical Spills

The mechanisms and effects of accidental oil or chemical spills are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2. As all breeding habitat and possibly stopover habitat in the Plan Area is outside of Covered Lands, the chance of a spill potentially affecting an interior least tern is low and therefore, the potential impact is expected to be minor.

Alternative D has no requirements to avoid these habitat areas and could result in new wind energy facilities constructed in or closer to interior least tern breeding habitats.

Decommissioning and Reclamation

The mechanisms and effects of decommissioning and reclamation are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Because decommissioning and reclamation will occur at sites that originally avoided interior least tern breeding habitat and possibly stopover habitat during construction, the potential effect of decommissioning and reclamation under Alternative A on interior least tern is expected to be minor.

Operation-Related Impacts

Collisions with Turbines

The mechanism and effects of collisions with turbines are the same mechanisms as those for Kirtland's warbler Alternative A, Section 4.1.3.2. The impact mechanism and effects of turbine lighting on take of interior least tern are the same as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. Additionally, terns are diurnal migrants (Newton 2010), suggesting that turbine lighting is not pertinent when considering collision due to lighting effects.

As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 17 interior least terns from existing facilities and new wind facilities without AMMs and other requirements of the MSHCP conservation strategy under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs), such as changing the operational parameters of wind turbines. Given the low percent of the interior least tern population affected annually by collisions

with wind turbines, and the measures that will be implemented to minimize lighting impacts, the effect of Alternative A on collisions with turbines by interior least tern is not expected to change measurably from baseline conditions (*i.e.,* Alternative D). In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. Therefore, take under Alternative A is expected to be minor on the interior least tern population.

Collisions with Meteorological Towers and Other Infrastructure

Mechanisms and effects of collisions with met towers and other infrastructure on interior least tern during the migration period and the measures that will be implemented to reduce collisions are the same as those described for Kirtland's warbler under Alternative A, Section 4.1.3.2. These MSHCP requirements under Alternative A would reduce the potential of interior least tern collisions with meteorological towers and other infrastructure compared to Alternative D which has no tower or transmission line requirements. In addition, likely migratory paths will occur along large rivers outside the Covered Lands. Therefore, this impact is expected to result in a minor effect on interior least terns under Alternative A.

Human Disturbance

Mechanisms and effects of human disturbance on interior least terns during the breeding and migration period are the same mechanisms as those described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Under Alternative A, wind energy facilities will be operating in Covered Lands, which excludes those areas within 1 mile of major rivers where breeding and much of the migratory stopover habitat for interior least tern occurs; Alternative D has no requirements to avoid these areas and could result in new wind energy facilities operating closer to these interior least tern habitats. Consequently human disturbance under Alternative A will have a minor effect on the interior least tern population.

Encounters with Vehicles and Construction Equipment

Mechanisms and effects of encounters with vehicles and construction equipment are the same mechanisms as those described for the Kirtland's warbler under Alternative A, Section 4.1.3.2. Under Alternative A, wind energy facilities will be operating in Covered Lands, which excludes those areas within one mile of major rivers where breeding and much of the migratory stopover habitat for interior least tern occurs; Alternative D has no requirements to avoid these areas and could result in new wind energy facilities operating closer to these interior least tern habitats. Under Alternative A the effect of vehicles and equipment on interior least tern during operations is expected to be minor.

Conservation Strategies

Mitigation for interior least tern consists primarily of restoring bare sandbars and sparsely-vegetated beaches of larger rivers in the Great Plains and Mississippi River Basin. This is accomplished on the Missouri River through habitat protection and restoration, as well as reservoir operation to maximize existing habitats. Dredge spoil from river maintenance operations that keep navigation channels open can be used to create or enhance nesting habitat. Removal of woody encroachment on sandbars and beaches of the large rivers is primarily carried out by mechanical means and is particularly useful in forested regions, such as those through which the Ohio and Wabash Rivers flow. These measures enlarge habitat and improve nesting success by exposing approaching predators. Nesting success is measured in terms of number of chicks fledged per

nesting pair. Predator control in the vicinity of nesting colonies is also used to improve nesting success. Monitoring is a necessary part of mitigation to demonstrate increases in the population size as habitat is restored.

The effect of mitigation and monitoring activities will be beneficial to the interior least tern population. Under Alternative A, mitigation will occur in consultation with the Service to avoid adverse effects of habitat creation. For example, nesting sites could be flooded if releases of water from dams to create nesting habitat will not be timed to avoid the peak breeding period. Mechanical vegetation clearing to expand habitat will occur at locations where breeding does not occur and thus will not affect breeding pairs. Mitigation will therefore be expected to have a beneficial effect on the interior least tern population.

Bald Eagle

Construction-Related Impacts

Habitat Loss, Fragmentation or Degradation

Impact mechanisms related to habitat loss, fragmentation or degradation for bald eagle are the same mechanisms as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. Substantial bald eagle breeding habitat is located within 3 miles of the Great Lakes coast and within 1 mile of large rivers, such as the Mississippi River (for the Great Lakes population); this breeding habitat is excluded from Covered Lands, and will not be affected by wind development activities under the MSHCP. As a result, Alternative A would have a reduced effect on bald eagle from habitat loss compared to Alternative D which has no requirement to avoid these bald eagle habitat areas. Other breeding habitat, however, occurs around other large lakes and rivers in Covered Lands of the Plan Area.

Direct effects, such as destruction of active bald eagle nests during land clearing activities, is very unlikely due to the nests' conspicuous presence, periodic nest surveys at state and regional levels, and the nest location database maintained by the U.S. Fish and Wildlife Service. By contrast, locations of small, cryptic nests of other Covered Species of birds often are not known. If trees and woody vegetation around nests are cleared for development during the critical breeding and nesting period, the noise and visual buffer protecting a nest may be removed, potentially leading to temporary or permanent nest abandonment. If eggs or chicks are in the nest, their survival will be affected. However, this effect is unlikely under Alternative A because land clearing for wind turbines will not be permitted within 0.5 mile of an active bald eagle nest and clearing for other purposes within 0.5 mile of a nest will not occur in the breeding season before young have fledged. Direct effects are anticipated to be minor.

Indirect effects to eagles from construction activities that lead to habitat loss, fragmentation, or degradation are slightly more likely. These impacts will be encountered depending on the proximity of wind farm construction to occupied bald eagle breeding or wintering habitat. Construction activities, even if performed outside the breeding season (January 1–August 31), can still cause habitat loss, fragmentation, or degradation. Winter clearing activities in winter habitat may displace congregating eagles. An avoid-clearing buffer of 0.25 mile around any bald eagle nest or known congregation site will minimize this potentially negative effect and will be recommended under Alternative A. As a result, the long-term indirect effects of construction-related habitat loss, fragmentation, or degradation on eagles are expected to be minor.

Human Disturbance

Impact mechanisms related to human disturbance are the same mechanisms as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. However, although they are short-lived, construction activities in close proximity to active nests may lead to direct effects on eggs and young if they occur during the critical period, defined by the Service's 2007 National Bald Eagle Management Guidelines as December through August in the northern United States. Because the MSHCP excludes substantial bald eagle breeding habitat from Covered Lands, Alternative A would likely have a reduced level of potential effect of human disturbance on bald eagles compared to Alternative D which does not require wind energy development to avoid these habitat areas.

If siting within a 1.6 miles of nests cannot be avoided, avoidance measures such as timing restrictions and seasonal curtailments may be implemented. Further, construction or operations-related activities within 1 mile of an occupied nest site will be subject to timing constraints to avoid impacts on nesting bald eagles. It is very challenging to obtain a take permit for eagles for projects within 1 mile of an occupied nest or other active use area because such projects are in Category 1, the highest level of risk defined in the Service's 2013 Eagle Conservation Plan Guidance. Implementing these avoidance and timing strategies will substantially reduce the risk to the species, and therefore, human disturbance associated with construction is expected to have a minor effect on bald eagles.

Encounters with Vehicles and Construction Equipment

Bald eagle encounters with vehicles and construction equipment is very unlikely because vehicles move slowly, allowing birds to avoid contact. In addition, being a large and conspicuous species, bald eagles on or near the ground, particularly young fledglings that are less skilled at evasion maneuvers, are likely to be seen and avoided by crew before impact. Because the MSHCP excludes substantial bald eagle breeding habitat from Covered Lands, Alternative A would likely have a reduced level of potential effect of vehicle encounters on bald eagles compared to Alternative D which does not require wind energy development to avoid these habitat areas. The risk of encounters with vehicles and construction equipment are minor.

Death or Injury from Accidental Oil or Chemical Spills

Bald eagle death or injury resulting from an oil or chemical spill could arise from eagles eating contaminated carrion that died from a spill. However, the chance of an accidental release of oil or chemicals during construction is very small, the amount released will likely be small, and procedures are in place for rapid response and clean-up. Because the MSHCP excludes substantial bald eagle breeding habitat from Covered Lands, Alternative A would likely have a reduced level of potential effect of spills on bald eagles compared to Alternative D which does not require wind energy development to avoid these habitat areas. The effects on eagles are expected to be minor.

Decommissioning and Reclamation

Potential effects to bald eagles during decommissioning and reclamation activities are similar to those encountered during construction, but of shorter duration. The effects on eagles are expected to be minor.

Operation-Related Impacts

Collisions with Turbines

As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 2,588 bald eagles while currently-operating facilities will take another 1,520 bald eagles, for a total of 4,108 bald eagles across the 45 year term of the MSHCP without AMMs and other requirements of the MSHCP conservation strategy under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs). However, wind facilities participating in the MSHCP under Alternative A will be required to implement four bald eagle-specific AMMs to avoid and minimize take during wind facility siting, construction and operations (See Chapter 2, *Proposed Action and Alternatives,* Table 2-6, *Species-Specific Avoidance and Minimization Measures – Alternative A*). These AMMs include minimization of construction-related disturbances during the nesting season, avoiding removal of nesting and roosting structures, siting requirements that account for locations of nest and roost sites, and removing carcasses that can attract foraging bald eagles near turbines. In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. These MSHCP requirements under Alternative A are not required under Alternative D; and therefore, bald eagle collisions with turbines under Alternative A would be less than Alternative D.

Collisions with Meteorological Towers and Other Infrastructure

Collision with meteorological towers and electrocution or collision with power lines are a threat to bald eagles, in particular when eagles use these as perching structures while hunting or if preoccupied with territorial defense, courtship, or prey pursuit (Olendorff *et al.* 1981; Thompson 1978). The risk of collisions with met towers and power lines will be minimized by requirements of the MSHCP AMMs that specify lighting protocols, exclusion of guy-wires, and by requiring that connector and communication lines be buried and that overhead power lines be built in accordance to Avian Power Line Interaction Committee (APLIC) guidelines designed to minimize such collisions and electrocutions (Avian Power Line Interaction Committee 2012). These MSHCP AMMs under Alternative A are not required under Alternative D; and therefore, bald eagle collisions with meteorological towers and other infrastructure under Alternative A would be less than Alternative D. Therefore, the effects are expected to be minor.

Human Disturbance

Human disturbance during operations and maintenance are as described for Kirtland's warbler under Alternative A, Section 4.1.3.2. Wind facility siting at least 1.6 miles from active eagle nests and 1 mile from winter congregation sites will greatly minimize the effects of human disturbance because noise and sight buffers around these areas will be maintained. In addition, because the MSHCP excludes substantial bald eagle breeding habitat from Covered Lands, Alternative A would likely have a reduced level of potential effect of operations human disturbance on bald eagles compared to Alternative D which does not require wind energy development to avoid these habitat areas. Therefore, the effects on bald eagles are expected to be minor.

Encounters with Vehicles and Construction Equipment

The impact mechanisms here are the same as described above under construction-related impacts. In addition, because the MSHCP excludes substantial bald eagle breeding habitat from Covered Lands, Alternative A would likely have a reduced level of potential effect of operations vehicles on bald eagles compared to Alternative D which does not require wind energy development to avoid these habitat areas. Therefore, the effects on bald eagles are expected to be minor.

Conservation Strategies

Ongoing fatality monitoring and subsequent adaptive management to reduce fatality rates that are higher than expected will help assure that the proposed AMMs in the MSHCP are effective at staying within permitted take limits. Year-round post-construction monthly monitoring will be conducted for 3 years at each facility to detect bald eagle fatalities. In addition, on an annual basis, the Service will monitor bald eagle take to determine whether wind facilities are exceeding their permitted level of take. If take is higher than expected, adaptive management strategies will be implemented; such strategies may include the ability to request a higher level of take at the affected facility. This may be granted by the Service only if take is below thresholds at other facilities, in order that total take remains below the Service's allowable take threshold for the region. If an increase in take thresholds at a facility cannot be granted, the facility may be required to shut down specific turbines during periods of high eagle activity until take numbers are brought into compliance. Over the longer term, certain turbines may be restricted to operating only from sunset to sunrise, when eagles are not active. Mitigation strategies may occur anywhere within the Plan Area, and include retrofitting of power lines to reduce the risk for electrocution. However, other forms of mitigation may be considered in the future, such as the protection and restoration of habitat and reducing the potential for ingestion of lead by bald eagles to reduce lead-related morbidity and mortality. It is unlikely that any of these measures will have negative effects on other Covered Species because conservation fund payment and habitat improvement will have broader conservation benefits, and retrofitting has a neutral effect on the other Covered Species.

Indiana Bat

Construction-Related Impacts

Human Disturbance

Development and decommissioning of wind energy sites requires the use of heavy construction equipment such as cranes, bulldozers, backhoes, dump trucks and excavating equipment. Such machines and their operators can create noise, dust, and vibration that could affect Indiana bats. Disturbance of roosting bats may cause juveniles to fall from the roost and die from exposure. Adults forced from roosts during daylight suffer dramatically higher rates of predation reducing life expectancies from years to a matter of minutes (Sparks *et al.* 2000).

Several factors serve to reduce the potential for interactions between bats and construction sites. As stated in the MSHCP, the region is dominated by agriculture lands, and the vast majority of construction associated with wind energy facilities in the region will occur within agricultural fields. Indiana bats routinely forage along the edges of agricultural fields (Sparks *et al.* 2005) at night, but spend their days in trees. Most construction activities will occur during the day in a habitat used by bats at night—thus temporally reducing the potential for adverse impacts associated with disturbance due to construction.

Several aspects of the ecology of Indiana bats also serve to reduce the effects of disturbance due to construction activity. Colonies of Indiana bats are known to survive and reproduce in areas where such construction-like activities are common; the same landscapes most likely to be disturbed by construction activities are already disturbed by agricultural vehicles such as tractors, combines, and grain trucks that are similar in most regards to construction equipment. Tree-roosting bats, such as the Indiana bat, routinely move among several roost trees that may be spread across a larger landscape. Individual bats also use multiple foraging areas, and these may differ between nights. This gives Indiana bats the behavioral flexibility to change roosts and foraging areas to avoid disturbance. Construction activities will be temporary, and thus bats have the behavioral flexibility to temporarily change roosting and foraging areas in response to such activities. The noise and vibration associated with construction of wind energy sites in the region will be expected to have a minor impact on the Indiana bat.

The MSHCP AMMs and survey requirements under Alternative A will further reduce the risk of human disturbance on Indiana bat impacts compared to Alternative D, which does not require these AMMs or survey requirements. General avoidance and minimization measures (AMMs) outlined in Chapter 2 (and as described in more detail in Chapter 5 of the MSHCP) reduce the potential for interactions between bats and construction equipment. The survey methodologies outlined in Table 2-3 are intended to identify where Indiana bats are present at a proposed wind energy site. In those cases where bats are present, the AMMs outlined in Table 2-4 serve as seasonal and spatial avoidance techniques to greatly reduce exposure of Indiana bats to disturbance by construction activities. Based on successful implementation of these AMMs, impacts of human disturbance during construction are expected to have a minor effect on the Indiana bat.

Interactions with Vehicles

During the construction and decommissioning process, vehicles will move around the facility on existing county roads as well as access roads specifically built for the wind energy facility. Indiana bats have been found dead on roads presumably as the result of collision with a vehicle (Russell *et al.* 2009). This mortality event was associated with bats that had to cross a busy highway to access key foraging areas. Roadways and associated traffic can also have an indirect effect on bats by rendering some foraging areas inaccessible (Bennett and Zurcher 2012; Bennett *et al.* 2013). Similarly, road noise can deter the foraging behaviors of gleaning bats (Schaub *et al.* 2008). In cases where bats are unable to access foraging areas, they can either abandon those foraging areas and move into other nearby suitable habitats as appears to have occurred at the Indianapolis Airport site (Sparks *et al.* 2008), or in extreme cases the colony may disband or decrease in numbers due to reduced reproduction and mortality.

The MSHCP notes that several features of construction will serve to reduce the potential for negative interactions between bats and construction vehicles. First, construction traffic will mostly occur during the daylight. Second, traffic will be spread throughout the project area (as facilities are widely placed on the landscape), with most construction occurring in areas of limited suitability for bats. Third, construction traffic will be temporary lasting only a few weeks for each portion of a facility. Fourth, construction machinery will move at slow speeds allowing bats time to detect the vehicle and avoid a collision. These factors will also serve to reduce the potential for indirect impacts even without the avoidance and minimization measures outlined in Chapter 2 (and as detailed in Chapter 5 of the MSHCP).

The MSHCP AMMs and survey requirements under Alternative A will further reduce the risk of the Indiana bat's interactions with vehicles compared to Alternative D, which does not require these AMMs or survey requirements. General AMMs outlined in Chapter 2 (and as described in more detail in Chapter 5 of the MSHCP) reduce the potential for interactions between bats and construction vehicles. The survey methodologies outlined in Table 2-3 are intended to identify where Indiana bats are present at a proposed wind energy site. In those cases where bats are present, the AMMs outlined in Table 2-4 serve as seasonal and spatial avoidance techniques to greatly reduce the exposure of Indiana bats to possible interactions with construction vehicles. Based on successful implementation of these avoidance and minimization measures, impacts of disturbance by vehicles during construction and decommissioning are expected to have a minor effect on the Indiana bat.

Removal of Forested Habitat

Indiana bats are strongly associated with forests, and thus removal of this habitat as part of the construction process has the potential to impact the species in both direct (*i.e.,* bats killed, harassed, or injured when trees are felled) and indirect means (harmed as a result of habitat loss). Table 4-2 of the MSHCP includes predictions of the amount of forest suitable for use by Indiana bats that will be removed resulting from the permitted activities. The table was created by intersecting 100 iterations of the build-out model with a model of suitable habitat that identified areas of 7 percent or greater forest (based on NLCD) within the known geographic range of the Indiana bat. This model predicts project footprints will contain between 64,246 acres (lower 5th percentile) to 100,153 acres (upper 95th percentile) with a mean of 81,176 acres. Assuming the typical wind energy project in the region removes 2 to 5 percent of the forest within its footprint, the MSHCP will permit removal of between 1,285 acres (lower 5th percentile at 2 percent) and 5,008 acres (upper 95th percentile at 5 percent) of forest suitable for Indiana bats. Without forested habitat, Indiana bats cannot survive or reproduce; however, unless a facility removed key roosting or foraging areas, construction impacts to Indiana bats will be temporary, even if the habitat removal is permanent.

As noted in Section 4.1.3.2 above, removal of forested habitat without the AMMs contained in the MSHCP was expected to have a moderate effect on Indiana bats. At a landscape-scale, the removal of such a small amount of forest is unlikely to result in an adverse effect on the Indiana bat. However, forested habitat removal during construction is most likely to occur during summer when Indiana bats could be using the trees. During such events, Indiana bats may be killed or disturbed. Under Alternative A, AMMs will be required to avoid locations and times when such risks are greatest; these AMMs are not required under Alternative D.

The MSHCP AMMs and survey requirements under Alternative A will further reduce the effects of forested habitat removal on Indiana bat compared to Alternative D, which does not require these AMMs or survey requirements. General AMMs outlined in Chapter 2 (and as described in more detail in Chapter 5 of the MSHCP) reduce the potential for Indiana bats to be affected by tree-clearing activities. Survey requirements outlined in Table 2-3 and AMMs outlined in Table 2-4 will ensure that tree-clearing activities occur in areas and times of year where direct impacts to Indiana bats will be avoided. These efforts will prevent the loss of keystone habitat features that may lead to take. A possible exception is the loss of small areas of habitat that may be used by migrating bats. At a landscape-scale, the removal of such a small amount of forest is unlikely to result in an adverse effect on the Indiana bat. Habitat restoration is a feature of the MSHCP's conservation plan (summarized in Chapter 2 of this Draft EIS) and is described below as an Operation-Related Impact. Tree-clearing activities are expected to have a minor effect on Indiana bats that will be off-set by

restoration efforts described below under operations. As such, impacts under Alternative A will be minor at first (as habitat is removed) with a long-term effect that is beneficial and moderate.

Death or Injury from Accidental Oil or Chemical Spills

Spills could occur at a variety of times during construction activities. However, these construction activities are also regulated under numerous laws that require containment and control of any spill that should occur. Spills can directly kill bats via toxicity or lead to indirect mortality or injury by impacting food resources. Toxic chemicals entering a hibernacula could have substantial effects, but such chances are low because many of these sites are already protected on private lands. As such, accidental spills associated with the development of wind energy facilities are expected to have a minor effect on Indiana bats, even in the absence of the conditions and requirements of the MSHCP. By placing most wind energy facilities outside areas where bats congregate under Alternative A this risk will be greatly reduced compared to Alternative D (which has no siting requirements), resulting in a minor effect.

Operation-Related Impacts

Sound from Operating Turbines

Operating wind turbines create noise audible to humans and ultrasound that could potentially interfere with foraging or commuting bats. Depending on the level of disturbance, the operating turbines could cause reduced foraging success (at an extreme leading to death of dependent young and possibly adults). A more likely scenario will be for bats to abandon a historic foraging or roosting area and suffer decreased reproduction as they learn the new site. The frequencies and volume of sound produced varies among turbine designs. Szewczak and Arnett (2006) recorded acoustic data at wind energy sites and concluded that these sounds were unlikely to attract bats to the site for foraging. Subsequent studies using thermal cameras detected bats making repeated passes in and around wind turbines (Horn *et al.* 2008). As such, even without the MSHCP, noise created by turbines will be unlikely to have an effect on the Indiana bat.

The MSHCP AMMs and survey requirements under Alternative A will further reduce the potential effects of operating turbine sound on Indiana bat compared to Alternative D, which does not require these AMMs or survey requirements. General avoidance and minimization measures outlined in Chapter 2 (and as described in more detail in Chapter 5 of the MSHCP) reduce the potential for adverse effects associated with noise created by operating turbines. The survey methodologies outlined in Table 2-3 are intended to identify cases where Indiana bats are present at a proposed wind energy site. In those cases where bats are present, the AMMs outlined in Table 2-4 serve to use seasonal and spatial avoidance techniques to greatly reduce the exposure of Indiana bats to possible interactions with turbines. Based on successful implementation of these AMMs, Indiana bats are not expected to be affected by the sound of operating turbines. As such, this is deemed a minor effect.

Lighting

The Federal Aviation Administration (FAA) requires warning lights (typically red strobe lights) to be deployed on objects (including wind turbines, and meteorological towers) that may pose a collision risk to aircraft. Available data indicated that neither bat activity nor mortality rates differ between turbines with and without FAA-mandated lighting (Arnett 2005; Arnett *et al.* 2008; Horn *et al.* 2008). As such, there is little indication that FAA lighting has a direct or indirect effect on bats.

Lighting is also commonly deployed in the turbine nacelles, above the door to the tower, and at operation and maintenance buildings and electrical substations. These are typically white lights used for security purposes and to aid in maintenance. The effects of white light on bats are unknown (Arnett *et al.* 2008), although Sparks *et al.* (2005) speculated that light pollution may contribute to the avoidance of developed landscapes by Indiana bats. Lighting may expose bats to predators that otherwise could not see them or invoke an antipredator response (Sparks *et al.* 2000). Lack of access to foraging areas could lead to mortality of adults and dependent juveniles. Bats may also abandon a historic foraging or roosting area and suffer decreased reproduction as they learn the new site.

Sparks et al (2005) analyzed a single year of foraging data from 11 Indiana bats, but studies at this site are ongoing. During the period 1997 to 2008 Indiana bats were regularly observed foraging in areas near isolated buildings where white lights similar to those used at wind energy sites were installed for security and maintenance purposes (Sparks pers. comm.). As such the bats continue to forage and roost in areas with limited white light. These observations indicate that any direct or indirect effects on Indiana bats were limited to the immediate area surrounding the light.

The MSHCP AMMs and survey requirements under Alternative A will reduce the effects of lighting on Indiana bat compared to Alternative D, which does not require these AMMs or survey requirements. General avoidance and minimization measures outlined in Chapter 2 (and as described in more detail in Chapter 5 of the MSHCP) will reduce any potential lighting effects to Indiana bat. The survey methodologies outlined in Table 2-3 are intended to identify cases where Indiana bats are present at a proposed wind energy site. In those cases where bats are present, the AMMs outlined in Table 2-4 serve to use seasonal and spatial avoidance techniques to place turbines and other infrastructure in areas where there is little chance that lighting will interfere with bats. In addition, AMM GEN 8 (Table 2-5 of this Draft EIS) identifies techniques that are used to reduce light levels in an effort to avoid avian fatalities. These same efforts will also benefit bats. Based on successful implementation of these AMMs, Indiana bats are not expected to be affected by lights associated with wind energy facilities. Thus, this is deemed a minor effect.

Vegetation Control

Mowing, herbicides, and tree-trimming will all be part of the routine maintenance activity associated with wind energy sites. Tree-trimming will primarily be used along the sides of rights-of-way associated with overhead collecting wires, removal of hazard trees/limbs near installations, and to maintain access roads. Herbicides and mowing will be used to control invasive species, maintain ROWs and other permanently disturbed areas.

Of these maintenance activities, tree trimming will have the most potential to directly affect Indiana bats, and could inadvertently disturb or kill roosting bats. Disturbance can cause bats to abandon a known roosting and foraging areas which could potentially cause a loss of reproductive success. Bats may be forced out of torpor increasing energetic expenditures. In extreme cases, when roosts are disturbed, adults may drop or abandon pups (leading to their death). Adult bats forced to flee roosts during the daytime are at a much higher risk of predation from a wide variety of predators (Reviewed by Sparks *et al.* 2000).

Mowing within existing open habitats will be unlikely to affect Indiana bats with the exception of noise and vibrations. As outlined in the discussion of construction equipment, impacts will likely be short-term disturbances to which bats living in an agricultural region may already be accustomed. Such activities, especially along ROWs and seldom-used access roads will maintain the type of edgy habitats used by foraging bats.

Bats may also be susceptible to potential toxic effects of herbicides, and changes in vegetation may change the prey base of a foraging area following use of herbicide. Bats are known to be sensitive to a variety of pesticides, including herbicides (O'Shea and Clark 2002; Eidels *et al.* 2006). Effects range from death in the case of acute toxicity to reduced reproduction. Of particular concern are the sublethal effects of pesticides which may include reduced coordination (at the low end this will include the potential for injury and decrease foraging efficiency) to bats being rendered incapable of flight and becoming easy prey for predators. However, given that most wind energy facilities will be built in existing agricultural fields, where such pesticides are commonly applied, the net effect of wind energy development under the MSHCP could result in a reduction of pesticide application at that particular site.

The MSHCP AMMs under Alternative A will reduce the effects of vegetation control on Indiana bat compared to Alternative D, which does not require these AMM requirements. The potential for any vegetation control technique to have an effect on Indiana bats will be decreased by AMMs that limit the development of wind energy sites in areas where bats concentrate. This effectively removes the limited risk of disturbance associated with mowing. Seasonal and spatial restrictions on tree-trimming activities including AMM GEN7 (see Chapter 2) restricts tree-trimming and clearing to areas and times when Indiana bats are absent. This includes a provision requiring permitted facilities to contact the Service even in cases where tree clearing is necessary for human safety. These efforts should reduce the potential for direct or indirect harm to Indiana bats to the point of being insignificant and discountable. Herbicide applications in areas where herbicides are not currently applied will likely increase under the MSHCP because of the need to clear plots to allow carcass searches under the MSHCP. This will likely increase the frequency of application, but to a level similar to existing agricultural practices. As such this remains a minor effect. At a minimum, this should require application consistent with label directions but could also include time of day and seasonal restrictions that provide additional protection to bats.

Overall, vegetation control is likely to have a minor effect on Indiana bats.

Death or Injury from Accidental Oil or Chemical Spills

Spills could occur at a variety of times from maintenance activities during operation. The potential impact will be the same as described under construction-related impacts above, and is considered a minor effect.

Collisions with Maintenance Vehicles

Operation and maintenance activities will require vehicles to move around facilities on existing roads as well as access roads purposely built for each facility. Indiana bats have been found dead on roads presumably as the result of collision with a vehicle (Russell *et al.* 2009). This mortality event was associated with bats that had to cross a busy highway to access key foraging areas. Similarly, roadways and associated traffic can also have an indirect effect on bats by rendering some foraging areas inaccessible (Bennett and Zurcher 2012; Bennett *et al.* 2013). In cases where bats are unable to access foraging areas, they can either abandon those foraging areas and move into other nearby suitable habitats as appears to have occurred at the Indianapolis Airport site (Sparks *et al.* 2008), or in extreme cases the colony my disband or decrease in numbers due to reduced reproduction and mortality.

Road noise can deter the foraging behaviors of bats that capture insects from the ground or vegetation (Schaub *et al.* 2008). Indiana bats occasionally capture some prey using this foraging

technique but capture most of their food while in flight. As such, road noise may slightly reduce foraging efficiency of Indiana bats.

The MSHCP AMMs and survey requirements under Alternative A will reduce the effects of collisions with maintenance vehicles on Indiana bat compared to Alternative D, which does not require these AMMs or survey requirements. General avoidance and minimization measures outlined in Chapter 2 (and as described in more detail in Chapter 5 of the MSHCP) further reduce the potential for interactions between bats and maintenance vehicles. The survey methodologies outlined in Table 2-3 are intended to identify cases where Indiana bats are present at a proposed wind energy site. In those cases where bats are present, the AMMs outlined in Table 2-4 serve to use seasonal and spatial avoidance techniques to greatly reduce the exposure of Indiana bats to possible interactions with maintenance vehicles. Based on successful implementation of these AMMs, impacts from collisions with maintenance vehicles are expected to have a minor effect.

Collisions with Turbines and Barotrauma[29]

To date, the carcasses of eight Indiana bats have been recovered under wind turbines, including six within the area covered by the MSHCP (Seymour pers. comm.). The cause of death for bats found under wind turbines is usually assumed to be collision with the turbine (or its monopole) although barotrauma (*i.e.,* decompression) may also play a role in the deaths of bats found dead under wind turbines (Baerwald *et al.* 2008).

As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 10, 604 Indiana bats while currently-operating facilities will take another 6,218 Indiana bats, for a total of 16,822 Indiana bats across the 45 year term of the MSHCP without AMMs and other requirements of the MSHCP under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs), such as changing the operational parameters of wind turbines such that they do not spin at a low speeds when bats (especially *Myotis*) are most likely to be killed. Two forms of operational curtailment are included in the MSHCP. The first, feathering, turns the blades out of the wind so the turbines do not spin until there is enough wind to generate electricity. Such an approach will be used under the MSHCP in areas where covered bats may be found in spring. MSHCP Table 5-1 reports two studies that used this approach; one approach reduced mortality of all bats by 36 percent while the other reduced mortality by 58 percent. A second curtailment measure is to raise the speed at which the turbines begin to generate electricity (*i.e.,* an increased cut-in speed). The MSHCP will both feather turbines and prevent them from cutting-in until sustained wind speeds of 5 meter per second are reached in areas where protected bats may occur in summer and fall. MSHCP Table 5-1 reports five studies that used this approach and had reductions in mortality of between 47 and 82 percent. It is important to note that these reductions in mortality are for all bats. Given the short, stubby wings of bats in the genus *Myotis* (Farney and Fleharty 1969, Aebischer *et al.* 1993) it is likely that the covered bats are protected at a higher rate at lower wind speeds.

Based on these data it is likely that bat mortality under the MSHCP will be reduced by at least 50 percent. Thus, wind energy development under the MSHCP will result in substantially lower mortality than under Alternative D which is the baseline condition that the overall take permit cap is

[29] Barotrauma is injury caused by a change in air pressure, typically affecting the ear or the lung.

based on. Mitigation measures presented in the MSHCP are meant to offset this population loss, but this is still a moderate effect.

Effects of the MSHCP on Take

An analysis of the number and expected distribution of mortality indicates that these losses, spread throughout the range and among multiple populations are unlikely to alter the long-term prognosis for survival of the Indiana bat. However, the loss of that many individuals and all future progeny is a moderate effect.

Steps within the MSHCP that serve to reduce impacts to Indiana bats include 1) exclusion from the Plan Area of areas near large hibernacula and potentially important migration routes (*i.e.,* along the Great Lakes and major regional rivers), 2) surveys to locate Indiana bats which are then used to tailor avoidance and minimization efforts around known concentrations of bats, 3) use of set-backs that will place most turbines 1,000 feet from woodlands—a potentially important measure where set-backs coincide with maternity colonies because non-migrating Indiana bats rarely cross large open areas, and 4) implementation of a curtailment program that reduces mortality at new wind energy sites and any existing facilities that obtain a COI. In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, without the MSHCP (i.e., Alternative D) the conservation requirements and mortality monitoring may not occur or will be spread among facilities with little coordination in techniques. A benefit of the MSHCP coordinated efforts is the ability to more rapidly implement system wide changes if take is higher, lower, or distributed differently than predicted by the take model.

Restoration Efforts Associated with the Conservation Program

The conservation program contained in the MSHCP uses a Resource Equivalency Analysis Model (REA) to identify the amount of summer and winter habitat restoration that must be completed for each project once it becomes covered by the MSHCP. Population level effects from the loss of individual Indiana bats will be offset by protecting and improving hibernacula and summer maternity habitat. In addition as outlined in the MSHCP, a Habitat Equivalency Analysis (HEA) Model (HEM) will be used to determine compensation to offset impacts from forest habitat removed during construction. These efforts will have a substantial beneficial effect on Indiana bat habitat.

Decommissioning and Reclamation

Decommissioning and reclamation could have short-term impacts on Indiana bat similar to the construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit the species' habitat that was affected from construction and operation. Reclamation typically includes restoring the project site to pre-construction development conditions similar to those surrounding the facility, and removes the source of operational mortality. Therefore, the effect of decommissioning and reclamation under Alternative A is expected to have a minor short-term adverse effect on Indiana and other covered bats (due to disturbance), but long-term will be a minor beneficial effect as these areas are restored to pre-construction conditions.

Northern Long-Eared Bat

Construction-Related Impacts

With the exception of the following construction impact, mechanisms and effects of construction-related impacts are the same as described for the Indiana bat under Alternative A, Section 4.1.3.2. The primary notable difference between the two species is the northern long-eared bat's larger geographic range, which will put a larger number of individual northern long-eared bats at risk from construction-related impacts compared to Indiana bat. Part of this increased range is associated with a tendency to use trees that generally are less suitable for Indiana bats such as smaller trees and live trees. These roosting behaviors increase the risk that northern long-eared bats will be impacted by tree-clearing efforts.

Removal of Forested Habitat

Northern long-eared bats are associated with forests, and thus removal of this habitat as part of the construction process has the potential to impact the species in both direct (*i.e.,* bats killed, harassed, or injured when trees are felled) and indirect means (harmed as a result of habitat loss). Table 4-2 of the MSHCP identifies the amount of forest suitable for use by northern long-eared bats that will be removed resulting from the permitted activities. The table was created by intersecting 100 iterations of the build-out model with a model of suitable habitat that identified areas of 7 percent or greater forest (based on NLCD) within the known geographic range of the northern long-eared bat. This model predicts project footprints will contain between 112,744 acres (lower 5th percentile) to 173,140 acres (upper 95th percentile) with a mean of 140,885 acres. Assuming the typical wind energy facility in the region removes 2 to 5 percent of the forest within its footprint, the MSHCP will permit the removal of between 2,255 acres (lower 5th percentile at 2 percent) and 8,657 acres (upper 95th percentile at 5 percent) of forest suitable for use by northern long-eared bats. Without forest habitat bats cannot survive or reproduce, but unless a facility removed key roosting or foraging areas, impacts to northern long-eared bats from construction will be temporary, even if the habitat removal is permanent. Given the small amount of forest that will be removed, it is realistic to consider this a minor effect.

Operation-Related Impacts

With the exception of the following operational impact, mechanisms and effects of operation-related impacts are the same as described for the Indiana bat under Alternative A, Section 4.1.3.2. The primary notable difference between the two species is the northern long-eared bat's larger geographic range, which will put a larger number of individual northern long-eared bats at risk from operation-related impacts compared to Indiana bat. Part of this increased range is associated with a tendency to use trees that generally are less suitable for Indiana bats such as smaller trees and live trees. These roosting behaviors increase the risk that northern long-eared bats will be impacted by any tree-trimming efforts during operations.

Collisions with Turbines and Barotrauma

To date, the Service has data indicating the carcasses of 43 northern long-eared bats have been recovered under wind turbines, with 19 of 81 (23.5 percent) surveyed facilities reporting at least one mortality (Seymour pers. comm.). Within the area covered by the MSHCP (Seymour pers. comm.) there are 8 reported carcasses from 6 of the 39 sites (15.4 percent) surveyed. As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 17,775

northern long-eared bats while currently-operating facilities will take another 11,484 northern long-eared bats, for a total of 29,259 northern long-eared bats across the 45-year term of the MSHCP without AMMs and other requirements of the MSHCP under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs), such as changing the operational parameters of wind turbines such that they do not spin at a low speeds when bats (especially *Myotis*) are most likely to be killed. Two forms of operational curtailment are included in the MSHCP. The first, feathering, turns the blades out of the wind so the turbines do not spin until there is enough wind to generate electricity. Such an approach will be used under the MSHCP in areas where covered bats may be found in spring. MSHCP Table 5-1 reports two studies that used this approach; one approach reduced mortality of all bats by 36 percent while the other reduced mortality by 58 percent. A second curtailment measure is to raise the speed at which the turbines begin to generate electricity (*i.e.,* an increased cut-in speed). The MSHCP will both feather turbines and prevent them from cutting-in until sustained wind speeds of 5 meter per second are reached in areas where protected bats may occur in summer and fall. MSHCP Table 5-1 reports five studies that used this approach and had reductions in mortality of between 47 and 82 percent. It is important to note that these reductions in mortality are for all bats. Given the short, stubby wings of bats in the genus *Myotis* (Farney and Fleharty 1969, Aebischer *et al.* 1993) it is likely that the covered bats are protected at a higher rate at lower wind speeds.

Based on these data it is likely that bat mortality under the MSHCP will be reduced by at least 50 percent. Thus, wind energy development under the MSHCP will result in substantially lower mortality than under Alternative D which is the baseline condition that the overall take permit cap is based on. While the mitigation efforts presented in the MSHCP are intended to replace any bats killed by operations, the overall effect of mortality is still deemed a moderate effect.

Effects of the MSHCP on Take

Steps within the MSHCP that serve to reduce impacts to northern long-eared bats include 1) exclusion from the Plan Area of areas near large hibernacula 2) surveys to locate northern long-eared bats which are then used to tailor avoidance and minimization efforts around known concentrations of bats, 3) use of set-backs that will place most turbines 1,000 feet from woodlands—a potentially important measure when set-backs coincide with maternity colonies because non-migrating northern long-eared bats rarely cross large open area, and 4) implementation of a curtailment program that reduces mortality at new wind energy sites and any existing facilities that obtain a COI. In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, without the MSHCP (i.e., Alternative D) the conservation requirements and mortality monitoring may not occur or will be spread among facilities with little coordination in techniques. A benefit of these MSHCP coordinated efforts is the ability to more rapidly implement system wide changes if take is higher, lower, or distributed differently than predicted by the take model.

Little Brown Bat

Construction-Related Impacts

With the exception of the following construction impact, mechanisms and effects of construction-related impacts are the same as described for the Indiana bat under Alternative A, Section 4.1.3.2.

The primary notable difference between the two species is the little brown bat's larger geographic range, which will put a larger number of individual little brown bats at risk from construction-related impacts compared to Indiana bat. The little brown bat can also be associated with buildings, and thus little brown bats may be exposed to disturbance in cases where existing buildings are used by little brown bat during construction activities. Construction-related impacts on the little brown bat are considered minor.

Removal of Forested Habitat

Little brown bats are associated with forests, and thus removal of this habitat as part of the construction process has the potential to impact the species in both direct (*i.e.,* bats killed, harassed, or injured when trees are felled) and indirect means (harmed as a result of habitat loss). Table 4-2 of the MSHCP identified the amount of forest suitable for use by little brown bats that will be removed resulting from the permitted activities. The table was created by intersecting 100 iterations of the build-out model with a model of suitable habitat that identified areas of 7 percent or greater forest (based on NLCD) within the known geographic range of the little brown bat. This model predicts project footprints will contain between 112,744 acres (lower 5th percentile) to 173,140 acres (upper 95th percentile) with a mean of 140,885 acres. Assuming the typical wind energy facility in the region removes 2 to 5 percent of the forest within its footprint, the MSHCP will permit the removal of between 2,255 acres (lower 5th percentile at 2 percent) and 8,657 acres (upper 95th percentile at 5 percent) acres of forest suitable for use by little brown bats. Without suitable forest habitat bats cannot survive or reproduce, but unless a facility removed key roosting or foraging areas, impacts to little brown bats from construction will be temporary and minor.

Operation-Related Impacts

With the exception of the following operational impact, mechanisms and effects of operation-related impacts are the same as described for the Indiana bat under Alternative A, Section 4.1.3.2. The primary notable difference between the two species is the little brown bat's larger geographic range, which will put a larger number of individual little brown bats at risk from operation-related impacts compared to Indiana bat. The little brown bat often roosts in buildings, and thus may be disturbed if these buildings are in the vicinity of an operating wind energy facility.

Collisions with Turbines and Barotrauma

To date, the carcasses of 339 little brown bats have been recovered under wind turbines within little brown bat range in the Plan Area (MSHCP Table 4-7). Because the range of little brown bats is much larger than the other two covered bats, there are numerous additional mortality records available from other portions of the range. As outlined under Alternative D, new wind energy sites built over the next 45 years are projected to kill 753,208 little brown bats while currently-operating facilities will take another 486,630 little brown bats, for a total of 1,239,838 little brown bats across the 45-year term of the MSHCP without AMMs and other requirements of the MSHCP under Alternative A.

The MSHCP did not quantify take reductions that account for the benefits of implementing the requirements of the MSHCP (e.g., AMMs), such as changing the operational parameters of wind turbines such that they do not spin at a low speeds when bats (especially *Myotis*) are most likely to be killed. Two forms of operational curtailment are included in the MSHCP. The first, feathering, turns the blades out of the wind so the turbines do not spin until there is enough wind to generate electricity. Such an approach will be used under the MSHCP in areas where covered bats may be found in spring. MSHCP Table 5-1 reports two studies that used this approach; one approach

reduced mortality of all bats by 36 percent while the other reduced mortality by 58 percent. A second curtailment measure is to raise the speed at which the turbines begin to generate electricity (*i.e.,* an increased cut-in speed). The MSHCP will both feather turbines and prevent them from cutting-in until sustained wind speeds of 5 meter per second are reached in areas where protected bats may occur in summer and fall. MSHCP Table 5-1 reports five studies that used this approach and had reductions in mortality of between 47 and 82 percent. It is important to note that these reductions in mortality are for all bats. Given the short, stubby wings of bats in the genus *Myotis* (Farney and Fleharty 1969, Aebischer *et al.* 1993) it is likely that the covered bats are protected at a higher rate at lower wind speeds.

Based on these data it is likely that bat mortality under the MSHCP will be reduced by at least 50 percent. Thus, wind energy development under the MSHCP will result in substantially lower mortality than under Alternative D which is the baseline condition that the overall take permit cap is based on. While the mitigation efforts presented in the MSHCP are intended to replace any bats killed by operations, the overall effect of mortality is still deemed a moderate effect.

Effects of the MSHCP on Take

An analysis of the number and expected distribution of mortality indicates that these losses, spread throughout the range and among multiple populations will be unlikely to alter the long-term prognosis for survival of the little brown bat. However, the loss of that many individuals will be a moderate effect.

Steps within the MSHCP that serve to reduce impacts to little brown bats include 1) exclusion from the Plan Area of areas near large hibernacula and potentially important migration routes, 2) surveys to locate little brown bats which are then used to tailor avoidance and minimization efforts around known concentrations of bats, 3) use of set-backs that will place most turbines 1,000 feet from woodlands—protecting little brown bats that use woodland edges for foraging, 4) implementation of a curtailment program that reduces mortality at new wind energy sites and any existing facilities that obtain a COI. In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, without the MSHCP (i.e., Alternative D) the conservation requirements and mortality monitoring may not occur or will be spread among facilities with little coordination in techniques. A benefit of these MSHCP coordinated efforts is the ability to more rapidly implement system wide changes if take is higher, lower, or distributed differently than predicted by the take model.

4.1.3.3 Other Rare, Endangered, Threatened and Candidate Species

Many non-covered Federal and state listed species will incidentally receive some protection under the MSHCP, depending on the location of a proposed wind energy facility, habitat conditions around the wind energy facility, and presence of species in the area. Permittees would be required to avoid all take of non-covered federally listed species. Permittees would also be required to comply with state regulations and requirements for state listed species, which may include avoidance, minimization, and mitigation measures. These measures could include minimizing temporary impacts during construction, such as noise and visual disturbance; avoiding, minimizing and mitigating permanent habitat loss as a result of construction; and minimizing long-term impacts due to operations, such as collisions with turbines and other infrastructure.

In general, the severity (minor, moderate, or substantial) and likelihood of impacts to Other Rare, Endangered, Threatened, and Candidate Species will be minor for most impact mechanisms due to participation in the MSHCP, and where avoidance, minimization, and mitigation measures may be required under state regulations or permit requirements.

Construction-Related Impacts

Habitat Loss, Fragmentation, or Degradation

In the Midwest, most wind energy facility construction occurs in agricultural lands obtained through lease agreements. The benefit to wildlife under this land use scenario is that valuable habitat is not commonly used for wind energy facilities. Table 4.1-2 shows the acreage of each MGIN habitat that could potentially be affected due to wind energy development based on the overlap with the MSHCP build-out model.

Table 4.1-2. Potential MGIN Habitat Impacts in Covered Lands (Acres)

MGIN Habitat	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Study Area Total
Core Forest	1,027	50	101	808	2,218	29	107	76	4,415
Forest Corridor	2,047	123	227	1,603	3,170	78	231	129	7,610
Core Wetland	155	41	32	506	1,485	7	21	60	2,307
Wetland Corridor	862	249	104	1,942	3,779	39	152	145	7,273
Core Grassland	207	126	461	109	226	382	116	45	1,673
Grassland Corridor	789	759	1,762	547	1,023	798	587	242	6,506
Core Aquatic	665	117	219	550	1,590	30	56	335	3,561
Aquatic Corridor	318	39	121	167	122	21	39	16	844
Sites	27	16	299	59	549	2	-	3	955
Total	**6,097**	**1,520**	**3,326**	**6,293**	**14,162**	**1,385**	**1,308**	**1,052**	**35,144**
Hubs[1]	1,880	149	672	1,858	5,015	388	235	456	10,653

[1] Hubs encompass some of the highest quality wildlife habitats comprised of one or more MGIN Habitats.

Natural habitat cleared for the development of a wind energy facility represents potential loss of habitat for every species group (e.g., birds, mammals, reptiles). Species occupying habitat that is cleared for a wind energy facility may be directly affected by loss of habitat, take of individuals and young, and other means. Species occupying habitat surrounding the wind energy facility may be indirectly affected through habitat fragmentation and edge effects. Where habitat remains in a natural state after construction, it may be degraded and its value to wildlife diminished due to the presence of the wind energy facility. Most wind energy development, however, will likely occur in agricultural lands. Grasslands also may be used for wind energy development projects because they are easily developed compared to forests or wetlands. Forests, wetlands, and aquatic habitats will be less likely to be used due to practical or regulatory constraints. Habitat impacts under Alternative A will be minor for species dependent on other habitats.

By contrast, due to the relative rarity of grassland habitat, the large number of federally and state-listed animals and plants using grasslands, the ease of developing this type of habitat, and the potential effects to the better quality core grassland habitat in the MGIN model, the effect on grassland-dependent species of plants and wildlife under Alternative A could be moderate to substantial, depending on species.

Permanent habitat loss will also occur from the construction of service roads, pads, substations, power lines, and met towers. Temporary loss of habitat could be caused by staging areas, vehicle parking, crane operation, and transmission line hook-up. Wildlife can be affected by permanent loss of habitat or temporary disturbances through the alteration of normal foraging, migratory, or breeding behaviors. Protected plants could also be damaged or removed by construction activities.

Table 4.1-3 shows the potential affect to Federal critical habitat acreage (or linear miles for one mussel species) from wind energy development under Alternative A based on overlap with the MSHCP build-out model.

Table 4.1-3. Acres and Linear Miles of Designated and Proposed Critical Habitat in the Study Area Potentially Affected by Wind Development

	Acres								
Species	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Total
Canada Lynx	-	-	-	-	1,165.85	-	-	-	1,165.85
Dakota Skipper*	-	-	-	-	7.9	-	-	-	7.9
Gray wolf	-	-	-	-	1,042.15	-	-	-	1,042.15
Hine's emerald dragonfly	0.9	-	-	-	-	-	-	0.3	1.2
Poweshiek skipperling*	-	-	4	2.1	8.5	-	-	-	14.6
Topeka shiner	-	-	4,544.7	-	1,981.65	-	-	-	6,526.35
Total Critical Habitat Affected	**0.9**	**-**	**4,548.7**	**2.1**	**4,206.05**	**-**	**-**	**0.3**	**8,758.05**
	Linear Miles								
Rabbitsfoot	1.65	-	-	-	-	-	1.05	-	2.7
Total Critical Habitat Affected	**1.65**	**-**	**-**	**-**	**-**	**-**	**1.05**	**-**	**2.7**

* Species with proposed critical habitat

For Niangua Darter, Tumbling Creek Cavesnail, and Short's Bladderpod, either none of the MSHCP build-out iterations overlapped on the comparatively small critical habitat of these species or the critical habitat is located in an area with little potential for wind energy development and outside of Covered Lands, such as sensitive caves. For the aquatic species critical habitat (rabbitsfoot and Topeka shiner), it is likely that these waters could be avoided due to regulatory constraints for avoidance of surface waters.

Although critical habitat may be developed for wind energy, the overall effect is expected to be minor. For example, 0.4 percent of Canada Lynx critical habitat may be affected by wind energy development, according to the MSHCP build out model. Practically speaking, however, this area of land is likely to occur in forested habitat in the northern portion of the Covered Lands, and it will be unlikely that this forested area will be cleared for wind energy development if agricultural or grassland habitat is available. These minor potential intrusions on critical habitat, should they even occur, should have no measurable effect on the continued and future survival of the species.

Noise and Visual Disturbance

Some wildlife may be averse to the sight and sound of human presence, vehicular movement, and machinery, and may be temporarily displaced from habitat at or around a wind energy facility during construction. Crane operation also represent a potentially substantial visual disturbance that could temporarily drive away many species of wildlife. Temporary noise and visual disturbance during construction could affect feeding, courtship, and breeding, reduce prey base, and place pressure on remaining habitat already occupied by wildlife, leading to competition between members of the same species. These factors could contribute to a small decline in the local population during construction. For species with young, this temporary disturbance could lead to direct mortality in the cases of nest or burrow abandonment. Due to its temporary nature, the overall effect of noise and visual disturbance under Alternative A is expected to be minor.

Encounters with Vehicles and Construction Equipment

Encounters with construction equipment broadly include collisions (e.g., a bird flying into a windshield), vehicles or construction equipment running over individuals or occupied nests or burrows, killing occupants. Most species could be at risk to be injured or killed by encounters with vehicles and construction equipment; however, due to the slow vehicle speeds and small number of vehicles in the construction area, compared to highway traffic, it is expected that fatalities with non-covered Federal and state listed wildlife will be an infrequent occurrence. Many species are mobile and can vacate the area once land clearing and construction start. Therefore, the effects of these types of encounters under Alternative A are expected to be minor.

Death or Injury from Accidental Oil or Chemical Spills

Terrestrial species could experience injury, illness, or death if exposed to an accidental oil or chemical release. Sources of this type of contamination could include hydraulic leaks and construction equipment oil spills. However, oil and chemical spills at wind energy facilities are expected to be very rare events because best management practices see Section 4.2.3.4, *Best Management Practices*) assure that these scenarios are prevented or rare, and if they occur, contamination is typically localized and clean-up and remediation are rapid. The effect of these temporary events under Alternative A will be minor.

Fish and macroinvertebrates could also be affected by accidental oil or chemical spills should such a spill reach a surface water that supports these species. The worst-case scenario will be acute toxicity depending on the species and the conditions of the spill, and mussels may be more vulnerable given their inability to move compared to fish or other aquatic species. However, such an accident is expected to be a rare event because best management practices to contain and clean up a spill will be implemented. These measures will be site-specific and are typically incorporated into a construction site's Stormwater Pollution Prevention Plan (SWPPP), a document that is required to obtain a National Pollutant Discharge Elimination System (NPDES) General Construction Permit under Section 402 of the CWA. The effects of these temporary events under Alternative A will be minor.

Access Road Stream Crossings

Construction of new access roads across streams can affect fish and macroinvertebrates. Construction and placement of bridges and culverts cause physical disturbance of stream beds at the crossing (Yount and Niemi 1990), and a moderate risk exists for collision between macroinvertebrates and the construction equipment itself; fish are more mobile and can typically avoid construction areas, although direct mortality cannot be entirely ruled out. However, in streams that support federally or state-listed freshwater mussels and fish, wind developers would likely consider relocating mussels and fish to other stream areas developers to reduce the chance of physical collisions and avoid take under the ESA, as well as to comply with state threatened and endangered species regulations. Therefore, this would be a minor effect.

Culverts can pose potential barriers for some aquatic macroinvertebrates in the following ways: increased velocities, vertical drops at the outlet, and the break of continuity of the stream surface (Anderson *et al.* 2012). Similar culvert barrier impacts can occur to fish. This potential moderate impact is largely due to the use of undersized and prefabricated crossings that are not properly designed for passage. These barriers can isolate upstream populations thus reducing gene flow, effective population size, and recolonization potential (Dillon 1988; Vaughan 2002; Anderson *et al.* 2012). Aquatic macroinvertebrates vary widely in their ability to traverse problem culvert road crossings. Species that occupy aquatic habitats for only a portion of their life cycle, are less likely to be affected. For those species that occupy aquatic habitats for all life stages, passage will depend on the ability of the organism to traverse steep grades or move against high velocity currents. These species include freshwater mussels, worms, and many species of amphipods, crayfish, and freshwater snails. The passage of freshwater mussels is inevitably linked to the passage of their host fish. If the host fish cannot pass, the mussel will not be able to colonize in an upstream direction. However, only species that occupy smaller streams and creeks will potentially be affected (e.g., Curtis pearlyshell [U.S. Fish and Wildlife Service 1986]). The risk of improperly-sized culverts can be reduced by proper culvert sizing via recommendations by Service staff and application of best management practices.

Increased Sedimentation and Turbidity

The impact mechanism of increased sedimentation and turbidity on water quality is described in Section 4.2.3.1, *Surface Waters*. The impact of increased turbidity in surface water can impact fish and macroinvertebrates.

High turbidity levels can directly affect the physical health of fish and alter fish behavior, but the severity of these impacts will vary, depending on species susceptibility. Impacts of turbidity on fish physiology can include affects to gill function, blood sugar levels, and osmoregulatory function

(*i.e.,* keeping the fish's fluids from becoming too diluted or too concentrated) in fish. Turbidity impacts to fish behavior can include altered responses to predation risk and predator avoidance, changes in foraging ability, and reduced territoriality.

Sediment suspension and deposition, if it occurs, can have an impact to aquatic macroinvertebrates. Impact mechanisms include several direct effects such as abrasion and dislodgement from suspended particles, potential burial, and the clogging of gills and respiratory systems (Jones *et al.* 2012). The majority of the federally listed aquatic macroinvertebrates within the Plan Area are filter feeders that cannot withstand heavy silt loads (see Table 3.1-6). These species, due to their limited mobility, have a heightened risk of burial when rates of sediment deposition are high (Wood and Armitage 1997). In such circumstances, sediment can also potentially build up on the respiratory organs of filter feeders (e.g., mussels), making breathing and feeding difficult. In addition to these direct effects, indirect effects such as alteration of physical habitat and changes in primary productivity can have detrimental effects on aquatic biota. Sedimentation changes the substrate of streams, rivers, and lakes by changing the average size of particles, filling the interstitial space between larger substrate, and altering the stability of the streambeds. Such alterations can limit the suitability of habitat for many aquatic macroinvertebrates, including crayfish (Taylor *et al.* 2007), mussels (Bogan 1993), insects (Wood and Armitage 1997) and snails (U.S. Fish and Wildlife Service 2003). In addition to these effects, several studies have shown that a common response to sedimentation within insects is that the number of individuals entering drift increases (see Jones *et al.* 2012 for a review of this effect). This response is thought to be both physical (due to increased dislodgement from moving particles) and behavioral.

The risk of increased sedimentation can be reduced by proper application of best management practices (e.g., seeding, check dams, silt fences, sediment traps) for erosion control, and any increase in turbidity during construction will be short-term and temporary. The best management practices will need to be site-specific and be included within the SWPPP. Therefore, the temporary impacts of sedimentation and turbidity under Alternative A will be minor.

Vegetation Removal around Surface Waters

In surface waters adjacent to and surrounding wind energy development sites, vegetation removal could locally alter the trophic interactions and predator-prey dynamics, which can moderately impact aquatic macroinvertebrates and fish. Vegetation removal can reduce shading of the waterbody (increasing water temperature [which favors low-oxygen tolerant species] and reducing escape cover), increase algae and macrophytes due to heightened solar exposure (potentially altering the trophic-interactions of the community by favoring herbivores), and increase predation from birds, mammals, and reptiles (King *et al.* 2000; Studinski *et al.* 2012). In addition to these impacts, vegetation removal can reduce bank stability. Bank instability can be an important attribute of suitable habitat for several of the federally listed species within the Plan Area (e.g., Neosho mucket [Obermeyer 2000]). Instability can lead to increased erosion and sedimentation and reduce sediment transport capacity. At the reach scale, tree and vegetation removal can alter stream hydrography, increase runoff of pollution and excess nutrients, and increase sedimentation into streams (Putz *et al.* 2003). All of these effects can adversely impact aquatic macroinvertebrates and fish both directly through decreased survival and indirectly through loss of suitable habitat (Yount and Niemi 1990). Although the level of impact from such vegetation removal depends on the site-specific conditions and species present, such impacts will likely be minor due to Federal or state regulatory requirements to avoid surface waters as much as practicable.

Water Withdrawals

Water withdrawals may be needed for wind energy construction activities, including dust suppression, hydroseeding, concrete mixing, and vehicle and machinery washing. These water withdrawals can temporarily limit available suitable habitat through decreased discharge and can entrain macroinvertebrates and fish. All withdrawals for construction activities will need to be conducted under state and/or local water withdrawal regulations, and the potential for entrainment can be reduced by using intake screens and keeping hoses off the bottom of the stream or waterbody. Although the level of impact from such withdrawals will depend on the volume withdrawn and the availability of water within the system, such impacts will likely be minor due to the limited amount of water needed and will be temporary in duration.

Operation-Related Impacts

Collisions with Turbines

Death of individual birds can result in loss of reproductive potential for local populations, but wind energy facilities are not large sources of bird mortality compared to other sources. For example, each year in the United States, an estimated 1.3 to 4 ***billion*** birds are killed by domestic cats, 365 to 988 million by collisions with buildings, 89 to 340 million by automobiles, and 6.8 million by communication towers (Loss *et al.* 2013 in U.S. Department of Agriculture 2015) (emphasis added). However, approximately 140,000 to 328,000 birds are estimated to be killed by collisions with wind turbines every year in the United States (Loss et al 2013 in U.S. Department of Agriculture 2015). Compared to birds killed by domestic cats alone, bird collisions with wind turbines using the more conservative estimates (328,000 kills for turbines and 1.3 billion for domestic cats) represent about 0.02 percent of all bird kills annually in the United States. Using the less conservative estimates and adding in collisions with buildings, automobiles, and communications towers pushes that percentage substantially lower (~0.003 percent). This context on annual bird kills in the United States is important when reading the following impact discussion on bird deaths from collisions with turbines.

The species groups that experience collisions with turbines include birds, bats (see *Protected Bats* below), and to an extent, flying insects. Under the MSHCP, wind energy facilities will be required to micro-site their turbines, or integrate other avoidance and minimization measures to reduce the number of federally-protected bird and bat fatalities. The annual total small bird fatalities for 33,000 MW of new wind energy facilities under Alternative A will be just over 130,000 individuals, as derived from Erickson *et al.'s* (2014) fatality rate estimate from publicly-available bird fatality data. The proportion of small bird turbine collision fatalities among all turbine collision fatalities in the Prairie Biome is 68 percent (Erickson *et al.* 2014). Extrapolating to all birds (e.g., raptors, upland game birds, shorebirds), the annual total bird fatalities under full build out will be just over 192,000 individual birds (Table 4.1-4). Over the course of an entire 45-year permit duration covering all eight states in the MSHCP, an estimated 7.3 million birds will collide with turbines, with just over 4.9 million of these being small birds.

Of the 2.3 million larger birds estimated to collide with turbines over the 45-year permit, the fatalities reported by Erickson *et al.* (2014) suggest that upland game birds, diurnal raptors, doves/pigeons, and waterfowl will constitute the majority of them (Table 4.1-5), or over one million individuals over 45 years.

Table 4.1-4. Bird Fatality Estimates in the Prairie Biome under Alternative A

State	Build Out (MW)[1]	Estimated annual small bird kill at full build out[2]	Estimated annual all bird kill at full build out [2]	Total estimated small bird kill from 2016-2061[3, 4]	Total estimated all bird kill from 2016-2061[3, 5]
Iowa	9,765	38,669	56,832	1,469,437	2,159,627
Illinois	4,094	16,212	23,827	616,065	905,429
Indiana	5,848	23,158	34,035	880,007	1,293,344
Michigan	727	2,879	4,231	109,399	160,783
Minnesota	2,030	8,039	11,815	305,474	448,955
Missouri	971	3,845	5,651	146,116	214,746
Ohio	7,108	28,148	41,369	1,069,612	1,572,005
Wisconsin	2,457	9,730	14,300	369,729	543,390
TOTAL	**33,000**	**130,680**	**192,060**	**4,965,840**	**7,298,280**

MW = megawatts.

[1] Estimate mean MW (2016 to 2031).

[2] Assumes completion of MW build out.

[3] Assumes 15 years of construction to reach build out capacity at year 15, and 30 years of operation at build out capacity.

[4] 3.96 small birds/MW/year in the Prairie Biome. Based on Erickson *et al.* (2014).

[5] Small bird fatality rate extrapolated to all birds gives 5.82 birds/MW/year, where 68 percent of all bird fatalities in the Prairie Biome are small birds, according to Erickson *et al.* (2014).

Table 4.1-5. Bird Fatalities by Bird Type Nationwide

Bird Type	No. of Fatalities Nationwide[1]	Percent of All Fatalities Nationwide
Passerines (Small Birds)	3,110	62.5
Upland Game Birds	407	8.2
Diurnal Raptors	386	7.8
Unidentified Birds	260	5.2
Doves/Pigeons	192	3.9
Waterfowl	133	2.7
Vultures	71	1.4
Owls	62	1.2
Rails/Coots	54	1.1
Woodpeckers	52	1.0
Shorebirds	49	1.0
Large Cuckoos	45	0.9
Large Corvids	38	0.8
Swifts/Hummingbirds	37	0.7
Goatsuckers	25	0.5
Gulls/Terns	24	0.5
Loons/Grebes	18	0.4
Waterbirds	9	0.2
Kingfishers	3	0.1
Overall	4,975	100

[1] From Erickson *et al.* (2014)

By comparison, several hundreds of millions of birds collide *each year* with buildings, power lines, vehicles, and tall towers (Erickson *et al.* 2005), and billions are killed each year by domestic cats (Loss *et al.* 2013 in U.S. Department of Agriculture 2015). Non-covered Federal and state-listed bird species represent a fraction of the individual birds encountering wind energy facilities each year. While fatalities of these protected bird species cannot be discounted, the total number for any one protected species is likely to be very small. In addition, the MSHCP AMMs that would be implemented for turbine operations under Alternative A may benefit some non-covered bird species; therefore, turbine collision impacts for these species would likely be less under Alternative A than under Alternative D, which has no AMM requirements for turbine operations. Consequently, the risk of collision with turbines by non-covered Federal and state-listed bird species is expected to be minor under Alternative A.

Collisions with Power Lines and Met Towers

Birds and bats may collide with met towers or collide with or be electrocuted by power lines, causing injury or death; this impact has the potential to be a locally important source of mortality for some species. Unguyed met towers have much lower fatality rates than guyed towers and the wind energy industry in general is shifting away from the use of guyed met towers. (See the section, Covered Species, Kirtland's warbler, Alternative A.) Under Alternative A, with MSHCP AMMs in place

to minimize collisions (e.g., unguyed met towers and buried power lines; see Table 2-5), the overall effect to non-covered Federal and state-listed species is expected to be minor. These measures would not be required under Alternative D.

Noise, Vibration, and Visual, and Thermal Disturbance

The presence of turbines and transmission towers may permanently drive away species of wildlife that cannot tolerate or adapt to the height, size, proximity, and density of turbines or towers. Turbine blade movement, shadow flicker, and rotor and motor hum may also cause certain wildlife to abandon otherwise suitable habitat. Other sources of noise and visual disturbance may include hum from power lines, flashing lights on turbines and met towers, or security lights on turbine towers, at substations, or other facilities. These disturbances may reduce the quality of habitat in the perception of some species of wildlife, leading to abandonment of otherwise good foraging and nesting habitat by some species. This reduces available habitat in the local area and reduces the density of breeding animals in that local area. A smaller population of those species results, which, if reduced sufficiently, becomes susceptible to local disappearance due to random events. Because most wind energy facilities will be placed in agricultural lands, the overall effect of noise and other disturbances will be less than if facilities were placed in higher quality habitat. Loss of higher quality habitat cannot be discounted - most likely to occur in grasslands rather than forests, wetlands, or aquatic habitat. For example, species of birds inhabiting grassland and brushland are known to be susceptible to habitat displacement due to noise and visual disturbance (Mabey and Paul 2007). These incidences of habitat displacement in grasslands under Alternative A are expected to be moderate, but in other habitats to be minor.

Thermal effects may occur as a result of buried powerlines, which generate heat. This may cause localized moderate effects to fossorial rare species or their habitat. For example, heat from a nearby buried powerline may prevent an overwintering slender glass lizard from entering a proper torpor state (a state of winter inactivity), which may diminish its chance of survival when it emerges in the spring.

Disturbance During Maintenance Activities

Nesting birds could be disrupted during routine vegetation maintenance activities. These activities include repairs to turbines and other infrastructure, raising and lowering of met towers, moving vehicles and operating equipment. These activities could cause visual disturbance, noise, and collisions. Collisions result in death of individuals. Temporary abandonment of territory exposes young to predation and poor weather conditions, which could lead to death and the loss of reproductive potential for the season. Many bird species will renest, however, if the disturbance occurs early in the breeding season. When wildlife are displaced temporarily, they cease their regular activities. Species defending territories, or with young, however, do not typically abandon territory but return to it after the disturbance ends. It is expected that overall the maintenance activities for wind energy facilities will be episodic and short in duration. Due to the intermittent and short nature of the disturbance, and because avoidance and minimization measures will be required under Alternative A, the effect of disturbances during maintenance is expected to be minor.

Death or Injury from Accidental Oil or Chemical Spills

The impact from an accidental oil or chemical spill during operations is the same as described for Covered Species in Section 4.1.4.2, *Covered Species*.

Decommissioning and Reclamation

Decommissioning and reclamation could have short-term impacts on other protected species similar to construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit the species' habitat that was affected from construction and operation. Reclamation typically includes restoring the project site to pre-construction development conditions similar to those surrounding the facility. Furthermore, if turbines are dismantled and removed after decommissioning, the chance for future collisions is eliminated. Therefore, the effect of decommissioning and reclamation under Alternative A is expected to have a minor short-term adverse effect on other protected species, but long-term, beneficial, minor effects.

4.1.3.4 Other Protected Bats

Construction-Related Impacts

Mechanisms and effects of construction-related impacts for other protected bats are the same as described for the covered bats under Alternative A, Section 4.1.3.2. The other protected bats will receive similar protection and benefits as the covered bats under the MSHCP because 7 of the 8 protected bat species are cave-hibernating species and have ranges and habitat needs that overlap the three covered bats. The evening bat, which uses trees year-round is not associated with caves, but will benefit due to an overlap in roosting requirements with the Covered Species. Evening bats are a southern species, with highest densities occurring in areas that have been excluded under the MSHCP (*i.e.,* outside of Covered Lands). In cases where evening bats or other tree-roosting bats occur in Covered Lands where a wind energy facility is constructed, the impacts will be similar to those described for covered bat species, and the AMMs (including bat surveys and wind facility siting), will have some benefits to evening bats because the species selects woodlands that are also used by the Covered Species. Therefore, the MSHCP requirements under Alternative A would result in reduced construction impacts on other protected bats compared to Alternative D which has no conservation strategy requirements (e.g., avoidance of sensitive habitats and AMMs). Construction-related impacts on other protected bats are expected to be minor.

Operation-Related Impacts

With the exception of the following operational impact, mechanisms and effects of operation-related impacts for other protected bats are the same as described for the covered bats under Alternative A, Section 4.1.3.2. In all cases, the other protected bats will benefit from MSHCP conservation measures developed for the Covered Species. Excluding important cave areas will provide important protection to 7 of the 8 protected bat species which share these hibernacula with the three covered bats. Evening bats are exclusively a tree-roosting species, but are most abundant at the southern end of the Covered Lands where most of the caves occur. In cases where protected bats, especially evening bats and tri-colored bats, use trees within the Covered Lands near operating wind energy facilities, the AMMs directed toward detecting and protecting woodlands used by the Covered Species will provide some protection for other protected bats as they share many of the same roosting areas. In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. Therefore, the MSHCP requirements under Alternative A would result in reduced operation impacts on other protected bats compared to Alternative D which has no conservation strategy requirements (e.g., avoidance of sensitive habitats and AMMs).

Collisions with Turbines and Barotrauma

The MSHCP Table 4-7 documents the detection of the carcasses of 8,934 bats under wind energy facilities throughout the range of protected bat species. Bats are killed at wind energy sites as a result of both collisions with turbines and barotrauma (Baerwald *et al.* 2008).

As summarized in Table 4.1-6, among the mortalities documented in the MSHCP Table 4-7 are 519 big brown bats, 24 tri-colored bats, and 28 evening bats. Although the table includes no data for eastern small-footed bats, carcasses of eastern small-footed bats are known from other regions and thus the model that was used in the MSHCP was created by assuming a single carcass had been found in the Midwest.

As noted for the covered bats, it was not possible to quantify take reductions that account for the benefits of implementing the MSHCP because the MSHCP did not quantify the potential benefit of AMMs. Chief amongst these is changing the operational parameters of wind turbines such that they do not spin at a low speeds when bats (especially *Myotis*) are most likely to be killed. The MSHCP will both feather turbines and prevent them from cutting-in until sustained wind speeds of 5 meter per second are reached in areas where covered bats may occur in summer and fall. MSHCP Table 5-1 reports five studies that used this approach and had reductions in mortality of between 47 and 82 percent. It is important to note that these reductions in mortality are for all bats. Based on these data it is likely that mortality will be reduced by at least 50 percent under Alternative A compared to Alternative D which has no conservation strategy requirement. However, this still may represent a moderate to substantial effect on those species (such as big brown and tri-colored bats) that are known to be susceptible to mortality at wind energy sites.

Evaluation of Risk for Species Without Known Mortalities

To date, no carcasses of Ozark big-eared bats, Rafinesque's big-eared bats, southeastern bats, or gray bats have been detected. However, few wind energy facilities have been completed within the range of these four species, and even fewer have conducted post-construction mortality studies. The chance of detecting very rare events (such as mortality of these species) is also relatively low.

Ozark big-eared bats

Even without the conservation measures associated with the MSHCP there will be little chance that wind energy development in the study area will impact the Ozark big-eared bats. Areas excluded from consideration for wind energy development under the MSHCP effectively eliminate those portions of Missouri where the species may occasionally still occur. The broad, paddle-shaped wings of the species, are more likely to be impacted by higher wind conditions and thus the species will be more apt to move at lower wind speeds. As such, the species likely benefits from seasonal curtailment at a higher than average rate and thus the chances of mortality for this species are remote and minor.

Rafinesque's big-eared bats

Even without the conservation measures associated with the MSHCP there will be little chance that wind energy development in the study area will impact Rafinesque's big-eared bats. Areas excluded from consideration for wind energy development under the MSHCP effectively eliminate those portions of Missouri, Indiana, Ohio, and especially Illinois where the species is most likely to occur. Given the broad, paddle-shaped wings of the species, the species likely benefits from seasonal

curtailment at a higher than average rate and thus the chances of mortality for this species are remote and minor.

Southeastern bat

Even without the conservation measures associated with the MSHCP there will be little chance that wind energy development in the study area will impact southeastern bats. Areas excluded from consideration for wind energy development under the MSHCP effectively eliminate those portions of Missouri, Indiana, and especially Illinois where the species is most likely to occur. Added to benefits from seasonal curtailment of wind energy development associated with the MSHCP will be unlikely to affect the Southeastern bat. As such, impacts are expected to be minor.

Gray bat

Conservation measures associated with the MSHCP eliminate those areas of Missouri, Indiana, and Illinois that are within the typical distribution of the gray bat. As noted above, the species wanders widely, and at great height. As such, the species will likely benefit from seasonal curtailment. However, even with the MSHCP there will still be some potential that individual bats will be killed. These events are likely to have minor population-level effects.

4.1.3.5 Other Wildlife Species

The impact mechanisms for Other Wildlife Species are the same as for Rare, Threatened, Endangered, and Candidate species since they fall into the same species groups and use the same habitats as protected species (e.g., protected vs. non-protected grassland birds). However, with the exception of migratory birds protected under the Migratory Bird Treaty Act, general wildlife is not protected from take. General wildlife will often benefit from the protections provided to state and federally-protected species and potentially from measures that will be implemented under the MSHCP, depending on the location of the wind energy facility, the habitat conditions, and the wildlife that may be in the area. Thus, impacts to general wildlife under Alternative A are expected to be minor.

There are many more species of unprotected wildlife than protected wildlife. By sheer force of numbers, the number of common species of wildlife to be affected will be higher. Depending on an individual species' behavior and ecology, the risk of an individual being impacted by wind energy development may be the same as for a similar protected species. For example, a song sparrow may have an equal risk of colliding with a turbine as a Henslow's sparrow, though many more song sparrows in total could be injured or killed because they are more numerous (and have a broader distribution) than Henslow's sparrows.

Because general wildlife populations are generally stable, even if there are greater impacts to certain species or species groups, the chances of wind energy development jeopardizing the continued survival of an entire species is minor, especially for bird collisions with wind turbines, where the number of collisions are far less compared to other anthropogenic sources, such as domestic cats and collisions with buildings (see Section 4.1.4.3, *Other Rare, Endangered, Threatened, and Candidate Species*).

Construction-Related Impacts

Mechanisms and effects of construction-related impacts on Other Wildlife Species are the same as described for Other Rare, Threatened, Endangered, and Candidate Species under Alternative A, Section 4.1.3.3.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts on Other Wildlife Species are the same as described for Other Rare, Threatened, Endangered, and Candidate Species under Alternative A, Section 4.1.3.3.

Collisions with Turbines

Most turbine collision fatalities in the Midwest are of common, non-protected species of passerine birds. Bird kill estimates from turbine collisions are provided in Table 4.1-4 above. The Migratory Bird Treaty Act does not require a permit or micrositing of turbines to reduce risk of collisions. However, it is usually in a wind energy facility's interest to reduce risk, as there is a possibility of enforcement action when a wind energy facility causes high numbers of avian fatalities and no avoidance or reduction of risk was attempted. In addition, implementation of measures under the MSHCP to reduce collisions will benefit non-covered migratory bird species (see Table 2-5 and Table 2-6); therefore, turbine collision impacts for these bird species under Alternative A would likely be less than Alternative D, which has no AMM requirements for turbine operations.

Migratory Tree Bat Species

As stated in Chapter 3, four species of migratory tree bats are found in the study area: eastern red bat, hoary bat, silver-haired bat, and Seminole bat. Migratory tree bat species make up 88.92 percent of bat carcasses found under wind turbines. Due to the scale of potential mortality the Service is providing an analysis of these species separate from all Other Wildlife Species in Section 4.1.4.4, even though no state in the study area has listed these species as threatened or endangered.

Construction-Related Impacts

Mechanisms and effects of construction-related impacts for migratory tree bats are the same as described for the covered bats under Alternative A, Section 4.1.3.2. These species (especially eastern red, hoary, and Seminole bats) may also occupy isolated, solitary trees or even very small trees and thus be at an increased risk of mortality during construction. All migratory tree bats will benefit from MSHCP conservation measures directed at the Covered Species. Areas excluded from the Covered Lands, including major water features and areas of cave habitat, are also used extensively by migratory tree bats, even though only silver-haired bats regularly use caves. Similarly, when migratory tree bats occur in Covered Lands where a wind energy facility is constructed, the impacts will be similar to those described for covered bat species, and the AMMs (including bat surveys and wind energy facility siting) will have some benefits to migratory tree bats because the species often share woodlands that are also used by the Covered Species. Therefore, the MSHCP requirements under Alternative A would result in reduced construction impacts on migratory tree bats compared to Alternative D which has no conservation strategy requirements (e.g., avoidance of sensitive habitats and AMMs). Construction-related impacts are expected to be minor for these species.

Operation-Related Impacts

With the exception of the following operational impact, mechanisms and effects of operation-related impacts for migratory tree bats are the same as described for the covered bats under Alternative A, Section 4.1.3.2. In all cases, the migratory tree bats will benefit from the MSHCP conservation measures developed for the Covered Species. Areas excluded from the Covered Lands including major water features and areas of cave habitat are also used extensively by migratory tree bats, even though only silver-haired bats regularly use caves. Similarly, when migratory tree bats occur in Covered Lands where a permitted wind energy facility is operating, the impacts will be similar to those described for covered bat species, and the operational AMMs will have some benefits to migratory tree bats because the species often share woodlands that are also used by the Covered Species. In addition, detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. Therefore, the MSHCP requirements under Alternative A would result in reduced operation impacts on migratory tree bats compared to Alternative D which has no conservation strategy requirements (e.g., avoidance of sensitive habitats and AMMs).

Collisions with Turbines and Barotrauma

The MSHCP Table 4-7 documents the carcasses of 8,934 bats under wind energy facilities throughout the range of the northern long-eared bat. Bats are killed at wind energy sites as a result of both collisions with turbines and barotrauma (Baerwald *et al.* 2008).

Among the mortalities documented in MSHCP Table 4-7 are 3,893 eastern red bats, 2,328 hoary bats, 1,621 silver-haired bats, and 13 Seminole bats. As noted for the covered bats, it was not possible to quantify the potential take benefits of the MSHCP because the MSHCP did not quantify the potential benefit of AMMs. Chief amongst these is changing the operational parameters of wind turbines such that they do not spin at a low speeds when bats are most likely to be killed. The MSHCP will both feather turbines and prevent them from cutting-in until sustained wind speeds of 5 meter per second are reached in areas where covered bats may occur in summer and fall. MSHCP Table 5-1 reports five studies that used this approach and had reductions in mortality of between 47 and 82 percent. It is important to note that these reductions in mortality are for all bats, and is directly applicable to migratory tree bats. Based on these data it is likely that mortality at participating facilities will be reduced by at least 50 percent under Alternative A compared to Alternative D which has no conservation strategy requirement. However, these bats are still likely to suffer hundreds of thousands of mortalities—a substantial effect without data to indicate otherwise.

Effects of Potential Mortality

Migratory tree bats have shorter life spans than other bats and females produce multiple pups each summer, as opposed to the Covered Species which produce a single pup each year. As such, the species may be capable of tolerating greater mortality than other species. However, the mortality of hundreds of thousands of eastern red, hoary, and silver-haired bats can only be deemed a substantial effect. Given the small number of carcasses retrieved and the accepted range of the Seminole bat these mortalities may be disoriented migrants whose deaths have no population-level effect. However, it is possible that Seminole bats are responding to climate change by moving into more northern landscapes, and mortality at wind energy facilities may restrict this movement.

4.1.3.6 Other Fish and Aquatic Resources

The impact mechanisms for other fish and aquatic resources are the same as those described for Rare, Threatened, Endangered, and Candidate species since they fall into the same species groups and use the same habitats as protected species (e.g., protected vs. non-protected mussels). General fish and aquatic species will often benefit from the protections provided to state and federally-protected species and potentially from measures that will be implemented under the MSHCP, depending on the location of the wind energy facility, the habitat conditions, and the species that may be in the area. Thus, impacts to other fish and aquatic resources under Alternative A are expected to be minor.

There are many more species of unprotected fish and aquatic species than there are protected species. By sheer force of numbers, the number of common species to be affected will be higher. Depending on an individual species' behavior and ecology, the risk of an individual being impacted by wind energy development may be the same as for a similar protected species. Because general fish and aquatic species populations are generally stable, even if there are greater impacts to certain species or species groups, the chances of wind energy development jeopardizing the continued survival of an entire species is minor. In addition, it is anticipated that wind energy developers will avoid impacting surface waters as much as possible due to the Federal and state regulatory protections of these resources.

4.1.4 Alternative B—Reduced Permit Duration

4.1.4.1 Vegetation Communities

The construction- and operation-related impacts to vegetation under Alternative B will be the same as those described for Alternative A, which are minor to moderate.

4.1.4.2 Covered Species

Kirtland's Warbler

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy projects will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects on Kirtland's warbler similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to adversely affect Kirtland's warbler compared to Alternative A, but less potential compared to Alternative D.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy projects will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and AMMs, and will therefore, have effects to Kirtland's warbler similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect Kirtland's warbler compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines

The mechanisms and effects of collisions with turbines on Kirtland's warbler under Alternative B are the same as those described under Alternative A, Section 4.1.3.2.

The effect on take under the 11,000 MW that would be developed under the MSHCP would be similar to Alternative A. If individual project ITPs can be obtained for the additional 22,000 MW, take levels will be the same as under Alternative A, Section 4.1.3.2. Coordination among projects for mitigation and monitoring, however, may not occur and administrative burden on the Service may be greater than under Alternative A (more similar to Alternative D). If ITPs are not obtained for the additional 22,000 MW, take levels would be greater because effects could occur outside the Covered Lands and closer to breeding habitats and no AMMs would be implemented (as in Alternative D). Given the small fraction of the population predicted to be affected under Alternative D and Alternative A, however, Alternative B is expected to have a minor effect on the Kirtland's warbler population in terms of collision with turbines, including lighting effects.

Piping Plover

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for piping plover under Alternative A, Section 4.1.3.2, which are minor. This means that the first 11,000 MW of wind energy will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy projects will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and potentially closer to breeding habitat) and conditions and mitigation measure requirements, and will therefore, have effects to piping plover similar to those described under Alternative D, Section 4.1.6.2. Given the locations of existing wind energy facilities around the Great Lakes, where only a couple are within one mile from the shore and most are over three miles from the shore, it is unlikely that new facilities under Alternative B will be built near the shoreline where breeding habitat occurs. Nevertheless, a new wind energy facility close to shoreline breeding habitat cannot be entirely ruled out and the risk of wind energy development closer to these areas is higher compared to

Alternative A. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. Therefore, Alternative B will have an overall greater potential to adversely affect piping plover compared to Alternative A, but less potential compared to Alternative D.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for piping plover under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy projects will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and AMMs, and will therefore, have effects to piping plover similar to those described under Alternative D, Section 4.1.6.2. Given the locations of existing wind energy facilities around the Great Lakes, where only a couple are within one mile from the shore and most are over three miles from the shore, it is unlikely that new facilities under Alternative B will be built near the shoreline where breeding habitat occurs. Nevertheless, a new wind facility close to shoreline breeding habitat cannot be entirely ruled out and the risk of wind energy operating closer to these areas is higher compared to Alternative A. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to adversely affect piping plover compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines

The mechanisms and effects of collisions with turbines on piping plover under Alternative B are the same as those described under Alternative A, Section 4.1.3.2.

The effect on take under the 11,000 MW that would be developed under the MSHCP would be similar to Alternative A. If individual project ITPs can be obtained for the additional 22,000 MW, take levels will be the same as under Alternative A, Section 4.1.3.2. Coordination among projects for mitigation and monitoring, however, may not occur and administrative burden on the Service will be higher than under Alternative A and more similar to Alternative D. If ITPs are not obtained for the additional 22,000 MW, take levels would be greater because effects could occur outside the Covered Lands and closer to breeding habitats and no AMMs would be implemented (as in Alternative D). Given the small percentage of the population affected under Alternative D and Alternative A, however, Alternative B is expected to have a minor effect on the piping plover population in terms of collision with turbines, including lighting effects.

Interior Least Tern

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for interior least tern under Alternative A, Section 4.1.3.2, which

are minor. This means that this 11,000 MW of wind energy will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy projects will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and potentially closer to breeding habitat) and conditions and mitigation measure requirements, and will therefore, have effects to interior least tern similar to those described under Alternative D, Section 4.1.6.2. However, interior least tern breeding habitat outside of Covered Lands are relatively low value wind resources areas and it will be unlikely that new wind energy development will occur in or near these areas. Nevertheless, a new wind energy facility constructed close to breeding habitat cannot be entirely ruled out and the risk of a wind energy facility operating closer to these areas is higher compared to Alternative A. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect interior least tern compared to Alternative A, but less potential compared to Alternative D.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for interior least tern under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy projects will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and AMMs, and will therefore, have effects to interior least tern similar to those described under Alternative D, Section 4.1.6.2. However, interior least tern breeding habitat outside of Covered Lands are relatively low value wind resources areas and it will be unlikely that new wind energy development will be operating in or near these areas. Nevertheless, a new wind energy facility close to breeding habitat cannot be entirely ruled out and the risk of a wind energy facility operating closer to these areas is higher compared to Alternative A. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect interior least tern compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines

The mechanisms and effects of collisions with turbines on interior least tern under Alternative B are the same as those described under Alternative A, Section 4.1.3.2.

The effect on take under the 11,000 MW that would be developed under the MSHCP would be similar to Alternative A. If individual project ITPs can be obtained for the additional 22,000 MW, take levels will be the same as under Alternative A, Section 4.1.3.2, but coordination among projects for mitigation and monitoring may not occur and administrative burden on the Service will be greater than under Alternative A and more similar to impacts under Alternative D. If ITPs are not obtained for the additional 22,000 MW, take levels would be greater because take could occur outside the Covered Lands and closer to breeding habitats and no AMMs would be implemented (as

in Alternative D). Given the small percentage of the population affected under Alternative D and Alternative A, Alternative B is expected to have a minor effect on the interior least tern population in terms of collision with turbines, including lighting effects.

Bald Eagle

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for bald eagle under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy projects will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to nesting sites, wintering habitat, or other high eagle use areas) and conditions and mitigation measure requirements, and will therefore have effects on bald eagle similar to those described under Alternative D, Section 4.1.6.2. Given the locations of existing wind energy facilities around the Great Lakes, where only a couple are within one mile from the shore and most are over three miles from the shore, it is unlikely that new facilities under Alternative B will be built near the shoreline where breeding habitat occurs. Nevertheless, a new wind facility close to shoreline breeding habitat cannot be ruled out and the risk of wind energy development closer to these areas is greater than Alternative A. As such, Alternative B will have a greater potential to affect bald eagles than Alternative A but a lesser potential than Alternative D.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for bald eagle under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of birds and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy projects will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to nesting sites, wintering habitat, or other high eagle use areas) and AMMs, and will therefore have effects to bald eagle similar to those described under Alternative D, Section 4.1.6.2. Given the locations of existing wind energy facilities around the Great Lakes, where only a couple are within one mile from the shore and most are over three miles from the shore, it is unlikely that new facilities under Alternative B will be built near the shoreline where breeding habitat occurs. Nevertheless, a new wind facility close to shoreline breeding habitat cannot be entirely ruled out and the risk of wind energy operating closer to these areas is higher compared to Alternative A. As such, Alternative B will have a greater potential to affect bald eagles than Alternative A but a lesser potential than Alternative D.

Collisions with Turbines

The mechanisms and effects of collisions with turbines on bald eagles under Alternative B are the same as those described under Alternative A, Section 4.1.3.2.

The effect on take under the 11,000 MW that would be developed under the MSHCP would be similar to Alternative A. If individual, project-specific Eagle Take Permits for non-purposeful take can be obtained for the additional 22,000 MW, take levels will be the same as under Alternative A, Section 4.1.3.2. Coordination among projects for mitigation and monitoring, however, may not occur and administrative burden on the Service will be higher than under Alternative A and more similar to Alternative D. If Eagle Take Permits are not obtained for the additional 22,000 MW, take levels could be greater because effects could occur outside the Covered Lands and closer to breeding habitats or other high-activity eagle use areas and no AMMs would be implemented(as in Alternative D). With a population of 27,617 bald eagles in the Great Lakes region (U.S. Fish and Wildlife Service 2009), the estimated total annual take represents less than 1 percent of the annual production of the bald eagle population in the Great Lakes. The Great Lakes population of bald eagles is currently increasing (U.S. Fish and Wildlife Service 2009); therefore, the actual percent take will likely be less than 1 percent, after accounting for population growth. The U.S. Fish and Wildlife Service (2009) states that annual take of 5 percent of the annual production of the Great Lakes population will be sustainable. Therefore, impacts due to collisions with turbines are expected to be minor. Given the small percentage of the population affected by turbines under Alternative D and Alternative A, however, Alternative B is expected to have a minor effect on the Great Lakes bald eagle population in terms of collision with turbines.

Indiana Bat

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Indiana bat under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to Indiana bat similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect Indiana bat compared to Alternative A, but less potential compared to Alternative D. Construction-related impacts are expected to be minor.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Indiana bat under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to sensitive bat areas) and AMMs, and will therefore, have effects to Indiana bat similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and

monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect Indiana bat compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines and Barotrauma

The 22,000 MW of new wind energy development beyond the 11,000 MW developed under the MSHCP is more likely to be built in high risk areas and operate with less intensive curtailment. Thus, these facilities turbine collision and barotrauma impacts will be the same as in Alternative D, resulting in Alternative B producing an overall level of mortality that is intermediate between Alternatives A and D. However, this is still a substantial effect due to the large numbers of Indiana bats that will be killed without compensation through the mitigation program.

As noted above, those wind energy facilities built without take coverage under the MSHCP could experience even higher mortality if facilities are built outside of Covered Lands and where bats congregate—especially around hibernacula supporting many bats.

Northern Long-Eared Bat

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for northern long-eared bat under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy projects will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to northern long-eared bat similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect northern long-eared bat compared to Alternative A, but less potential compared to Alternative D. Construction-related impacts are considered minor for this species.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for northern long-eared bat under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to sensitive bat areas) and AMMs, and will therefore, have effects to northern long-eared bat similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will

under Alternative A. As such, Alternative B will have an overall greater potential to affect northern long-eared bat compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines and Barotrauma

The 22,000 MW of new wind energy development beyond the 11,000 MW developed under the MSHCP is more likely to be built in high risk areas and operate with less intensive curtailment. Thus, these facilities' turbine collision and barotrauma impacts will be the same as in Alternative D, resulting in Alternative B producing an overall level of mortality that is intermediate between Alternatives A and D. However, this is still a substantial effect due to the large numbers of northern long-eared bats that will be killed without compensation through the mitigation program.

As noted above, those wind energy facilities built without take coverage under the MSHCP could experience even higher mortality if facilities are built outside of Covered Lands and where bats congregate—especially around hibernacula supporting many bats.

Little Brown Bat

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for little brown bat under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to little brown bat similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect little brown bat compared to Alternative A but less potential compared to Alternative D. Construction-related impacts are considered minor for this species.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for little brown bat under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy projects will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to sensitive bat areas) and AMMs, and will therefore, have effects to little brown bat similar to those described under Alternative D, Section 4.1.6.2. If take for these 22,000 MW occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A. As such, Alternative B will have an overall greater potential to affect little brown bat compared to Alternative A but less potential compared to Alternative D.

Collisions with Turbines and Barotrauma

The 22,000 MW of new wind energy development beyond the 11,000 MW developed under the MSHCP is more likely to be built in high risk areas and operate with less intensive curtailment. Thus, these facilities' turbine collision and barotrauma impacts will be the same as in Alternative D, resulting in Alternative B producing an overall level of mortality that is intermediate between Alternatives A and D. However, this is still a substantial effect due to the large numbers of little brow bats that will be killed without compensation through the mitigation program.

As noted above, those wind energy facilities built without take coverage under the MSHCP could experience even higher mortality if facilities are built outside of Covered Lands and where bats congregate—especially around hibernacula supporting many bats. Little brown bats may be disproportionately affected by these factors because the species is not currently protected under ESA, and thus facilities face a much lower legal requirement to conserve this species.

4.1.4.3 Other Rare, Endangered, Threatened and Candidate Species

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Other Rare, Endangered, Threatened and Candidate Species under Alternative A, Section 4.1.3.3, which are minor. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to Other Rare, Endangered, Threatened and Candidate Species similar to those described under Alternative D, Section 4.1.6.3. As such, Alternative B will have an overall greater potential to affect Other Rare, Endangered, Threatened and Candidate Species compared to Alternative A, but less potential compared to Alternative D.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Other Rare, Endangered, Threatened and Candidate Species under Alternative A, Section 4.1.3.3, which are minor. This means that this 11,000 MW of wind energy facilities will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and AMMs, and will therefore, have effects to Other Rare, Endangered, Threatened and Candidate Species similar to those described under Alternative D, Section 4.1.6.3. As such, Alternative B will have an overall greater potential to affect Other Rare, Endangered, Threatened and Candidate Species compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines

Under Alternative B potential bird kills will be estimated the same as under Alternative A (see Table 4.1-4 above) for the first 11,000 MW of wind energy development. However, after the 11,000 MW are built, the remaining 22,000 MW will be built under scenarios identical to Alternative D,

meaning that micro-siting and other protective measures that will be required under the MSHCP may not always be required or implemented, potentially leading to more bird collisions. Therefore, it is anticipated that Alternative B will have a greater potential for bird collisions compared to Alternative A, but less potential for bird collisions compared to Alternative D.

Other Protected Bats

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for other protected bats under Alternative A, Section 4.1.3.2, which are minor. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to other protected bats similar to those described under Alternative D, Section 4.1.6.2. As such, Alternative B will have an overall greater potential to affect other protected bats compared to Alternative A, but less potential compared to Alternative D. Construction-related impacts are considered minor for these species.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for other protected bats under Alternative A, Section 4.1.3.2, which are minor to substantial. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to sensitive bat areas) AMMs, and will therefore, have effects to other protected bats similar to those described under Alternative D, Section 4.1.6.2. As such, Alternative B will have an overall greater potential to affect other protected bats compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines and Barotrauma

The 22,000 MW of new wind energy development beyond the 11,000 MW developed under the MSHCP is more likely to be built in high risk areas and operate with less intensive curtailment. Thus, these facilities' turbine collision and barotrauma impacts will be the same as in Alternative D, resulting in Alternative B producing an overall level of mortality that is intermediate between Alternatives A and D. Large numbers of bats will still be killed (especially at those existing facilities that do not opt-in to the MSHCP) rendering this a substantial effect.

Evaluation of Risk for Species with Assumed Mortality Risk

Ozark big-eared bats

The slightly increased risk associated with constructing turbines within the areas used by this bat will slightly elevate risk, but this risk was already minor due to the species ecology and abundance.

Rafinesque's big-eared bats

The slightly increased risk associated with constructing turbines within the areas used by this bat will slightly elevate risk, but this risk was already minor due to the species ecology and abundance.

Southeastern bat

There is an increased risk associated with constructing turbines within the areas used by this bat and operations will slightly elevate mortality risk, but this risk was already minor due to the species ecology and abundance.

Gray bat

Conservation measures associated with the MSHCP eliminate those areas of Missouri, Indiana, and Illinois that are within the typical distribution of the gray bat—if turbines are constructed in those areas, which could be possible under Alternative B, then there is an increased risk. As noted previously, the species wanders widely, and at great height. As such, the species will likely benefit from seasonal curtailment. However, even with the MSHCP there will still be some potential that individual bats will be killed. These events are likely to have minor population-level effects.

4.1.4.4 Other Wildlife Species

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Other Wildlife Species under Alternative A, Section 4.1.3.4, which are minor. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to Other Wildlife Species similar to those described under Alternative D, Section 4.1.6.3. As such, Alternative B will have an overall greater potential to affect Other Wildlife Species compared to Alternative A, but less potential compared to Alternative D.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Other Wildlife Species under Alternative A, Section 4.1.3.4, which are minor. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and AMMs, and will therefore, have effects to Other Wildlife Species similar to those described under Alternative D, Section 4.1.6.3. As such, Alternative B will have an overall greater potential to affect Other Wildlife Species compared to Alternative A, but less potential compared to Alternative D.

Collisions with Turbines

Under Alternative B potential bird kills will be estimated the same as under Alternative A (see Table 4.1-4 above) for the first 11,000 MW of wind energy development. However, after the 11,000 MW are built, the remaining 22,000 MW will be built under scenarios identical to Alternative D, meaning that micro-siting and other protective measures that will be required under the MSHCP may not always be required or implemented, potentially leading to more bird collisions. Therefore, it is anticipated that Alternative B will have a greater potential for bird collisions compared to Alternative A, but less potential for bird collisions compared to Alternative D.

Migratory Tree Bat Species

Construction-Related Impacts

Under Alternative B, construction-related impacts for the first 11,000 MW of new wind energy projects are the same as described for migratory tree bats under Alternative A, Section 4.1.3.2. This means that this 11,000 MW of wind energy development will be restricted to Covered Lands and will need to implement all the conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be constructed under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands) and conditions and mitigation measure requirements, and will therefore, have effects to migratory tree bats similar to those described under Alternative D, Section 4.1.6.2. As such, Alternative B will have an overall greater potential to affect migratory tree bats compared to Alternative A, but less potential compared to Alternative D. Construction-related impacts are considered minor for these species.

Operation-Related Impacts

Under Alternative B, operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for migratory tree bats under Alternative A, Section 4.1.3.2, which are minor to substantial. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP, such as the detailed carcass surveys and mortality studies will be conducted throughout the permit duration, which will provide detailed analyses of mortality of bats and assist in the adaptive management program. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to sensitive bat areas) and AMMs, and will therefore, have effects to migratory tree bats similar to those described under Alternative D, Section 4.1.6.2. As such, Alternative B will have an overall greater potential to affect migratory tree bats compared to Alternative A, but less potential impact compared to Alternative D.

Collisions with Turbines and Barotrauma

The 22,000 MW of new wind energy development beyond the 11,000 MW developed under the MSHCP is more likely to be built in high risk areas and operate with less intensive curtailment. Thus, these facilities' turbine collision and barotrauma impacts will be the same as in Alternative D, resulting in Alternative B producing an overall level of mortality that is intermediate between Alternatives A and D. The result remains the death of hundreds of thousands of bats—a substantial effect in the absence of data on population viability.

4.1.4.5 Other Fish and Aquatic Resources

Under Alternative B, construction and operation-related impacts for the first 11,000 MW of new wind energy projects are the same as described for Other Fish and Aquatic Resources under Alternative A, Section 4.1.3.5, which are minor. This means that this 11,000 MW of wind energy development will be restricted to operating in Covered Lands and will need to implement all the operational conditions and mitigation measures of the MSHCP. However, the remaining 22,000 MW of new wind energy facilities will not be operating under the same MSHCP permit geographic restrictions (*i.e.,* could occur outside of Covered Lands and closer to large lakes and rivers) and AMMs, and will therefore, have effects to Other Fish and Aquatic Resources similar to those described under Alternative D, Section 4.1.6.3. As such, Alternative B will have an overall greater potential to affect Other Fish and Aquatic Resources compared to Alternative A, but less potential compared to Alternative D.

4.1.5 Alternative C—Increased Cut-In Speed

4.1.5.1 Vegetation Communities

The construction- and operation-related impacts to vegetation under Alternative C will be the same as those described for Alternative A, which are minor.

4.1.5.2 Covered Species

Kirtland's Warbler

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on Kirtland's warbler are similar to those described under Alternative A, Section 4.1.3.2, which are minor.

Operation-Related Impacts

Collisions with Turbines

The mechanisms and effects of collisions with turbines are the same under Alternative C as those discussed under Alternative A, Section 4.1.3.2. In theory, shutting turbines down for a portion of nights during which large numbers of migrating birds and bats are passing through will likely reduce the exposure of birds and bats to collisions with moving blades. Passerine migrants, and in particular migrants from the tropics, of which Kirtland's warbler is one, have the highest collision rates among bird groups killed at wind energy facilities and at other high man-made objects (Erickson *et al.* 2001). Nocturnal passerine migration, however, occurs chiefly during and following the passage of frontal systems regardless of wind speed in the rotor swept area where collisions occur (Lack 1960). In spring, migrants move northward with winds from a southerly direction, and in fall they move southward with winds from a northerly direction. During and just after the passage of weather fronts, wind speeds are usually higher than average wind speeds. Consequently, birds often migrate with wind speeds greater than the cut-in speeds proposed under Alternative C. For these reasons, implementing an increase in cut-in speed during the spring and fall migration may not affect fatality rates for Kirtland's warbler. At the same time, reducing the number of hours turbines are operating will reduce the total hours available during which bird collisions could occur. From a simple statistical standpoint, this may reduce bird strikes with turbines under Alternative C

compared to Alternative A. Therefore, Alternative C is expected to have a minor effect on the Kirtland's warbler population.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all birds and assist in the adaptive management program.

Piping Plover

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on piping plover are similar to those mechanisms described under Alternative A, Section 4.1.3.2, which are minor.

Operation-Related Impacts

Collisions with Turbines

The mechanism and effect of collisions with turbines under Alternative C are the same mechanisms as those for piping plover Alternative A, Section 4.1.3.2. Collisions with turbines by individuals from the Great Lakes population of piping plover will occur during migration chiefly in Michigan and Ohio, whereas collisions of individual piping plovers from the Northern Great Plains population colony at Lake of the Woods, Minnesota, will occur during migration between Lake of the Woods and the western Gulf Coast and Florida. Shorebirds in general are night migrants, but plovers *(Charadriidae)* also migrate during the day (Newton 2010), raising the possibility that some plover migration takes place at night and higher cut-in speeds could reduce collision risk during spring and fall migration. On the other hand, some shorebirds have been shown to require a tailwind to complete their migratory journey while not exhausting the fat reserves which power their migration flight (Newton 2010). Therefore piping plover may usually migrate with a tailwind at wind speeds higher than the cut-in speed. If tailwinds are necessary for piping plover migration, then raising the cut-in speed during the spring and fall bat migration may not affect the risk of turbine collision for piping plover. At the same time, reducing the number of hours turbines are operating will reduce the total hours available during which bird collisions could occur. From a simple statistical standpoint, this may reduce bird strikes with turbines under Alternative C compared to Alternative A. Take of piping plovers under Alternative C is expected to be minor.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all birds and assist in the adaptive management program.

Interior Least Tern

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on interior least tern are similar to those described under Alternative A, Section 4.1.3.2, which are minor.

Operation-Related Impacts

Collisions with Turbines

Interior least terns migrate during the day (Newton 2010) and therefore increasing turbine cut-in speeds during the night in order to reduce fatalities of bats will not reduce the fatality rates of

interior least terns. Consequently, under Alternative C the effect of collisions with turbines is expected to be the same as under Alternative A, Section 4.1.3.2, and is expected to be minor.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all birds and assist in the adaptive management program.

Bald Eagle

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on bald eagles are similar to those described under Alternative A, Section 4.1.3.2, which are minor.

Operation-Related Impacts

Collisions with Turbines

The mechanisms and effect of collisions with turbines under Alternative C are the same mechanisms as those for bald eagles under Alternative A, Section 4.1.3.2. Bald eagles migrate during the day, and therefore, increasing turbine cut-in speeds during the night in order to reduce fatalities of bats will not reduce the fatality rates of bald eagles. Consequently, under Alternative C the effect of collisions with turbines is expected to be the same as under Alternative A, Section 4.1.3.2, and is expected to be minor.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all birds and assist in the adaptive management program.

Indiana Bat

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on Indiana bat are similar to those described under Alternative A, Section 4.1.3.2, which are minor to moderate.

Operation-Related Impacts

Collisions with Turbines and Barotrauma

Increasing cut-in speeds to 6.5 mps during fall migration and in summer when colonies of covered bats are known to be present will yield additional decreases in mortality. As noted in MSHCP Table 5-1, mortality decreases as the cut-in speed increases. As described for the Indiana bat under Alternative D, the average mortality reduction for five studies that used a 5 meter per second cut-in speed was 61 percent (range 47-82%). Conversely, four studies that used a 6.5 meter per second cut-in yielded an average reduction of 77 percent (range 60-82%). Indiana bats are more migratory than the other covered species and thus have higher mortality during fall and should thus also benefit disproportionately from such a change. When combined with the mitigation effort outlined in the MSHCP, Alternative C would have less impact than all other alternatives, and should be considered to have a minor to moderate effect.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all bats and assist in the adaptive management program.

Restoration Efforts Associated with the Conservation Program

Increased curtailment speeds (especially in spring) will likely have an indirect effect on restoration efforts. This could substantially reduce the amount of conservation efforts because less bats likely will be killed and compensation for each bat mortality is tied to multiple acres of conservation. These reductions are likely to have minor effects on the Indiana bat.

Northern Long-Eared Bat

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on northern long-eared bat are similar to those described under Alternative A, Section 4.1.3.2, which are minor to moderate.

Operation-Related Impacts

Collisions with Turbines and Barotrauma

Increasing cut-in speeds to 6.5 mps during fall migration and in summer when colonies of covered bats are known to be present likely will yield additional decreases in mortality. As noted in MSHCP Table 5-1, mortality decreases as the cut-in speed increases. As described for the Indiana bat under Alternative D, the average mortality reduction for five studies that used a 5 meter per second cut-in speed was 61 percent (range 47-82%). Conversely, four studies that used a 6.5 meter per second cut-in yielded an average reduction of 77 percent (range 60-82%). When combined with the mitigation effort outlined in the MSHCP Alternative C would have less impact that all other alternatives, and should be considered a minor to moderate effect.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all bats and assist in the adaptive management program.

Restoration Efforts Associated with the Conservation Program

Increased curtailment speeds (especially in spring) will likely have an indirect effect on restoration efforts. This could substantially reduce the amount of conservation efforts because less bats likely will be killed and compensation for each bat mortality is tied to multiple acres of conservation. These reductions are likely to have minor effects on the northern long-eared bat.

Little Brown Bat

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on little brown bat are similar to those described under Alternative A, Section 4.1.3.2, which are minor to moderate.

Operation-Related Impacts

Collisions with Turbines and Barotrauma

Increasing cut-in speeds to 6.5 mps during fall migration and in summer when colonies of covered bats are known to be present likely will yield additional decreases in mortality. As noted in MSHCP Table 5-1, mortality decreases as the cut-in speed increases. As described for the Indiana bat under Alternative D, the average mortality reduction for five studies that used a 5 meter per second cut-in speed was 61 percent (range 47-82%). Conversely, four studies that used a 6.5 meter per second cut-in yielded an average reduction of 77 percent (range 60-82%). These benefits should disproportionately benefit those species at greatest risk during the time of increased curtailment (*i.e.,* those that make long-distance migrations). When combined with the mitigation effort outlined in the MSHCP Alternative C would have less impact than all other alternatives, and should be considered a minor to moderate effect.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all bats and assist in the adaptive management program.

Restoration Efforts Associated with the Conservation Program

Increased curtailment speeds (especially in spring) will likely have an indirect effect on restoration efforts. This could substantially reduce the amount of conservation efforts because less bats will be killed.

4.1.5.3 Other Rare, Endangered, Threatened and Candidate Species

Except for those impacts mechanisms and effects discussed below, construction and operation impacts and effects of Alternative C on Other Rare, Endangered, Threatened and Candidate Species are identical to those described under Alternative A, Section 4.1.3.3, which are minor to substantial.

Operation-Related Impacts

Collisions with Turbines

Although the purpose of increasing cut-in speeds under Alternative C is to further reduce the risk of bats colliding with turbines, it may also help reduce collisions with birds. Birds may benefit from an increased cut-in speed because turbines will be operating slightly less often compared to Alternative A.

Other Protected Bats

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on other protected bats are similar to those described under Alternative A, Section 4.1.3.2, which are minor to substantial.

Operation-Related Impacts

Collisions with Turbines and Barotrauma

Increasing cut-in speeds to 6.5 mps during fall migration and in summer when colonies of covered bats are known to be present likely will yield additional decreases in mortality. As noted in MSHCP

Table 5-1, mortality decreases as the cut-in speed increases. As described for the Indiana bat under Alternative D, the average mortality reduction for five studies that used a 5 meter per second cut-in speed was 61 percent (range 47-82%). Conversely, four studies that used a 6.5 meter per second cut-in yielded an average reduction of 77 percent (range 60-82%). These benefits should disproportionately benefit those species at greatest risk during the time of increased curtailment (*i.e.,* those that make long-distance migrations). Alternative C would have less impact than all other alternatives. These should still be considered a minor to moderate effect until mortality patterns and population viability are better understood.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all bats and assist in the adaptive management program.

Evaluation of Risk for Species with Assumed Mortality Risk

Ozark big-eared bats

Increased cut-in speeds will provide additional protection for a species with little risk—a minor effect.

Rafinesque's big-eared bats

Increased cut-in speeds will provide additional protection for a species with little risk—a minor effect.

Southeastern bat

Increased cut-in speeds will provide additional protection for a species with little risk—a minor effect.

Gray bat

Increased cut-in speeds will provide additional protection for the gray bat; however, it is still expected that occasional gray bats will be taken under this permit. As noted above, the species wanders widely, and at great height. As such, the species will likely benefit from seasonal curtailment. However, even with the MSHCP there will still be some potential that individual bats will be killed. These events are likely to have minor population-level effects.

Restoration Efforts Associated with the Conservation Program

Increased curtailment speeds (especially in spring) will likely have an indirect effect on restoration efforts. This could substantially reduce the amount of conservation efforts because less bats will be killed, and take of listed species is directly tied to multiple acres of mitigation and conservation which could benefit other species.

4.1.5.4 Other Wildlife Species

Except for those impacts mechanisms and effects discussed below, construction and operation impacts and effects of Alternative C on Other Wildlife Species are identical to those described under Alternative A, Section 4.1.3.4, which are minor.

Operation-Related Impacts

Collisions with Turbines

Although the purpose of increasing cut-in speeds under Alternative C is to further reduce the risk of bats colliding with turbines, it may also help reduce collisions with birds. Birds may benefit from an increased cut-in speed because turbines will be operating slightly less often compared to Alternative A.

Migratory Tree Bat Species

Except for those impact mechanisms and effects discussed below, construction and operation impact mechanisms and effects of Alternative C on migratory tree bats are similar to those described under Alternative A, Section 4.1.3.2, which are minor to substantial.

Operation-Related Impacts

Increasing cut-in speeds to 6.5 mps during fall migration and in summer when colonies of covered bats are known to be present likely will yield additional decreases in mortality. As noted in MSHCP Table 5-1, mortality decreases as the cut-in speed increases. As described for the Indiana bat under Alternative D, the average mortality reduction for five studies that used a 5 meter per second cut-in speed was 61 percent (range 47-82%). Conversely, four studies that used a 6.5 meter per second cut-in yielded an average reduction of 77 percent (range 60-82%). These benefits should disproportionately benefit those species at greatest risk during the time of increased curtailment (*i.e.,* those that make long-distance migrations). This is likely to be especially beneficial to the migratory tree bats due to their ability to move at higher wind speeds and their annual migration cycles. Alternative C would have less impact than all other alternatives. Regardless this will remain a moderate-to-severe effect due to the large number of mortalities that would be expected.

Detailed carcass surveys and mortality studies will be conducted throughout the permit duration. These surveys will provide detailed analyses of mortality of all bats and assist in the adaptive management program.

Restoration Efforts Associated with the Conservation Program

Increased curtailment speeds (especially in spring) will likely have an indirect effect on restoration efforts. This could substantially reduce the amount of conservation efforts because less bats will be killed, and take of listed species is directly tied to multiple acres of mitigation and conservation which could benefit other species including migratory tree bats.

Changes in cut speeds under Alternative C will have no impact on this resource; all construction and operation impacts will be the same as Alternative A.

4.1.5.5 Other Fish and Aquatic Resources

Changes in cut speeds under Alternative C will have no impact on this resource; all construction and operation impacts will be the same as Alternative A.

4.1.6 Alternative D—No Action

Construction and operations-related impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same mechanisms as those described for Alternative A. Those impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). For the purposes of comparison with other alternatives, this EIS assumes that up to 33,000 MW of wind energy capacity could be developed in the Plan Area under Alternative D, which is in addition to the 18,004 MW of existing wind energy in the Plan Area.

For the Covered Species, note in the above statement the impacts of Alternative D will be more severe if wind energy facilities are located in or near areas of particular importance to these species (e.g., breeding habitat, migratory bird corridors, near bat hibernacula) and that these are the areas that have been specifically excluded from Covered Lands under Alternative A. Therefore, it is reasonable to assume that there is an overall greater potential for impact to Covered Species under Alternative D compared to Alternative A, simply because areas of greater sensitivity for Covered Species have been completely avoided under Alternative A. In addition, Alternative D may not implement the same (or any) general AMMs (see Chapter 2, *General Avoidance and Minimization Measures*) consistently across the Plan Area., and detailed carcass surveys and mortality studies would not be required so no effective adaptive management would be possible. This further increases the risk of impact on Covered Species under Alternative D compared to Alternative A because Alternative A will require a consistent conservation strategy, general AMMs and compensatory mitigation across the Plan Area.

For Other Rare, Endangered, Threatened, and Candidate Species, and Other Wildlife, it is possible that Alternative D will have greater impact on these species than Alternative A because while Alternative A is specific to Covered Species under the MSHCP, and the conditions and requirements of the MSHCP are specific to those species, it is reasonable to assume that some of the AMMs in the MSHCP that will be implemented under Alternative A will also provide benefits to some of these species compared to Alternative D, depending on the location of a proposed wind facility, the quality of the habitat present, and the species that may be in the vicinity of the wind facility. For example, lighting schemes on turbines and meteorological towers to minimize impacts to Covered Birds under Alternative A will benefit other birds that may be susceptible to collision impacts.

4.1.6.1 Vegetation Communities

Construction-Related Impacts

Construction-related impacts associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A, which are minor to moderate. Those impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential vegetation impacts from construction include temporary disturbance and permanent removal of vegetation; altered plant germination and growth from soil compaction, erosion, dust suppression, and accidental chemical spills; and spread of invasive species.

Operation-Related Impacts

Operation-related impacts associated with existing and new wind energy facilities under Alternative D will be the same as those described for Alternative A, which are minor. Those impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential vegetation impacts from operations include degradation and permanent removal of vegetation from vegetation maintenance (trimming, mowing, and herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance.

4.1.6.2 Covered Species

Kirtland's Warbler

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside Covered Lands and, however unlikely, inside or near the Kirtland's Warbler Management Areas (KWMAs), or near other known breeding sites. In addition, under Alternative D, wind energy facilities could be built in important migration and stop-over areas. This unrestricted placement of wind-energy facilities under Alternative D creates a greater risk to Kirtland's warbler during construction when compared to Alternative A, which prohibits projects participating in the MSHCP from developing in or near these sensitive areas. If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will also be limited under Alternative D, as will opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for Kirtland's warbler under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near the KWMAs, or near other known breeding sites. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to Kirtland's warbler during operations when compared to Alternative A, which prohibits development, or imposes constraints such as restrictions on times of operation, in or near these sensitive areas.

Collisions with Turbines

The mechanisms and effects of collisions with turbines are the same under Alternative D as those discussed for Kirtland's warbler under Alternative A, Section 4.1.3.2. If take under Alternative D occurs without an ITP, operators of the wind energy facility could be subject to enforcement action. Under Alternative D, any mitigation and monitoring that does occur will not be conducted in a coordinated manner as it will under Alternative A.

It has been documented that collisions with the blades of operating turbines is the chief cause of bird deaths, including warbler species, at wind energy facilities (NRC 2007). At 116 facilities, passerines comprised 62.5 percent of all bird fatalities (Erickson *et al.* 2014). Fatalities of birds across the year have been documented to be highest in the fall when adults and young of the year migrate south. Individuals are struck by moving blades when they attempt to fly through the rotor-swept area of the turbine. Blade tips move at 150 miles per hour or more, affording little time for a bird in flight to avoid a strike. Death of individual birds results in loss of reproductive potential for the local population., but the wind energy facilities are not a large source of bird mortality compared to buildings, power lines, domestic cats, vehicles, pesticides, and communication towers (Erickson *et al.* 2015).

The method of collision risk analysis described for Kirtland's warbler in Section 4.1.2.2 calculated a direct take due to collisions with operating wind turbines of 0.000048 Kirtland's warblers per MW per year. Using this method, the product of the following factors represents the direct take (fatality rates are from Erickson *et al.* 2014):

- 2/497 – blackpolls per year/total warbler fatalities per year;
- 2.16– total small bird fatalities per MW per year in Prairie Region (Midwest Corn Belt);
- 4,180/750,000 – Kirtland's warbler/blackpoll warbler individuals traversing Covered Lands.

The baseline for existing wind energy facilities is 18,004 MW and new facilities will total 33,000 MW. Over the 45-year term of the MSHCP, take for the existing baseline is 39 Kirtland's warblers and for the full build-out is 60 Kirtland's warblers, for a total of 99 Kirtland's warbler killed without the AMMs required under the MSHCP. The annual take for baseline plus full build-out (2.44 per year) represents 0.06 percent of the 2012 adult population. Because all small bird fatalities per MW per year were used rather than just warblers, and because full build-out was assumed to occur in the first year of the MSHCP, this estimate of take from the total population is higher and more conservative than if the total warbler fatality rate were used, if non-reproductive young birds were included, and if an incremental ramp-up in new facilities over 15 years were assumed to occur. Annual take under baseline plus full build-out is expected to have a minor effect on the Kirtland's warbler population under Alternative D.

Piping Plover

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for piping plover under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near piping plover breeding habitat. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to piping plover during construction when compared to Alternative A, which prohibits development in or near these breeding areas. If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will also be limited under Alternative D, as will opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service. Under Alternative D, wind energy developers also have the option of

constructing without considering the risk of take and may build without an ITP. This increases the risk that take will occur under Alternative D.

Although piping plover critical habitat and other breeding habitat in the Plan Area is outside the Covered Lands, under Alternative D wind energy facilities could be located in or near critical habitat or other breeding habitat for piping plover. Piping plover critical habitat for the Great Lakes population extends 1,640 feet (500 meters) inland of the Great Lakes shore and for the Great Plains population in the Plan Area it is located on beaches and sand points at Lake of the Woods, Minnesota. Given the locations of existing wind energy facilities around the Great Lakes, where only a couple are within 1 mile of the shore and most are over three miles from the shore, it is unlikely that new facilities under Alternative D will be built less than 1,640 feet from the shore and within critical habitat for the Great Lakes population. For the Great Plains population critical habitat on Lake of the Woods is at the shoreline, which is a challenging location for siting wind energy facilities given current industry practices in the Plan Area. Siting of wind energy facilities in critical habitat of piping plover in the Plan Area has not occurred and is not likely to occur given industry standards and past siting decisions with respect to Great Lakes shorelines. The effect of habitat loss under Alternative D is expected to be minor.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for piping plover under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside Covered Lands and potentially inside or near piping plover breeding habitat, although unlikely (see Construction-Related Impacts above). This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to piping plover during operations when compared to Alternative A, which prohibits development in or near these sensitive areas.

Collisions with Turbines

The mechanism and effect of collisions with turbines are the same mechanisms as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. Under Alternative D, annual piping plover take under ITPs for individual wind energy facilities will be the same as under Alternative A, which is expected to be minor, but could occur outside Covered Lands in the Plan Area, including areas closer to breeding habitats. If take occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A.

The method of collision risk analysis described for piping plover in Section 4.1.2.2 calculated a direct take due to collisions with operating wind turbines of 0.00064 piping plover/MW/year. This fatality rate is not surprising given the overall small population size in Region 3 and low number of fatalities reported for shorebirds in other studies, from 1 to 2 percent of all reported fatalities (e.g., Erickson *et al.* 2001; Johnson and Erickson 2011).

The MSHCP estimated take over the 45-year term of the MSHCP is 26 plovers from the Great Plains population and 2 from the Great Lakes population for the 33,000 MW build-out, and 15 from the Great Plains and 1 from the Great Lakes populations for existing facilities. (This includes 11 individuals expected to collide with collector lines.). The take estimate over the 45-year period represents 0.04 percent of the 110 bird Great Lakes population and 0.02 percent of the 2,959 bird U.S. Northern Great Plains population counted in the 2006 census (Elliott-Smith *et al.* 2009). To date,

no documented piping plover fatalities are known to have occurred at wind energy facilities (Erickson *et al.* 2014 and supporting WEST, Inc. database). Take under Alternative D is expected to have a minor impact on piping plover populations.

Interior Least Tern

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for interior least tern under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside Covered Lands and potentially inside or near interior least tern breeding habitat. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to interior least tern during construction when compared to Alternative A, which prohibits development in or near these breeding areas. If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will also be limited under Alternative D, as will opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service.

Under Alternative D wind energy facilities could be located in or near breeding habitat for interior least tern. This will not be likely if an ITP were obtained due to potential siting requirements. Siting of wind energy facilities in or near breeding habitat for interior least tern has not occurred in the Plan Area. Interior least tern breeding habitat in the Plan Area is located in areas of lower quality or lower priority wind resource areas compared to locations where facilities have been built in the Plan Area. The effect of construction-related impacts and habitat loss under Alternative D is expected to be minor.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for interior least tern under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near interior least tern breeding habitat, although unlikely (see Construction-Related Impacts above). This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to interior least tern during operations when compared to Alternative A, which prohibits development in or near these sensitive areas.

Collisions with Turbines

The mechanism and effect of collisions with turbines are the same mechanisms as those for Kirtland's warbler under Alternative A, Section 4.1.3.2. Under Alternative D, annual interior least tern take for those individual wind energy facilities operating under an ITP will be the same as under Alternative A, which is expected to be minor, but could occur outside of Covered Lands in the Plan Area, including areas closer to breeding habitats. If take occurs without an ITP, operators of the wind energy facility could be subject to enforcement action, and mitigation and monitoring will not occur in a coordinated manner as it will under Alternative A.

The method of collision risk analysis described for interior least tern in Section 4.1.2.2 estimated a direct take due to collisions with operating wind turbines of 0.0011 terns/MW/year. This fatality rate is not surprising given the low number of fatalities reported for waterbirds in other studies and no documented interior least tern fatalities to date (e.g., Erickson *et al.* 2014). In addition, interior least tern is thought to migrate through the mid-continent along large rivers like the Mississippi, Ohio, and Missouri where the value of the wind resource is relatively low for the area and construction of wind energy facilities has not been a priority (National Renewable Energy Laboratory 2011).

Over the 45 year term of the MSHCP, total take of baseline and full build-out is 17 interior least terns (0.38 per year). The annual take represents 0.01 percent of the 2,766 interior least terns reported in the 2005 census and which nest in the upper Great Plains and fly through the Plan Area (Leidos 2015; Lott 2006). Ongoing monitoring indicates that the global population size of interior least tern is likely higher today than in the 2005 census (U.S. Fish and Wildlife Service 2013). Take under Alternative D is expected to be greater than under Alternative A, but will still have a minor impact on interior least tern populations.

Bald Eagle

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for bald eagles under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside Covered Lands and near known breeding sites, winter congregation areas, or other high-activity eagle use areas, such as migration corridors. This unrestricted placement of wind-energy facilities under Alternative D creates a greater risk to bald eagles during construction than Alternative A, which prohibits or restricts development in or near these sensitive areas. If wind energy developers and operators seek project-specific Eagle Take Permit for non-purposeful take under Alternative D, minimization and monitoring requirements for bald eagles at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service will be limited under Alternative D.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for bald eagles under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and near known breeding sites, winter congregation areas, or other high-activity eagle use areas, such as migration corridors. This unrestricted placement of wind-energy facilities under Alternative D creates a greater risk to bald eagles during operations than Alternative A, which prohibits development or imposes constraints, such as restrictions on times or locations of operation, in or near these sensitive areas.

Collisions with Turbines

The mechanisms and effects of collisions with turbines are the same under Alternative D as those discussed for bald eagles under Alternative A. Under Alternative D, annual take under ITPs for individual wind energy facilities may be higher than under Alternative A because facilities could

occur outside Covered Lands in the Plan Area, including near large rivers and lakes, and in areas closer to nest sites and other important eagle habitats. Because baseline collisions with turbines are rare, infrequent events compared to other sources of eagle mortality (e.g., lead poisoning), the effect to the population is expected to be minor under Alternative D, though still greater than under Alternative A. If take occurs without an Eagle Take Permit, operators of the wind energy facility could be subject to enforcement action. Under Alternative D, any monitoring that does occur will not be conducted in a coordinated manner as it will under Alternative A.

Bald eagle collisions with operating wind turbines could occur at any time of year, but the risk increases during migration. A total of 8 known collisions with wind turbines have occurred in the Plan Area. Under Alternative A, collisions with turbines will be minimized because wind farms will be sited outside known breeding habitat and migration corridors. Other anthropogenic sources of mortality are far greater, as discussed in the Service's 2009 Final Environmental Assessment related to the eagle take permit.

Take of bald eagles for new facilities has been calculated to be 2,588 bald eagles over the life of the 45 year permit, or a total of up to 57.5 eagles per year, on average, over the eight-state Plan Area (see methods in Section 4.9.1.2.2 of Chapter 4 of the MSHCP). Bald eagle take at existing facilities that opt-in to the MSHCP is estimated to be up to 1,520 eagles over 45 years, or 33.7 per year, for a total of 4,108 bald eagle fatalities (91.5 per year). With a population of 27,617 bald eagles in the Great Lakes region (U.S. Fish and Wildlife Service 2009), the estimated total annual take represents 2 percent of the annual production of the bald eagle population in the Great Lakes. The Great Lakes population of bald eagles is currently increasing (U.S. Fish and Wildlife Service 2009); therefore, the actual percent take will likely be less than 1 percent, after accounting for population growth. The U.S. Fish and Wildlife Service (2009) states that annual take of 5 percent of the annual production of the Great Lakes population will be sustainable. Therefore, impacts due to collisions with turbines under Alternative D are expected to be minor.

Covered Bats

Overview of Take Models

Estimating mortality at wind energy sites is a challenging undertaking. At a large, programmatic scale where the locations of new facilities are not known, the species composition approach is the preferred approach. However, it is important to understand that each wind facility will have different levels of threat associated with it as a result of the facility's location, number of turbines, with variables such as landscape context and weather conditions likely being important, but remaining poorly understood at present. A better understanding of bat mortality associated with these facilities will require a larger and standardized data set such as will be collected under Alternative A, but is not currently being collected at many facilities. When mortality data is collected, the methodology and analyses may vary between sites because such monitoring is often optional.

Tighter Regulatory Controls

At present, most wind energy sites within the region are being developed in a manner that avoids Federal nexi that will trigger ESA Consultation under Section 7. As such, developers presently have four choices to address the potential for taking covered bats. These include:

- Working with the Service to develop a technical assistance letter (TAL) that identifies conditions under which an individual project can operate with minimal risk of taking a listed bat. These

letters vary between field offices, and provide the operator with no legal protection from prosecution should a take be documented. At present at least 10 facilities (including one that is not yet built) have developed a TAL (Seymour pers. comm.). Some of these were developed as an interim measure while the MSHCP was under development.

- Working with the Service to develop a Habitat Conservation Plan that provides the operator with legal protection from take and mandates standardized AMMs and a site-specific mortality monitoring plan.
- Identifying a Federal nexus that requires the lead Federal agency to consult with the Service under Section 7 of the ESA. Given the high probability of take, the likely result will be the issuance of a Biological Opinion and Incidental Take Statement.
- Voluntarily taking steps to avoid the take of a listed species. From a practical standpoint, most facilities operating under this approach are doing little to avoid a take and accept the risk of prosecution should a take be documented. Such facilities have a vested interest in not conducting mortality monitoring in cases where it is not required but may lead to detection of a listed species.

At present, mortality monitoring data for 22 unique facilities within the Plan Area has been provided to the Service's Ohio Ecological Services Field Office (Seymour pers. comm.). Three of these facilities are collecting the data as part of the monitoring component of an HCP, and 10 have developed a TAL that represents a clear intent to comply with ESA. Presumably many of these sites will have enrolled in the MSHCP if it was available. As such, without the MSHCP, at least half the sites are likely to operate without ESA coverage resulting and likely will not take steps to avoid and minimize the potential for take. While a true quantification of impacts is not possible, it is clear that Alternative D will have a greater risk of substantial negative impact on covered bats compared to Alternative A.

Indiana Bat

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for Indiana bat under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near important bat hibernacula or by areas with known and high bat concentrations. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to Indiana bat during construction when compared to Alternative A, which prohibits development in or near these sensitive bat areas, and implements avoidance and minimization measures when facilities are developed near sensitive areas. If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area, which will occur under the other action alternatives. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will also be limited under Alternative D, as will opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service. Without the MSHCP, impacts of construction are likely to be minor to moderate for Indiana bat under Alternative D.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for Indiana bat under Alternative A, Section 4.1.3.2, which are minor to substantial. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near important bat hibernacula or areas with known and high bat concentrations. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to Indiana bat during operations when compared to Alternative A, which prohibits development in or near these sensitive bat areas.

Collisions with Turbines and Barotrauma

The MSHCP provides take coverage for both current (if they choose to opt-in) and future wind energy development within the study area. The MSHCP take model accounts for these separately, and thus estimates take for 9,768 MW[30] of capacity that are present prior to the MSHCP being finalized and an additional 33,000 MW that will be built under the permit conditions of the MSHCP. Without the general avoidance and minimization measures (AMMs) that will be required under Alternative A, the existing 9,768 MW are expected to kill 138 Indiana bats per year for a total of 6,218 bats across the 45 years (MSHCP Tables 4-14 and 4-16). Constructing an additional 19,725 MW[31] of capacity within the range of the Indiana bat is expected to kill 10,604 Indiana bats without conservation measures (MSHCP Tables 4-14, 4-15, and 4-16). Combined mortality for existing and future facilities is 16,822 Indiana bats spread across 45 years (MSHCP Tables 4-14 and 4-16). These mortality estimates include an estimated 10 percent decrease in population numbers due to WNS (see MSHCP Section 4.2.2.2.2). This estimated population reduction is based on hibernacula surveys conducted between the 2013 (when modeling efforts began) and 2015 that indicated the number of Indiana bats in the region declined by approximately 10 percent due to WNS.

In reality, facilities may choose to operate with no or a reduced curtailment plan and risk violation and subsequent enforcement action, while other facilities actively implement measures to avoid take, and while still others develop an individual HCP to obtain an ITP, or with the support of a lead Federal agency obtain an incidental take statement under Section 7 of the ESA. The number of sites using these strategies and the application of these strategies will substantially affect the estimate of total mortality.

Without the MSHCP (Alternative A), the loss of individuals due to collisions and barotrauma under Alternative D will have a substantial impact on the Indiana bat. In addition, detailed carcass surveys and mortality studies would not be required so no effective adaptive management would be possible.

Northern Long-Eared Bat

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for northern long-eared bat under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near

[30] There are currently 9,768 MW of wind energy in the Indiana bat's range.

[31] Out of the 33,000 MW being proposed across the Covered Lands, 19,725 MW would fall within the Indiana bat's range.

important bat hibernacula or by areas with known and high bat concentrations. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to northern long-eared bat during construction when compared to Alternative A, which restricts development in or near these sensitive bat areas and mandates AMMs for all areas. If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will also be limited under Alternative D, as will opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service. Without the MSHCP (Alternative A), impacts due to construction are likely to be moderate to minor for the northern long-eared bat under Alternative D.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for northern long-eared bat under Alternative A, Section 4.1.3.2, which are minor to substantial. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near important bat hibernacula or areas with known and high bat concentrations. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to northern long-eared bat during operations when compared to Alternative A, which prohibits development in or near these sensitive bat areas.

Operation-related impacts are expected to have moderate impacts on the northern long-eared bat under Alternative D.

Collisions with Turbines and Barotrauma

The MSHCP provides take coverage for both current (if they choose to opt-in) and future wind energy development within the study area. The MSHCP take model accounts for these separately, and thus estimates take for 18,004 MW[32] of capacity that are present prior to the MSHCP being finalized. The MSHCP estimated potential mortality for northern long-eared bats associated with both facilities in operation prior to the MSHCP and the expected development of an additional 33,000 MW[33] of wind energy within the study area. Based on data contained in the MSHCP Table 4-7, potential mortality at these sites is approximately 255 northern long-eared bats per year at those facilities operating in the study area by 2016 for a total of 11,484 bats across the 45 years (see MSHCP Tables 4-19 and 4-21) without conservation measures. Full build-out as predicted in the plan will add an additional 17,775 fatalities without conservation measures for a total of 29,259 northern long-eared bats taken during the next 45-years (MSHCP Tables 4-19, 4-20, and 4-21). These mortality estimates include an estimated 10 percent decrease in population numbers due to WNS (see MSHCP Section 4.2.2.2.2). This estimated population reduction is based on hibernacula surveys conducted between 2013 (when modeling efforts began) and 2015 that indicated the number of Northern long-eared bats in the region declined by approximately 10 percent due to WNS.

[32] This number is different for the northern long-eared bat compared to the Indiana bat because all existing 18,004 MW of wind energy are in the northern long-eared bat's range.

[33] All of the 33,000 MW being proposed across the Covered Lands would fall within the northern long-eared bat's range. This is different than the Indiana bat.

Impacts under Alternative D could include this level of mortality or greater if wind energy facilities are built in areas where bats concentrate and no conservation measures are taken. As noted in Section 4.1.3.2, Indiana Bat—*Collisions with Turbines and Barotrauma*, these impacts will vary depending on what (if any) conservation measures are taken at each facility and the site-specific risk to northern long-eared bats. As is the case for Indiana bats, it is likely that at least half the facilities will operate without regard to listed bats and other may pursue separate conservation strategies. Without the conservation measures that will be implemented under Alternative A due to the MSHCP, the loss of this many northern long-eared bats under Alternative D is likely to have a substantial adverse impact on the species compared to Alternative A. In addition, detailed carcass surveys and mortality studies would not be required so no effective adaptive management would be possible.

Little Brown Bat

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for little brown bat under Alternative A, Section 4.1.3.2, which are minor. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near important bat hibernacula or areas with known and high bat concentrations. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to little brown bat during construction when compared to Alternative A, which prohibits development in or near these sensitive bat areas. If wind energy developers and operators seek project-specific ITPs under Alternative D, minimization, monitoring and mitigation requirements for ESA-listed species at those facilities will continue to be developed on a project-by-project basis. Accordingly, these requirements may vary by facility, and may not apply consistent methodologies that allow for comparison across the Plan Area. Opportunities to consolidate compensatory mitigation requirements for independent wind energy facilities will also be limited under Alternative D, as will opportunities to streamline the permit application and evaluation process for both wind energy developers and the Service. Without the MSHCP (Alternative A), the construction-related impacts on little brown bats are likely to be minor to moderate.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for little brown bat under Alternative A, Section 4.1.3.2, which are minor to substantial. However, under Alternative D, new wind energy facilities could be sited outside of Covered Lands and potentially inside or near important bat hibernacula or areas with known and high bat concentrations. This unrestricted placement of wind-energy facilities under Alternative D provides a greater risk to little brown bat during operations when compared to Alternative A, which prohibits development in or near these sensitive bat areas.

Operation-related impacts are expected to have substantial impacts on the little brown bat under Alternative D.

Collisions with Turbines and Barotrauma

The MSHCP provides take coverage for both current (if they choose to opt-in) and future wind energy development within the study area. The MSHCP take model accounts for these separately,

and thus estimates take for 18,004 MW[34] of capacity that are present prior to the MSHCP being finalized. The MSHCP estimated potential mortality for little brown bats associated with both facilities in operation prior to the MSHCP and the expected development of an additional 33,000 MW[35] of wind energy within the study area. Accounting for a 10 percent reduction in population due to WNS (MSHCP Section 4.2.2.2.2) mortality of 486,630 (10,814 per year) little brown bats per year at those facilities operating in the study area by 2016 for a total of 486,630 little brown bats across the 45 years (see MSHCP Tables 4-24 and 4-26) without conservation measures. Adding another 33,000 MW of capacity in the time period and locations predicted by the build-out model will result in an additional 753,208 fatalities without conservation measures for a total of 1,239,838 little brown bats taken during the next 45-years (MSHCP Tables 4-24, 4-25, and 4-26). Impacts under Alternative D could include this level of mortality or greater if wind energy facilities are built in areas where bats concentrate and no conservation measures are taken. As noted in Section 4.1.3.2, Indiana Bat—*Collisions with Turbines and Barotrauma*, these impacts will vary depending on what (if any) conservation measures are taken at each facility and the site-specific risk to little brown bats. As is the case for Indiana bats, it is likely that at least half the facilities will operate without regard to listed bats and other will pursue separate conservation strategies. In the case of little brown bats, the legal ramifications of take are restricted to violation of state laws until such time as the species is listed. Without the conservation measures that will be implemented under Alternative A due to the MSHCP, the loss of this many little brown bats under Alternative D is likely to have a substantial and adverse impact on the species compared to Alternative A as illustrated by a comparison of the projected mortality for Indiana (103,516 little brown bats across 45 years) (MSHCP Table 4-26) compared to the current population in the state. Whitaker *et al.* (2002) estimated a population of 561,237 little brown bats in Indiana prior to the arrival of WNS. Recent survey efforts in hibernacula within the state indicate population declines in the state exceed 90 percent (Brack *et al.* 2015). As such, the current population of little brown bats in Indiana may be 50-60,000 bats. Without the MSHCP, the loss of individuals due to collisions and barotrauma will have a substantial adverse impact on the little brown bat. In addition, detailed carcass surveys and mortality studies would not be required so no effective adaptive management would be possible.

4.1.6.3 Other Rare, Endangered, Threatened and Candidate Species

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for Other Rare, Endangered, Threatened and Candidate Species under Alternative A, Section 4.1.3.3, which are minor to substantial. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to certain species (e.g., migratory bird corridors) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for species covered in the MSHCP, these areas could also be important for other wildlife. Further, under Alternative D, measures to minimize impacts to Covered Species under the MSHCP that may also benefit Other Rare, Endangered, Threatened and Candidate Species, may not be implemented and coordinated under Alternative D as they will under Alternative A. As such, impacts under Alternative D may be more moderate in areas of particular importance to Other Rare, Endangered, Threatened and Candidate Species.

[34] All existing 18,004 MW of wind energy are in the little brown bat's range.

[35] All of the 33,000 MW being proposed across the Covered Lands would fall within the little brown bat's range.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for Other Rare, Endangered, Threatened and Candidate Species under Alternative A, Section 4.1.3.3, which are minor to substantial. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to certain species (e.g., migratory bird corridors) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for species covered in the MSHCP, these areas could also be important for other wildlife. Further, under Alternative D, measures to minimize impacts to Covered Species under the MSHCP that may also benefit Other Rare, Endangered, Threatened and Candidate Species, may not be implemented and coordinated under Alternative D as they will under Alternative A.

The mechanisms and effects of bird collisions with turbines are the same under Alternative D as those discussed for Other Rare, Endangered, Threatened and Candidate Species under Alternative A, Section 4.1.3.3. In some cases, a wind energy facility may be placed within a bird migration corridor that may be been excluded from Covered Lands as in Alternative A. Birds that do not or cannot reroute around or over an operating wind facility are exposed to risk of collision with turbines in these areas.

Other Protected Bats

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for other protected bats under Alternative A, Section 4.1.3.3, which are minor. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to covered bat species (e.g., important bat hibernacula or areas with known and high bat concentrations) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for bat species covered in the MSHCP, these areas could also be important for other protected bats because most of the protected bat species are cave-hibernating species and have ranges and habitat needs that overlap the three covered bats (see Section 4.1.3.2). Further, under Alternative D, measures to minimize impacts to covered bat species under the MSHCP that may also benefit other protected bats, may not be implemented and coordinated under Alternative D as they will under Alternative A. As such, wind energy development under Alternative D may pose a greater risk to other protected bats compared to Alternative A.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for other protected bats under Alternative A, Section 4.1.3.3, which are minor to substantial. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to covered bat species (e.g., important bat hibernacula or areas with known and high bat concentrations) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for bat species covered in the MSHCP, these areas could also be important for other protected bats because most of the protected bat species are cave-hibernating species and have ranges and habitat needs that overlap the three covered bats (see Section 4.1.3.2). Further, under Alternative D, measures to minimize impacts to covered bat species under the MSHCP that may also benefit other protected bats, may not be implemented and coordinated under Alternative D as they will under Alternative A. As such, wind energy development and operations under Alternative D may pose a greater risk to other protected bats compared to Alternative A.

Collisions with Turbines and Barotrauma

The MSHCP Table 4-7 documents the detection of the carcasses of 8,934 bats under wind energy facilities throughout the range of protected bat species. Bats are killed at wind energy sites as a result of both collisions with turbines and barotrauma (Baerwald *et al.* 2008).

As summarized below (Table 4.1-6), among the mortalities documented in the MSHCP Table 4-7 are 519 big brown bats, 24 tri-colored bats, and 28 evening bats. To date, no carcasses of Ozark big-eared bats, Rafinesque's big-eared bats, southeastern bats, or gray bats have been detected, and carcasses of eastern small-footed bats are not known from other regions (and thus modeled as if a single carcass had been found within the region). However, few wind energy facilities have been completed within the range of these four species, and even fewer have conducted post-construction mortality studies.

Estimation of Potential Mortality for Species Known to be at Risk

Using the techniques outlined in the MSHCP and detailed in the discussion of protected bats in Section 4.1.4.3, it is possible to estimate the number of protected bats that will be killed at wind energy facilities within the study area. Using this approach, the effects of building and operating 51,004 MW (18,004 in operation by 2016 with 33,000 MW added over the next 15 years) of wind energy capacity will include the death of 1,898,355 big brown bats, 416 eastern small-footed bats, 63,976 evening bats, and 51,389 tri-colored bats. These estimates include a 10 percent reduction in population from those species known to be killed by WNS (big brown bats, eastern small-footed bats, and tri-colored bats) which is used for consistency with the methods outlined in the MSHCP.

Impacts of the projected mortality vary by species. Evening bats have made rapid expansions into the region from the south and east during the past 50 years, and thus the amount of predicted mortality likely represents a moderate effect. Eastern small-footed bats are apparently rare in the region and have received little study. As such, population-level effects are unknowable. Given the long life-spans of other bats, increasing effects of WNS, and the fact that each female produces only a single pup per year, these effects are likely substantial. Both tri-colored and big brown bats typically produce 2 pups per year and thus may have greater resilience to mortality. Tri-colored bats are among the species most severely impacted by both WNS and wind energy development. As such, it is likely that WNS will further reduce populations of this bat such that the mortality estimates obtained herein are far beyond what will actually occur. However, even if the impacts are proportional to the remaining population, they will be substantial. Big brown bats remain abundant despite a variety of challenges. As such, this mortality spread across 45 years may not result in large-scale loss of populations, but should be considered substantial unless demonstrated otherwise by a population viability analysis.

As noted for the covered bat species in Section 4.3.1.2 above, the actual impacts will vary widely depending on site-specific risk and conservation measures (if any) applied by each facility.

Estimation of Potential Mortality for Species with Potential Risk

At present, there are no records of gray bats, Ozark big-eared bats, Rafinesque's big-eared bats, or southeastern bats being found dead at existing wind energy sites.

Ozark big-eared bats

The species at lowest risk of mortality at wind energy sites is the Ozark big-eared bat, which historically was known from caves in the southwestern corner of Missouri. Ozark big-eared bats are one of three recognized subspecies of Townsend's big-eared bat. Both other subspecies live in areas where wind energy has been developed, yet no mortality has been observed for either subspecies. Thus, it is likely that mortality for this species from wind energy facilities is very rare. Given its near absence from the study area there is little risk of mortality to the Ozark big-eared bat. As such, the wind energy development in the study area will likely have a minor effect on this species.

Rafinesque's big-eared bats

The two species of big-eared bats share many aspects of their ecology. Rafinesque's big-eared bats occupy several portions of Appalachia where wind energy has become established and there are no records of this species being found dead under wind turbines. Given the lack of mortality for any member of the genus *Corynorhinos*, the closely related Allen's big-eared bat (*Idionycteris phyllotis*), and the rarity of the species in the study area, the chance of mortality for this species is remote. Given its near absence from the study area, there is little risk of mortality to the Rafinesque's big-eared bat. As such wind energy development in the study area will likely have a minor effect on this species.

Table 4.1-6. Estimated Mortality (Corrected To Account for Declines due to WNS) Under Alternative D for Big Brown Bats, Eastern Small-Footed Bats, Evening Bats, and Tri-Colored Bats without Avoidance and Minimization Measures Implemented under Alternative A and Contained in the MSHCP

Species of bat	Number of Carcasses	Percent of Total Mortality	Mortality (bats/MW/yr)	Mortality at initial 18,004 MW (bats)	Mortality associated with 33,000 additional MW	Cumulative Mortality (51,004 MW)	Percent of Range Overlapping with Projected Capacity	Percent Reduction In Population Due to WNS	Projected Mortality
Big brown bat	519	5.81	1.02	827,883	1,281,400	2,109,283	100	10	1,898,355
Eastern small-footed bat	1*	0.01	0.002	1,595	2,469	4,064	11	10	416
Evening bat	28	0.31	0.06	44,664	69,131	113,796	56	0	63,976
Tri-colored bat	24	0.27	0.05	38,284	59,256	97,539	59	10	51,389
Data Source	MSHCP Table 4-7	Derived for EIS	Derived for EIS	Derived for EIS	Derived for EIS	Derived for EIS	Derived for EIS	Based on Covered Species	Derived for EIS

* No studies within the region have found this species, but it has been found at wind energy sites in Appalachia and thus mortality was modeled based on a single carcass to allow comparison between the four alternatives.
MW = megawatts
WNS = White Nose Syndrome
MSHCP = Multi-species Habitat Conservation Plan
EIS = Environmental Impact Statement

Southeastern bat

Based on data contained in MSHCP Table 4-7, approximately 3.95 percent of the bats found dead under wind turbines belong to the genus *Myotis*. When this fact is combined with the virtual absence of commercial wind energy facilities in the swamps of the Coastal Plain where this species is common, it is reasonable to suspect that the lack of mortality records for this species has more to do with the locations of high suitability wind resources than the biology of the bat. Southeastern bats are rare in the study area with only southern Illinois being a reliable location for the species. Much of this land is heavily forested, publicly owned, and the species is closely associated with wetlands that will be regulated under the Clean Water Act. Even without the MSHCP it is unlikely that a commercial wind energy site will be placed within the range of southeastern bats in the study area. As such, it is possible, although unlikely that southeastern bats will be killed by wind turbines in the study area. Impacts, if any, to southeastern bats are expected to be minor.

Gray bat

Based on data contained in MSHCP Table 4-7, approximately 3.95 percent of the bats found dead under wind turbines belong to the genus *Myotis*. When this fact is combined with the virtual absence of commercial wind energy facilities in karst areas where gray bats are common, it is reasonable to suspect that the lack of mortality records for this species has more to do with the locations of high suitability wind resources than the biology of the bat. Gray bats have several ecological factors that likely put the species at risk. The species is highly migratory, moving each year between summer and winter caves. Alternative D does not exclude all important caves from the Plan Area like Alternative A.

There are millions of bats in Missouri, and the species is locally common in portions of southern Illinois and Indiana. As such, a facility placed within areas where this species congregates in large numbers may take many bats. When moving between foraging areas and during migration the species is known to move at heights that will place the species within the Rotor Swept Zone (Robbins unpublished). Finally, it is not unusual for gray bats to be captured outside their typical range with the most clear-cut example being the detection of multiple bats hibernating in Black Ball Mine in Illinois and Hellhole Cave in West Virginia—sites hundreds of miles from the closest known population (Decher and Choate 1995). In this regard, the species is similar, but more numerous in the region, than the Seminole bat of which there have been 13 documented mortalities in the region, most of which are not considered within the typical range of the species. Based on these observations, there is some potential for isolated mortalities of gray bats, but these mortalities will be expected to have little population effect. Population level effects on gray bats are expected to be minor.

4.1.6.4 Other Wildlife Species

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for Other Wildlife Species under Alternative A, Section 4.1.3.4, which are minor. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to certain species (e.g., migratory bird corridors) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for species covered in the MSHCP, these areas could also be important for other wildlife, depending on the location of a proposed wind facility, the

quality of the habitat present, and the species that may occur around the wind facility. Further, under Alternative D, measures to minimize impacts to Covered Species under the MSHCP that may also benefit Other Wildlife Species, may not be implemented and coordinated under Alternative D as they will under Alternative A. As such, impacts under Alternative D may be more moderate in areas of particular importance to Other Wildlife Species.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for Other Wildlife Species under Alternative A, Section 4.1.3.3, which are minor. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to certain species (e.g., migratory bird corridors) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for species covered in the MSHCP, these areas could also be important for other wildlife, depending on the location of a proposed wind facility, the quality of the habitat present, and the species that may occur around the wind facility. Further, under Alternative D, measures to minimize impacts to Covered Species under the MSHCP that may also benefit Other Wildlife Species, may not be implemented and coordinated under Alternative D as they will under Alternative A.

Migratory Tree Bat Species

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for migratory tree bats under Alternative A, Section 4.1.3.4, which are minor. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to bat species (e.g., areas with known and high bat concentrations) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for bat species covered in the MSHCP, these areas could be important for migratory tree bats because major water features and areas of cave habitat that will be excluded from Covered Lands are also used extensively by migratory tree bats (see Section 4.1.4.4). Further, under Alternative D, measures to minimize impacts to covered bat species under the MSHCP that may also benefit migratory tree bats, may not be implemented and coordinated under Alternative D as they will under Alternative A. Based on analysis in the Indiana bat section, above, it is likely that at least half the facilities will provide little to no protection for listed bats, which also protect migratory tree bats. As such, wind energy development under Alternative D will pose a greater risk to migratory tree bats compared to Alternative A. Construction-related effects on migratory tree bats are expected to be minor to moderate even without the MSHCP.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for migratory tree bats under Alternative A, Section 4.1.3.4, which are substantial. However, under Alternative D, wind energy facilities could be located in or near areas of particular importance to covered bat species (areas with known and high bat concentrations) that are specifically excluded from Covered Lands under Alternative A. While these areas have been excluded specifically for bat species covered in the MSHCP, these areas could be important for migratory tree bats because major water features and areas of cave habitat that will be excluded from Covered Lands are also used extensively by migratory tree bats (see Section 4.1.4.4). Further, under Alternative D, measures to minimize

impacts to covered bat species under the MSHCP that may also benefit migratory tree bats, may not be implemented and coordinated under Alternative D as they will under Alternative A. As such, wind energy development and operations under Alternative D will pose a greater risk to migratory tree bats compared to Alternative A.

Collisions with Turbines and Barotrauma

The MSHCP Table 4-7 documents the detection of the carcasses of bats under wind energy facilities throughout the range of migratory tree bats. Bats are killed at wind energy sites as a result of both collision with turbines and barotrauma (Baerwald *et al.* 2008).

Among the mortalities documented in MSHCP Table 4-7 are 3,893 eastern red bats, 2,328 hoary bats, 1,621 silver-haired bats, and 13 Seminole bats. These are documented fatalities from fatality monitoring studies at wind energy facilities in the Plan Area range of the northern long-eared bat and the little brown bat. These fatality monitoring studies occurred from 1999–2001, 2005–2006, and 2009–2015. Using an approach similar to that outlined in the MSHCP it was possible to estimate the number of these bats that will be killed without conservation measures (Table 4.1-7). As noted in Section 4.1.4.1 for covered bats, the actual impacts will be influenced by site-specific risk factors including the use of operational curtailment to protect bats and birds.

Estimation of Potential Mortality

Unlike the covered bats whose reproductive potential is limited to one pup per year, migratory tree bats produce 2 pups per year for hoary and silver-haired bats and up to four pups per year for red and Seminole bats (Hayssen *et al.* 1993). Similarly, there are no multi-decade records of survival as are known for both little brown and Indiana bats (Humphrey and Cope 1976; Wilkinson and South 2002; Boyles *et al.* 2007), and there is a strong association between litter size and lifespan among bats (Wilkinson and South 2002). As such, migratory tree bats should be considered more r-selected[36] and will be expected to tolerate higher levels of mortality. It is unknown what component of mortality for any bat species is compensatory (*i.e.,* animals that will die anyway and thus have little to no effect on population dynamics) versus additive (*i.e.,* mortality that causes population-level declines). This is especially true with fall migrants when mortality is highest, but also comprised of bats unlikely to survive winter. However, the mortality of millions of red, hoary, and silver-haired bats will be a substantial effect, and could lead to population declines regionally and across the species range. Given the small number of carcasses retrieved and the accepted range of the Seminole bat these individuals may be migrants whose deaths have no population-level effect. However, it is possible that Seminole bats are responding to climate change by moving into more northern landscapes (Lacki *et al.* 2014), and mortality at wind energy sites may restrict this movement. As such, the risk of mortality of migratory tree bats at wind energy sites under Alternative D, without the conservation measures of the MSHCP under Alternative A, are expected to be substantially greater than Alternative A.

[36] Biologist recognize a continuum of population traits ranging from those species that typically live short lives and produce many offspring (R-selected) to those that produce fewer offspring and live longer lives (K-selected).

Table 4.1-7. Estimated Mortality for Migratory Tree Bats under Alternative D without the Avoidance and Minimization Measures Contained in Alternative A under the MSHCP

Species of bat	Number of Carcasses	Percent of Total Mortality	Mortality (bats/MW/yr)	Mortality at initial 18,004 MW (bats)	Mortality associated with 33,000 additional MW	Cumulative Mortality (51,004 MW)
Eastern red bat	3,893	43.58	7.66	6,209,917	9,611,736	15,821,653
Hoary bat	2,328	26.06	4.58	3,713,508	5,747,784	9,456,292
Silver-haired bat	1,621	18.14	3.19	2,585,737	4,002,215	6,587,953
Seminole bat	13	0.15	0.03	20,737	32,097	57,834
Data Source	MSHCP Table 4-7	Derived for EIS using data from Table 4-7 of the MSHCP	Derived for EIS using data from Table 4-12 of the MSHCP	Derived for EIS	Derived for EIS	Derived for EIS

MW = megawatts
MSHCP = Multi-Species Habitat Conservation Plan
EIS = Environmental Impact Statement

4.1.6.5 Other Fish and Aquatic Resources

Construction-Related Impacts

Mechanisms and effects of construction-related impacts are the same as described for Other Fish and Aquatic Resources under Alternative A, Section 4.1.3.5. However, under Alternative D, wind energy facilities could be located closer to large lakes and rivers that are specifically excluded from Covered Lands under Alternative A. Thus, under Alternative D there is a greater risk of erosion, sedimentation, and chemical spills from a wind energy construction site reaching these waterbodies and posing a threat to fish and aquatic invertebrates compared to Alternative A. If proper BMPs are not required or followed under Alternative D, the impacts to other fish and aquatic wildlife could be moderate.

Operation-Related Impacts

Mechanisms and effects of operation-related impacts are the same as described for Other Fish and Aquatic Resources under Alternative A, Section 4.1.3.5, which are minor. However, under Alternative D, wind energy facilities could be operating closer to large lakes and rivers that are specifically excluded from Covered Lands under Alternative A. Thus, under Alternative D there is a greater risk of operation impacts from a wind energy site on Other Fish and Aquatic Resources compared to Alternative A.

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4.2 Water Resources

This section describes the potential impacts on water resources (e.g., surface waters, floodplains, and wetlands) in the study area for each of the alternatives.

4.2.1 Regulatory Context

4.2.1.1 Surface Waters

Clean Water Act

The principle regulatory authority governing the protection of surface waters at the Federal level is the CWA, particularly Sections 404, 402, and 401 of the Act. Section 404, administered jointly by the U.S. Army Corps of Engineers (Corps) and EPA, establishes a program to regulate the discharge of dredged or fill material into waters of the United States[37]. Section 402 of the CWA requires an NPDES permit for point source discharges into waters of the United States. The NPDES permit authority is typically delegated to state water resource agency (or tribal authority for tribal lands) by the EPA. There are several types of NPDES permits, but the most common for a construction project is the NPDES Construction General Permit, which is required for any construction activity that would disturb one or more acres of land. The primary requirement of this permit is the development of an SWPPP by the project proponent that outlines how stormwater run-off, erosion and sediment would be controlled, and the specific sediment and erosion control measures that will be implemented, in order to minimize polluted stormwater run-off into nearby surface waters.

Section 401 of the CWA requires a Water Quality Certification for a project to ensure it does not violate state or tribal water quality standards. Section 401 authority is typically delegated to state water resource agencies (or tribal authorities for tribal lands) by the EPA. Before obtaining a Section 404 permit and Section 402 NPDES permit, project proponents must first obtain a Section 401 Water Quality Certification. Under Section 401, States have the authority to review and approve, condition, or deny any Federal permits or licenses that might impact state water quality standards. This authority may be used by States to protect wetland resources (see "State Wetland Protection" below).

Rivers and Harbors Act

A Section 10 Rivers and Harbors Act permit may be required for any construction in, over, or under any navigable water of the United States. The Corps administers the Section 10 permit and Section 404 permit together, if applicable, and the Corps typically issues a joint permit because navigable waters are subsumed by waters of the United States. Before obtaining a Section 10 permit, project proponents must also first obtain a Section 401 Water Quality Certification.

[37] See 40 CFR 230.3 for definition of "waters of the United States."

4.2.1.2 Floodplains

National Flood Insurance Act

The National Flood Insurance Act established the National Flood Insurance Program (NFIP), a voluntary floodplain management program for communities (cities, towns, or counties) that is implemented by FEMA. The program requires FEMA to delineate floodplains in participating communities throughout the United States and present the information on Flood Insurance Rate Maps. These maps are used to determine if existing or future projects are located in flood hazard areas and to determine if those projects would be prone to future flood risks. Any action within a FEMA-mapped 100-year floodplain in a participating community must follow the community's FEMA-approved floodplain management regulations.

Executive Order 11988, Floodplain Management

Executive Order (EO) 11988, "Floodplain Management," addresses floodplain management and establishes requirements to ensure Federal agencies avoid directly and indirectly supporting the development of floodplains when alternatives are feasible. In addition, it prohibits impacts to floodplains from short-term and long-term occupancy and modification of floodplains when alternatives exist. Agencies are required to document that there is no practicable alternative prior to taking action that would encroach on a 100-year floodplain. Additionally, if avoidance of the floodplain location is not practicable, agencies are required to minimize harm to the floodplain. Because specific locations for siting wind facilities are not known at this time, the Service, in collaboration with the wind energy company, would document compliance with EO 11988 once specific project details are known and before issuance of the ITP to the wind energy company.

4.2.1.3 Wetlands

Clean Water Act

The principle regulatory authority governing the protection of wetlands at the Federal level is CWA Sections 404, 402, and 401 (see Section 4.2.1.1).

Executive Order 11990, Protection of Wetlands

EO 11990, "Protection of Wetlands," established the protection of wetlands and riparian systems as the official policy of the Federal government. It states that Federal actions must "...avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative." EO 11990 states that Federal agencies shall provide leadership and shall take action to minimize the destruction, loss, or degradation of wetlands. Federal agencies are also responsible for preserving and enhancing the natural and beneficial values of wetlands. EO 11990 does not apply to the issuance by Federal agencies of permits, licenses, or allocations to private parties for activities involving wetlands on non-Federal property.

State Wetland Protection

Every state regulates, to some degree, activities that affect wetlands. Many States (including Illinois, Iowa, and Missouri) rely solely on CWA Section 401 certification to provide input into the dredge and fill permitting process, while others (including Indiana, Michigan, Minnesota, Ohio, and Wisconsin) have formal state wetland permitting programs that serve as their primary regulatory mechanism for protecting wetlands from dredge and fill impacts. Michigan is one of two states (the other is New Jersey) that has "assumed" the Section 404 permitting program, meaning that it has full control over CWA dredge and fill permitting decisions for regulating waters in the state (Association of State Wetland Managers 2015).

Michigan and Minnesota

Michigan and Minnesota have the authority to issue permits for dredge and fill activities in wetlands, including both coastal/tidal/shoreline areas and freshwater wetlands. Michigan is one of two States (New Jersey is the other) that has assumed the authority to issue Section 404 dredge and fill permits. However, in areas where the Corps retains jurisdiction (e.g., interstate waters), Section 401 certification or a state permit may still be required.

Indiana, Ohio, and Wisconsin

Indiana, Ohio, and Wisconsin have adopted regulations that extend their jurisdiction to "geographically isolated" wetlands. Where actions require a Federal permit, license, or approval that result in a discharge into waters of the state, the state requires a Section 401 certification. Where there is no Section 404 permit, and therefore no opportunity to weigh in through Section 401, these states also require a state permit for activities that affect aquatic resources, such as geographically isolated wetlands.

Illinois

Illinois has a more restricted ability to regulate the discharge of dredge and fill material into wetlands. Illinois's wetland protection program only gives the Illinois Department of Natural Resources the ability to regulate state-funded projects and activities that impact wetlands, except for activities on private lands.

4.2.2 Methods and Approach

The following sections discuss the methods and approach for characterizing impacts on water resources. Impacts are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known.

4.2.2.1 Surface Waters

The National Hydrography Dataset (NHD) GIS data for the study area were overlain with the MSHCP build-out model to provide an estimate of surface water areas and linear distances that could potentially be impacted by the alternatives for each state (refer to Section 4.0 for additional information regarding the build-out model). Surface water impacts are also described qualitatively by identifying construction, operation, and decommissioning and reclamation-related impact mechanisms of new commercial wind-energy projects and associated facilities within Covered

Lands. Impact mechanisms associated with mitigation activities under the MSHCP conservation strategy are also qualitatively described.

4.2.2.2 Floodplains

The FEMA and NRCS GIS data for the study area were overlain with the MSHCP build-out model to provide an estimate of floodplain area that could potentially be impacted in each state (refer to Section 4.0 for additional information regarding the build-out model). Floodplain impacts are also qualitatively described by identifying construction, operation, and decommissioning and reclamation-related impact mechanisms of new commercial wind energy projects and associated facilities within Covered Lands. Impact mechanisms associated with mitigation activities under the MSHCP conservation strategy are also qualitatively described.

4.2.2.3 Wetlands

The NWI GIS data for the study area were overlain with the MSHCP build-out model to provide an estimate of wetland area that could potentially be impacted in each state (refer to Section 4.0 for additional information regarding the build-out model). Wetland impacts are also qualitatively described by identifying construction- and operation-related impact mechanisms of new commercial wind energy projects and associated facilities within Covered Lands. Impact mechanisms associated with mitigation activities under the MSHCP conservation strategy are also qualitatively described.

4.2.3 Alternative A—Proposed MSHCP Alternative

4.2.3.1 Surface Waters

Construction-Related Impacts

While there is potential for a direct surface water impact from construction of wind turbines and related project infrastructure within surface waters, it is likely that most surface waters will be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state and local surface water laws and regulations. Direct construction impacts (*i.e.,* placement of fill or structures) to surface waters will likely result from access road and collection line crossings, where crossing structures (e.g., culverts) will need to be installed; it is unlikely a wind turbine will be sited in a surface water. Avoidance of surface waters is a practical consideration for developers, as construction in these areas is more difficult and triggers more regulatory requirements (e.g., CWA Section 404), which can increase cost through mitigation requirements and avoidance and minimization measures. Therefore, it is beneficial to developers to avoid surface waters to the extent practicable and to address the potential for changes in surface water drainage patterns, runoff, erosion, sedimentation, and water quality to alter surface waters by implementing appropriate construction management practices. One of the required BMPs is to site new roads to avoid crossing streams and minimize the number of stream crossings (see Section 4.2.3.4).

If wind energy development were to impact surface waters, project proponents will be required to comply with all applicable Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local laws and regulations protecting surface waters. If a particular wind turbine project required placement of fill

in a surface water that exceeds the allowance under a Corps CWA Section 404 Nationwide Permit[38], the project proponent would have to obtain a General Permit[39] or an Individual Permit[40] from the Corps, which would require NEPA compliance by the Corps. As part of the permitting process, project proponents must identify the boundaries of surface waters, avoid impacts to those surface waters, minimize unavoidable impacts, and compensate for any unavoidable impacts as required by the agencies with responsibility for these resources (e.g., Corps, state natural resource agencies). Potential surface water impacts from construction are described below. Compliance with Federal, state and local regulations should minimize potential surface water impacts.

Increased Sedimentation

Development of wind-energy sites requires ground disturbance activities, altering both the erodibility (due to the loosening and exposure of fine particles) and the potential for runoff on the site. Exposure of bare soils during construction of wind towers, ancillary structures, and related energy infrastructure increases the potential for detachment of soil particles, thus potentially increasing deposition within adjacent and nearby waterbodies. Such sediment deposition in surface waters can impact aquatic resources by degrading aquatic habitat, increasing turbidity and decreasing light penetration; raising the streambed; and decreasing the storage capacity of reservoirs in downstream areas. Sediment can also introduce other pollutants into waterbodies by carrying excess contaminants and nutrients such as nitrogen and phosphorus (Walling 1999). Excess nutrients can accelerate the growth of algae to form algal blooms that can deplete the availability of dissolved oxygen within the waterbody. The risk of sedimentation can be reduced by avoiding surface waters as much as practicable and by proper application of BMPs for erosion control (see Section 4.2.3.4 for a list of BMPs). These measures will be site specific and included within the a construction site's SWPPP, the plan that is required to obtain an NPDES General Construction Permit under Section 402 of the CWA.

Table 4 2-1 summarizes potential impacts to streams and waterbodies by state from construction of new wind energy infrastructure under Alternative A. As described in the approach section above, these acreages were generated by overlaying NHD GIS data for the study area with the MSHCP build-out model, which approximates where wind energy development may occur over the MSHCP permit term. In reality, much of these streams and waterbodies will likely be directly avoided due to engineering and cost constraints and Federal, state and local surface water regulations. Also, one of the required BMPs is to site new roads to avoid crossing streams.

Based on the GIS analysis, approximately 170 miles of stream and 1,251 acres of surface waters could be affected by wind development. This represents approximately 0.03 percent and 0.02 percent of the amount of stream and surface waters in the study area, respectively. Potential stream impacts could be greatest in Illinois and Iowa, and potential surface water impacts could be greatest in Minnesota and Wisconsin.

[38] By definition, Nationwide Permits only authorize activities that have minimal individual and cumulative adverse effects on the aquatic environment (77 *FR* 10184–10290). Nationwide Permits that have been used on other wind energy projects include Nationwide Permit No. 12 (Utility Line Activities), Nationwide Permit No. 14 (Linear Transportation Projects), and Nationwide Permit No. 51 (Land-Based Renewable Energy Generation Facilities).

[39] Like Nationwide Permits, General Permits are issued when proposed activities are minor in scope with minimal projected impacts. There are two categories of General Permits: Statewide and Regional.

[40] Activities in wetlands that involve more than minimal impacts require an individual permit.

Table 4.2-1. Potential Impacts to Streams and Waterbodies under Alternative A

State	Miles of Streams	Acres of Waterbodies
Illinois	55	119
Indiana	10	30
Iowa	37	64
Michigan	21	189
Minnesota	25	533
Missouri	4	8
Ohio	13	22
Wisconsin	5	286
Total	**170**	**1,251**

Source: U.S. Environmental Protection Agency and U.S. Geological Survey 2012.

Accidental Petro-Chemical Spills

Increased vehicular traffic, use of construction equipment, and the presence of hydraulic machinery on construction sites increases the chance of accidental spills of construction-related fluids (e.g., oil, gasoline, or hydraulic fluids) on the landscape or directly into waterbodies. Although the risk of major contamination of surface waters is minor, such accidental discharges can kill aquatic plants and animals, adversely altering the stream ecosystem, and limit the use of the water for drinking and recreation by humans. Accidental spills can also have chronic effects to surface waters because some pollutants (e.g., petroleum) can be sequestered into the bed-sediments and slowly released back into the water. The respective impact, however, would depend on the type and quantity of the spill and the dispersal and attenuation characteristics of the waterbody (Jobson 1997). If directional drilling is used (e.g., utility line crossings of streams) there is potential to release drilling fluids via frac-outs resulting in the migration seepage of drilling fluids to the surface. Like the chemicals discussed previously, drilling fluids associated with frac-outs can adversely impact aquatic biota. The introduction of this material can occur at any point along the bore, and therefore, vigilant monitoring of these activities is important to ensure any potential issue is addressed in the appropriate timeframe. The risk of impacts from construction-related fluid spills should be low due to implementation of BMPs to prevent, control, and clean-up spills. These BMPs will be site-specific and incorporated into a construction site's SWPPP.

Vegetation Removal and Increased Instream Temperatures

In surface waters adjacent to and surrounding wind energy development and associated facilities, the loss of riparian coverage and other streamside vegetation may reduce shading of the waterbody and lead to locally elevated water temperatures. Elevated water temperatures can, in turn, lead to reductions in levels of dissolved oxygen reducing the function and ability of the waterbody to host aquatic organisms (Studinski *et al.* 2012). Removal of vegetation can also alter stream hydrography, increase runoff of pollution and excess nutrients, and increase sedimentation into streams (Putz *et al.* 2003). These changes can have moderate impacts to surface waters nearby and adjacent to wind energy development construction sites.

Water Withdrawals

During construction of wind-energy sites and infrastructure, water withdrawals may be needed for construction activities, including dust suppression, concrete mixing, and vehicle and machinery washing. If water is not brought in from other waterbodies outside of the development site, available water from adjacent and nearby surface waters may be used. Such withdrawals could temporarily reduce stream discharge, which could temporarily alter the natural hydrologic regime of the stream system. The level of impact from such withdrawals depends on the volume withdrawn and the availability of water within the system. Such impacts are expected to be minor. In states that regulate surface water withdrawals, water withdrawals for construction activities will be required to meet all state and/or local regulations for water withdrawals and use in order to avoid or minimize any adverse effects.

Alteration of Overland Runoff and Natural Drainage Systems

Development of a site for wind-energy will likely require grading, excavation and placement of fill, all of which can change the surface topography and alter natural overland runoff (*i.e.,* stormwater runoff). These changes can redirect and change velocities of overland runoff, which can affect receiving surface water. Given that grading, excavation and placement of fill disturb the ground, these actions also increase the potential for erosion and sedimentation, and their respective impacts as discussed above. In addition to changes in topography, development of a site requires the placement of impervious surfaces for towers and wind-turbines. These areas are likely to increase stormwater runoff, especially if the surfaces are hydrologically connected to nearby streams (*i.e.,* precipitation falling on the surfaces is effectively transported to the waterbody) via trenches, ditches, or roads with limited porosity. Stormwater runoff increases the dispersion of pollutants into nearby streams and waterbodies, increases bank instability, and can increase the amplitude of stream flows.

Construction of wind-energy sites also requires the development of staging areas and laydown areas. These areas are normally prepared by grading and compacting the soil, thus reducing the filtration ability of the soil and increasing stormwater runoff. These minor to moderate impacts can be mitigated by using site-specific BMPs that will be included within a site-specific SWPPP.

Access Road and Collection Line Crossings

New access road development is a necessary component for wind-energy development. In areas where streams need to be crossed, culvert structures are often installed to facilitate water flow under the access road. However, these structures can have adverse impacts on the hydrology and function of the stream ecosystems they cross if not properly designed. Possible impacts include: an increase in stream width and/or depth immediately downstream of the structure, a decrease of bank stability downstream due to increased scour during high flow periods, and channel incision (*i.e.,* the lowering of a streambed over time)(Levine *et al.* 2007). These potential effects can be seen both locally and at the reach level (Castro 2003), but can be minimized to a minor or negligible impact by installing culverts sized to accommodate high flows as well as low flows. In addition to the impacts culverts pose, road crossings in general can have impacts to the surface waters they cross by increasing the chance of pollutants entering waterways and potentially increasing the water temperature due to the reduced canopy coverage (King *et al.* 2000). Any installation of a culvert across a waterbody is subject to Federal and state and/or local surface water impact permitting requirements which would minimize impacts. The installation of collection line crossings have the potential for similar impacts if constructed similarly.

Mitigation Measures – Bats

Construction of new wind energy facilities may require implementation of mitigation measures that could affect surface waters. Mitigation is proposed to compensate for the take of the Indiana bat, northern long-eared bat, and little brown bat. Because project-specific information concerning the footprint of the new wind energy facilities is not available, the Service's HEA model cannot be used to determine mitigation requirements. Assumptions regarding the proportion of land cover types supporting occupied habitat that are removed are used to provide a reasonable range of mitigation acreage requirements. The mitigation acreage range for the Indiana bat is 319 to 7346 acres; northern long-eared bat 565 to 13,000 acres; and little brown bat 565 to 13,000 acres. The management and enhancement of acquired mitigation sites may involve implementing actions, such as invasive plant removal and partial stand harvests to encourage age class diversity and structural heterogeneity, to reach desired habitat conditions. These actions may influence various aspects of local hydrologic regimes, such as rates of overland flow and infiltration. The maintenance of forest habitat, especially in riparian areas, that may otherwise be converted to agricultural land may reduce surface run-off and the intensity of peak flows in landscapes dominated by agriculture.

Mitigation Measures – Kirtland's Warbler

The MWE MSHCP outlines conservation measures to mitigate impacts to the Kirtland's warbler by promoting increased breeding success. Most of these measures will be applied in the northern Lower Peninsula and the Upper Peninsula of Michigan and within Wisconsin. One measure includes management of jack pine stands through burning, logging, seeding, and replanting. These activities could result in similar surface water impacts as the other construction impact mechanisms described above. Fire and logging can alter the natural hydrologic cycle or streams through reduction of evapotranspiration, infiltration, and sub-surface flow and an increase of overland flow (Putz *et al.* 2003) resulting in increased runoff and sedimentation and their associated effects described above in the construction-related impacts section. Use of vehicles and equipment to conduct these activities will probably result in petro-chemical spills that could affect surface waters as described above. It is projected that 50 acres or less of habitat would be needed for mitigation for incidental take; therefore, this jack pine management only poses a minor potential impact to surface waters within the Plan Area given the small acreage of habitat expected for mitigation and the amount of surface waters in the Plan Area.

Mitigation Measures – Interior Least Tern and Piping Plover

The MWE MSHCP describes implementing measures to create nest sites to off-set the take of the interior least tern and piping plover. Mitigation measures involving the creation and management of one nesting site (30 acres) for interior least tern and two nesting sites (30 acres each) for piping plover may include immediate and long-term impacts to surface water. Creation of sandbar-nesting sites may involve in-stream activities that introduce sediment and have the potential to disturb river substrate resulting in increased loads of sediment. Sedimentation has the potential to increase embeddedness in bed substrate, impacting water quality and aquatic species. Management and protection of sandbars and shoreline from mitigation measures may influence surface water dynamics, potentially resulting in greater bank stability and reducing the risk of persistent sediment-issues.

Operation-Related Impacts

Operation-related activities include vegetation maintenance (trimming, mowing, herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance. These activities should be infrequent and brief. Typical impact mechanisms with the potential to affect surface water include: increased risk of accidental oil or chemical spills, water quality impacts from vegetation maintenance and use of pesticides/herbicides, and alteration of the hydrologic network.

Accidental Petro-chemical Spills

Increased vehicular traffic, compared to pre-construction levels, for operations and maintenance of wind-energy sites increases the potential for accidental spills of petro-chemicals. In addition to this risk, accidental spill or leaks can occur from the transformers and other machinery. In both of these cases, accidental spills could adversely impact nearby streams and waterbodies if not properly contained, especially if they occur on hydrologically linked impervious surfaces. As mentioned in the construction-related impacts, the risk and impact of accidental spills would be low due to implementation of BMPs that are site-specific and included in a SWPPP. With these measures, the risk of impacting surface waters is minor.

Vegetation Maintenance, Herbicides, and Pesticides

General maintenance of operational sites includes the periodic removal of trees or tree limbs, vegetation control in the form of herbicides and mowing, and the use of pesticides. If these maintenance activities occur around surface waters, these measures can have minor impacts on surface waters by reducing the riparian coverage around streams, thus reducing their natural ability to protect against non-point source pollutants and contributing to increased stream temperatures and lower dissolved oxygen (Dosskey *et al.* 2010). In addition to these impacts, vegetation removal around surface waters can reduce bank stability and increase sedimentation. When herbicides and pesticides are used, there is also the potential of contaminating surface waters through direct exposure and runoff (Battaglin *et al.* 2009). These additions can be harmful to aquatic life depending on the herbicide or pesticide, the existing conditions of the surface water that may be affected, and the aquatic species present.

In addition to general vegetation maintenance, the MWE MSHCP requires monitoring for bat and bird mortalities at the wind facility. In order to increase efficiency and detection of these searches, sites will likely utilize larger amounts of mowing and apply larger amounts of herbicides. Therefore, the intensity of impacts from vegetation maintenance and herbicide application will be greatest at the wind facilities. The application of additional herbicides and vegetation clearing poses a minor increase in the potential to impact surface waters. One of the required BMPs is to limit herbicide and pesticide use to non-persistent, immobile compounds and apply them using a properly licensed applicator in accordance with label requirements (see Section 4.2.3.4).

Alteration of Hydrologic Network

Changes in topography during construction and the overlying drainage structure will likely persist during operations of wind-energy sites, as described above under construction-related impacts. These changes have the potential to alter the stormwater runoff and water budget of sites and increase sediment erosion.

Decommissioning and Reclamation-Related Impacts

Decommissioning and reclamation of wind energy sites could have short-term degradation impacts on surface waters similar to construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit surface waters affected by construction and operations. Reclamation typically includes restoring the project site to the pre-development condition or to conditions similar to those surrounding the facility. The reclamation process could result in restoring surface waters that were impacted from project construction. The extent of restoring surface waters to pre-development conditions depends on the success of the reclamation process.

4.2.3.2 Floodplains

Construction-Related Impacts

While there is potential for floodplain impacts from construction of wind turbines and related project infrastructure within 100-year floodplains, it is likely that most floodplains will be avoided due to engineering challenges related to a floodplain's high erosion potential and in order to comply with relevant Federal and local floodplain laws and regulations. Surface and subgrade soils in these areas are susceptible to being soft and loose. If turbines are sited within a floodplain, detailed geotechnical work to determine the need for undercut/fill must be completed prior to construction. Avoidance of floodplains is a practical consideration for developers, as construction in these areas is more difficult and more regulatory requirements are triggered (e.g., NFIP-participating community floodplain management regulations). If project structures would be developed in a floodplain, they must meet the NFIP development criteria for building in a floodplain. Therefore, it is beneficial to developers to avoid floodplain areas to the extent practicable. Also, because better wind conditions are usually present on uplands, placement of wind turbines in floodplain areas typically would be avoided because floodplains are usually found along rivers and streams in valleys with low elevations relative to other areas. Nevertheless, project infrastructure could be located in the floodplain. Potential floodplain impacts from construction in the floodplain are described below. As applicable, compliance with NFIP floodplain regulations should minimize potential floodplain impacts in FEMA-mapped 100-year floodplains.

Floodplain Loss and Degradation from Land Disturbing Activities

Land disturbing activities, such as vegetation clearing, excavation, placement of structures, and road building, associated with construction of new wind energy facilities have the potential to impact floodplains where floodplains occur in proximity to proposed development sites. These activities could result in the permanent loss or alteration of floodplain areas and floodplain functions (see Table 3.2-8), particularly floodwater storage capacity, conveyance, and retention, as discussed below.

Table 4.2-2 summarizes potential impacts to FEMA mapped floodplains by state from construction of new wind energy infrastructure under Alternative A. Table 4.2-3 does the same for NRCS flood-prone soils. As described in the approach section above, these acreages were generated by overlaying FEMA and NRCS data for the study area (see Section 3.2.2.2) with the MSHCP build-out model, which approximates where wind energy development may occur over the MSHCP permit term. In reality, much of this floodplain area will likely be avoided due to engineering constraints, wind suitability in floodplain areas, and Federal and local floodplain regulations.

Based on the GIS analysis, approximately 4,365 acres and 7,431 acres of FEMA 100-year floodplain and NRCS flood-prone soils, respectively, could be affected. This represents approximately 0.02 percent each of the amount of 100-year floodplain and flood-prone soils in the study area. Potential floodplain impacts could be greatest in Illinois and Iowa.

Compensatory mitigation actions under the MSHCP may result in a temporary disturbance of floodplains, but these actions would ultimately benefit floodplain through protecting and restoring floodplain habitat for Covered Species. These impacts could be greater than under Alternative D, where compensatory mitigation may not be required for construction or operation of wind energy facilities within the Plan Area.

Table 4.2-2. Potential Impacts to FEMA Mapped 100-year Floodplain under Alternative A

State	Amount (acres)
Illinois	1,490
Indiana	391
Iowa	856
Michigan	380
Minnesota	377
Missouri	137
Ohio	257
Wisconsin	477
Total	**4,365**

Source: Federal Emergency Management Agency 2015

Table 4.2-3. Potential Impacts to NRCS Flood-Prone Soils under Alternative A[a]

State	Amount (acres)
Illinois	2,315
Indiana	296
Iowa	2,667
Michigan	351
Minnesota	590
Missouri	463
Ohio	253
Wisconsin	496
Total	**7,431**

Source: Natural Resources Conservation Service 2015.

[a] Includes soils with the following flood frequency classes: very frequent, frequent, common, occasional, and rare.

Decreased Floodwater Storage Capacity and Conveyance

Placement of fill and/or structures within the floodplain can interfere with the passage, storage, and infiltration of floodwaters—the surface area on the upstream side of the structure will impede the

flow of floodwater; turbines, fill, and other structures within the floodplain will cause a direct loss of flood storage capacity equivalent to the volume of the structure or fill below the flood elevation; and capacity for infiltration will be lost within the structures' footprints. A reduction in flood storage capacity results in more floodwater downstream and an increase in floodwater levels. Placement of fill and/or structures constricts flood flow paths and increases floodwater elevation upstream of the constriction, resulting in a backup of floodwaters and potential upstream flooding. Placement of fill and/or structures in the floodplain also redirects flood flows to existing channels, leading to channel erosion and the potential alteration of channel alignment. The extent of these impacts will vary based on the topographic modification required for construction, which would depend on the location or design characteristics of the project infrastructure as determined during the final design and permitting processes.

Access roads and transmission lines have the capacity to interfere with infiltration as well. If access roads consisted of gravel (*i.e.,* not paved), some infiltration is possible within the road beds. The effects on floodplains from roads and transmission lines will likely be observed in the form of small localized increases in flood elevation and duration. Access roads and transmission lines would have no measurable effect on flood storage or passage provided they have no above-grade components (e.g., a raised roadbed). Overhead lines will have no effect on floodplains provided the supports are constructed outside the floodplain boundaries.

Decreased Floodwater Retention

Clearing floodplain vegetation will remove a floodplain's capacity to slow down, retain, and absorb floodwaters. Denser floodplain vegetation has a greater ability to provide this function. Clearing floodplain vegetation leads to increased downstream flood flows, sedimentation, channel erosion, and flooding. The extent of such impacts will vary based on the topographic modification required for construction, which depends on the location or design characteristics of the project infrastructure as determined during the final design and permitting processes.

Operation-Related Impacts

Operation-related activities include vegetation maintenance (trimming, mowing, herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance. These activities will be infrequent and brief and are expected to have minor impacts on floodplains. Also, any stream or river channel stabilization measures, such as riprap, designed to protect project infrastructure from channel migration could increase channel migration upstream and downstream by altering flow velocities and erosive forces.

Decommissioning and Reclamation-Related Impacts

Decommissioning of wind energy sites could have short-term degradation impacts on floodplains similar to construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit floodplains that were affected by construction and operations. Reclamation typically includes restoring the project site to the pre-development condition or to conditions similar to those surrounding the facility. The reclamation process could result in restoring floodplain and floodplain functions that were lost to project construction. The extent of restoring floodplain functions to pre-development conditions depends on the success of the reclamation process.

4.2.3.3 Wetlands

Construction-Related Impacts

While there is potential for a direct wetland impacts from construction of wind turbines and related project infrastructure, it is likely that most wetlands would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations. Prior to impacting wetlands, project proponents will be required to comply with all applicable state and Federal laws protecting jurisdictional wetlands. If a particular wind turbine project required filling jurisdictional wetlands in excess of the allowance under a Corps CWA Section 404 Nationwide Permit[41], the project proponent must obtain a Regional Permit or an Individual Permit from the Corps, which requires NEPA compliance by the Corps.

As part of a permitting process, project proponents must identify the boundaries of wetlands, avoid and minimize impacts to those wetland areas, and compensate for any unavoidable impacts as required by the agencies with responsibility for these resources (e.g., Corps, state natural resource agencies). Because of these requirements, wetlands are typically considered avoidance areas during siting of project elements. Avoidance of wetlands is a practical consideration for developers, as construction in these areas is more difficult and has increased costs, more mitigation is required that is more costly, and more regulatory requirements are triggered. Therefore, it is beneficial to developers to avoid wetlands to the extent practicable and to address the potential for changes in surface water drainage patterns, runoff, erosion, sedimentation, and water quality to alter wetlands by implementing appropriate construction management practices. Nevertheless, project infrastructure (e.g., access roads) could potentially be sited in or near wetlands even after considerations to avoid and minimize wetlands. Potential wetland impacts from construction are described below. Compliance with state and Federal regulations should minimize potential wetland impacts.

Wetland Loss and Degradation from Land Disturbing Activities

Land disturbing activities have the potential to affect wetland water quality, hydrology, and the habitat functions (see Section 3.2.2.3), and may result in the permanent loss, degradation, or fragmentation of some wetland areas if they are filled to accommodate wind energy infrastructure, such as roads. Impacts to wetland functions are further described below.

Table 4.2-4 summarizes potential impacts to NWI mapped wetlands by state from construction of new wind energy infrastructure under Alternative A. As described in the approach section above, these acreages were generated by overlaying NWI data for the study area (see Section 3.2.2.3) with the MSHCP build-out model, which approximates where wind energy development may occur over the term of the MSHCP. In reality, much of this wetland area will likely be avoided due to engineering constraints and Federal and local wetland regulations.

Based on the GIS analysis, approximately 4,882 acres of freshwater emergent and freshwater forested/shrub wetlands could be affected. This represents approximately 0.02 percent of these wetlands in the study area. Potential wetland impacts could be greatest in Michigan and Minnesota.

[41] By definition, Nationwide Permits only authorize activities that have minimal individual and cumulative adverse effects on the aquatic environment (77 *FR* 10184–10290). Nationwide Permits that have been used on other wind energy projects include Nationwide Permit No. 12 (Utility Line Activities), Nationwide Permit No. 14 (Linear Transportation Projects), and Nationwide Permit No. 51 (Land-Based Renewable Energy Generation Facilities).

Compensatory mitigation actions under the MSHCP may result in a temporary disturbance of wetland habitats, but these actions would ultimately benefit wetlands through protecting or restoring wetland habitat for Covered Species. These impacts could be greater than under Alternative D, where compensatory mitigation may not be required for construction or operation of wind energy facilities within the Plan Area.

Reduce Wetland Habitat

Fill material placed in wetlands will result in the permanent loss of wetland and associated vegetation communities. If a wetland is completely filled, these functions will be lost entirely. As part of the Section 404 permitting process, compensatory mitigation will be required to offset the loss of wetland functions and values. The mitigation is intended to replace the lost wetland functions and values and could occur in a different location. If a wetland is partially filled and fragmented or if wetland vegetation is trimmed or cleared, vegetation communities and habitat will be altered and degraded. Wetland habitat and vegetation communities could also be affected if the hydrology of the wetland system is altered by construction of access roads (or other project infrastructure), which could result in wetland draining or ponding on either side of the access road embankments. This hydrology alteration could affect vegetation and wetland habitat by changing plant species' composition (*i.e.,* from wetland to upland plants if the wetland were to dry up over time due to a modified hydrologic regime).

Table 4.2-4. Potential Wetland Impacts under Alternative A

	Acres of Potential Wetland Impact, by Wetland Type								
Wetland Type[a]	Illinois	Indiana	Iowa	Michigan	Minnesota	Missouri	Ohio	Wisconsin	Total
Freshwater Emergent Wetland	93	49	94	265	924	10	16	82	1,533
Freshwater Forested/Shrub Wetland	328	138	68	958	1,617	27	72	141	3,349
Freshwater Pond	94	28	46	65	71	16	25	8	353
Lake	108	32	52	174	482	5	21	284	1,158
Riverine	21	5	38	16	21	2	6	5	114
Other	<1	0	0	17	<1	0	0	8	25
Total	**644**	**252**	**298**	**1,495**	**3,115**	**60**	**140**	**528**	**6,532**

Source: U.S. Fish and Wildlife Service 2015.

[a] "Freshwater Emergent Wetland" includes wetlands in the emergent class of the palustrine system (e.g., herbaceous marsh, fen, swale, or wet meadow); "Freshwater Forested/Shrub Wetland" includes wetlands in the forested and scrub-shrub classes of the palustrine system (e.g., forested swamp or shrub bog); "Freshwater Pond" includes wetlands (ponds) in the unconsolidated bottom, rock bottom, aquatic bed, and unconsolidated shore classes of the palustrine system; "Lake" includes wetlands and deep-water habitats in the lacustrine system; "Riverine" includes wetlands and deep-water habitats in the riverine system. "Other" includes miscellaneous wetlands in the palustrine system (e.g., farmed wetlands).

Compromised Water Quality Function and Degraded Wetland Water Quality

Fill material placed in a wetland during construction would result in the permanent loss of the wetland's ability to improve water quality; on a watershed level, any permanent wetland loss could reduce the capacity of regional wetlands to attenuate flooding, filter pollutants, and improve water quality. Any alteration of wetland hydrology could also reduce a wetland's ability to improve water quality by changing the natural hydrologic flows. For example, if a wetland with a high ability to retain water is channelized to direct flow through a culvert under a road, the amount of time water remained in the wetland could be reduced, thereby affecting the ability of the wetland to retain and filter sediments and other contaminants. Conversely, roads could fragment the normal flow through wetlands, leading to the creation of surface water impoundments that decrease water circulation and lead to water stagnation. Decreased water circulation can result in increased water temperature, lower dissolved oxygen levels, changes in salinity and pH, the prevention of nutrient outflow, and increased sedimentation (U.S. Environmental Protection Agency 1997). Compliance with the CWA (*i.e.,* Sections 401 and 404) and other state or local wetland permitting requirements would minimize these impacts.

Ground disturbance in or near wetlands could also result in degraded water quality of the wetland itself. The primary concerns are impacts associated with sedimentation and petroleum products. Soil disturbance and exposure to rain and surface runoff during construction could increase sediment in nearby wetlands, potentially increasing surface water turbidity, smothering vegetation, reducing water oxygen levels, and reducing water storage capacity. Biodiversity may be reduced in wetland communities as sensitive species are displaced by species more tolerant of disturbance. Changes in community composition may also include the increase or establishment of invasive plant species. Although the effects of sedimentation associated with a wind energy project may not be widespread, they could result in long-term impacts on local wetland communities in certain circumstances. Also, during construction, fugitive dust from loose soil could be generated by heavy equipment operation. Any accumulation of fugitive dust on wetland vegetation could affect plant growth by inhibiting photosynthesis, which could result in reduced vegetation density and plant diversity. This could also allow invasive plant species to take hold and colonize wetland areas, which could reduce plant species' richness. However, because construction BMPs limit the generation of fugitive dust (see Section 4.5.3.3) and release of sediments, it is likely that impacts from these factors would be minor.

Petroleum leaks and accidental spills from construction equipment are other potential sources of wetland water contamination. Accidental releases of hazardous materials could impact plant communities in the vicinity of the spill or in wetlands located downgradient from the project site. The magnitude of impacts depends on the type and volume of material spilled, the location, and habitat affected. An uncontained spill of hazardous materials will likely be small and affect a limited area because the volume of these materials that may be present at a construction location will be small, and there will be no long-term storage of hazardous materials at construction locations. In addition, the implementation of required spill prevention and response plans should limit potential impacts from a spill, if one occurs.

While many wetlands act to filter out sediment and contaminants, any substantial increase in sediment or contaminant loading could exceed the capacity of a wetland to perform its normal water quality functions.

Decreased Wetland Stormwater and Floodwater Storage Capacity

Fill material placed in a wetland during construction results in the permanent loss of the wetland's ability to impede and retain stormwater and floodwater; on a watershed level, any permanent wetland loss could reduce the capacity of regional wetlands to impede and retain these flows. Any alteration of wetland hydrology could also reduce a wetland's ability to retain water by changing the natural hydrologic flows. For example, if a wetland with a high ability to retain stormwater and floodwater is channelized to flow directly through a culvert under a road, the volume of water that the wetland would have otherwise been able to retain could be reduced.

Clearing and trimming of wetland vegetation also reduce the capacity of wetlands to impede and retain stormwater and floodwater. Densely vegetated wetlands have a greater ability to slow down and retain stormwater and floodwater; clearing or removing wetland vegetation from project construction will reduce this functional capacity.

Operation-Related Impacts

Operation-related activities include vegetation maintenance (trimming, mowing, herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance. These activities will be infrequent and brief. Vegetation maintenance could permanently alter a wetland vegetation community and structure (e.g., a scrub/shrub wetland that is continuously cleared for maintenance could convert an existing wetland to an emergent wetland). Any change in wetland vegetation structure could alter the habitat, water quality, and hydrology functions that the wetland provides. Maintenance associated with access roads and other project infrastructure could disturb the ground surface, require the use of chemicals (such as herbicides), or result in petroleum leaks and spills from maintenance vehicles and equipment. Any mobilized sediment, spilled chemicals, or petroleum products could reach wetlands, which could degrade vegetation communities, habitat, water quality, and overall wetland productivity. Implementation of spill prevention and response plans (if developed for operations) should limit potential impacts from a spill, if one occurs.

Fugitive dust from loose soil and gravel access roads could be generated from vehicles and equipment involved in maintenance activities. Any accumulation of fugitive dust on wetland vegetation could affect plant growth by inhibiting photosynthesis, which could result in reduced vegetation density and plant diversity. This could also allow invasive plant species to take hold and colonize wetland areas, which could reduce plant species richness.

Decommissioning and Reclamation-Related Impacts

Decommissioning of wind energy sites could have short-term degradation impacts on wetlands similar to construction-related impacts described above. However, the reclamation process following decommissioning should ultimately benefit wetlands that were affected from construction and operations. Reclamation typically includes restoring the project site to the pre-development condition or to conditions similar to those surrounding the facility. The reclamation process could result in restoring wetland and wetland functions that were lost to project construction. The extent of restoring wetland functions to pre-development conditions depends on the success of the reclamation process.

4.2.3.4 Best Management Practices

The main objective of BMPs for water resources is to protect the quality and quantity of water in natural water bodies in and around a wind energy project. Specific wind energy projects may require the completion of geotechnical engineering and hydrology reports that characterize site conditions related to drainage patterns, soils (including erosion potential), vegetation, surface water bodies, and steep or unstable slopes. In the geotechnical engineering report, soil properties, engineering constraints, the corrosive potential of construction materials, stability, and facility design criteria would be identified. The hydrology report would present a compilation of data on local water bodies, surface water drainage patterns, floodplains, rainfall, and expected run-on and runoff volumes and flow rates. Many of the BMPs listed below would be components of the various plans (particularly the SWPPP) required by Federal, state, and local agencies to minimize the impacts of wind energy facilities. Those BMPs listed below that are not a component of a required plan would not be required under the MSHCP.

- Minimize the extent of land disturbance to the extent possible.
- Use existing roads and disturbed areas to the extent possible.
- Site new roads to avoid crossing streams and wetlands; if streams and wetlands cannot be avoided, minimize the number of crossings.
- Apply standard erosion control BMPs to all construction activities and disturbed areas (e.g., sediment traps, water barriers, erosion control matting) as applicable to minimize erosion and protect water quality.
- Apply erosion controls relative to possible soil erosion from vehicular traffic.
- Identify and avoid unstable slopes and local factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, high slope angles, and certain geologic landforms).
- Construct drainage ditches only where necessary; use appropriate structures at culvert outlets to prevent erosion.
- Avoid altering existing drainage systems, especially in sensitive areas such as erodible soils or steep slopes.
- Clean and maintain catch basins, drainage ditches, and culverts regularly.
- Limit herbicide and pesticide use to non-persistent, immobile compounds and apply them using a properly licensed applicator in accordance with label requirements.
- Dispose of excess excavation materials in approved areas to control erosion and minimize leaching of hazardous materials.
- Re-establish the original grade and drainage pattern to the extent practicable.
- Re-seed (non-cropland) disturbed areas with a native seed mix and re-vegetate disturbed areas immediately following construction.
- Develop a plan to prevent, control, and clean-up any accidental petro-chemical spills during construction and operation.

4.2.4 Alternative B—Reduced Permit Duration

4.2.4.1 Surface Waters

The reduced permit duration would not affect the potential construction, operation, and decommissioning and reclamation-related impacts to surface waters. Like Alternative A, Alternative B estimates up to 33,000 MW of new wind energy development. The impact mechanisms under Alternative B would be the same as described for Alternative A. The location of potential impacts may be different because 11,000 MW could occur within Covered Lands, while the other 22,000 MW could occur anywhere in the Plan Area. While there is potential for a direct surface water impact from construction of wind turbines and related project infrastructure within surface waters, it is likely that most surface waters would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations.

4.2.4.2 Floodplains

The reduced permit duration would not affect the potential construction, operation, and decommissioning and reclamation-related impacts to floodplains. Like Alternative A, Alternative B estimates up to 33,000 MW of new wind energy development. The impact mechanisms under Alternative B would be the same as described for Alternative A. The location of potential impacts may be different because 11,000 MW could occur within Covered Lands, while the other 22,000 MW could occur anywhere in the Plan Area. While there is potential for floodplain impacts from construction of wind turbines and related project infrastructure within 100-year floodplains, it is likely that most floodplains would be avoided due to engineering challenges related to a floodplain's high erosion potential and in order to comply with relevant Federal (*i.e.,* National Flood Insurance Act and EO 11988) and local floodplain laws and regulations, including NFIP participating community floodplain management regulations in FEMA-mapped 100-year floodplains, as applicable.

4.2.4.3 Wetlands

The reduced permit duration would not affect the potential construction, operation, and decommissioning and reclamation-related impacts to wetlands. Like Alternative A, Alternative B estimates up to 33,000 MW of new wind energy development. The impact mechanisms under Alternative B would be the same as described for Alternative A. The location of potential impacts may be different because 11,000 MW could occur within Covered Lands, while the other 22,000 MW could occur anywhere in the Plan Area. While there is potential for a direct wetland impacts from construction of wind turbines and related project infrastructure, it is likely that most wetlands would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations. Prior to impacting wetlands, project proponents would be required to comply with all applicable state and Federal laws protecting wetlands.

4.2.5 Alternative C—Increased Cut-In Speed

4.2.5.1 Surface Waters

The increased cut-in speed would have no additional effects on surface waters; therefore, the construction, operation, and decommissioning and reclamation-related impacts to surface waters under Alternative C would be the same as those described under Alternative A. While there is

potential for a direct surface water impact from construction of wind turbines and related project infrastructure within surface waters, it is likely that most surface waters would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations.

4.2.5.2 Floodplains

The increased cut-in speed would have no additional effects on floodplains; therefore, the construction, operation, and decommissioning and reclamation-related impacts to floodplains under Alternative C would be the same as those described under Alternative A. While there is potential for floodplain impacts from construction of wind turbines and related project infrastructure within 100-year floodplains, it is likely that most floodplains would be avoided due to engineering challenges related to a floodplain's high erosion potential and in order to comply with relevant Federal (*i.e.,* National Flood Insurance Act and EO 11988) and local floodplain laws and regulations, including NFIP participating community floodplain management regulations in FEMA-mapped 100-year floodplains, as applicable.

4.2.5.3 Wetlands

The increased cut-in speed would have no additional effects on wetlands; therefore, the construction, operation, and decommissioning and reclamation-related impacts to wetlands under Alternative C would be the same as those described under Alternative A. While there is potential for a direct wetland impacts from construction of wind turbines and related project infrastructure, it is likely that most wetlands would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations. Prior to impacting wetlands, project proponents would be required to comply with all applicable state and Federal laws protecting wetlands.

4.2.6 Alternative D—No Action

4.2.6.1 Surface Waters

Construction-Related Impacts

Construction-related impact mechanisms associated with installation of new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). While there is potential for a direct surface water impact from construction of wind turbines and related project infrastructure within surface waters, it is likely that most surface waters would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations. Potential surface water impacts from construction will be related to increased sedimentation, accidental petro-chemical spills, vegetation removal and increased water temperatures, water withdrawals, alteration of overland runoff and natural drainage systems, access road crossings of streams, and Covered Species mitigation.

Operation-Related Impacts

Operation-related impact mechanisms associated with existing and new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential surface water impacts from operations are related to accidental petro-chemical spills; vegetation maintenance, herbicide, and pesticide use; and alteration of hydrologic network.

Decommissioning and Reclamation-Related Impacts

Decommissioning and reclamation-related impact mechanisms associated with existing and new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential surface water impacts from decommissioning and reclamation will be similar to construction-related impacts described above, but will be short-term and temporary and will have the potential to ultimately benefit surface waters that were affected by construction and operations.

4.2.6.2 Floodplains

Construction-Related Impacts

Construction-related impact mechanisms associated with installation of new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). While there is potential for floodplain impacts from construction of wind turbines and related project infrastructure within 100-year floodplains, it is likely that most floodplains will be avoided due to engineering challenges related to a floodplain's high erosion potential and in order to comply with relevant Federal (*i.e.,* National Flood Insurance Act and EO 11988) and local floodplain laws and regulations, including NFIP participating community floodplain management regulations in FEMA-mapped 100-year floodplains, as applicable. Potential floodplain impacts from construction include loss and degradation from land disturbing activities, decreased floodwater storage capacity and conveyance, and decreased floodwater retention.

Operation-Related Impacts

Operation-related impact mechanisms associated with existing and new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential floodplain impacts from operations include altering floodplain functions by vegetation

maintenance (trimming, mowing, and herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance.

Decommissioning and Reclamation-Related Impacts

Decommissioning and reclamation-related impact mechanisms associated with existing and new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential floodplain impacts from decommissioning and reclamation will be similar to construction-related impacts described above, but will be short-term and temporary and will have the potential to ultimately benefit floodplains that were affected by construction and operations.

4.2.6.3 Wetlands

Construction-Related Impacts

Construction-related impact mechanisms associated with installation of new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential wetland impacts from construction include loss and degradation from land disturbing activities, reduced wetland habitat, degraded water quality, and decreased wetland stormwater and floodwater storage capacity. While there is potential for a direct wetland impacts from construction of wind turbines and related project infrastructure, it is likely that most wetlands would be avoided in order to comply with relevant Federal (*i.e.,* CWA and Rivers and Harbors Act), state, and local surface water laws and regulations. Prior to impacting wetlands, project proponents will be required to comply with all applicable state and Federal laws protecting wetlands, including CWA Section 404.

Operation-Related Impacts

Operation-related impact mechanisms associated with existing and new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential wetland impacts from operations include degradation from vegetation maintenance (trimming, mowing, and herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance.

Decommissioning and Reclamation-Related Impacts

Decommissioning and reclamation-related impact mechanisms associated with existing and new wind energy facilities under Alternative D would be the same as those described under Alternative A. Impacts would be comparable in scale because both alternatives contemplate up to 33,000 MW of

new wind energy development, although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands). Potential wetland impacts from decommissioning and reclamation will be similar to construction-related impacts described above, but will be short-term and temporary and will have the potential to ultimately benefit wetlands that were affected by construction and operations.

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4.3 Geology and Soils

This section describes potential environmental consequences to geology and soil resources in the study area for each alternative.

4.3.1 Regulatory Context

The primary Federal regulation pertaining to geology and soils is the NPDES permit process, which is authorized under Section 402 of the CWA. Each of the states within the Plan Area administers the NPDES permit process through an EPA-approved state NPDES permit program. The NPDES permit process establishes restrictions on, among other things, stormwater runoff and effluent water quality from construction activities that disturb one or more acres.

Individual states or municipalities within the Plan Area may have additional regulations related to development in karst areas. The municipal karst regulations, in particular, are often part of the zoning regulations and land development approval process. The regulations typically cover subsidence, groundwater contamination, and prohibitions against cave destruction and include stormwater management rules and minimum setback distances from karst features. Because of the number of municipalities within the Plan Area, this section does not cite specific municipal karst regulations.

4.3.2 Methods and Approach

The geology and soils effects analysis considers the activities required for the construction and operation of wind energy sites, including road access, and qualitatively describes impact mechanisms to geologic and soil resources due to ground disturbance from Covered Activities. A similar qualitative analysis is provided for ground disturbance associated with implementation of compensatory mitigation activities. Impacts are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known.

This section also qualitatively describes how soil disturbance from wind energy infrastructure development may increase soil loss due to wind and water erosion, and how wind infrastructure may be affected by landslides, faults, or karsts, dependent on how they are sited within the study area.

4.3.3 Alternative A—Proposed MSHCP Alternative

4.3.3.1 Construction-Related Impacts

Construction activities affecting soils include access road construction, the preparation of wind tower foundations, preparing space for associated permanent equipment or site structures, establishing transmission line rights-of-way, installing transmission line support poles or towers, and using temporary staging areas. Under Alternative A, separate project-specific evaluations could be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Land Disturbance

Land disturbance activities include site clearance, grading, excavation, and soil stockpiling. Under construction BMPs, disturbed topsoil will be segregated, stockpiled, and then reused for site restoration following construction.

Soil disturbance may loosen soils making them more susceptible to wind and water erosion, compact soils reducing their water infiltration capacity and increasing runoff, or displace soils altering surface runoff patterns. BMPs include minimizing the areal footprint of ground disturbance and minimizing the length of time between clearing and site restoration.

Impacts to geology and soil resources from land disturbing activities associated with construction of new wind energy facilities under Alternative A will likely be moderate. Separate project-specific consistency evaluations will be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Soil Erosion

Soil erosion by water can remove productive soil and degrade water quality by increasing turbidity and sedimentation in surface waters. Soil erosion by wind can also remove productive soil, especially when removal of vegetation exposes the soil drying conditions. Windblown soil can degrade air quality and visibility. BMPs to minimize erosion include minimizing the disturbed footprint, dust control, and proper stormwater management.

Soil erosion impacts associated with construction of new wind energy facilities under Alternative A will likely be moderate. Separate project-specific consistency evaluations will be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Stormwater Runoff

Ground disturbance activities can alter surface drainage patterns, concentrate surface flows, increase runoff quantities, and increase runoff velocities. Increased and concentrated surface flows promote soil erosion. BMPs to manage stormwater include minimizing the disturbed footprint, reducing the runoff velocity, and removing suspended soil particles by settling or filtration.

Stormwater runoff impacts associated with construction of new wind energy facilities under Alternative A will likely be moderate. Separate project-specific consistency evaluations will be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Ground Destabilization

Construction activities can destabilize soils and geologic formations that initially have marginal stability, such as areas with karst features or a high landslide potential. The site selection process for wind turbines and their associated infrastructure—including temporary construction access roads—must either avoid potentially unstable areas or ensure that proper geotechnical evaluations are performed to identify and mitigate any stability risks.

Impacts to soils and geologic formations with marginal stability from construction of new wind energy facilities under Alternative A will likely be moderate. Separate project-specific consistency

evaluations will be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Compensatory Mitigation Activities Required by the MSHCP

The development of wind energy sites may require mitigation at other locations within the Plan Area. The potential geology and soil impacts discussed above may also apply to mitigation activities.

Impacts to geology and soil resources from mitigation activities associated with construction of new wind energy facilities under Alternative A will likely be moderate and mitigated through a project-specific permitting process and well-established BMPs.

Compared to Alternative D, the construction-related impacts are the same.

4.3.3.2 Operation-Related Impacts

Operation of wind energy facilities will not require additional road construction, foundation preparation, or other site development. However, the wind energy facility sites will need to be maintained to prevent or correct degradation from wind and water.

Soil Erosion

If the site grading, vegetation, or land cover does not perform as planned, soil loss may occur from the development of erosion features or from the exposure of bare soil. Periodic site inspections and maintenance should minimize the development of easily erodible soil conditions.

Soil erosion impacts associated with operation of wind energy facilities under Alternative A will likely be moderate. Separate project-specific consistency evaluations will be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Stormwater Runoff

Surface drainage patterns established by ground contours, natural channels, and permanent engineering controls may not perform as predicted, leading to concentrated, turbid discharges or uncontrolled flows. The proper performance of the drainage system should be periodically verified to ensure that suspended soil particles are not discharged into surface waters. Periodic inspection and maintenance should minimize improper discharges.

Stormwater runoff impacts associated with operation of wind energy facilities under Alternative A will likely be moderate. Separate project-specific consistency evaluations will be required, and avoidance, minimization, and mitigation measures for projects will be identified based on those project-specific evaluations.

Compared to Alternative D, the operation-related impacts are the same.

4.3.4 Alternative B—Reduced Permit Duration

4.3.4.1 Construction-Related Impacts

The reduced permit duration will not affect the potential construction impacts to geology and soil resources under Alternative B because, like Alternative A, it estimates up to 33,000 MW of new wind

energy development. Although the location of impacts may vary because 11,000 MW could occur within Covered Lands, while the other 22,000 MW could occur anywhere in the Plan Area, the potential impacts under Alternative B will generally be the same as described for Alternative A, and will likely be moderate. Compared to Alternative D, the construction-related impacts are the same.

4.3.4.2 Operation-Related Impacts

The reduced permit duration will not affect operation-related impacts on geology and soils. Therefore, operation-related impacts associated with new wind energy facilities under Alternative B will be the same as those described for Alternative A, and will likely be moderate. Compared to Alternative D, the operation-related impacts are the same.

4.3.5 Alternative C—Increased Cut-In Speed

4.3.5.1 Construction-Related Impacts

The increased cut-in speed will have no effect on geology and soil resources. Therefore, the potential construction impacts under Alternative C are identical to those under Alternative A, and will likely be moderate. Compared to Alternative D, the construction-related impacts are the same.

4.3.5.2 Operation-Related Impacts

The increased cut-in speed will have no effect on geology and soil resources. Therefore, the potential operation-related impacts under Alternative C are identical to those under Alternative A, and will likely be moderate. Compared to Alternative D, the operation-related impacts are the same.

4.3.6 Alternative D—No Action

4.3.6.1 Construction-Related Impacts

Construction-related impact mechanisms associated with the installation of new wind energy facilities under Alternative D will be the same as those described under Alternative A, and will likely be moderate. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. Separate project-specific evaluations could be required, and avoidance, minimization, and mitigation measures for projects would be identified based on those project-specific evaluations.

4.3.6.2 Operation-Related Impacts

Operation-related impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A, and will likely be moderate. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development.

4.4 Climate Change

As discussed in Section 3.4, there is broad scientific consensus that humans are changing the chemical composition of Earth's atmosphere through activities that result in the emission of greenhouse gases (GHGs) (U.S. Global Change Research Program 2014). The primary GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several industrial gases. Regulatory agencies have not established specific thresholds for assessment of the impacts of GHG emissions under NEPA. This section identifies the potential impacts to climate change in the study area for each of the alternatives.

4.4.1 Regulatory Context

The EPA Mandatory Reporting of Greenhouse Gases Rule (40 CFR Part 98) requires monitoring, reporting, and recordkeeping of GHG emissions from suppliers of fossil fuels and facilities that emit greater than or equal to 25,000 metric tons (about 27,600 U.S. tons) of GHG per year and greater than 30 million British thermal units per hour. As well, Council on Environmental Quality (CEQ) guidance on considering climate change under NEPA (Council on Environmental Quality, 2014) suggests 25,000 metric tons per year as a reference level above which quantification of GHG emissions from a Federal action should be considered. In the Plan Area, several states and cities have developed climate action plans or sustainability plans that aim to minimize emissions of GHGs.

4.4.2 Methods and Approach

Climate impacts are assessed in terms of the likely GHG emissions associated with wind energy projects. Impacts are assessed at a programmatic level because the characteristics of individual wind energy projects that may be proposed and implemented in the Plan Area are not known. Construction and operation impacts are discussed separately for each alternative.

4.4.3 Alternative A—Proposed MSHCP Alternative

4.4.3.1 Construction-Related Impacts

Construction of a wind energy project and other projects in the area involves the use of vehicles and equipment that generate emissions of GHGs. The vehicles and equipment typically used during each phase of construction are summarized in Air Quality Section 4.5.3.1. The potential impacts to climate change from construction-related activities under Alternative A are expected to be moderate, assuming applicable BMPs related to exhaust emissions are implemented (see Air Quality Section 4.5.3.3). Compared to Alternative D, the construction-related impacts are the same.

4.4.3.2 Operation-Related Impacts

Wind energy facilities generate very low emissions during the operation period, as discussed in Air Quality Section 4.5.3.2. The wind turbines do not produce emissions. Vehicles and equipment associated with regular site inspections as well as maintenance activities will produce exhaust emissions of GHGs. Routine testing of diesel-fueled emergency generators (typically 50 hours or fewer annually) will produce a small amount of exhaust GHGs, as might operation of heating systems

for offices and maintenance shops. The potential negative impacts to climate change from these operation-related activities under Alternative A will be minor.

To the extent that the electricity produced by wind energy projects will displace power that otherwise would have been generated by combustion of fossil fuels, the emissions of GHGs that would have been produced by fossil-fuel power plants will be avoided. The quantity of emissions actually reduced will depend on future trends in electrical demand and energy prices, and the electrical load characteristics and power plant dispatching procedures of the regional electric grid. This net reduction in GHG emissions is likely to be the largest operation-related climate effect, and could have a moderate positive impact on climate change. For example, in 2013, the United States wind energy market reduced power sector emissions by 96 million metric tons, or 4.4 percent. On average, wind generation will avoid roughly 0.6 metric ton (1,300 pounds) of CO_2 for every megawatt hour of wind generation. (American Wind Energy Association 2015)

To the extent that changes in climate in the Plan Area will include increased occurrence of severe weather, wind turbines and other project facilities potentially could be subjected to increased stress from high winds and extreme temperatures and precipitation. Project facilities will be designed to withstand predicted severe weather conditions and so are not expected to be affected by changes in the climate of the Plan Area.

Compared to Alternative D, the operation-related impacts are the same.

4.4.4 Alternative B—Reduced Permit Duration

4.4.4.1 Construction-Related Impacts

The reduced permit duration will not affect the construction process or the facilities to be constructed. Therefore, construction-related GHG emissions associated with installation of new wind energy facilities under Alternative B will be the same as those described for Alternative A, and are expected to be moderate. Compared to Alternative D, the construction-related impacts are the same.

4.4.4.2 Operation-Related Impacts

The reduced permit duration will not affect any emissions related to operations. Therefore, operation-related GHG emissions associated with new wind energy facilities under Alternative B will be the same as those described for Alternative A. Similar to Alternative A, potential effects on climate during operation will primarily result from displacement of fossil-fueled electric generation by wind energy, which will avoid the GHG emissions that would have been produced by the affected fossil-fuel power plants, and could have a moderate positive impact on climate change. Compared to Alternative D, the operation-related impacts are the same.

4.4.5 Alternative C—Increased Cut-In Speed

4.4.5.1 Construction-Related Impacts

The increased cut-in speed will not affect the construction process or the facilities to be constructed. Therefore, construction-related GHG emissions associated with installation of new wind energy facilities under Alternative C will be the same as those described for Alternative A, and are expected to be moderate. Compared to Alternative D, the construction-related impacts are the same.

4.4.5.2 Operation-Related Impacts

The increased cut-in speed will not affect any emissions directly related to operations. The increased cut-in speed will delay the start of wind turbine rotation, which could reduce slightly the amount of energy each turbine would provide. This could reduce slightly any GHG emissions decrease from the displacement of fossil-fueled electrical generation. Therefore, operation-related climate impacts associated with new wind energy facilities under Alternative C will be very similar to those described for Alternative A. Similar to Alternative A, potential effects on climate during operation will primarily result from displacement of fossil-fueled electric generation by wind energy, which will avoid the GHG emissions that would have been produced by the affected fossil-fuel power plants, and could have a moderate positive impact on climate change. Compared to Alternative D, the operation-related impacts are expected to be slightly less beneficial to reducing GHG emissions.

4.4.6 Alternative D—No Action

4.4.6.1 Construction-Related Impacts

Construction-related climate impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale because both alternatives contemplate up to 33,000 MW of new wind energy development, and are expected to be moderate.

4.4.6.2 Operation-Related Impacts

Operation-related climate impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale and magnitude because both alternatives contemplate up to 33,000 MW of new wind energy development. Similar to Alternative A, potential effects on climate during operation will primarily result from displacement of fossil-fueled electric generation by wind energy, which will avoid the GHG emissions that would have been produced by the affected fossil-fuel power plants, and could have a moderate positive impact on climate change.

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4.5 Air Quality

Many human activities cause gases and particles to be emitted into the atmosphere. When certain gases and particles accumulate in the air in high enough concentrations, they can harm humans, especially children, the elderly, asthmatics, and other sensitive individuals, and can damage crops, vegetation, buildings, and other property. To reduce air pollution levels, the Federal government and state agencies have passed legislation and established regulatory programs to control sources of emissions. This section describes the potential impacts on air quality in the study area for each of the alternatives.

4.5.1 Regulatory Context

The Clean Air Act (CAA) (42 U.S.C. § 7401 et seq.), as amended, is the primary Federal legislation that addresses air quality. The CAA requires the EPA to develop and enforce regulations to protect the public from air pollutants and their health impacts. The remainder of this section describes the major programs under the CAA relevant to the alternatives.

4.5.1.1 National Ambient Air Quality Standards

The National Ambient Air Quality Standards (NAAQS) specify the maximum acceptable ambient concentrations for six criteria air pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter up to 10 micrometers in size (PM10), particulate matter up to 2.5 micrometers in size (PM2.5), and sulfur dioxide (SO_2), as discussed in Section 3.5.2. Under CAA Sec. 172, in nonattainment and maintenance areas the state must develop a State Implementation Plan (SIP) that demonstrates how the area will reach attainment by the required date, and the SIP must be approved by EPA. A SIP includes inventories of emissions within the area and establishes emission budgets (targets) and emission control programs that are designed to bring the area into compliance with the NAAQS. In maintenance areas (former nonattainment areas that have achieved attainment), SIPs document how the state intends to maintain compliance with the NAAQS. No SIP requirement applies in attainment areas.

4.5.1.2 Hazardous Air Pollutants

The CAA requires EPA to regulate hazardous air pollutants (HAPs) through emission standards. Certain HAPs typically are associated with mobile (transportation) sources including construction equipment and motor vehicles. The most important of these HAPs are acetaldehyde, acrolein, benzene, 1,3-butadiene, ethyl benzene, formaldehyde, n-hexane, toluene, and xylene.

4.5.1.3 General Conformity Rule

The EPA General Conformity Rule (40 CFR Part 93, Subpart B) prohibits Federal entities from taking actions in nonattainment or maintenance areas that do not conform to the SIPs for those areas. The rule establishes emissions thresholds, known as de minimis levels, for use in evaluating the conformity of a project. For a project that is subject to conformity, if the net emission increases due to a project would be less than these thresholds, the project is presumed to conform and no further conformity evaluation is necessary. If the net emissions increases exceed any of these thresholds, a conformity determination is required. The conformity determination can entail air quality modeling

studies, consultation with the EPA and state air quality agencies, and commitments to revise the SIP or to implement measures to mitigate air quality impacts.

4.5.1.4 Prevention of Significant Deterioration

The Prevention of Significant Deterioration (PSD) program protects certain lands designated as mandatory Federal Class I areas because air quality is a special feature of the area. EPA has designated all other areas in the U.S. as Class II. In general, if a new major stationary source is located within 62 miles (100 km) of a Class I area, its impacts on concentrations of criteria pollutants in the Class I area must be determined. Impacts are compared to the PSD increments, which are concentration thresholds issued by EPA and used in permitting major stationary emissions sources in attainment areas. PSD increments are designed to prevent air quality that is better than the NAAQS from deteriorating to the level set by the standards and thus they are more restrictive than the NAAQS. The allowable increments are very small in Class I areas, and moderate in Class II areas. In addition to criteria pollutant concentrations, damage to plants and ecosystems from ozone and PM2.5, visibility or regional haze, and acidic deposition are of concern in Class I areas.

4.5.1.5 Visibility

Visibility impacts occur when emissions absorb and scatter light in the atmosphere, causing haze and reducing the clarity of views. Regional haze impairs visibility and is produced by emissions from numerous sources located across broad geographic areas. Regional haze is made up of directly emitted PM2.5 and secondary PM2.5, which is formed in the atmosphere from chemical reactions of fine particle precursors. PM2.5 precursors include emissions of SO2 and other sulfur oxides (SOx), nitrogen oxides (NOx), ammonia, and Volatile Organic Compounds (VOCs). The most important secondary PM2.5 particles for visibility impairment are sulfates and nitrates, which are formed from emissions of SOx and NOx, respectively. Visibility is measured over 24-hour periods and calculated as a percent increase in light extinction (reduced visibility) compared to a presumed pristine background. EPA regulates visibility under the PSD program and the Regional Haze Regulations (40 CFR Part 51.300 et seq.).

4.5.1.6 Regional Haze Rule

The EPA Regional Haze Rule (Section 169A of CAA, 40 CFR. Parts 51 and 52) sets goals for visibility in many national parks, wilderness areas, and international parks and provides a comprehensive visibility protection program for mandatory Federal Class I areas. The visibility improvement goal stated in the rule is to ensure that in Class I areas, visibility on the worst days improves toward natural conditions, and visibility on the best days does not get worse. The Regional Haze Rule requires states with impaired visibility to develop SIPs to address emissions that contribute to regional haze.

4.5.1.7 Acidic Deposition

Acidic deposition occurs when nitrates and sulfates formed in the atmosphere are deposited to soil, vegetation, and surface water. Acid deposition to lakes can impair water quality by reducing their acid-neutralizing capacity. To assess lake acidification, Federal land management agencies apply thresholds based on guidance from the U.S. Forest Service and other agencies.

4.5.1.8 Air Quality Permit Requirements and Emission Standards

Each of the states in the Plan Area regulates air quality by means of permitting and other programs and may implement certain EPA regulations as well. Stationary emission sources (e.g., industrial plants) must obtain air quality permits from the state air quality agency whether they are located in attainment or nonattainment areas. In order to be granted the permit the facility must demonstrate that its emissions will not cause or contribute to a violation of the NAAQS, and that certain stationary sources meet emissions limits specified in EPA New Source Performance Standards (40 CFR Part 60). There is no such permit requirement for mobile sources such as construction equipment and motor vehicles. The regulations that define the air quality programs of each state are the following:

- Illinois Environmental Protection Agency – 35 IAC Subtitle B
- Indiana Department of Environmental Management – 326 IAC 1-26
- Iowa Department of Natural Resources – 567 IAC 20-34
- Michigan Department of Environmental Quality – MAC R.325, 326
- Minnesota Air Pollution Control Agency – MAR 7001-7027
- Missouri Department of Natural Resources – 10 CSR 10
- Ohio Environmental Protection Agency – 3745 OAC 14-26, 31, 71-80, 100-105, 108, 109, 112-114
- Wisconsin Department of Natural Resources – NR 400-499

4.5.2 Methods and Approach

Air quality impacts are assessed in terms of the likely direct and indirect emissions associated with wind energy projects. Impacts are assessed at a programmatic level because the characteristics of individual wind energy projects that may be proposed and implemented in the Plan Area are not known. Each stage of the project life cycle is considered separately including site characterization, construction, operation, and decommissioning. Any anticipated instances where these emissions could lead to a violation of an AAQS are identified. The analysis describes typical air quality BMPs that are implemented to reduce the adverse effects of emissions.

4.5.3 Alternative A—Proposed MSHCP Alternative

4.5.3.1 Construction-Related Impacts

Construction of a wind energy project will involve the use of vehicles and equipment that will generate emissions of air pollutants. Because a wind energy project typically comprises a number of small, dispersed sites, construction will be short-term at any one location. Emissions will occur intermittently depending on the work schedule and the specific equipment in use on any particular day. Construction emissions are likely to be minor to moderate and not likely to cause a violation of ambient air quality standards or have a substantial impact on long-term air quality in the region. Construction proceeds in a number of steps or phases. The vehicles and equipment typically used during each phase are summarized below.

Site characterization activities are carried out prior to construction and primarily involve meteorological data collection and subsurface soil sampling. Light and medium duty trucks will be used to transport meteorological towers to the site and erect them, and to transport augurs or drilling rigs mounted on trailers to the soil sampling locations. Emissions associated with these activities will consist of criteria pollutants, VOCs, and HAPs from engine exhaust, and fugitive particulate matter (dust). Site characterization activities will be of short duration and require minimum site disturbances by a small crew having relatively little heavy equipment. Potential air quality impacts of site characterization activities should be much less than those of construction or decommissioning activities.

Typical construction activities involve a number of separate operations, including mobilization/staging, access road and staging/laydown area construction, grubbing/land clearing, topsoil stripping, earthmoving, grading, ground excavation, drilling, foundations, wind turbine erection, ancillary structure erection, digging trenches for underground electrical cables, electrical and mechanical installation, and landscaping. The equipment used in the site preparation phase include chainsaws, chippers, dozers, scrapers, graders, end loaders, trucks, and rock drills. Equipment used in the general construction phase include cranes, loaders, backhoes, dozers, heavy trucks, and trenchers. Smaller equipment such as mixers, vibrators/compactors, and concrete pumps also will be used. Tower structures will be carried to the site in sections by truck, assembled in laydown areas, and lifted into place with a crane. In remote or environmentally sensitive areas, helicopters might be used for tower transport and erection. Construction of transmission lines needed to connect new wind energy development projects to the nearest regional grid will involve phases and equipment similar to those of general construction.

Construction activities generate criteria pollutants, VOCs, and HAPs from engine exhaust, and fugitive dust from disturbed earth surfaces. Typically, the greatest potential for emissions and adverse air quality impacts occurs during the site preparation phase when soil disturbance and earthwork is greatest, producing fugitive dust, and the intense use of heavy equipment over a short time period produces relatively high exhaust emissions.

In more remote areas, if the required quantities of concrete are not available from local vendors, a temporary concrete batch plant might be needed. Concrete batch plants generate exhaust and fugitive dust emissions and are subject to the air quality permitting requirements of the state air quality agency.

Decommissioning includes dismantling the towers and their support facilities, disposal of debris, and restoration and revegetation of the sites. Belowground structures, such as turbine foundations and electrical cables, probably will not be removed but will be abandoned in place. Decommissioning activities are similar to construction activities but on a lesser scale and for a shorter duration. Potential impacts on ambient air quality should be correspondingly less than those for construction activities.

The potential impacts to air quality from construction-related activities under Alternative A are expected to be minor, assuming applicable BMPs are implemented (see Section 4.5.3.3). If BMPs are not implemented, the potential impacts to air quality from construction-related activities under Alternative A will be moderate.

Compared to Alternative D, the construction-related impacts are the same.

4.5.3.2 Operation-Related Impacts

Wind energy facilities generate very low emissions during the operation period. The wind turbines do not produce emissions. Vehicles and equipment associated with regular site inspections as well as maintenance activities produce exhaust emissions of criteria pollutants, VOCs, and HAPs. Movement of vehicles and equipment used for inspections and maintenance generates small amounts of fugitive dust. Application of lubricants and greases during routine maintenance could emit very small quantities of VOCs. Routine testing of diesel-fueled emergency generators (typically 50 hours or fewer annually) produces a small amount of exhaust emissions, as might operation of heating systems for offices and maintenance shops. These emissions are likely to be minor and not likely to cause a violation of ambient air quality standards or have a substantial impact on long-term air quality in the region.

To the extent that the electricity produced by wind energy projects displaces power that otherwise would have been generated by combustion of fossil fuels, the emissions of criteria pollutants, VOCs, and HAPs that would have been produced by fossil-fuel power plants will be avoided. This net reduction in emissions is likely to be the largest operation-related air quality impact, and could have a positive effect on ambient air quality, visibility, and acid deposition in the Plan Area. The quantity of emissions actually reduced depends on future trends in electrical demand and energy prices, and the electrical load characteristics and power plant dispatching procedures of the regional electric grid.

The potential impacts to air quality from operation-related activities under Alternative A will be minor. Compared to Alternative D, the operation-related impacts are the same.

4.5.3.3 Best Management Practices

BMPs are recommended to minimize potential air quality impacts. The following are common BMPs that may be applicable to construction and decommissioning depending on the activity and the equipment being used. These practices are often required by state air quality agencies and local jurisdictions to minimize air quality impacts.

Measures to Minimize Generation of Fugitive Dust

1. Develop and implement a fugitive dust control plan.
2. Pave, gravel, or otherwise stabilize the surfaces of access roads, on-site roads, and parking lots.
3. Post and enforce speed limits on unpaved access roads.
4. Stage construction activities to limit the area of disturbed soils exposed at any one time.
5. Apply water or dust palliatives to access roads, on-site roads, and parking lots as necessary during high wind conditions.
6. Water earth surfaces disturbed or exposed during project activities as necessary.
7. Stabilize soil stockpiles by watering, covering, treating with dust suppressants, or vegetating, particularly for stockpiles that will be inactive for long periods.
8. Install wind fences around disturbed areas if windborne dust is likely to affect sensitive areas beyond the site boundaries (e.g., nearby residences).
9. Cover vehicles transporting loose materials.

10. Inspect and clean dirt from construction-related vehicles, as necessary, at site exits to public roadways.
11. Remove visible trackout or runoff dirt from the construction site off public roadways (e.g., using street vacuum sweeping).

Measures to Minimize Exhaust Emissions

1. Ensure that all equipment and vehicles are maintained regularly to meet manufacturer specifications to achieve efficient combustion and minimum emissions. This may include retrofitting engines with an exhaust filtration device to capture diesel particulate matter before it enters the construction site, or using catalytic converters to reduce carbon monoxide, aldehydes, and hydrocarbons in diesel fumes.
2. Ensure that all diesel engines are properly fueled (*i.e.,* ultra-low sulfur diesel with a maximum 15 ppm sulfur content).
3. Limit idling of engines to no more than 5 minutes unless necessary for proper operation.
4. Where feasible, use electric rather than engine-powered equipment. This may include using electric starting aids (such as block heaters) to warm engines.
5. Develop and implement a traffic management plan for traffic both on- and off-site.
6. Where offsite traffic congestion is a concern, limit use of construction vehicles and workers' personal vehicles on public roads during commuting hours.
7. Where offsite traffic congestion is a concern, or to limit vehicle volumes traveling to sites that are remote from staging areas, require workers to park in designated areas and provide buses to construction sites.

4.5.4 Alternative B—Reduced Permit Duration

4.5.4.1 Construction-Related Impacts

The reduced permit duration will not affect the construction process or the facilities to be constructed. Therefore, construction-related air quality impacts associated with installation of new wind energy facilities under Alternative B will be the same as those described for Alternative A. The potential impacts to air quality from construction-related activities are expected to be minor, assuming applicable BMPs are implemented (see Section 4.5.3.3). If BMPs are not implemented, the potential impacts to air quality from construction-related activities will be moderate. Compared to Alternative D, the construction-related impacts are the same.

4.5.4.2 Operation-Related Impacts

The reduced permit duration will not affect any emissions related to operations. Therefore, operations-related air quality impacts associated with new wind energy facilities under Alternative B will be the same as those described for Alternative A. The potential impacts to air quality from operation-related activities will be minor. Compared to Alternative D, the operation-related impacts are the same.

4.5.5 Alternative C—Increased Cut-In Speed

4.5.5.1 Construction-Related Impacts

The increased cut-in speed will not affect the construction process or the facilities to be constructed. Therefore, construction-related air quality impacts associated with installation of new wind energy facilities under Alternative C will be the same as those described for Alternative A. The potential impacts to air quality from construction-related activities are expected to be minor, assuming applicable BMPs are implemented (see Section 4.5.3.3). If BMPs are not implemented, the potential impacts to air quality from construction-related activities will be moderate. Compared to Alternative D, the construction-related impacts are the same.

4.5.5.2 Operation-Related Impacts

The increased cut-in speed will not affect any emissions directly related to operations. The increased cut-in speed would delay the start of wind turbine rotation, which could reduce slightly the amount of energy each turbine would provide. This could reduce slightly any emissions decrease from the displacement of fossil-fueled electrical generation as discussed in Section 4.5.3.2. Therefore, operation-related air quality impacts associated with new wind energy facilities under Alternative C will be similar to those described for Alternative A. The potential impacts to air quality from operation-related activities will be minor. Compared to Alternative D, the operation-related impacts are expected to be less beneficial, because there will be a lesser reduction in emissions from the displacement of fossil-fuel electrical generation.

4.5.6 Alternative D—No Action

4.5.6.1 Construction-Related Impacts

Under Alternative D, potential effects on air quality during construction will result from ground-disturbing activities and from exhaust emissions from equipment and vehicles.

Construction-related air quality impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. The potential impacts to air quality from construction-related activities are expected to be minor, assuming applicable BMPs are implemented (see Section 4.5.3.3). If BMPs are not implemented, the potential impacts to air quality from construction-related activities will be moderate.

4.5.6.2 Operation-Related Impacts

Operation-related air quality impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), those impacts will be comparable in scale and magnitude because both alternatives contemplate up to 33,000 MW of new wind energy development. Similar to Alternative A, potential effects on air quality during operation

will primarily result from displacement of fossil-fueled electric generation by wind energy, which will avoid the emissions that would have been produced by the affected fossil-fuel power plants. The potential impacts to air quality from operation-related activities will be minor.

4.6 Noise

The noise effects of Wind Turbine Generators (WTGs) on humans have been studied extensively in the U.S. and in Europe. Analysis of WTG noise is localized and site specific, with study areas on the order of a few thousand feet from proposed WTG locations.

Individual WTGs produce varying amounts of noise depending on their size (energy output). WTG manufacturers publish sound power level data for their turbine models which in turn can be used to calculate sound pressure level (*i.e.,* noise level) at various distances away from the WTG. WTG noise can add cumulatively for windfarms where there are multiple WTGs, depending how far the turbines are spaced apart from each other. The sound of a WTG can be perceived as a pulsating sound associated with the turbine blade turbulence. In addition, very low frequency sound due to the relatively slow blade passage frequency can be annoying and easily penetrate buildings depending on WTG proximity.

WTG noise impacts are also highly dependent upon existing ambient noise levels. If ambient noise levels are high, WTG noise can be masked. WTG noise becomes increasingly more audible the lower the ambient noise level.

For the proposed project, the noise study area is comprised of the eight states within the Plan Area, including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. This section describes the potential noise impacts in the study area for each of the alternatives.

4.6.1 Regulatory Context

WTG noise effects are analyzed both on the basis of absolute noise level impacts and relative noise impacts with respect to existing ambient noise levels. Many states and local jurisdictions have property line-based noise level limits set for daytime and nighttime, with lower nighttime noise limits to account for people's increased sensitivity at night. Such property-line noise level limits are often expressed as a single value in terms of A-weighted decibels (dBA).However, the exact manner in which this is handled varies by jurisdiction. For example, the state of Illinois employs frequency-based (octave frequency bands) property line limits for both daytime and nighttime hours.

EPA has also evaluated general public response to changes in noise levels (*i.e.,* relative noise impacts) (U.S. Environmental Protection Agency, 1974). In general, an increase above existing ambient noise levels of 5 dB would be noticeable to most people and would be expected to elicit widespread complaints. An increase of 20 dB would be expected to result in vigorous community response. An increase of ambient noise levels of less than 3 dBA is generally considered insignificant.

4.6.2 Methods and Approach

Potential noise impacts are assessed at a programmatic level because the characteristics of individual wind energy projects that may be proposed and implemented in the Plan Area are not known. A noise screening approach was used to inform the noise impact assessment. The screening approach is described in more detail in Appendix D.

Potential construction noise impacts were assessed for typical construction equipment operating on a construction site. Operational noise impacts were assessed for one of the randomly generated

WTG build-out scenarios (see Section 4.0 for a discussion of the MSHCP Build-Out Model). The noise impacts from one WTG in operation were calculated and then described in relationship to a wind farm or multiple WTGs, and an entire build-out scenario. Operational noise impacts are assessed in terms of whether or not operations will conflict with Federal, state, and local ordinances.

4.6.3 Alternative A—Proposed MSHCP Alternative

4.6.3.1 Construction Noise

Construction noise was evaluated for typical construction equipment operating on a construction site. Typical construction equipment was assumed to be used (see Table 4.6-1 [Federal Highway Administration 2006]). For purposes of analysis, it was assumed that the primary sources of noise during these activities will be truck and vehicle traffic, heavy earth-moving equipment, and other construction equipment or infrastructure powered by internal combustion engines used on site.

Construction noise will cause a temporary and short-term increase to the ambient sound environment within the affected area. Workers associated with construction activities will be expected to wear appropriate hearing protection as required by the Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910.95).

Table 4.6-1. Maximum Noise Levels at 50 Feet for Common Construction Equipment

Equipment Type	Maximum Noise Level (Lmax) at 50 feet (dBA, slow)
Compactor (ground)	80
Dozer	85
Dump Truck	84
Excavator	85
Generator	82
Grader	85
Pickup Truck	55
Warning Horn	85
Crane	85

dBA = A-weighted decibels; L_{max} = maximum noise level.

The potential noise impacts from construction activities under Alternative A are expected to be minor in the long-term, but could be moderate or substantial in the short-term depending on the project details such as location and number of WTGs. Compared to Alternative D, the construction-related impacts are the same.

4.6.3.2 WTG Operational Noise

For assessing potential noise impacts from an individual WTG, the following conditions indicate noise impacts:

- Predicted WTG noise levels exceeding local noise ordinance nighttime or daytime noise level limits at noise sensitive locations (e.g., residences) and/or at property lines.
- Predicted WTG noise levels exceeding ambient noise levels by 10 dBA or more at noise sensitive locations.

Appendix D includes a screening analysis to show the likelihood of WTG noise impacts in the Plan Area, based on estimated ambient noise levels in the Plan Area and a sample projected build-out scenario. The conclusions of this analysis are as follows:

- WTG noise impacts are likely to occur in less than half of the modeled build-out scenario, assuming the construction of 1 WTG within each build-out area[42]. This percentage will increase commensurately with the construction of windfarms or multiple WTGs.
- WTG noise will be noticeable in all build-out areas.
- The estimated number of homes impacted (273) is relatively small considering the large eight-state study area. However, this value will increase commensurately with the construction of multiple WTGs.

This analysis also reveals the tradeoffs between siting WTGs in rural versus more densely populated areas. WTG sites in rural areas by definition will affect fewer homes but WTG noise could be heard for greater distances due to lower ambient noise levels. Conversely, WTG sites in more densely populated areas may impact more homes, but higher ambient noise levels may mask WTG noise. These complications show why detailed local noise studies are required for specific WTG siting.

Potential noise impacts due to WTG operations could be substantial depending on the exact siting and layout of WTGs relative to residential and other noise sensitive areas. Site-specific noise studies will be needed to address both absolute and relative (*i.e.,* ambient noise level based) operational noise impacts.

To predict the noise level at receptor locations from a known power level, sound propagation mechanisms by which noise reaches our ears from a source should be considered. Because of inhomogeneities (not uniform in nature) in the atmosphere, there will be a multitude of variations in the noise transmission paths, which result in a wide fluctuation in sound level at the listener's ears. Several important factors affecting the propagation of sound in the outdoor environment include (Anderson and Kurze 1992):

- Source characteristics, such as sound spectrum (sound power as a function of frequency), directivity, and configuration;
- Geometric spreading as the sound moves away from the source, which does not depend on frequency, and 6- and 3-dB reductions per doubling of distance from point (e.g., fixed equipment) and line (e.g., road traffic) sources, respectively;
- Air absorption, which depends strongly on frequency (e.g., low frequencies are not well attenuated by air absorption) and relative humidity;

[42] A build-out scenario consists of several build-out areas or squares.

- Ground effects, which include absorption and reflection of sound on the ground, depending on source/receptor height, intervening land cover, ground acoustical properties, incoming frequencies, etc.; the sound reflected by the ground can constructively or destructively interfere with direct sound;
- Meteorological effects due to turbulence and variations in vertical wind speed and temperature; and
- Screening effects by topography, structures, dense vegetation, and other natural or man-made barriers.

Among the factors listed above, meteorological effects along with geometric spreading are likely the most important in noise propagation for wind turbine analysis. Other effects will be minimal: ground effects due to the relatively high elevation of noise sources (around 330 feet [100 meters] tall for a utility-scale wind turbine); air absorption due to low frequency ranges; and screening effects due to the turbine's location in wide-open flat terrain or rolling hills. Because of surface friction, wind speed increases with height, which will bend the path of sound to "focus" it on the downwind side and make a "shadow" on the upwind side of the source ("wind gradient effects"). On a clear night, temperature increases with height due to radiative cooling of surface air; this is called the "nocturnal temperature inversion." Another type of inversion occurs when cold air underlies warmer air during the passage of a cold front or invasions of a cooler onshore sea/lake breeze. This temperature inversion could focus sound on the ground surface ("temperature gradient effects"), with effects exerted uniformly in all directions from the source. During clear nights, both wind and temperature gradient effects occur frequently, allowing noise from the wind turbine to bend toward the ground and potentially impact the neighboring communities, which currently have relatively lower background levels.

Terrain features may affect wind turbine noise impacts. For example, wind turbines located on ridges and hills where relatively high wind speeds prevail can disturb residences that are positioned in a deep valley or sheltered from the wind in other ways, since the noise from the turbines cannot be masked. Valleys can sometimes serve as natural channels for noise propagation, allowing turbine noise to be heard as being louder than it otherwise will be on flat terrain.

A refined noise analysis will employ a sound propagation model that integrates most of the sound attenuation mechanisms noted above, along with detailed source-, receptor-, and site-specific data. In many screening applications, however, geometric spreading with or without other effects (e.g., air absorption or ground effects) is considered when predicting noise levels.

Compared to Alternative D, the operation-related impacts are the same.

4.6.4 Alternative B—Reduced Permit Duration

The reduced permit duration will not affect the construction process or the facilities to be constructed. The reduced permit duration will not affect noise impacts related to operations. Therefore, both construction-related and operations-related noise impacts associated with new wind energy facilities under Alternative B will be the same as those described for Alternative A. The potential noise impacts from construction activities under are expected to be minor in the long-term, but could be moderate or substantial in the short-term depending on the project details such as location and number of WTGs. Potential noise impacts due to WTG operations could be substantial depending on the exact siting and layout of WTGs relative to residential and other noise

sensitive areas. Compared to Alternative D, the construction-related impacts and operation-related impacts are the same.

4.6.5 Alternative C—Increased Cut-In Speed

The increased cut-in speed will not affect the construction process or the facilities to be constructed. Therefore temporary construction noise impacts under Alternative C will be the same as those described under Alternative A. The potential noise impacts from construction activities under are expected to be minor in the long-term, but could be moderate or substantial in the short-term depending on the project details such as location and number of WTGs

Operations-related noise levels could be reduced in Alternative C by virtue of some WTG's being non-operational under certain low wind speed conditions. However, site-specific noise studies will be needed to determine these effects since WTG noise levels are directly related to blade tip speed. In addition, in general, ambient noise levels are increased during times of higher wind speeds, which would mask the overall impact of WTG noise. Potential noise impacts due to WTG operations could be moderate to substantial depending on the exact siting and layout of WTGs relative to residential and other noise sensitive areas.

Compared to Alternative D, the construction-related impacts and operation-related impacts are the same.

4.6.6 Alternative D—No Action

Under Alternative D, wind energy development will not be constructed under the MSHCP but would still occur as independent projects that will need to comply with project specific noise assessment requirements. Noise impacts resulting from the construction and operation of new wind energy facilities under Alternative D will be similar to those described in more detail under Alternative A. Because new wind energy development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the location of these impacts may not be the same. The potential noise impacts from construction activities under are expected to be minor in the long-term, but could be moderate or substantial in the short-term depending on the project details such as location and number of WTGs. Potential noise impacts due to WTG operations could be substantial depending on the exact siting and layout of WTGs relative to residential and other noise sensitive areas.

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4.7 Visual Resources

Visual resources are all objects (human-made and natural, moving and stationary) and features (e.g., landforms and waterbodies) visible on a landscape. These resources add to or detract from the scenic quality of the landscape (*i.e.,* the visual appeal of the landscape). A visual impact is the creation of an intrusion or perceptible contrast that affects the scenic quality of a 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/seasonal conditions).

For the proposed project, the study area of visual effect (AVE) is comprised of the eight states within the Plan Area including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. This section describes the potential impacts on visual resources in the study area for each of the alternatives.

4.7.1 Regulatory Context

This section provides the regulatory framework for Federal lands, and state and local lands. In Section 3.7, Table 3.7-1 identifies the federally protected sensitive visual resources affected by the proposed project, and Table 3.7-2 identifies the state resources. In addition, other visual resources protected at the state and local levels that are not included in these tables could be affected by the proposed project.

4.7.1.1 Federal Lands

National Park Service Lands

National Park Service lands include National Heritage and Historic Sites/Areas, National Lakeshores, National Memorials and Monuments, National Parks, National Scenic Areas, and National Trails. Visual resources associated with these lands are protected by Federal laws, such as the Scenic Area Act (16 U.S.C. § 544) and the National Trails System Act (16 U.S.C. § 1241 et seq.), and these lands may be managed by the National Park Service or by commissions that have been developed to oversee their land management. Management plans are developed for these areas to protect associated resources, including visual resources.

National Scenic Byways Program

Under the National Scenic Byways Program, implemented by the Federal Highway Administration, roadways are designated as National Scenic Byways or All-American Roads based upon their scenic, historic, recreational, cultural, archaeological, and/or natural intrinsic qualities. A road must significantly meet criteria for at least one of the above six intrinsic qualities to be designated a National Scenic Byway. For the All-American Roads designation, criteria must be met for multiple intrinsic qualities. Additionally, there must be a local commitment "provided by communities along the scenic byway that they would undertake actions, such as zoning and other protective measures, to preserve the scenic, historic, recreational, cultural, archaeological, and natural integrity of the scenic byway and the adjacent area as identified in the corridor management plan." In addition, new signs cannot be erected if they are not in conformance with 23 U.S.C. 131(c) along any highway that

has been designated as a scenic byway under the state's scenic byway program and includes highways that are designated scenic byways under the National Scenic Byways Program and All-American Roads Program, whether or not they are designated as state scenic byways (Federal Highway Administration 1995.)

If these roadways no longer possess the intrinsic qualities that supported their designation, local commitment has failed to retain these intrinsic qualities, or if the roadways are not maintained in accordance with their corridor management plan, they can be de-designated.

While governed for their scenic qualities by the Federal Highway Administration as described above, these designated byways fall under jurisdiction of the local county, state, or U.S. Forest Service (USFS) (if on Forest Service lands) and are, therefore, primarily protected under those jurisdictions.

National Forests

USFS-managed lands are scattered throughout the AVE and could be affected by all action alternatives. USFS is required to protect the scenic value of the public lands under its management and uses the older Visual Management System (VMS) Visual Quality Objectives (VQOs) and the more recent Scenery Management System (SMS) Scenic Integrity Objectives (SIOs), depending on the forest. Individual forest land and resource management plans identify the VQOs or SIOs specified for each management area. In addition, forest plans may identify and protect special places of visual interest or scenic byways, rivers, or trails that occur on USFS lands.

National Wild and Scenic Rivers

The Wild and Scenic Rivers Act (16 U.S.C. §§ 1271 et seq.) establishes a National Wild and Scenic Rivers System for the protection of rivers with important scenic, recreational, fish and wildlife, and other values. Rivers are classified as wild, scenic, or recreational. The Wild and Scenic Rivers Act designates specific rivers for inclusion in the System and prescribes the methods and standards by which additional rivers may be added. Designation by the Secretary of the Interior may occur at the request of the state governor when the river is already protected under that state's wild and scenic rivers preservation act (U.S. Fish and Wildlife Service, 2007: pp. 1). Local plans are developed to serve as the management plan that satisfies the requirements of the Wild and Scenic Rivers Act (Sec. 1274b-2).

Wildlife Refuges

Comprehensive Conservation Plans (CCPs) are developed by every refuge, as required by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. § 668dd). Local communities, volunteers and friends of refuges, state conservation agencies, and other stakeholders participate in development of each CCP that guides refuge management (U.S. Fish & Wildlife Service 2012). Some CCPs may have goals and objectives that directly relate to the protection of visual resources. However, all CCPs have goals and objectives that indirectly relate to visual resources because they protect and maintain natural habitat areas that are accessed by recreationists visiting the refuge.

Bureau of Land Management Lands

The Bureau of Land Management (BLM) administers lands scattered throughout the AVE that could be affected by all action alternatives. The BLM is required to protect the scenic value of the public lands under its management. The BLM uses its Visual Resource Management (VRM) system to

inventory, analyze, and manage those resources. VRM mapping covers BLM lands and can range from the landscape scale to site-specific mapping. The BLM field offices develop Resource Management Plans for their associated lands that include VRM objectives to protect visual resources.

4.7.1.2 State and Local Lands

Siting authority for wind energy projects varies from state to state. In some cases, a state agency has primary siting authority while in other states local governments are the main siting authority for wind energy projects, doing so through local land use and zoning ordinances (American Wind Energy Association, 2008). Siting regulations may require setbacks from property lines and residential structures, as well as compatibility with county land use plans and zoning ordinances. State and local jurisdictions also have regulations and policy documents, such as management plans, to oversee land management and to protect associated resources, including visual resources, for state and local historic sites/areas, forests, nature preserves/wildlife refuges, parks/recreational areas, trails, scenic byways/roadways, and wild and scenic rivers.

4.7.2 Methods and Approach

Visual resource impacts are assessed in terms of whether or not the alternatives will conflict with Federal, state, and local ordinances and regulations or if the alternatives will substantially alter visual resources. Impacts are assessed at a programmatic level because the characteristics of individual wind energy projects that may be proposed and implemented in the Plan Area are not known. When assessing visual resource impacts, the following conditions will adversely affect visual resources:

- Substantial degradation of the visual character or scenic quality of a visually important landscape on state or Federal lands.
- Substantial dominant visual changes in the landscape that are seen at highly sensitive viewer locations such as community enhancement areas (community gateways, roadside parks, viewpoints, and historic markers) or locations with special scenic, historic, recreation, cultural, archaeological, or natural qualities that have been recognized as such through legislation or some other official declaration.
- Unresolved conflict with visual standards identified by a Federal land management agency (e.g., USFS, BLM, National Park Service).
- Substantial increase in light and glare or shadow flicker in the study area.
- Long-term adverse visual changes or contrasts to the existing landscape as viewed from areas with high visual sensitivity.

4.7.3 Alternative A—Proposed MSHCP Alternative

4.7.3.1 Construction-Related Impacts

Temporary Visual Impacts

Construction of new wind energy development associated with Alternative A will create temporary changes in views of and from affected locations within the AVE (including Federal, state, local, and

private lands) over the course of 15 years to construct up to 33,000 MW of new wind energy capacity. Construction activities may create views of heavy equipment and associated vehicles into the viewshed of sensitive receptors, recreation areas, scenic byways, and from other sensitive visual resources. Construction will also require crane pads, laydown areas for offloading turbine components, and, likely, concrete batch plants. Nearby residences, recreationists using the recreation areas and trails, and employees of nearby businesses will be the principal viewer groups. While motorists in the area will be moderately sensitive to changes in views, they have intermittent and short-term visual access to affected areas as they are passing by, and so are not likely to be adversely affected by temporary construction activities.

Residents are considered highly sensitive viewers and could be adversely affected by construction activities because they will have prolonged views of construction activities and may not be accustomed to construction activities in the area. Recreationists are also considered highly sensitive to views of construction activity because they could have prolonged views when using regional trails or spending periods of time at recreational sites, such as when camping; they value the views from these recreation areas; and they will not be accustomed to construction activities in the area. Employees of businesses are likely to be less affected by construction activities because they should be mostly focused on their work rather than construction activities, although construction activities are likely to be visible from businesses.

The potential visual resource impacts from construction-related activities under Alternative A are expected to be moderate but temporary, and could be minor if the recommended Mitigation Measure VIS-1 is implemented (see Appendix E). Compared to Alternative D, the construction-related impacts are expected to be less if the recommended mitigation measures are implemented, but will be the same if the recommended mitigation measures are not implemented.

4.7.3.2 Operation-Related Impacts

Visual Character and Scenic Quality

Substantial degradation of the visual character or scenic quality of a visually important landscape will occur where dominant visual changes take place in the landscape that are seen from highly sensitive viewer locations, such as from community enhancement areas (community gateways, roadside parks, viewpoints, and historic markers) or locations with special scenic, historic, recreation, cultural, archaeological, or natural qualities that have been recognized as such through Federal, state, or local legislation or some other official declaration. Wind energy development under the MSHCP could adversely affect sensitive visual resources by altering the quality of views from places such as national forests, scenic byways, state parks, and scenic rivers.

Strings of turbines, power lines, transformers, access roads, and substations will be the most visually distinct artificial features introduced as part of the approved wind energy development under the MSHCP that will be visible within the AVE. Turbines will introduce tall, human-made industrial-looking structures that tower over the surrounding landscape that will attract viewers' attention toward them in both flat and hillier landscapes because the eye will be drawn toward these tall vertical features.

The movement and sound of the blades spinning will also act to draw attention toward wind fields. Wind energy developments act to clutter views with the numerous, prominent turbines that will stick up across the landscape, back-dropped against the sky, interrupting existing horizon lines and scenic vistas. In addition, the effects of vegetation removal will be visible and access roads,

transmission lines, substations, and other associated infrastructure are likely to be visible, depending upon location. This existing visual character and quality of views from unprotected landscapes will be affected in the same manner. Operation of wind energy facilities under the MSHCP will primarily be visible to recreationists, area residents, motorists, and businesses' workers and patrons.

In addition to direct physical changes to the visual environment resulting from construction and operation of wind energy facilities, indirect visual effects could result from the MSHCP potentially setting a precedent for other development, wind-related or otherwise, to occur. The primary contributor to indirect impacts on visual resources will be from changes to development that might result indirectly from the project. All of these effects will alter the visual character and scenic quality of the AVE's existing visual landscape. Site restoration following decommissioning should aid in restoring the visual environment at those locations after operations cease.

The potential impacts to visual character and scenic quality from operation-related activities under Alternative A could be substantial, depending on the siting and location of sensitive viewers in the area. However, compared to Alternative D, the impacts may be less intrusive on visual character and scenic quality, as a result of the areas of importance that are excluded from Covered Lands (e.g., land within 3 miles of the shores of the Great Lakes; land within 1 mile of the edges of major rivers supporting bird migration corridors and/or concentrations of wintering waterfowl; land within floodplain areas along the Mississippi and Illinois Rivers). Further, implementation of recommended Mitigation Measures VIS-2 through VIS-4 should lessen visual impacts to the existing visual character and scenic quality of views within the AVE (see Appendix E).

Federal Lands

The potential impacts to Federal lands from operation-related activities under Alternative A could be substantial, depending on the siting and location of Federal lands and the associated sensitive viewers in the area. However, implementation of recommended Mitigation Measures VIS-1 through VIS-6 should lessen visual impacts within the AVE (see Appendix E). Mitigation Measure VIS-2 should ensure that early coordination occurs with the operating agencies of sensitive visual resource areas, including Federal land agencies. Mitigation Measures VIS-1 and VIS-3 through VIS-6 should reduce visual impacts upon Federal lands for better compliance with their visual resource management objectives.

Light, Glare, and Shadow Flicker

Wind turbines and meteorological towers will likely require FAA lighting. This could affect daytime and nighttime views in the AVE depending on the amount of FAA-required lighting. Buildings and new substations or existing substations that will be reconstructed or expanded will be lighted for safety and security. Lighting could include interior lighting and light-emitting diode (LED) lighting for security purposes that could affect sensitive receptors if not properly designed. This is because LED lights can adversely affect humans by increasing nuisance light and glare, in addition to increasing ambient light glow, if proper shielding is not provided and blue-rich white light lamps are used (International Dark-Sky Association 2010a, 2010b, 2015). This will result in a substantial source of nighttime light and glare that could adversely affect nighttime views in the area.

Generally, turbines are painted white, and installing wind energy facilities in areas where no turbines exist could create a new source of substantial glare. Project-specific elements could

increase reflective glare if exposed surfaces are not treated properly, and this could create a new source of substantial light and glare in the AVE that will affect daytime or nighttime views.

The potential impacts of light and glare from operation-related activities under Alternative A could be moderate to substantial, depending on the siting of the turbines and location of sensitive viewers in the area. If implemented, Mitigation Measure VIS-5 should lessen light and glare impacts caused by project lighting. In addition to improving aesthetics, Mitigation Measure VIS-2 should serve to lessen light and glare impacts caused by project lighting by using glare-reducing colors and surfaces and by implementing measures to reduce vegetation clearing and by contributing to vegetation plantings.

Generally, the potential for shadow flicker is expected to be low for sensitive receptors that are located distances that are greater than the diameter of 10 rotors away from the turbine (United Kingdom Department of Energy and Climate Change 2010). However, topographic position in relation to the sensitive receptor may affect this distance. For example, a wind turbine located on a hill that is higher than the receptor will cast a longer shadow with the added height of the terrain compared to if the turbine was at the same elevation or lower than the sensitive receptor. Shadow flicker in excess of 30 minutes in a given day or 30 hours in a given year is deemed excessive. Blade rotation could cause shadow flicker that could be a visual intrusion to viewers and could be especially disruptive to residents who will be exposed to these conditions for long periods of time (United Kingdom Department of Energy and Climate Change 2011: 5-18).

The potential impacts of shadow flicker from operation-related activities under Alternative A could be moderate depending on the siting and location of sensitive viewers in the area. Setback requirements for siting turbines in relation to certain types of land uses may be established for various jurisdictions within the AVE, and turbines will not be allowed to be located within these setback distances. However, these setbacks may not be sufficient to prevent shadow flicker, depending on the turbine used. Implementation of Mitigation Measure VIS-6 should reduce impacts associated with shadow flicker.

Compared to Alternative D, the operation-related impacts are expected to be less if the recommended mitigation measures are implemented, but will be the same if the recommended mitigation measures are not implemented.

4.7.4 Alternative B—Reduced Permit Duration

4.7.4.1 Construction-Related Impacts

The reduced permit duration will not affect the construction process or the facilities to be constructed. Therefore, construction-related visual impacts associated with installation of new wind energy facilities under Alternative B will be the same as those described for Alternative A. The potential visual resource impacts from construction-related activities are expected to be moderate but temporary, and could be minor if the recommended Mitigation Measure VIS-1 is implemented (see Appendix E). Compared to Alternative D, the construction-related impacts are expected to be less if the recommended mitigation measures are implemented, but will be the same if the recommended mitigation measures are not implemented.

4.7.4.2 Operation-Related Impacts

The reduced permit duration will not affect visual impacts related to operations. Therefore, operations-related visual resource impacts associated with new wind energy facilities under Alternative B will be the same as those described for Alternative A, as further detailed below. The potential visual resource impacts from operation-related activities are expected to be moderate to substantial, and could be lessened if the recommended mitigation measures are implemented (see Appendix E). Compared to Alternative D, the operation-related impacts are expected to be less if the recommended mitigation measures are implemented, but will be the same if the recommended mitigation measures are not implemented.

Visual Character and Scenic Quality

The existing visual character and quality of views from protected and unprotected landscapes will be affected in the same manner by projects in operation under Alternative B as those described for Alternative A, regardless of the opt-in time period for the MSHCP. Alternative B will shorten the term that wind energy facilities under the MSHCP are in operation, but will not change the fact that such elements will be a part of the visual landscape for decades.

Federal Lands Visual Standards

Regardless of the opt-in time period or permit term for the MSHCP, wind energy facilities built in the vicinity of Federal lands under the MSHCP may require coordination on visual standards with Federal land agencies.

Light, Glare, and Shadow Flicker

Regardless of the opt-in time period or permit term for the MSHCP, wind energy facilities will result in increases to light and glare and will introduce shadow flicker into the visual landscape.

4.7.5 Alternative C—Increased Cut-In Speed

4.7.5.1 Construction-Related Impacts

Temporary Visual Impacts

The increased cut-in speed will not affect the construction process or the facilities to be constructed. Therefore, construction-related visual impacts associated with installation of new wind energy facilities under Alternative C will be the same as those described for Alternative A. The potential visual resource impacts from construction-related activities are expected to be moderate but temporary, and could be minor if the recommended Mitigation Measure VIS-1 is implemented (see Appendix E). Compared to Alternative D, the construction-related impacts are expected to be less if the recommended mitigation measures are implemented, but will be the same if the recommended mitigation measures are not implemented.

4.7.5.2 Operation-Related Impacts

The potential visual resource impacts from operation-related activities are expected to be moderate to substantial, and could be lessened if the recommended mitigation measures are implemented (see Appendix E). Compared to Alternative D, the operation-related impacts are expected to be less

if the recommended mitigation measures are implemented, but will be the same if the recommended mitigation measures are not implemented.

Visual Character and Scenic Quality

The increased cut-in speeds will not reduce or increase the number of wind energy facilities that may be built. Therefore, visual impacts resulting from operation of new wind energy facilities under Alternative C will be the same as those described under Alternative A.

Federal Lands Visual Standards

Increasing the cut-in speeds for turbines will not reduce or increase the number of wind energy facilities that may be built and may require coordination on visual standards with Federal land agencies. Therefore, visual impacts resulting from operation of new wind energy facilities under Alternative C will be the same as those described under Alternative A.

Light, Glare, and Shadow Flicker

Increasing the cut-in speeds for turbines will not reduce or increase the number of wind energy facilities that may be built. Therefore, light and glare impacts resulting from operation of new wind energy facilities under Alternative C will be generally the same as those described under Alternative A. Periodic increases in cut-in speeds will slightly reduce shadow flicker effects because the turbines will not spin until those higher wind speeds are met. Therefore, shadow flicker impacts resulting from operation of new wind energy facilities under Alternative C will be slightly reduced compared to Alternative A, but shadow flicker will still occur.

4.7.6 Alternative D—No Action

Visual impacts resulting from the construction and operation of new wind energy facilities under Alternative D will be similar to those described in more detail under Alternative A. Because new wind energy development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the location of these impacts may not be the same. For projects where the developer is not consulting with the Service to receive an individual ITP, impacts to visual resources under Alternative D may be substantial.

4.7.6.1 Construction-Related Impacts

Construction-related visual impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A if the recommended mitigation measures are implemented (see Appendix E). Visual impacts from construction of wind energy facilities will occur at various locations within the AVE and temporarily affect the existing visual character, visual quality, and could affect light and glare. These activities will be seen by affected viewer groups and sensitive Federal, state, and local visual resources will also be affected. Accordingly, the potential impacts to visual resources from construction activities under Alternative D could be substantial, depending on the project details such as location and scale of the wind energy facility.

4.7.6.2 Operation-Related Impacts

Operation-related visual impact mechanisms (e.g., visual character and scenic quality; light; glare; and shadow flicker) associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A if the recommended mitigation measures are implemented (see Appendix E). Visual impacts from operation of wind energy facilities will occur at various locations within the AVE and affect the existing visual character, visual quality, and could affect light and glare. These activities will be seen by affected viewer groups and sensitive Federal, state, and local visual resources will also be affected. Accordingly, the potential impacts to visual resources from operational activities under Alternative D could be substantial, depending on the project details such as location and scale of the wind energy facility.

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4.8 Transportation

This section assesses the potential effects of the alternatives on transportation during construction and operations, including management of compensatory mitigation lands.

4.8.1 Regulatory Context

Vehicles on the interstate highway system may not exceed weight and size limits established by the Federal Highway Administration (Federal Highway Administration 2003). State departments of transportation typically set size and weight limits for vehicles travelling on state roads and permits are required for vehicles exceeding those limits. State departments of transportation also typically require a permit for construction of access roads that connect with state roads (American Wind Energy Association 2008). Counties may require permits for oversize/overweight vehicles (American Wind Energy Association 2008). In addition, the FAA regulates an object that may impact or interfere with navigable airspace, and construction of wind turbines often require FAA review.

4.8.2 Methods and Approach

Implementation of the alternatives may affect transportation use (traffic), transportation safety, and transportation infrastructure (including construction of access roads). This section discusses the potential for construction of new transportation infrastructure for wind energy development based on the expected development by state from the MSHCP build-out model. Potential impacts on traffic and safety are discussed based on the volume of freight transport expected relative to current freight transport in the Plan Area and on the transportation of heavy haul, oversize or overweight wind project components. Impacts are assessed at a programmatic level because the characteristics of individual wind energy projects that may be proposed and implemented in the Plan Area are not known.

The analysis assumes projects would have no impact on air transportation, because project interference with navigable airspace would need to be avoided in order to receive project approval by the FAA.

4.8.3 Alternative A—Proposed MSHCP Alternative

4.8.3.1 Construction-Related Impacts

Construction of Access Roads or Modification of Existing Public Roads

Development of 33,000 MW of new wind energy capacity within the Covered Lands may require construction of access roads or upgrades to public roads to allow access to the construction sites and transportation of project components. Access roads will typically not be available for public use, and pre-development conditions could be restored during decommissioning and reclamation. Public roads may need to be modified to allow transport of wind project components. Project components are often oversize and/or overweight. Modifications may include widening of roads, temporary bridge shoring, or temporarily raising utility cables.

The MSHCP build-out model suggests almost 30 percent of the new wind energy capacity will be developed in Iowa, followed by Ohio, Indiana, and Illinois, with the least new wind energy

development in Michigan and Missouri. Assuming the average size of a project does not vary by state[43], it would be expected that the number of wind energy development projects would follow the same distribution. New access roads will be more likely in those states with the greatest number of expected new projects. The actual number and length of new roads will depend on the locations of the projects.

The potential impacts to transportation from construction-of access roads or modification of existing public roads under Alternative A are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and number of new or modified roads.

Transportation of Project Components, Materials, and Construction Staff

Transportation of project components to project sites may occur by truck, train, or barge, depending on location of project sites and origin of components. Roads will typically be used for transportation of construction materials and workers. Table 4.8-1 estimates the total annual freight expected to be transported over the 15 year construction period of up to 33,000 MW of new wind energy were developed. The estimate is based on a recent wind energy application using 2 MW turbines and includes turbine components, rebar, and concrete, which are estimated to be over 90 percent of the freight by weight (Mud Springs Wind Development 2014). The total of 2.2 million tons of freight a year is less than 0.1 percent of the truck freight transport in the Plan Area forecasted for 2015 (Table 3.8-2). Impacts on local traffic from transportation of project components, construction materials, and construction staff may also occur near the location of the project site.

[43] A random sample of 100 simulated outcomes resulted in an average project size of less than 300 MW to accommodate restrictions, such as no overlap with existing projects or with non-Covered Lands.

Table 4.8-1. New Wind Project Related Freight

	Number of Load Trips per Turbine	Loaded truck weights (tons)	Number of turbines (assuming 33,000 MW with 2 MW/turbine)	Total Weight for 33,000 MW (tons)
Nacelle	1	54	16,500	891,000
Rotor Shaft/ Gear box	1	44	16,500	721,050
Hub[a]	1	20	16,500	330,000
Blades	3	12	16,500	572,715
Tower	6	56	16,500	5,523,210
Switch Cabinet/ Transformer[b]	0.5	3	16,500	24,503
Rebar[c]	2	20	16,500	660,000
Concrete[d]	44	33	16,500	23,958,000
Total Freight over 15 year Construction Period				**32,680,478**
Total Annual Freight				**2,178,699**

Source: Estimates based on Mud Springs Wind Development (2014), except where noted.
MW = megawatts
[a] Weight from American Wind Energy Association 2013
[b] 2 per load
[c] Weight assumed maximum non overweight load
[d] Weight from Texas Aggregates and Concrete Association 2011

Traffic and transportation safety will also be affected by oversize and/or overweight project components. These components include the wind turbine blades, tower sections, turbine nacelle, and hub. Transport of oversize and overweight components by road typically requires specialized vehicles, special traffic controls, and may require temporary road closures for safety. This could result in traffic delays along the routes taken for transportation of these components and intersections crossing these routes.

The potential impacts from the transportation of project components, materials, and construction staff under Alternative A are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location, method of transport, and number of components. Compared to Alternative D, the construction-related impacts are the same.

4.8.3.2 Operation-Related Impacts

Transportation of Operations and Maintenance Staff

Operation and maintenance of wind projects and management of wind facilities and compensatory mitigation lands will require transportation of staff to project locations or mitigation lands. Because of the small number of staff typically employed in these activities, the impact on transportation should be negligible. The potential impacts to transportation from operation-related activities under Alternative A are expected to be minor. Compared to Alternative D, the operation-related impacts are the same.

4.8.4 Alternative B—Reduced Permit Duration

4.8.4.1 Construction-Related Impacts

Construction of Access Roads or Modification of Existing Public Roads

The reduced permit duration will not affect the potential impacts of constructing access roads or modifying existing public roads due to the installation of new wind energy facilities because both alternatives estimate up to 33,000 MW of new wind energy development. The potential impacts under Alternative B will generally be the same as those described for Alternative A; however, the location of new access roads or modification of existing public roads may be different because 11,000 MW could occur within Covered Lands, while the other 22,000 MW of development could occur anywhere within the Plan Area. The potential impacts to transportation from construction-of access roads or modification of existing public roads are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and number of new or modified roads.

Transportation of Project Components, Materials, and Construction Staff

The reduced permit duration will not affect the potential impacts of transporting project components, materials, and construction staff to project sites. Therefore, the potential impacts to transportation under Alternative B will generally be the same as those described for Alternative A, with a potential differences in routes, given that two thirds of new wind development under Alternative B could occur anywhere within the Plan Area. The potential impacts from the transportation of project components, materials, and construction staff are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location, method of transport, and number of components.

Compared to Alternative D, the construction-related impacts are the same.

4.8.4.2 Operation-Related Impacts

Transportation of Operations and Maintenance Staff

The reduced permit duration will not affect operation and maintenance impacts on transportation. Therefore, operations-related transportation impacts associated with new wind energy facilities under Alternative B will be the same as those described for Alternative A. The potential impacts to transportation from operation-related activities are expected to be minor. Compared to Alternative D, the operation-related impacts are the same.

4.8.5 Alternative C—Increased Cut-In Speed

4.8.5.1 Construction-Related Impacts

Construction of Access Roads or Modification of Existing Public Roads

The increased cut-in speed will not affect the impacts of constructing access roads or modifying existing public roads. Therefore, construction-related transportation impacts associated with installation of new wind energy facilities under Alternative C will be the same as those described for Alternative A. The potential impacts to transportation from construction-of access roads or

modification of existing public roads are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and number of new or modified roads.

Transportation of Project Components, Materials and Construction Staff

The increased cut-in speed will not affect the impacts of transporting project components, materials, and construction staff to project sites. Therefore, construction-related transportation impacts associated with installation of new wind energy facilities under Alternative B will be the same as those described for Alternative A. The potential impacts from the transportation of project components, materials, and construction staff are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location, method of transport, and number of components.

Compared to Alternative D, the construction-related impacts are the same.

4.8.5.2 Operation-Related Impacts

Transportation of Operations and Maintenance Staff

The increased cut-in speed will not affect the operation and maintenance impacts on transportation. Therefore, operation-related transportation impacts will be the same as under Alternative A. The potential impacts to transportation from operation-related activities are expected to be minor. Compared to Alternative D, the operation-related impacts are the same.

4.8.6 Alternative D—No Action

4.8.6.1 Construction-Related Impacts

Construction of Access Roads or Modification of Existing Public Roads

Construction-related impact mechanisms (e.g., development of access roads or modification of existing public roads) associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW or new wind energy development. The potential impacts to transportation from construction-of access roads or modification of existing public roads are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and number of new or modified roads.

Transportation of Project Components, Materials, and Construction Staff

Construction-related impact mechanisms (e.g., transportation of project components, materials, and construction staff to project sites) associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW or new wind energy development. The potential impacts from the transportation of project components, materials, and construction staff are

expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location, method of transport, and number of components.

4.8.6.2 Operation-Related Impacts

Transportation of Operations and Maintenance Staff

Operation and maintenance impact mechanisms associated with the installation of new wind energy facilities under Alternative D will be the same as under Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. The potential impacts to transportation from operation-related activities are expected to be minor.

4.9 Land Resources

This section assesses the potential effects of the alternatives on land resources during construction and operations, including management of compensatory mitigation lands and decommissioning.

4.9.1 Regulatory Context

Siting authority for wind energy projects varies from state to state. In some cases, a state agency has primary siting authority while in other states local governments are the main siting authority for wind energy projects, doing so through local land use and zoning ordinances (American Wind Energy Association 2008). Siting regulations may require setbacks from property lines and residential structures, as well as compatibility with county land use plans and zoning ordinances.

The Farmland Protection Policy Act of 1981 requires that Federal agencies and programs minimize conversion of farmland to nonagricultural uses (7 U.S.C. Chapter 73).

All states in the study area, with the exception of Missouri, participate in a federally-approved Coastal Management Program, where they collaborate with the Federal government to achieve the goals of the Coastal Zone Management Act (16 U.S.C. Chapter 33).

4.9.2 Methods and Approach

Implementation of the alternatives may change land use in the form of leases, easements, or land ownership (e.g., purchase of land for compensatory mitigation). This section compares results from the MSHCP build-out model showing expected development by state with land ownership and use in the Plan Area, as described in Section 3.9. Land use impacts are assessed at a programmatic level because the exact location and characteristics of individual wind energy projects that may be proposed and implemented in the study area are not known.

This section also discusses the potential for land use conflict based on siting regulations and the impact on recreational activities through temporary and long-term changes in the physical and natural environment. The discussion is qualitative and based on general causal mechanisms of impact, as well as on the general order of magnitude of proposed new wind energy development, as described in the MSHCP build-out model.

4.9.3 Alternative A—Proposed MSHCP Alternative

4.9.3.1 Construction-Related Impacts

Land Rights

Construction of wind energy projects will typically require land purchases, leases, and/or easements for placement of turbines and associated infrastructure and for access to project sites. Construction will typically require rights to disturb larger areas than those disturbed for operations, and some of the construction impacts to land rights will be temporary. The potential impacts to land rights from construction activities under Alternative A are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and the type of land purchased or leased.

Changes in Land Use

Construction of each wind project will temporarily disturb land for construction of access roads, placement of turbines and cables, construction of operations and maintenance facilities, and for staging areas. After construction, the land disturbed will be reduced to the land necessary for operations, the remaining being restored to its original use. During construction activities, land use of surrounding areas may be affected by road and access closures, traffic, noise, air quality, and visual disturbances. However, due to the short-term duration of construction activities, these impacts should be temporary and will vary by project. Accordingly, the potential impacts to changes in land use from construction activities under Alternative A could be moderate in the short-term. However, in the long-term, changes in land use resulting from construction activities are expected to be minor.

Consistency with Land Use Programs and Plans

As described in Section 4.9.1, siting of wind energy projects is often restricted by state or local authorities to avoid conflict with some types of land use, such as residential structures, and to ensure consistency with state and local land use plans and ordinances. To the extent covered by state and local siting regulations, construction of new wind energy projects will be required to be consistent with state and local land use plans, including coastal zone management plans. The potential impacts to land use programs or plans from construction activities under Alternative A could range from minor to moderate, depending on the project details and the level to which state and local authorities require strict compliance and consistency with these programs and plans.

Temporary Disruption of Recreation Activities

Recreation activities in the vicinity of wind energy project areas may be temporarily affected during construction of wind energy projects by noise, air quality, and temporary road closures. The potential impacts to recreation activities from construction activities under Alternative A are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and the type of disruption to the recreationist's experience.

Compared to Alternative D, the construction-related impacts are the same.

4.9.3.2 Operation-Related Impacts

Land Rights

As described in Section 3.9.2, almost 90 percent of the land in the study area is privately owned. Operation of wind energy projects will typically require land purchases, leases, and/or easements for operations and maintenance of turbines and associated infrastructure and for access to project sites. Operations typically require rights to disturb smaller areas than those disturbed for construction, but these land rights will be long-term.

The MSHCP estimates that wind energy projects under this alternative will have an average project size of 305 MW occupying an average of 18,700 acres of land per project. Table 4.9-1 shows how this project area would be distributed by state. New wind energy projects are estimated to occupy between 0.1 percent (Michigan, Missouri) and 1.7 percent (Iowa, Ohio) of the total Plan Area land in each state.

Table 4.9-1. Land Occupied by New Wind Energy Development, 2016-2030

	Installed Capacity (MW)	Acres	Percent of Plan Area
Illinois	4,094	251,403	0.7
Indiana	5,848	359,112	1.6
Iowa	9,765	599,645	1.7
Michigan	727	44,643	0.1
Minnesota	2,030	124,657	0.2
Missouri	971	59,627	0.1
Ohio	7,108	436,485	1.7
Wisconsin	2,457	150,879	0.4
Total	**33,000**	**2,026,451**	**0.7**

Source: Calculated from MSHCP Build Out model
MW = megawatts

Compensatory mitigation requires rights to protect or restore habitats in the Plan Area. The potential impacts to land rights from operation activities under Alternative A could range from moderate to substantial, depending on the project details such as location and the type of land purchased or leased.

Changes in Land Use

Changes in land use will occur to a much smaller area than that reflected in Table 4.9-1 because most current land use within the project areas will be maintained and not converted to built structures. A recent 100 MW project, for example, was estimated to convert 128.9 acres to built structures (U.S. Fish and Wildlife Service 2013). The Service used this example to estimate the order of magnitude of land converted over the Plan Area shown in Table 4.9-2.

Table 4.9-2. Land Use by New Wind Energy Development, 2016-2030

	Installed Capacity (MW)	Acres	Percent of Plan Area
Illinois	4,094	5,277	0.015
Indiana	5,848	7,538	0.033
Iowa	9,765	12,587	0.035
Michigan	727	937	0.003
Minnesota	2,030	2,617	0.005
Missouri	971	1,252	0.003
Ohio	7,108	9,162	0.035
Wisconsin	2,457	3,167	0.009
Total	**33,000**	**42,537**	**0.014%**

Source: Calculated from MSHCP Build Out model and based on U.S. Fish and Wildlife Service (2013)
MW = megawatts

Based on Table 3.9-2, land converted to built structures for new wind energy projects is expected to be largely agriculture, livestock grazing areas, and undeveloped land, such as forests and grasslands. Based on the share of state lands occupied by prime farmland, the state most likely to have affected farmland is Illinois, followed by Indiana (Table 3.9-3).The potential impacts to changes in land use from operation activities under Alternative A could range from minor to moderate, depending on the project details such as location and the nature of the change of land use.

Consistency with Land Use Programs and Plans

To the extent covered by state and local siting regulations, operations of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. The potential impacts to land use programs or plans from operation activities under Alternative A could range from minor to moderate, depending on the level to which state and local authorities require strict compliance and consistency with these programs and plans.

Long Term Impacts to Recreational Areas

Recreation activities in the vicinity of wind energy project areas may be affected during operations of wind energy projects by noise, the visual quality of the scenery, and by shadow flicker from the operating wind turbines. Compensatory mitigation may favor wildlife viewing. Additionally, lands used for mitigation purposes may eventually be open to the public for non-consumptive recreation (e.g., wildlife viewing). The states with the most visitors to National Forests are Michigan and Minnesota; the states with the most visitors to state parks are Ohio and Illinois; and the states with the most participants in wildlife-related recreation activities are Ohio, Michigan, and Illinois (Section 3.9.2.3). The potential impacts to recreation activities from operation activities under Alternative A are expected to range from moderate to substantial, depending on the project details such as location and the type of disruption to the recreationist's experience.

Compared to Alternative D, the operation-related impacts are the same.

4.9.4 Alternative B—Reduced Permit Duration

4.9.4.1 Construction-Related Impacts

The potential impacts to land resources from construction activities are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location. Compared to Alternative D, the construction-related impacts are the same.

Land Rights

Impacts to land rights through land purchases, leases, and/or easements associated with installation of new wind energy facilities under Alternative B will be generally the same as those described for Alternative A. Because 11,000 MW will be restricted to Covered Lands, and other development could occur anywhere within the Plan Area, the location of these impacts may not be the same.

Changes in Land Use

Land use impacts under Alternative B will be generally the same as those described for Alternative A, with potential differences in location, given that 11,000 MW will be restricted to Covered Lands, and other development could occur anywhere within the Plan Area.

Consistency with Land Use Programs and Plans

To the extent covered by state and local siting regulations, construction of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. Potential impacts under Alternative B will be generally the same as those described for Alternative A.

Temporary Disruption of Recreation Activities

Impacts to recreation activities under Alternative B will be generally the same as those described for Alternative A, with potential differences in location, given that 11,000 MW will be restricted to Covered Lands, and other development could occur anywhere within the Plan Area.

4.9.4.2 Operation-Related Impacts

The potential impacts to land resources from operation activities could range from minor to substantial, depending on the project details such as location and the nature of the land resources being impacted. Compared to Alternative D, the operation-related impacts are the same.

Land Rights

Impacts to land rights through land purchases, leases and/or easements associated with operations of new wind energy facilities under Alternative B will be generally the same as those described for Alternative A because both alternatives contemplate up to 33,000 MW of new wind energy development.

Changes in Land Use

Land use impacts under Alternative B will be generally the same as those described for Alternative A.

Consistency with Land Use Programs and Plans

To the extent covered by state and local siting regulations, construction of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. Potential impacts under Alternative B will be generally the same as those described for Alternative A.

Temporary Disruption of Recreation Activities

Impacts to recreation activities under Alternative B will be generally the same as those described for Alternative A.

4.9.5 Alternative C—Increased Cut-In Speed

4.9.5.1 Construction-Related Impacts

The potential impacts to land resources from construction activities are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location. Compared to Alternative D, the construction-related impacts are the same.

Land Rights

Impacts to land rights through land purchases, leases, and/or easements associated with operations of new wind energy facilities under Alternative C will be generally the same as those described for Alternative A because both alternatives contemplate up to 33,000 MW of new wind energy development.

Changes in Land Use

Land use impacts under Alternative C will be generally the same as those described for Alternative A.

Consistency with Land Use Programs and Plans

To the extent covered by state and local siting regulations, construction of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. Potential impacts under Alternative C will be generally the same as those described for Alternative A.

Temporary Disruption of Recreation Activities

Impacts to recreation activities under Alternative C will be generally the same as those described for Alternative A.

4.9.5.2 Operation-Related Impacts

The potential impacts to land resources from operation activities could range from minor to substantial, depending on the project details such as location and the nature of the land resources being impacted. Compared to Alternative D, the operation-related impacts are the same.

Land Rights

Impacts to land rights through land purchases, leases and/or easements associated with installation of new wind energy facilities under Alternative C will be generally the same as those described for Alternative A because both alternatives contemplate up to 33,000 MW of new wind energy development.

Changes in Land Use

Land use impacts under Alternative C will be generally the same as those described for Alternative A.

Consistency with Land Use Programs and Plans

To the extent covered by state and local siting regulations, construction of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. Potential impacts under Alternative C will be generally the same as those described for Alternative A.

Temporary Disruption of Recreation Activities

Impacts to recreation activities under Alternative C will be generally the same as those described for Alternative A.

4.9.6 Alternative D—No Action

4.9.6.1 Construction-Related Impacts

Construction-related impact mechanisms (e.g., impacts to land rights through land purchases, leases, and/or easements; changes in land use; consistency with land use programs and plans; and temporary disruption of recreation activities) associated with installation of new wind energy facilities under Alternative D will be the same as those described under Alternative A. To the extent covered by state and local siting regulations, construction of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. The potential impacts to land resources from construction activities are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location.

4.9.6.2 Operation-Related Impacts

Operation-related impact mechanisms (e.g., impacts to land rights through land purchases, leases, and/or easements; changes in land use; consistency with land use programs and plans; and temporary disruption of recreation activities) associated with installation of new wind energy facilities under Alternative D will be the same as those described under Alternative A. To the extent covered by state and local siting regulations, operation of new wind energy projects will be required to be consistent with state and land use plans, including coastal zone management plans. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. The potential impacts to land resources from operation activities could range from minor to substantial, depending on the project details such as location and the nature of the land resources being impacted.

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4.10 Public Services and Utilities

This section assesses the potential effects of the alternatives on public services and utilities during construction and operations, including management of compensatory mitigation lands and decommissioning.

4.10.1 Regulatory Context

Various Federal agencies have jurisdiction over radar systems and telecommunications that may be affected by wind energy development. The FAA reviews construction of structures that may affect navigable airspace and often engages other agencies to assess the potential to obstruct radar systems, such as the National Telecommunications and Information Administration (NTIA), Interdepartment Radio Advisory Committee (IRAC), and the National Weather Service (American Wind Energy Association 2008).

All states in the Plan Area have renewable portfolio standards, with the exception of Indiana, which has a voluntary renewable energy target. Renewable portfolio standards mandate that utilities sell a designated amount or percentage of electricity that is generated from renewables by an established year, which varies by state. These standards may only pertain to investor-owned utilities (IOUs), but some states incorporate municipalities and electric cooperatives as well—applying equivalent or lower standards, relative to IOUs. Of the eight states comprising the Plan Area, Iowa requires IOUs to sell 105 MW of energy from renewable sources. Indiana has a voluntary portfolio standard program, wherein participating electricity providers must supply at least 10 percent of their electricity from renewable energy sources by 2025. The remaining states mandate that a share of the electricity provided by IOUs be generated from renewable energy, ranging from 10 percent in Michigan and Illinois to 25 percent in Minnesota and Ohio[44]. Wisconsin has a goal of 6 percent above their 2001–2003 average (National Conference of State Legislatures 2015).

4.10.2 Methods and Approach

Potential impacts of the alternatives on public services and utilities are assessed in three ways:

- Increase in the demand for public services at the site of wind development projects during construction and decommissioning.
- Interference with telecommunication signals during operations.
- Increase in the supply of electricity available to power utilities during operations.

Potential impacts on public services and utilities are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known.

Potential impacts of the alternatives are discussed qualitatively by characterizing duration and relative magnitude of increased demand for public services, mechanisms of potential interference with communication systems, and by discussing the contribution to electricity supply within the study area and to state renewable portfolio standards and goals.

[44] The Ohio state standard is currently pending a cost-benefit analysis.

4.10.3 Alternative A—Proposed MSHCP Alternative

4.10.3.1 Construction-Related Impacts

Increased Demand for Public Services

Areas within commuting distance of construction sites could see an increase in the demand for public services from wind project construction related workers. This is more likely to occur in suburban and rural areas and for projects that need a sizeable labor force and construction service providers. In these areas, workers could move to areas within commuting distance of the construction sites. The resulting temporary increase in the local population will generate a temporary increase in demand for public services, including increased consumption of electricity, water and sewage, and demands on local emergency services such as fire departments, law enforcement, and health services.

Based on estimates from the National Renewable Energy Laboratory (2015) Jobs and Economic Development Impact models, expenditures made for construction of a 300 MW wind energy project will support approximately 150 Full-Time Equivalent jobs during the construction period. Most of these jobs will be generated within the project site region: the region from which workers are able to commute and from which construction materials and services are available. Peak numbers of project related construction workers could be higher or lower than 150, depending on the duration of construction, the share of jobs that are part-time and the share of construction direct expenditures that are done locally. However, if an average 300 MW wind energy project employed 150 local workers at peak employment, and assuming temporary construction workers move without their families, the increased demand for public services from 150 workers moving to commuting distance from a relatively isolated rural area could have a perceptible effect on the demand for public services, For less isolated areas, this increase in demand for public services will be negligible.

Based on Table 2-2, almost 30 percent of the 33,000 MW of new wind energy capacity expected to be developed over a 15 year period would be located in Iowa. Although it is not possible to assess the likelihood of projects being sited in areas where the increased demand for public services during construction would be more than negligible without knowledge of exact project locations, Iowa is the state in the Plan Area with the lowest population density (Table 3.12-1). Location of individual projects is determined by many factors, including wind power potential and proximity to roads and transmission lines, and will be limited to Covered Lands.

The potential impacts from increased public service demand from construction activities under Alternative A are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and availability of public services.

Compared to Alternative D, the construction-related impacts are the same.

4.10.3.2 Operation-Related Impacts

Interference with Telecommunication Systems

Wind turbines can interfere with telecommunication systems by obstructing and scattering telecommunication signals or by interference through electromagnetic signals generated by the wind turbines themselves. The scattering patterns of wind turbine electromagnetic signals vary

from project to project and depend on multiple factors, including orientation of the nacelle, blade rotation, and other factors (Angulo *et al.* 2014; Krug 2009). Among the types of services that may be affected by interference from wind turbines are the following:

AM/FM Radio. Radio signals may be obstructed by wind turbines, generating a diffraction effect[45]. They may also suffer the scattering interference from the signals generated by the wind turbines (Cascón *et al.* 2013).

Television. Television broadcasting signals may also be scattered by wind turbine electromagnetic activity. The result could vary between loss of color and detail and buzz on sound to secondary or ghost images. These effects are more likely in analog television systems and the Advanced Television Systems Committee (ATSC) digital standard used in the U.S. includes technical advances that are capable of minimizing distortion, within certain boundaries (Cascón *et al.* 2013; Angulo *et al.* 2014).

Weather radars. Radars operate by transmitting electromagnetic signals and receiving echoes from target objects. Wind turbines may interfere with the information detected by radars by obstructing signals, cluttering returns due to the scattering effect of wind turbines, and by interference from the Doppler[46] effect generated by rotating blades (Angulo *et al.* 2014; Cascón *et al.* 2013).

Aeronautical navigation systems. Wind turbines may interfere with aeronautical radionavigation systems and landing systems. The interference could affect the perceived north by aircraft systems as well as flight calibration aspects (Angulo *et al.* 2014; Cascón *et al.* 2013).

Interference with telecommunication systems is largely avoided by proper siting of wind projects at a distance from potentially affected systems. Siting authority for wind energy projects varies from state to state. In some cases, a state agency has primary siting authority while in other states local governments are the main siting authority for wind energy projects, doing so through local land use and zoning ordinances (American Wind Energy Association 2008).

The potential impacts to telecommunication systems from operation activities under Alternative A could range from minor to moderate, depending on project-specific factors such as location and the type of telecommunication systems interference that occurs.

Contribution to Electricity Supply

Up to 33,000 MW of new wind energy development will contribute to the energy supply within the eastern interconnection and to state renewable energy portfolios. As discussed in Section 3.10.1.1 of the MSHCP, *Electricity*, the North American Electric Reliability Corporation anticipates demand for electricity in the eastern interconnection to grow at an annual rate of up to 1.02 percent between 2015 and 2024 (North American Electric Reliability Corporation 2014). If the same growth rate were extended to the 2013–2030 period and if growth in supply in the Plan Area accompanied growth in demand in the eastern interconnection, the 2030 electric industry capability in the Plan Area will be 244,300 MW, or a growth of 38,712MW.[47] The 33,000 MW maximum anticipated build-out of new wind energy project corresponds to 85.2 percent of that growth. This magnitude of wind energy development will contribute substantially to state renewable energy portfolios. The potential

[45] A bending or alteration of a wave when encountering an object.

[46] The changes in wave frequency between two points when at least one of these is moving.

[47] Based on 205,588 MW in 2013, per *Table 3.10-1. Selected Industry Data by State, 2013*.

impacts to electricity supply contribution from operation activities under Alternative A will be substantial.

Compared to Alternative D, the operation-related impacts are the same.

4.10.4 Alternative B—Reduced Permit Duration

4.10.4.1 Construction-Related Impacts

Increased Demand for Public Services

Increased demand for public services associated with installation of new wind energy facilities under Alternative B will be generally the same as described for Alternative A because both alternatives contemplate up to 33,000 MW of new wind energy development. Because 11,000 MW will be restricted to Covered Lands, and other development could occur anywhere within the study area, the location of potential increases in demand for public services may not be the same. The potential impacts from increased public service demand from construction activities are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and availability of public services. Compared to Alternative D, the construction-related impacts are the same.

4.10.4.2 Operation-Related Impacts

Interference with Telecommunication Systems

The likelihood of interference with telecommunication systems under Alternative B will be generally the same as under Alternative A, with potential differences in location, given that a portion of the new wind development under Alternative B could occur anywhere within the study area. The potential impacts to telecommunication systems from operation activities could range from minor to moderate, depending on project-specific factors such as location and the type of telecommunication systems interference that occurs.

Contribution to Electricity Supply

The contribution of new wind energy development to the supply of electricity in the Plan Area will be the same as under Alternative A. The potential impacts to electricity supply contribution from operation activities will be substantial. Contribution to state renewable energy portfolios may be slightly different because the distribution of projects among the states may not be the same.

Compared to Alternative D, the operation-related impacts are the same.

4.10.5 Alternative C—Increased Cut-In Speed

4.10.5.1 Construction-Related Impacts

Increased Demand for Public Services

Increased demand for public services associated with installation of new wind energy facilities under Alternative C will be the same as described for Alternative A. The potential impacts from increased public service demand from construction activities are expected to be minor in the long-

term, but could be moderate in the short-term depending on the project details such as location and availability of public services. Compared to Alternative D, the construction-related impacts are the same.

4.10.5.2 Operation-Related Impacts

Interference with Telecommunication Systems

The likelihood of interference with telecommunication systems under Alternative C will be the same as under Alternative A. The potential impacts to telecommunication systems from operation activities could range from minor to moderate, depending on project-specific factors such as location and the type of telecommunication systems interference that occurs.

Contribution to Electricity Supply

The contribution of new wind energy development to the supply of electricity in the Plan Area will be generally the same as under Alternative A. The potential impacts to electricity supply contribution from operation activities will be substantial. To the extent that the increased cut-in speed reduces average operating time of wind projects, some reduction in power generation is expected.

Compared to Alternative D, the operation-related impacts are the same.

4.10.6 Alternative D—No Action

4.10.6.1 Construction-Related Impacts

Increased Demand for Public Services

Construction-related impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. The potential impacts from increased public service demand from construction activities are expected to be minor in the long-term, but could be moderate in the short-term depending on the project details such as location and availability of public services.

4.10.6.2 Operation-Related Impacts

Operation-related impact mechanisms (e.g., interference with telecommunication systems and contribution to the electricity supply) associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. However, contribution to state renewable energy portfolios may be slightly different because the distribution of projects among the states may not be the same. The potential impacts to telecommunication systems from operation activities could range from minor to moderate, depending on project-specific factors such as location and the type of telecommunication

systems interference that occurs. The potential impacts to electricity supply contribution from operation activities will be substantial.

4.11 Public Health and Safety

This section describes the potential impacts on public health and safety in the study area for each of the alternatives.

4.11.1 Regulatory Context

There are no Federal statutes or regulations directly related to public health and safety aspects of wind energy development. State and local government ordinances regulate aspects of wind projects, such as their location, the permitting process, and construction, which may have public health and safety implications (U.S. Department of Energy 2014). According to the 2010 U.S. Department of Energy Wind Energy Ordinances Factsheet, the following public health and safety related provisions are typically included in state and local wind energy ordinances and/or wind energy company standard BMPs:

- **Access** – Defined access standards help to ensure safety by limiting contact with the interior of wind turbine towers, electrical equipment, climbing apparatuses, and transmission infrastructure.
- **Clearance –** A defined clearance height, which is normally measured between the bottom point of the arc created by rotating blades and the ground, serves to protect public safety.
- **Setbacks** – Setback standards are defined to create space between wind turbines and common areas of concern, which may include inhabited structures, public roads, property lines, communication lines, and electrical lines.
- **Signage** – Signage standards may require warning notices and may also identify the turbine's owner or manufacturer.
- **Spacing and Density –** Spacing and density standards ensure that individual wind turbines are not sited too close together. (U.S. Department of Energy 2010)

4.11.2 Methods and Approach

Impacts on public health and safety are qualitatively described by identifying construction-related and operation-related impact mechanisms of new commercial wind energy projects and associated facilities within Covered Lands. Impacts are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known. Mitigation activities under the MSHCP conservation strategy, which include protecting and restoring habitat, will not result in more than minor impacts related to public health and safety. Accordingly, they are not characterized in detail below.

4.11.3 Alternative A—Proposed MSHCP Alternative

4.11.3.1 Construction-Related Impacts

Overall, many of the safety concerns associated with the construction of wind energy facilities are similar to the potential risks associated with the construction of other tall structures. These risks, which could result in injuries to the general public and construction workers, include the potential for collisions with construction vehicles, equipment, and materials; falls from structures or falls into

open excavations; and electrocution. Public access to wind energy facilities under construction will be limited; therefore, the potential risk to the general public will be low. The potential risk of construction-related injuries to workers could be minimized through safety training, use of appropriate safety equipment, and development and adherence to health and safety plans. Beyond the issues identified above, Alternative A will not result in adverse impacts on public health and safety, and construction-related impacts will be minor. Compared to Alternative D, the construction-related impacts are the same.

4.11.3.2 Operation-Related Impacts

Potential operation-related public health and safety risks that could result from Alternative A are described below. These potential risks include impacts from structural failure, ice shedding, lightning strikes, stray voltage, and fuels and fire. Adherence to standard industry safety measures and compliance with applicable state and local regulations will minimize the following public health and safety risks resulting from the Alternative A.

Structural Failure

Structural failure has the potential to occur in any wind energy facility. Structural failure includes turbine collapse and blade shear, both of which are rare but potentially serious complications of wind turbine operation. Many of the risks associated with structural failures can be minimized by creating buffers around wind energy facilities. While there are currently no uniform setback standards for the wind industry, many state and local ordinances include provisions designed to create space between wind turbines and common areas of concern. Additionally, technological improvements and other mandatory safety standards implemented during turbine design, manufacturing, and installation largely minimize the risk of public health and safety impacts. Accordingly, potential impacts related to structural failure will be minor.

Ice Shedding

Operation of wind energy facilities may result in ice shedding. Ice shedding occurs when ice accumulates on rotor blades and subsequently breaks free and falls to the ground. All projects will be required to comply with applicable state and local regulations governing the minimum setback distance between the wind energy facilities and common areas of concern. As a result, it is unlikely that health and safety impacts resulting from Alternative A will affect the general public. Accordingly, public health and safety impacts resulting from ice shedding will be minor.

Lightning Strikes

Lightning strikes have the potential to impact wind energy facilities during operation. However, they are not expected to pose a risk to public health and safety because modern wind turbines are usually equipped with lightning protection systems. Wind turbine lightning protection systems typically involve automatic shutdown procedures in the event of damage to the blades. While a direct lightning strike could result in a fire, it is expected that any fires will be contained within or immediately adjacent to the affected turbine. Accordingly, public health and safety impacts resulting from lightning strikes will be minor.

Stray Voltage

Operation of wind energy facilities may generate stray voltage, which is a low-level electrical current that results primarily from an improperly grounded electrical distribution system. Adherence to proper electrical installation and grounding practices prevents stray voltage from occurring. All projects will be equipped with electrical systems that meet applicable safety and design regulations, and proper electrical installation protocols will be followed. Accordingly, public health and safety impacts resulting from stray voltage will be minor.

Fuels and Fire

Operation of wind energy facilities may result in exposure of workers or the general public to hazardous fuels and fires. Wind turbines contain relatively few flammable components. However, as discussed above, lightning strikes have the potential to start fires in wind energy facilities. Adherence to project health and safety plans and communication and coordination between wind energy facility workers and emergency response personnel will minimize the potential for impacts to workers and the general public. Accordingly public health and safety impacts resulting from exposure to fuels and fires will be minor.

Wind Turbine Syndrome

Wind turbine syndrome, which is not currently a recognized medical diagnosis, is a term used to identify the suite of symptoms reportedly experienced by people who live near wind turbines. Symptoms included sleep disturbances, headaches, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, concentration and memory problems, and panic episodes. It has been suggested that these symptoms are related to infrasound emitted from the operation of wind turbines. As cited by the 2013 Final Environmental Impact Statement for the Proposed Habitat Conservation Plan and Incidental Take Permit for the Indiana Bat (*Myotis sodalis*) for the Buckeye Wind Power Project Champaign County, Ohio, several literature reviews have been conducted on the health effects of wind turbine sound, none of which have been found to wind turbine syndrome to be supported by sufficient verifiable scientific evidence (Colby *et al.* 2009; Knopper and Ollson 2011; Ellenbogen *et al.* 2012). As there is no sufficient verifiable scientific evidence of any relationship between wind turbine sound and adverse physiological health impacts, public health and safety impacts resulting from wind turbine syndrome will be minor (U.S. Fish and Wildlife Service 2013).

Compared to Alternative D, the operation-related impacts are the same.

4.11.4 Alternative B—Reduced Permit Duration

Construction- and operation-related impacts to public health and safety under Alternative B will be minor, and the same as those described under Alternative A. Impacts under Alternative B will be generally the same as those described for Alternative A, with potential differences in location, given that only 11,000 MW will be restricted to Covered Lands, and other 22,000 MW of development could occur anywhere within the Plan Area. Compared to Alternative D, the construction-related impacts and operation-related impacts are the same.

4.11.5 Alternative C—Increased Cut-In Speed

Construction- and operation-related impacts to public health and safety under Alternative C will be minor, and the same as those described under Alternative A. Compared to Alternative D, the construction-related impacts and operation-related impacts are the same.

4.11.6 Alternative D—No Action

4.11.6.1 Construction-Related Impacts

Construction-related impact mechanisms associated with the installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, and construction-related impacts will be minor.

4.11.6.2 Operation-Related Impacts

Operation-related impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described for Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, and operation-related impacts will be minor.

4.12 Socioeconomics and Environmental Justice

This section assesses the potential socioeconomic and environmental justice effects of the alternatives during construction and operations, including management of compensatory mitigation lands and decommissioning.

4.12.1 Regulatory Context

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations*, instructs agencies to identify and address disproportionately high and adverse human health or environmental effects of its program, policies and activities on minority and low-income populations. The Council on Environmental Quality *Environmental Justice Guidance under the National Environmental Policy Act* provides guidance for agencies in complying with EO 12898 within the NEPA process.

4.12.2 Methods and Approach

Potential socioeconomic and environmental justice impacts are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known.

Implementation of the alternatives may affect output, employment, and earnings in the study area. The Service used publicly available wind energy development models from the NREL and input from the MSHCP build-out model by state to estimate the general magnitude of impacts on output, employment, and earnings at the state level, and compared these to the baseline discussed in Section 3.12.

The estimates of relative impacts on output, employment, and earnings allows for an informed qualitative discussion of the potential impacts on population, demand for housing and public services, and fiscal revenues. Additional discussion of potential socioeconomic impacts includes a qualitative discussion of the effects of wind energy development on property values and on consumer electricity rates. This discussion is based on current literature.

The discussion of potential impacts on minority and low-income populations is based on a review of the results from the impact analysis of other resource areas, focusing on whether any potentially high and adverse human health or environmental impacts were identified. To the extent that potentially high and adverse human health or environmental effects were identified by any individual resource area, this section discusses the potential for disproportionately high and adverse effects on minority and low-income groups.

4.12.3 Alternative A—Proposed MSHCP Alternative

4.12.3.1 Construction-Related Impacts

Output, Employment, and Income

Development of 33,000 MW of new wind energy capacity will create construction jobs, as well as turbine and supply chain jobs (indirect jobs) and jobs supported by local expenditures of direct and

indirect earnings (induced jobs). Table 4.12-1 shows the estimated average annual jobs by state over the 15-year construction period. Table 4.12-1 also shows estimates for labor earnings and value added. Estimates were obtained using the NREL Jobs and Economic Development Impact models for each state separately and inputting estimated new installed capacity, as developed in the MSHCP. The NREL estimates assume 300 MW projects using 2 MW turbines. The resulting estimates shown in Table 4.12-1 were updated to 2014 dollar values to allow comparison with values in Table 3.12-4 and Table 3.12-5 (using Bureau of Labor Statistics 2015b). Jobs are shown in Full-Time Equivalents[48].

Table 4.12-1. Average Annual Contribution of Construction of New Wind Energy Capacity in the Study Area

		Annual Estimated Impacts of New Construction					
			FTE Jobs				
	Average Annual New Built Capacity (MW), 2016-2030	Value Added (millions of 2014 $)	Project Development and Onsite Labor Impacts	Turbine and Supply Chain Impacts	Induced Impacts	Total	Labor Earnings (millions of 2014 $)
Illinois	273	$105	133	610	366	1,108	$74
Indiana	390	$123	196	901	489	1,585	$88
Iowa	651	$189	330	1,552	707	2,589	$137
Michigan	48	$16	24	122	67	213	$12
Minnesota	135	$50	66	311	176	554	$34
Missouri	65	$21	32	157	87	275	$16
Ohio	474	$160	234	1,183	662	2,079	$117
Wisconsin	164	$54	82	403	213	698	$39
Grand Total [a]	**2,200**	**$718**	**1,097**	**5,239**	**2,766**	**9,102**	**$517**

Sources: National Renewable Energy Laboratory 2015; Bureau of Labor Statistics 2015b.
MW = megawatts
FTE = full-time equivalent
[a] Estimated value added, jobs, and earnings impacts for the study area as a whole may be underestimated, because the potential resulting impacts to neighboring states are not included.

Assuming one FTE job was filled by one worker, the 9,102 total average annual new wind energy related jobs in the Plan Area corresponds to approximately 0.03 percent of the 31 million labor force of the Plan Area (Table 3.12-3). The new wind energy related $718 million in value added corresponds to a bit over 0.02 percent of the $3,162,662 million Gross Domestic Product (GDP) of the Plan Area. The average annual contribution of the new wind energy related jobs and value added to each state, over the 15-year construction period, will vary from less than 0.01 percent in Missouri and Michigan to over 0.1 percent in Iowa.

The potential value-added energy output (positive revenue) under Alternative A is expected to be minor across the eight-state study area, but could be moderate (and positive) when looking at

[48] Full-time equivalent jobs corresponds to a full-time job held during 1 year. Full Time Equivalent jobs are not directly comparable with the jobs reported by the Bureau of Labor Statistics (such as those shown in Table 3.12-3) which may be full-time or part-time jobs.

impacts relative to a specific community. The potential employment and income impacts (positive, beneficial) from construction activities under Alternative A are expected to be minor in the long-term across the eight-state study area, but could be moderate (and positive) in the short-term depending on the project details such as location and the duration of the construction activities.

Population

Because the average annual contribution of the new wind energy projects to job creation will be less than 0.1 percent of the labor force in any state in the Plan Area, the Service does not expect any perceptible impact on population in the Plan Area. Individual projects, however, could bring a temporary yet meaningful inflow of workers to specific localities if projects sites are in relatively isolated rural areas and if only small communities are located within commuting distance from these sites. The construction-related impacts from an increase in population will be minor across the eight-state Plan Area, but could approach moderate impacts, if project construction sites are located in relatively isolated rural areas and if only small communities are located within commuting distance from these sites.

Demand for Housing and Public Services

The construction-related impact on housing and public services from the inflow of workers to individual project sites will be proportional to the increase in population. As discussed above, this increase will be minor, except for individual projects located in relatively isolated rural areas.

Fiscal Revenues

The main sources of fiscal revenues for state and local governments during construction will be sales and use taxes associated with the purchase or use of construction equipment, materials, services, and wind energy project components. Because the value added is a small share of the Plan Area GDP (as discussed above), and because of the tax incentives for renewable energy in the Plan Area (see Section 4.12.3.2 for more detail), the increase in fiscal revenues from the new wind energy projects during construction will be minor but positive across the eight-state Plan Area, but could approach moderate if the increased revenue has a positive impact on a relatively small community.

Disproportionately High and Adverse Human Health or Environmental Effects on Minority or Low-Income Populations

The existence of disproportionately high and adverse human health or environmental effects on minority or low-income populations depends on:

a. The presence of minority or low-income populations in the study area.

b. The existence of high and adverse human health or environmental effects (adverse impacts of sufficient magnitude or severity to potentially lead to disproportionately high and adverse effects).

c. The incidence of high and adverse human health or environmental effects disproportionately on minority or low-income populations.

Section 3.12.2.5, *Environmental Justice*, describes the presence of minority or low-income populations in the Plan Area at the state and county level. Both minority and low-income counties

are present throughout the Plan Area. Within counties, communities may also form minority and low-income populations and are likely to be present throughout the Plan Area.

Chapter 4 of this EIS assesses potential impacts of construction of new wind energy development on specific environmental and socioeconomic resources. No potentially high and adverse human health or environmental effects from construction of 33,000 MW of new wind energy capacity were identified for the Plan Area as a whole. However, high and adverse human health or environmental effects from construction of individual projects may occur at a specific location. This could be true with respect to impacts, including but not limited to noise, visual resources, and land use. In conclusion, potential impacts from construction are not anticipated to be high and adverse or disproportionately impact low-income or minority populations; however, the location and specific elements of the wind energy development is not known.

Compared to Alternative D, the construction-related impacts are the same.

4.12.3.2 Operation-Related Impacts

Output, Employment, and Income

Operations of 33,000 MW of new wind energy capacity will support local employment and earnings and add value to local economies. Table 4.12-2 provides estimates of the economic contribution of new wind energy capacity in the study area. Estimates were obtained using the NREL Jobs and Economic Development Impact models for each state separately and inputting estimated new installed capacity, as developed in the MSHCP. The NREL estimates assume 300 MW projects using 2 MW turbines and operation and maintenance costs of $20 per kW in 2013 dollars. Table 4.12-2 also shows estimates for annual lease payments assuming payments of $6,000 per turbine, also in 2013 dollars. The resulting estimates shown in Table 4.12-2 were updated to 2014 dollar values to allow comparison with values in Tables 3.12-4 and 3.12-5 (using Bureau of Labor Statistics 2015b). Jobs are shown in Full-Time Equivalents.

Table 4.12-2. Contribution of Operations of New Wind Energy Capacity in the Study Area

	New Installed Capacity (MW) by 2030	Annual Land Lease Payment Estimate	Annual Estimated Impacts of New Operations		
			Value Added (millions of 2014 $)	FTE Jobs	Labor Earnings (millions of 2014 $)
Illinois	4,094	$12,480,968	$101.2	655	$44.4
Indiana	5,848	$17,828,213	$198.1	1,131	$61.4
Iowa	9,765	$29,769,579	$172.0	1,432	$76.1
Michigan	727	$2,216,332	$28.1	158	$8.6
Minnesota	2,030	$6,188,658	$35.8	291	$17.9
Missouri	971	$2,960,191	$12.5	133	$7.6
Ohio	7,108	$21,669,449	$310.6	1,682	$93.9
Wisconsin	2,457	$7,490,410	$37.5	352	$20.0
Grand Total [a]	**33,000**	**$100,603,800**	**896**	**5,833**	**$330**

Sources: National Renewable Energy Laboratory 2015; Bureau of Labor Statistics 2015b.
MW = megawatts.
[a] Estimated value added, jobs and earnings impacts for the study area as a whole may be underestimated, because the potential resulting impacts to neighboring states are not included.

Assuming one full-time equivalent job were filled by one worker, the 5,833 total new wind energy related jobs in the Plan Area corresponds to less than 0.02 percent of the 31 million labor force of the Plan Area (Table 3.12-3). The new wind energy related $896 million in value added corresponds to almost 0.03 percent of the $3,162,662 million GDP of the Plan Area. The average annual contribution of the new wind energy related jobs and value added to each state, over the 30 year operations planning period, will vary from less than 0.01 percent in Missouri and Michigan to around 0.1 percent in Iowa.

Owners of property leased for development of wind energy projects are estimated to jointly receive approximately $100 million annually over the 30-year operations planning period, assuming a payment of $6,000 per turbine in 2013 dollars.

Management of compensatory mitigation lands and the monitoring program should generate additional output, employment and income in the Plan Area. Because of the modest amount of labor required for operation of these programs, the impact on output, employment and income in the Plan Area will be negligible.

The potential value-added energy output (positive revenue) under Alternative A is expected to be minor across the eight-state study area, but could be moderate (and positive) when looking at impacts relative to a specific community. The potential lease payments, jobs, and labor earnings (positive, beneficial) from operation activities under Alternative A are expected to be minor in the long-term across the eight-state study area, but could be moderate (and positive) depending on the project details and their location.

Population

Because the average annual contribution of the new wind energy projects to job creation would be less than 0.1 percent of the labor force in any state in the Plan Area, the Service does not expect any

perceptible impact on population in the Plan Area. Therefore, the potential operation-related impacts resulting in an increase in population will be minor across the eight-state Plan Area.

Demand for Housing and Public Services

The operation-related impacts on housing and public services from the inflow of workers to individual project sites will be proportional to the increase in population. As discussed above, this increase will be minor.

Property Values

A review of the current literature suggests there is little evidence of an impact of wind energy facilities on surrounding property values.

A 2013 study by the Lawrence Berkeley National Laboratory collected data on about 50,000 home sales among 27 counties in nine states, within 10 miles of 67 different wind energy facilities (Lawrence Berkeley National Laboratory 2013). The study found no statistical evidence that property values near wind energy facilities were impacted in either the pre- or post-construction phase of the wind energy facilities.

A 2014 joint study by the University of Connecticut and the Lawrence Berkeley National Laboratory analyzed data on about 122,000 home sales, between 1998 and 2012, in densely populated Massachusetts communities near current or planned sites of 41 wind turbines (University of Connecticut and Lawrence Berkeley National Laboratory 2014). Despite weak evidence that the announcement of a wind energy project can cause a modest adverse impact on home prices, this impact disappeared during the construction and post-construction phase of wind energy facilities. Overall, the study concluded that the introduction of wind energy facilities had no net effect on property values.

A 2013 study by the University of Rhode Island analyzed data from 48,554 homes within 5 miles of wind energy facilities in Rhode Island and further categorized these homes according to their relative distance from the facilities (University of Rhode Island 2013). The study authors found that, relative to properties 3 to 5 miles from wind energy facilities, properties within 0.5 mile of wind energy facilities experienced an estimated price change of -0.2 percent. The study authors concluded that "wind towers have virtually no effect on prices of nearby properties" (University of Rhode Island 2013).

In conclusion, the potential impacts to property values from operation activities under Alternative A should be minor.

Consumer Electricity Rates

The extent to which wind energy development will reduce or increase energy rates paid by consumers depends largely on production costs relative to other sources of energy. Production costs relative to other sources of energy depend on technology development, fluctuate with market prices, and are also considerably influenced by tax incentives. A number of recent studies have focused on the influence of tax incentives and public policies on the cost of wind power, arguing the private cost of wind power is lowered considerably by current tax incentives and public policies (Simmons *et al.* 2015; Giberson 2013; U.S. Government Accountability Office 2013). Because of the high level of uncertainty regarding the development of the factors affecting energy costs over the 45-year

planning period, the Service cannot predict the extent to which development of new wind energy in the Plan Area will affect consumer electricity rates.

Fiscal Revenues

Operations of wind energy projects may contribute to state and local fiscal collections through state corporate income taxes, sales and use taxes, property taxes and production taxes, among others. Sales taxes tend to be of particular importance to states and property taxes tend to be of greater importance to local governments. Electric power utilities are an important source of local fiscal revenues in some counties. The fiscal contribution of wind energy projects to states and local governments over the 45-year MSHCP period depends largely on what tax incentives are in place. Since 1995, North Carolina State University maintains a database of tax incentives for renewable energy by state. Some of the tax incentives include the following shown in Table 4.12-3.

Table 4.12-3. State Fiscal Incentives for Wind Energy Developers

Federal	Renewable electricity production tax credit (PTC), Business energy investment tax credit (ITC), DOE loan guarantee program
Illinois	Sales tax exemption for wind energy business designated high impact business
Indiana	Sales and use tax exemption for electrical generating equipment
Iowa	Renewable energy equipment exemption, local (county) option for special assessment of wind energy devices, energy replacement generation tax exemption, renewable energy production tax credits
Michigan	None
Minnesota	Wind energy sales tax exemption, wind energy systems property tax exemption
Missouri	None
Ohio	Qualified energy property tax exemption for projects over 250 kW
Wisconsin	Wind energy equipment property tax exemption

Source: North Carolina State University 2015.
kW = kilowatts

Additional tax incentives may exist at the county level. Because the value added is a small share of the Plan Area GDP (as discussed above) and because of the tax incentives for renewable energy in the Plan Area (see Section 4.12.3.2 for more detail), the increased fiscal revenues from the new wind energy projects in the Plan Area as a whole during operations will be negligible. However, the contribution of individual projects to the increased fiscal revenues of the counties where they are located could be meaningful, depending on the location of the project and county level tax incentives in place. Therefore, the increase in fiscal revenues from the new wind energy projects during operation will be minor but positive across the eight-state Plan Area, and impacts could be moderate if the increased revenue has a positive impact on a relatively small community.

Disproportionately High and Adverse Human Health or Environmental Effects on Minority or Low-Income Populations

Chapter 4 of this EIS assesses potential impacts of operation of new wind energy facilities on specific environmental and socioeconomic resources. No potentially high and adverse human health or environmental effects from operation of 33,000 MW of new wind energy capacity were identified for the Plan Area as a whole. However, high and adverse human health or environmental effects from

the operation of individual projects may occur at a specific location. This could be true with respect to impacts, including but not limited to noise, visual resources, and recreational land use. In conclusion, potential impacts from operations are not anticipated to be high and adverse or disproportionately impact low-income or minority populations; however, the location and specific elements of the wind energy development is not known.

Compared to Alternative D, the operation-related impacts are the same.

4.12.4 Alternative B—Reduced Permit Duration

4.12.4.1 Construction-Related Impacts

All socioeconomic and environmental justice impact mechanisms associated with construction activities under Alternative B will generally be the same as those described under Alternative A. Although both alternatives contemplate up to 33,000 MW of new wind energy development, 11,000 MW could occur on Covered Lands and the other 22,000 MW could occur anywhere within the study area. Therefore, the location of construction-related socioeconomic and environmental justice impacts may not be the same, but are expected to range from minor to moderate depending on the project details such as location and the duration of the construction activities. Compared to Alternative D, the construction-related impacts are the same.

4.12.4.2 Operation-Related Impacts

All socioeconomic and environmental justice impact mechanisms associated with operations under Alternative B will generally be the same as those described under Alternative A. Although both alternatives contemplate up to 33,000 MW of new wind energy development, 11,000 MW could occur on Covered Lands and the other 22,000 MW could occur anywhere within the study area. Therefore, the location of operation-related socioeconomic and environmental justice impacts may not be the same, but are expected to range from minor to moderate depending on the project details such as location. Compared to Alternative D, the operation-related impacts are the same.

4.12.5 Alternative C—Increased Cut-In Speed

4.12.5.1 Construction-Related Impacts

All socioeconomic and environmental justice impact mechanisms associated with construction activities under Alternative C will generally be the same as those described under Alternative A, and are expected to range from minor to moderate depending on the project details such as location and the duration of the construction activities. This applies to all the impact mechanisms described in Section 4.12.3.1. Compared to Alternative D, the construction-related impacts are the same.

4.12.5.2 Operation-Related Impacts

Most socioeconomic and environmental justice impact mechanisms associated with operation activities under Alternative C will generally be the same as those described under Alternative A, and are expected to range from minor to moderate depending on the project details such as location, with a few minor differences described here. Alternative C will increase cut-in speeds during specific times of the year and depending on location, time of day and temperature. The increase in cut-in speeds will decrease the power generated by individual projects. It will also likely increase

management costs for wind energy project operators who will need to set up processes for adjusting cut-in speeds according to changes in field conditions. The result will be a decrease in the energy output, and may result in decreases in employment and income contribution to the Plan Area. The extent to which this happens depends on the specific location of individual projects. Compared to Alternative D, the operation-related impacts are expected to be less beneficial due to the decrease in power generated, increase in management costs, and potential decrease in employment and income contribution.

4.12.6 Alternative D—No Action

4.12.6.1 Construction-Related Impacts

Construction-related socioeconomic and environmental justice impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described under Alternative A. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development, and could range from minor to moderate (positive, beneficial) depending on the project details such as location and the duration of the construction activities.

4.12.6.2 Operation-Related Impacts

Operation-related socioeconomic and environmental justice impact mechanisms associated with installation of new wind energy facilities under Alternative D will be the same as those described under Alternative A, and are expected to range from minor to moderate depending on the project details such as location. Although the location of impacts may vary because new wind development under Alternative D could occur anywhere within the study area (rather than limited to the Covered Lands), the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development.

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4.13 Cultural Resources

This section provides the regulatory setting applicable to cultural resources and describes the potential impacts on cultural resources in the study area for each of the alternatives. As previously described, the study area for cultural resources is concurrent with the Plan Area. This section also provides the methods and approaches for completing the impacts analysis for cultural resources. Given the scale of the study area, this section broadly describes the effects that may occur on cultural resources.

4.13.1 Regulatory Context

4.13.1.1 Section 106 of the National Historic Preservation Act of 1966, As Amended

Section 106 of the National Historic Preservation Act (NHPA) (54 U.S.C. 300101 et seq.) requires Federal agencies to take into account the effects of their undertakings on historic properties. Historic properties include both architectural and archaeological resources that are listed as eligible for inclusion in the National Register of Historic Places (NRHP). Architectural resources include buildings, structures, objects, sites, and districts, usually above ground. Archaeological resources are physical remains, usually subsurface of the prehistoric (Native American) and historic periods, including burials, foundations, artifacts, wells, and privies. Historic properties may also include properties with religious and cultural significance to federally recognized Indian tribes. Issuance of an ITP by the Service is a Federal undertaking subject to compliance with the NHPA.

The Section 106 process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation between the Federal agency and other parties interested in the effects of those undertakings on historic properties. It also affords the Advisory Council for Historic Preservation (ACHP) a reasonable opportunity to comment on those undertakings. The ACHP has issued regulations on how to carry out the historic preservation review process mandated by Section 106.

Tribal Consultation under Section 106

Section 106 also lays out the requirements for tribal consultation at 54 U.S.C. 302701(e), which requires Federal agencies, when carrying out their Section 106 responsibilities, to consult with any Indian tribe and Native Hawaiian organization that attaches religious and cultural significance to historic properties that could be affected by a Federal undertaking. For federally recognized tribes, tribal consultation must be carried out by the Federal government following the guidelines and practices established by the ACHP for government-to-government consultation. For the alternatives, the Service is responsible for coordinating with federally recognized tribes as the lead Federal agency. In keeping with these guidelines, Indian tribes should be afforded the opportunity to identify their concerns and provide input on the process to identify sensitive cultural resources, and also to provide input on and the approach to the resolution of potential adverse effects.

4.13.2 Methods and Approach

The analysis of the potential effects to historic properties is undertaken by applying the criteria of adverse effect at 36 CFR § 800.5(a)(1). An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative. Impacts on cultural resources are assessed at a programmatic level because the characteristics and location of individual wind energy projects that may be proposed and implemented in the study area are not known.

4.13.3 Alternative A—Proposed MSHCP Alternative

4.13.3.1 Construction-Related Impacts

Disturbance or Alteration of Historic Properties

Construction of wind energy infrastructure under Alternative A may adversely affect historic properties where those properties occur on or in close proximity to areas where infrastructure may be sited. Adverse effects on historic properties include, but are not limited to:

- Physical destruction of or damage to all or part of a historic property;
- Alteration of a historic property, including the restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 68) and applicable guidelines;
- Removal of a historic property from its historic location;
- Change of the character of the historic property's use of or physical features within the property's setting that contribute to its historic significance;
- Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significantly historic features;
- Neglect of the historic property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe; and
- Transfer, lease, or sale of a historic property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

As described in Section 4.13.1.1, Section 106 of the NHPA requires Federal agencies to consider the effects of their undertakings on cultural resources, including the effects new construction may have on historic properties. In circumstances where the footprint of a specific project is known, the Service's Regional Historic Preservation Officer (RHPO) works with the project applicant to identify an area of potential effects (APE) and to assess the potential for ground disturbing or other land alteration activities to affect historic properties within the APE. Where a historic property may be adversely affected, the Service, in collaboration with the applicant, State Historic Preservation

Officer (SHPO), Tribes, and other individuals with an interest in the affected property, work to identify site-specific avoidance and minimization that resolve or reduce the adverse impacts. If the facilities will be on tribal lands, the Tribal Historic Preservation Officer (THPO) may assume the functions of the SHPO.

Under Alternative A, the specific locations of future wind energy facilities that may be permitted under the MSHCP are not known, and an APE cannot be determined until individual project applicants request ITP coverage under the MSHCP. Under 36 CFR 800.14(b)(1)(iii), a Federal agency and the ACHP may negotiate a PA "when effects on historic properties cannot be fully determined prior to approval of an undertaking." Accordingly, to meet the requirements of Section 106 under Alternative A, the Service anticipates executing Programmatic Agreements (PAs). Appendix F includes a draft PA from another wind energy project, the Buckeye Wind Power Project. This draft PA provides a representative example of the process that must be utilized by each ITP applicant to identify and avoid adverse effects on historic properties and other cultural resources. The Service anticipates the ACHP, wind industry, and SHPOs within the Plan Area will be signatories to the PA.

Implementation of a PA under Alternative A will ensure potential effects on historic properties from construction of new wind energy infrastructure are specifically considered before an ITP is issued, and resolved or minimized to the extent possible. Accordingly, impacts to historic properties will not be substantial and would instead be minor with the implementation of a PA.

Disturbance of Unknown or Buried Cultural Resources

Construction of new wind energy facilities under Alternative A will result in varying degrees of ground-disturbance depending on the size, location, and configuration of the proposed development. Ground disturbing activities have the potential to adversely impact cultural resources if those resources are buried and inadvertently disturbed during installation of wind infrastructure, access roads, or staging areas. However, if buried resources are located during construction, all activities at the project site will be halted, and the SHPO will be contacted within 24 hours to examine the find.

As described above, under Alternative A, the Service, through a PA, will work with individual ITP applicants to ensure buried cultural resources (or areas particularly sensitive for buried cultural resources) are identified prior to construction, and that measures are included to avoid potential adverse impacts to those resources. Accordingly, implementation of a PA under Alternative A should ensure potential effects on buried cultural resources from construction of new wind energy infrastructure are minor.

Compared to Alternative D, the construction-related impacts are expected to be less due to the protective nature of implementing a PA.

4.13.3.2 Operation-Related Impacts

The operation of wind energy facilities could result in visual impacts to cultural or historic resources. The extent of the impacts will depend upon the exact siting and layout of the WTGs relative to visually sensitive cultural or historic resources. The visual impacts to cultural or historic resources could be moderate or substantial depending on the project details such as the number of WTGs and location. Implementation of a PA will ensure potential visual effects on cultural or historic properties from operation of new wind energy infrastructure are specifically considered before an ITP is issued, and minimized or mitigated to the extent possible. Accordingly, operation-related

impacts to cultural and historic properties will not be substantial and would instead be minor with the implementation of a PA.

Compared to Alternative D, the operation-related impacts are expected to be less due to the protective nature of implementing a PA.

4.13.4 Alternative B—Reduced Permit Duration

Construction-related cultural resources impact mechanisms under Alternative B will be the same as those described for Alternative A, and impacts are expected to be minor due to the implementation of a PA. Although the location of impacts may vary because 11,000 MW will be restricted to Covered Lands, and the other 22,000 MW of development could occur anywhere within the Plan Area, the impacts will be comparable in scale since both alternatives contemplate up to 33,000 MW of new wind energy development. The process by which the individual ITP applicants comply with Section 106 of the NHPA compliance process will be the same as that described for Alternative A. Similar to Alternative A, the operation of wind energy facilities could result in visual impacts to cultural or historic resources but will be minor due to being mitigated through the PA process. Compared to Alternative D, the operation-related impacts and construction-related impacts are expected to be less due to the protective nature of implementing a PA.

4.13.5 Alternative C—Increased Cut-In Speed

Construction-related cultural resources impact mechanisms under Alternative C will be the same as those described for Alternative A, and impacts are expected to be minor due to the implementation of a PA. Increased cut-in speeds proposed in Alternative C will not increase or decrease the likelihood of direct or indirect impacts to historic properties or cultural resources and impacts will be the same as those described under Alternative A. The process by which the individual ITP applicants comply with Section 106 of the NHPA compliance process will be the same as that described for Alternative A. Similar to Alternative A, the operation of wind energy facilities could result in visual impacts to cultural or historic resources but will be minor due to being mitigated through the PA process. Compared to Alternative D, the operation-related impacts and construction-related impacts are expected to be less due to the protective nature of implementing a PA.

4.13.6 Alternative D—No Action

Under Alternative D, it is assumed that, for the wind energy developers and operators who coordinate with the Service, compliance with Section 106 will continue to occur on a project-by-project basis, as the Service receives ITP applications from wind proponents. However, because coordination with the Service does not currently occur for all existing and proposed wind energy facilities, wind energy facilities will continue to be built and operated without coordination with the Service and subsequent Section 106 consultation. Accordingly, construction and operational impacts to cultural resources under Alternative D may be substantial, as Section 106 consultation will only occur for a subset of all existing and proposed wind energy development.

Chapter 5
Cumulative Effects

5.1 Overview

The Council on Environmental Quality (CEQ) Regulations that implement the National Environmental Policy Act (NEPA) define a cumulative impact as "the impact on the environment which results from the incremental consequences of an action when added to past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions" (40 Code of Federal Regulations [C.F.R.] § 1508.7). This chapter describes the cumulative impacts resulting from the addition of impacts from the alternatives to impacts of other past, present, and reasonably foreseeable future projects and actions, captured in this analysis as trends.

The sections that follow describe the cumulative impacts in the study area, the methods used to analyze cumulative impacts, and the environmental consequences. The contribution of impacts from the alternatives to cumulative impacts is summarized for each resource area examined in this Draft Environmental Impact Statement (EIS). Appendix G, *Cumulative Impacts Analysis*, provides a table for each state and trends applicable to that geographic area.

In summary, cumulative impacts result from the impacts of population shifts (increased urbanization and suburbanization), agricultural trends concerning agricultural productivity and farmland values, and economic growth (e.g., industrial, technological, and energy sectors including renewable energy). These cumulative impacts affect most resources analyzed in this Draft EIS to varying degrees. Resources that potentially have substantial cumulative impacts include protected bats, migratory tree bats, and visual resources. Transportation potentially has moderate cumulative impacts; however, these types of impacts only occur in areas affected by suburban sprawl or experiencing greater economic growth. Air quality and climate changes have the potential for beneficial cumulative impacts. Other resources have negligible, potential or minor cumulative impacts.

5.2 Study Area and Approach

This section explains the study area, analysis approach, and summarizes the actions included in the analysis. Please see Appendix G, *Cumulative Impacts Analysis*, for more detail on the trends analyzed.

5.2.1 Cumulative Effects Study Area

As described in the Multi-Species Habitat Conservation Plan (MSHCP), the Plan Area encompasses each of the eight states associated with the Midwest Region of the U.S. Fish and Wildlife Service (Service): Ohio, Indiana, Illinois, Missouri, Michigan, Minnesota, Wisconsin, and Iowa. Covered Lands are a subset of the Plan Area where incidental take authorization for Covered Species is being considered. Compensatory mitigation under the MSHCP is expected to occur anywhere within the Plan Area, as appropriate for Covered Species.

The cumulative impacts analysis study area (study area) encompasses the same geographic area (spatial boundary) as the Plan Area—the eight states associated with the Midwest Region of the

Service—the Midwest and Ozark Central Recovery Units (RU) boundaries for the Indiana Bat range, and habitat for nesting birds that may extend beyond the Plan Area. The cumulative impacts analysis covers the same time frame (temporal boundary) that is applicable to the MSHCP—up to 15 years for construction and the option for participants to opt into the MSHCP, and an additional 30 years for general operations (up to a total MSHCP term of 45 years).

5.2.2 Cumulative Effects Approach

The cumulative analysis is a programmatic-level review of various relevant trends or actions that are or could affect resources also potentially affected by the alternatives. Specifically, the analysis looks at the contribution of the alternatives to cumulative impacts on various resources.

For all alternatives, wind energy development is expected to occur in the upper mid-west region with or without a regional HCP. Under Alternative D, construction could occur anywhere within the eight states. Under Alternatives A–C, construction will occur anywhere within the Covered Lands. Differences between potential impacts of the alternatives are noted where applicable.

5.2.3 Actions Considered in Analysis

The cumulative effects analysis utilizes population, land use, mortality, White Nose Syndrome (WNS), and economic data to characterize trends in the study area that may contribute to cumulative effects when considered in combination with the alternatives. The following three trends were identified as regional trends throughout the study and will be explained in greater detail below.

- Trend A – Population Shifts: urbanization and suburbanization (e.g., suburban sprawl)
- Trend B – Agricultural Trends: productivity/value (e.g., farmland value trends)
- Trend C – Economic Growth: industries fueling growth (e.g., industrial, technological, and energy sectors including renewable energy)

Population shifts, particularly increased urbanization and suburbanization, were identified as a regional trend in the study area. Cities in the study area such as Minneapolis/St. Paul, Des Moines, Kansas City, Cincinnati, and Indianapolis are experiencing population growth and reductions in population sprawl, whereas other cities such as Milwaukee, Detroit, Grand Rapids, Cleveland, Columbus, and Chicago are experiencing growth in their suburbs. While the particulars of this trend varied among states and within states, overall the suburban share of metropolitan growth averaged more than 100 percent in the Midwest (compared to 83.7 percent nationally) as a result of population losses in several large Midwestern cities.

Agricultural trends concerning productivity and farmland values were also identified as a regional trend in the study area. Recent trends indicate that farms are declining in the Midwest. Overall, farming is declining as a primary source of income for farmers and the share of farmers with primary occupations off the farm has grown to around 50 percent. The cost of farmland continues to rise along with expenses related to farming, such as equipment, fuel, feed, fertilizer, and pesticides. This is further exacerbated by the aging population of farmers. Finally, increases in land valuations and property taxes are outpacing crop prices thereby indicating that farmland values and agricultural outputs are expected to decline. These trends are apparent throughout the states identified in the study area.

The trend of economic growth in the study area varies among states and within states. Overall, growth is occurring in industrial, technology, and energy sectors in this region. Regional transportation plans are being developed to increase connectivity and passenger rail between cities and states. In addition to investments in transportation and infrastructure, the region is seeing many investments in wind energy as its technology is advancing and the costs are declining. Different industry clusters are also forming in the cities throughout the region as manufacturers and businesses are expanding and investing in Midwestern cities. From these trends, increases in job creation and job growth are occurring throughout the region.

Of particular interest in the Plan Area and neighboring RUs are the spread of WNS and effects of urbanization on bats. Primary literature was used to provide details on the status of effects of WNS, a fatal bat disease that is leading to wide-spread mortality amongst bats (including Covered Species) in the region. Impacts of urbanization on bats (including all three Covered Species) have been studied extensively at the Indianapolis International Airport (Sparks *et al.* 2009), and expertise gained from that study is included below.

For additional information on these trends, please refer to the tables for each state in Appendix G, *Cumulative Impacts Analysis*.

5.3 Environmental Consequences by Resource

5.3.1 Biological Resources

5.3.1.1 Vegetation

The cumulative effects analysis of vegetation focuses on the loss or alteration of natural vegetation within the Plan Area. The primary impacts to vegetation from the alternatives include permanent removal and temporary disturbance of vegetation; constraining plant germination and growth through soil compaction and erosion; spread of invasive weeds; affecting plant growth from dust deposition; and accidental petro-chemical spills. The identified trends - population shifts, falling farmland values, and economic growth –all contribute to similar types of impacts to vegetation due to construction associated with changes in land use and with infrastructure development. The magnitude of the potential impacts to vegetation is roughly proportional to the area of land disturbance. The area of land disturbance from wind energy development is expected to be several orders of magnitude smaller than the likely area of land disturbance from the broader development trends in the eight-state Plan Area; therefore, the contribution of wind energy development to the cumulative impacts on vegetation is expected to be minor. Because all of the alternatives involve the construction of up to 33,000 MW of new wind energy capacity within the Plan Area, the cumulative impacts are similar among the alternatives. Therefore, impacts from the alternatives when added to impacts from the identified trends are expected to result in minor cumulative impacts on vegetation.

5.3.1.2 Covered Species

Kirtland's Warbler

Human population growth trends in the Plan Area are expected to have little effect on Kirtland's warbler breeding habitat because it is predicted to occur largely in metropolitan regions, while declines are expected to occur in rural areas of Michigan and Wisconsin where Kirtland's warbler

breeding habitat occurs. This trend is likely to continue through the 15-year opt-in period. In the 30–45 year MSHCP permit period, rural population declines may slow as population reaches a minimum size to support industrialized agriculture. With continued economic recovery and strong income growth in the Great Lakes states, however, cabin and hunting camp development may occur on private lands in and near breeding habitat. This could affect Kirtland's warbler breeding habitat by making it more challenging to use prescribed burning to maintain breeding habitat. Buildings, transmission lines, vehicles and tall towers are a significant cause of bird fatalities, and migratory passerine birds, including Kirtland's warbler, experience the majority of fatalities. To the extent that economic growth in the Plan Area continues, it will result in new construction and increased vehicle use, and thus, migratory passerine fatalities are expected to increase over the MSHCP permit term. The impact mechanisms and effects associated with growth trends and development under the cumulative actions considered are expected to be generally similar to the impact mechanisms and effects described for Kirtland's warbler for construction of wind energy facilities (see Section 4.1, *Biological Resources*). It is important to note that proponents of projects considered in this cumulative effects analysis are responsible under the ESA to ensure their action will not jeopardize the continued existence of the species.

Alternative A—Midwest Wind Energy MSHCP

To the extent that economic growth promotes development of cabins and hunting camps in and near Kirtland's warbler breeding habitat, cumulative impacts under Alternative A could result in reduced capacity to manage breeding habitat. Development in and near breeding habitat may include clearing of trees and brush for cabins, hunting camps, new roads, transmission lines, and commercial enterprises such as restaurants and gas stations. This will increase fragmentation of breeding habitat and potentially reduce warbler nesting success due to higher rates of nest parasitism in the vicinity of these developments. Economic growth also may affect the warbler during its migration by increasing the risk of collision. Economic growth over the 45-year term of the HCP is predicted to be considerable, assuming 1.5–2.5 percent per year, which is a reasonable economic growth projection given recent regional growth patterns. This represents at least a doubling of the development footprint in the Plan Area, with much of that concentrated in the high density population and industrial centers along this warbler's migratory route in Ohio, Michigan, Indiana, Illinois, and Wisconsin. The consequences of a doubling of the development footprint along the migration route may represent twofold increase in those factors which account for the majority of fatalities to Kirtland's warbler while it is in flight. These collision factors, from greatest to least, are buildings, transmission lines, moving vehicles, and tall towers, especially those with guy wires (Erickson *et al.* 2005). To this could be added fatalities due to other sources (as described in Section 4.1.4.3). Thus trends in development are expected to have a substantially greater future effect on Kirtland's warbler during migration than wind energy development, which currently represents much less than 1 percent of all bird fatalities caused by these other factors (see Section 4.1.4.3), and in the future is expected to represent a similarly small percentage of all bird facilities. Implementation of the AMMs listed in Chapter 2 would help minimize the cumulative number of bird fatalities in the study area. Under Alternative A, wind energy development will not occur in or near breeding habitat.

Alternative B—Reduced Permit Duration

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. An important difference is that, under Alternative B, wind energy development will not occur in or near breeding habitat during the first

11,000 MW of wind energy facility development, but could occur in or near breeding habitat in the subsequent 22,000 MW of development, adding to consequences of population and economic growth trends. Implementation of the AMMs listed in Chapter 2 for the 11,000 MW of wind energy would help minimize the cumulative number of bird fatalities in the study area.

Alternative C—Increased Cut-In Speed

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. Increased cut-in speed under Alternative C will not be expected to have an effect on Kirtland's warbler, or at most a minor beneficial effect. Implementation of the AMMs listed in Chapter 2 would help minimize the cumulative number of bird fatalities in the study area.

Alternative D—No Action

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. An important difference is that, under Alternative D, wind energy development could occur in and near breeding habitat, compounding issues caused by trends in population and economic growth. Also, the AMMs listed in Chapter 2 would not be implemented under Alternative D.

Piping Plover

Population, agriculture, and economic growth trends for piping plover are similar to those for Kirtland's warbler, with the additional issue that development in and near breeding habitat for the Great Lakes population of piping plover is expected to increase with economic growth due to development and increased use of breeding habitat and foraging areas for beach-oriented recreation. This development will largely consist of new homes, garages, driveways, and power poles built at the edges of the dune and beach habitat used by plovers for breeding and foraging. Assuming a doubling of development in the region over the next 45 years, the amount of development at these locations will be expected to increase twofold. It is, however, more likely that these highly desirable locations will be developed at a faster rate and more completely than at other locations in the region. Observations by plover monitors at nesting beaches indicate that, with greater development comes greater human use of beaches and dunes. Off-leash dogs brought to beaches by people can disturb adults and cause death of eggs and chicks. With increased human activity and a greater presence of dogs, disturbances to nesting or foraging adults can in turn expose chicks to gulls, crows, raccoons, foxes, and other predators. When adults leave the nest, eggs and chicks are exposed to cold and damp weather. When adults are away from the nest for long periods during inclement weather, the survival rates of eggs and chicks fall.

The impact mechanisms and effects associated with growth trends and development under the cumulative actions considered will be generally similar to the impacts described for piping plover for construction of wind energy facilities (see Section 4.1, *Biological Resources*). It is important to note that proponents of projects considered in this cumulative effects analysis will also be responsible under the Endangered Species Act (ESA) process to ensure their action will not jeopardize the continued existence of the species.

Alternative A—Midwest Wind Energy MSHCP

To the extent that economic growth promotes the expansion of shoreline development in and near piping plover breeding habitat, cumulative impacts under Alternative A could result in reduced nesting success. With a doubling of the development footprint over the 45-year HCP term, presumably piping plover collision risk will be higher. On the other hand, shorebird collision rates are extremely low; even a doubling of the rate will not represent a substantial effect on the population of piping plover. Implementation of the AMMs listed in Chapter 2 would help minimize the cumulative number of bird fatalities in the study area. Under Alternative A, wind energy development will not occur in or near breeding habitat.

Alternative B—Reduced Permit Duration

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. Under Alternative B, wind energy development will not occur in or near breeding habitat during the first 11,000 MW of wind energy facility development, but could occur in or near breeding habitat in the subsequent 22,000 MW of development, adding to the effects of economic growth. Implementation of the AMMs listed in Chapter 2 for the 11,000 MW of wind energy would help minimize the cumulative number of bird fatalities in the study area.

Alternative C—Increased Cut-In Speed

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. Increased cut-in speed under Alternative C will not be expected to have an effect on piping plover. Implementation of the AMMs listed in Chapter 2 would help minimize the cumulative number of bird fatalities in the study area.

Alternative D—No Action

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. Under Alternative D, wind energy development could occur in and near breeding habitat, adding to impacts from regional trends. Also, the AMMs listed in Chapter 2 would not be implemented under Alternative D.

Interior Least Tern

Population, agriculture, and economic growth trends for interior least tern are similar to those for Kirtland's warbler, with the additional issue that recreational activities in and near breeding habitat on the Ohio and Wabash Rivers may increase with economic growth in nearby metropolitan areas whose residents may engage in recreation on beaches of those rivers. This will increase disturbances of nesting or foraging adults, which in turn could expose chicks to predation and adverse weather conditions that reduce survival.

The impact mechanisms and effects associated with growth trends and development under the cumulative actions considered will be generally similar to the impacts described for interior least tern for construction of wind energy facilities (see Section 4.1, *Biological Resources*). It is important to note that proponents of projects considered in this cumulative effects analysis will also be responsible under the ESA to ensure their action will not jeopardize the continued existence of the species.

Alternative A—Midwest Wind Energy MSHCP

To the extent that economic growth promotes the expansion of recreation on river beaches in and near interior least tern breeding habitat at the southern edge of the Plan Area, cumulative impacts under Alternative A could result in reduced nesting success. With a doubling of the development footprint over the 45-year HCP term, presumably interior least tern collision risk will be higher. On the other hand, water bird collision rates are extremely low; even a doubling of the rate will not represent a substantial effect on the population of interior least tern. Implementation of the AMMs listed in Chapter 2 would help minimize the cumulative number of bird fatalities in the study area. Under Alternative A, wind energy development will not occur in or near breeding habitat.

Alternative B—Reduced Permit Duration

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. An important difference is that, under Alternative B, wind energy development will not occur in or near breeding habitat during the first 11,000 MW of wind energy facility development, but could occur in or near interior least tern breeding habitat in the subsequent 22,000 MW of development, compounding effects due to regional trends. Implementation of the AMMs listed in Chapter 2 for the 11,000 MW of wind energy would help minimize the cumulative number of bird fatalities in the study area.

Alternative C—Increased Cut-In Speed

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. Increased cut-in speed under Alternative C will not be expected to have an effect on interior least tern because curtailment occurs during bat migration and therefore only occurs at night. Implementation of the AMMs listed in Chapter 2 would help minimize the cumulative number of bird fatalities in the study area.

Alternative D—No Action

The mechanisms for the cumulative impacts of trends in population, agriculture, and economic growth in the Plan Area are like those under Alternative A. An important difference is that, under Alternative D, wind energy development could occur in and near interior least tern breeding habitat, adding to effects from regional trends. Also, the AMMs listed in Chapter 2 would not be implemented under Alternative D.

Bald Eagle

Human population growth trends will result in the expansion of suburban areas around the large urban areas of the Plan Area over the 15-year opt-in and the 30–45 year MSHCP permit periods. Rural counties are expected to continue their population declines due to farm consolidation, although regional centers in rural areas will experience slow but steady population growth. Agricultural commodity prices affect the rate of land clearing, which in turn affects the amount of forest edge habitat near large water bodies. It is difficult to predict trends in agricultural price, however, given the uncertainties around global commodity production and climate trends. It is possible that agricultural commodity prices, which are currently at a low point, would rise again, stimulating land clearing in the Plan Area. The land by agricultural producers, however, usually involves fencerows, formerly cultivated ground with young trees, and forest edges, and not entire woodlots with mature trees which are typically used as nest sites by bald eagles in the Plan Area.

Forest edges within a mile of large water bodies represent the best eagle nesting habitat in the Plan Area. Congregation areas outside the breeding season also occur at large water bodies. With continued economic recovery and steady income growth in the Great Lakes states, where most of the Plan Area's eagles breed, development for recreation and homes will occur in and near breeding and winter foraging habitat along the Great Lakes and the large rivers and lakes of the Plan Area. This trend has been ongoing for decades and will continue to bring development and activity into close proximity with the Plan Area's better bald eagle nesting and foraging habitat. It is likely that these highly desirable locations will be developed at a faster rate and more completely than at other locations in the Plan Area. Furthermore, large rivers and lakes within commuting distance of large metropolitan areas may also develop more quickly and completely than rural areas and small urban areas of the Plan Area.

While eagles have been documented to habituate to some degree to development and human activity, the Service's National Bald Eagle Management Guidelines (U.S. Fish and Wildlife Service 2007) recommends physical and visual separation of 330 to 660 feet between eagle nests and developments. It is likely that economic growth trends and associated development near large water bodies in the Plan Area will encroach on these recommended setbacks, reducing the quantity of eagle nesting habitat at ideal nesting locations in the Plan Area.

Economic development trends will increase the number of buildings, transmission lines, vehicles and tall towers in the Plan Area. While these are a significant cause of bird fatalities, the visual acuity of eagles greatly reduces the collision probability compared to passerine birds which account for the majority of collision fatalities. The Service's Final Environmental Assessment (FEA) for the 2009 Eagle Take Permit Rule identified collisions as representing 2 percent of eagle fatalities in the Great Lakes Eagle Management Unit, a number greatly exceeded by poisoning, shooting, electrocution and trapping. Collision with wind turbines represented 0.6 percent of all fatalities, according to the FEA.

While the bald eagle population in the Plan Area has been increasing steadily since DDT was banned in 1972, the trend cannot continue indefinitely. Eagle population growth in the Plan Area will eventually cease. At that point, it is likely that the human population and economic growth trends will begin to exert downward pressure on the eagle population, not due to collisions, but rather loss of nesting habitat and other anthropogenic sources of mortality. This may occur during the term of the MSHCP permit period.

The impact mechanisms and effects associated with these trends are expected to be generally similar to the impact mechanisms and effects described for Kirtland's warbler for construction of wind energy facilities (see Section 4.1, *Biological Resources*). Proponents of projects that fall within the cumulative actions considered here are also responsible under the Bald and Golden Eagle Protection Act to ensure their action will not result in take of bald eagles.

Alternative A—Midwest Wind Energy MSHCP

To the extent that human population and economic growth promote the expansion of recreation and development near the Great Lakes and the large rivers and lakes in the Plan Area, after eagle population growth ceases, the cumulative impacts under Alternative A could begin to reduce the eagle population. With a doubling of the development footprint over the 45-year HCP term, development near the Great Lakes and large rivers and lakes is expected to occur more quickly and completely, substantially affecting the better nesting habitat as opposed to the nesting habitat on smaller water bodies of the Plan Area.

Calculation of expected fatalities using the Service's Eagle Fatality Model, after implementation of avoidance and minimization measures (AMMs), suggests that collisions with wind turbines would require a take authorization over the 45-year MSHCP permit period of 4,108 individuals, or 91.5 individuals per year—approximately 2 percent of the 2009 estimated annual production in the Great Lakes Bald Eagle Management Unit (U.S. Fish and Wildlife Service 2009). This is a conservative overestimate of the take that is likely to occur because the fatality model used the fatality rate for golden eagle collisions with wind turbines. Given observed golden and bald eagle fatalities at operating wind energy facilities, that rate is considerably greater than the fatality rate for bald eagles (e.g., Pagel *et al.* 2013).

Implementation of AMMs at wind turbines and associated power transmission infrastructure is essential to reduce cumulative impacts below the 5-percent annual take level allowed in the Plan Area. This level will allow the eagle population to continue growing until nesting habitat in the Plan Area is fully occupied. Without AMMs, the Eagle Fatality Model estimates take at full build-out to be 152.4 bald eagles per year (see Eagle Fatality Models 1-4 of the MSHCP, Chapter 4. The eagle population in the Great Lakes Bald Eagle Management Unit (equivalent to the Plan Area) was estimated at 27,617 individuals in 2009, with an annual take threshold determined by the Service of 224 individuals (U.S. Fish and Wildlife Service 2009). Considering the other sources of anthropogenic mortality and a future reduction in available nesting habitat described above, wind energy facilities would consume a large percentage of the annual take threshold, even if fatalities are over-estimated by the model. As a result, implementation of AMMs under Alternative A is essential to accommodate other anthropogenic mortality and future reduction in nesting habitat given human population and economic trends.

Under Alternative A, however, wind energy development will not occur in or near breeding or congregating habitat within 3 miles of the Great Lakes and one mile of several large rivers and lakes in the Plan Area. This will reduce the effect of wind energy development on bald eagles by eliminating risk at locations which provide better nesting and congregating habitat than the smaller water bodies elsewhere in the Plan Area.

Alternative B—Reduced Permit Duration

The mechanisms and general effects for the cumulative impacts on the bald eagle population in the Plan Area under Alternative B, given the trends in human population and economic growth, are like those under Alternative A. An important difference is that, under Alternative B, wind energy development would not take place in the better nesting and congregating habitat along the Great Lakes coast and near the shores of large lakes and rivers in the Plan Area during the first 11,000 MW of wind energy facility development. During the subsequent 22,000 MW of development, wind energy development could occur at these better nesting locations, adding to the effects of population and economic growth trends. Implementation of the AMMs listed in Chapter 2 for the 11,000 MW of wind energy would help minimize the cumulative number of bird fatalities in the study area.

Alternative C—Increased Cut-In Speed

The mechanisms and general effects for the cumulative impacts on the bald eagle population in the Plan Area under Alternative C, given the trends in human population and economic growth, are like those under Alternative A. Under this alternative wind energy development will not occur in the better nesting and congregating habitat along the Great Lakes coast and near the shores of large lakes and rivers in the Plan Area. Increased cut-in speed under Alternative C, however, is not expected to have a substantial effect on bald eagle mortality because eagles are diurnal flyers with

good visual acuity and a very low collision probability (Curtailment is chiefly implemented to protect bats, which fly at night). A minor beneficial effect may exist if curtailment is required in the daytime for individual wind turbines at locations where bald eagle activity is high, such as within one mile of nests, winter concentration areas, or migratory corridors. It is unlikely, however, that wind turbines at such locations would be permitted under the MSHCP, which would require that turbines avoid such locations. Avoidance of important eagle activity areas is recommended by the Service's Bald and Golden Eagle Conservation Plan guidance; projects containing important eagle activity areas are placed by the Service in Category 1, the highest risk category, and are unlikely to receive an ITP for take of eagles.

Alternative D—No Action

The mechanisms and general effects for the cumulative impacts on the bald eagle population in the Plan Area under Alternative D, given the trends in human population and economic growth, are like those under Alternative A. An important difference is that, under Alternative D, wind energy development could occur in the better nesting and congregating habitat along the Great Lakes coast and near the shores of large lakes and rivers in the Plan Area. This would compound the effects caused by trends in population and economic growth. Also, the AMMs listed in Chapter 2 would not be implemented under Alternative D.

Cumulative Impact Summary - Covered Birds

As indicated above, it is likely that all four alternatives under consideration will add cumulatively to other factors that are impacting the covered birds. Because the cumulative actions would occur additively over time and in equal degree to any of the four alternatives, the true differentiating factor between the alternatives when including cumulative impacts are the alternatives themselves (i.e., the impact discussion/comparison of covered birds in DEIS Chapter 4.1). Therefore, the alternative with the least potential effect on covered birds when incorporating potential cumulative effects would be Alternative C, followed by Alternatives, A, B and D.

Covered Bats

Cumulative effects on bats are generalized enough to allow a generalized discussion. The three covered bat species are all members of the genus *Myotis* (mouse-eared bats) that often are found in the same communities by summer, same hibernacula by winter, and thus are especially appropriate to discuss as a unit.

White Nose Syndrome (WNS)

In 2006, bats near Albany, New York, were observed with WNS (a fungal disease). The fungus (*Pseudogymnoascus destructans*) thrives in cold and humid conditions, characteristic of the caves and mines that hibernating bats, including the Indiana bat, use (Gargas *et al.* 2009). When bats are using the caves and mines during hibernation, they have a reduced immune response (Carey *et al.* 2003), which may predispose them to infection from a variety of diseases including WNS. WNS has caused a decrease in the population of most cave-hibernating bats in the Midwest. As a direct result of this fungal disease, two of the Covered Species have gone from being relatively abundant species to a federally threatened species (in the case of the northern long-eared bat) and a species protected in multiple states (little brown bat).

Current statistics and readily available data suggest WNS will continue to substantially impact bat populations. For example, Thogmartin *et al.* (2013) provided a model that demonstrated the potential for long-term survival of Indiana bats at larger hibernacula, but also suggested smaller hibernacula will be extirpated. However, this model made two critical assumptions: (1) Indiana bats will become resistant to the disease, and (2) once the populations become resistant they will resume a pre-WNS population trajectory. Further, Francl *et* al. (2012) provided evidence that reproductive seasonality and success can change once WNS has arrived in an area. These data indicate that WNS is the largest threat facing the covered bats. It is likely that a wide variety of activities that otherwise will have marginal or even inconsequential effect on bat populations is contributing to a substantial cumulative effect on these species.

Urbanization

In the Midwest, the greatest current change in landscape is caused by the development of residential and commercial properties associated with larger cities in the region. Studies of multiple bat species at the Indianapolis International Airport have demonstrated that most bat species in the Midwest are sensitive to large blocks of suburban development, but can survive within a few miles of such developments (Whitaker *et al.* 2004; Sparks *et al.* 2009; Damm *et al.* 2014). Expansion of urban development poses a threat to bats, primarily through the potential to remove habitats that could support the covered bats. The impact mechanisms and effects associated with expansion of urbanization will be generally similar to the impacts described for covered bats for construction of wind energy facilities (see Section 4.1, *Biological Resources*). It is important to note that proponents of projects considered in this cumulative effects analysis will also be responsible for addressing impacts to Indiana and northern long-eared bats under the ESA to ensure their action will not jeopardize the continued existence of the species. One should note that less bats on the landscape likely results in a reduced mortality at wind energy sites simply because there are less bats available to be killed.

Agriculture Trends

The Midwest is dominated by agriculture, and unbroken blocks of row crops are not suitable habitat for bats (Carter *et al.* 2002; Silvis *et al.* 2014). All three covered bat species routinely forage along the edges of agricultural fields (Sparks *et al.* 2009). As such, the region-wide trend in the loss of farms is an area of concern. An examination of Table 5-1 suggests the decline in farms is from two causes. First, farmers sell ground that is then developed for other purposes—especially suburban expansion. Second, smaller farms are conglomerated and managed in bulk, which likely lead to a loss of the type of edge habitats in which bats live. Conversion of farmland to urban habitats and the conglomeration of smaller farms pose a threat to bats. These threats are primarily associated with habitat removal or disturbance. The impact mechanisms and effects will be generally similar to the impacts described for covered bats for construction of wind energy facilities (see Section 4.1, *Biological Resources*). It is important to note that proponents of any activity to agricultural land are responsible for addressing impacts to Indiana and northern long-eared bats under the ESA to ensure their action will not jeopardize the continued existence of the species. One should also note that less bats on the landscape likely results in a reduced mortality at wind energy sites simply because there are less bats available to be killed.

Bats are suspected of being susceptible to potential toxic effects of pesticides which may also have impacts on the foraging base—either by directly (in the case of insecticides) killing some prey species or indirectly (in the case of herbicides), changing the underlying vegetation upon which

insects feed. Bats are known to be sensitive to a variety of pesticides (O'Shea and Clark 2002; Eidels *et al.* 2006). Effects range from death in the case of acute toxicity to reduced reproduction. Of particular concern are the sublethal effects of pesticides, which may include reduced coordination (at the low end this will include the potential for injury and decreased foraging efficiency) to bats being rendered incapable of flight and becoming easy prey for predators. As with losses due to changes in habitat, the primary mechanism by pesticides will interact with wind energy will be a reduced number of bats available to be killed at wind energy sites. In cases where pesticides have a sublethal effect, it is possible that impaired bats may be more prone to collision. It is also possible these bats are less capable of making it through hibernation and thus any mortality occurring at wind energy sites prior to hibernation will have a strong component of compensatory mortality (*i.e.,* the mortality has little population-level effect because these bats will not survive the winter). There is also the possibility that a decline in bats will lead to an increase in pest insects which in turn would lead to an increase in pesticides. This could have substantial impacts on the agricultural industry's economy due to the need to purchase more pesticides. Additionally, it could have adverse impacts on the environment due to the shift in the ecosystem balance from the loss of bats and increase in pesticide use.

Forestry Trends

Throughout the region (and much of the United States) the amount of forest increased between the Great Depression and late 20th century as farms were abandoned and either underwent natural succession or (in the case of many state and Federal forests) were planted with trees (Crocker *et al.* 2009; Miles *et al.* 2012; Nelson *et al.* 2008; Perry *et al.* 2010; Price *et al.*, 2010; Raeker *et al.* 2011; Widman *et al.* 2012; Woodall *et al.* 2011). Over time, this led to not only an increase in forest cover, but to larger and more mature trees that are more suitable for use by bats. Over the past decade, many of these forests have reached matured and thus the amount of harvest is beginning to increase on managed forests. The economic down turn of the early 21st century also led to wide-spread timber mining on many small land holdings in the region (D.W. Sparks Unpublished Observations). In addition, other land pressures such as increased development of homes have led to clearing of small amounts of forest. Together all of these factors have reversed the long-standing trend of increasing forest cover. As such, there is expected to be a decreasing amount of forest available for use by roosting and foraging bats. It is noteworthy that four of the eight states (Indiana, Michigan, Minnesota, and Wisconsin) are preparing or have prepared Habitat Conservation Plans aimed at addressing the impact of forest management on Indiana and northern long-eared bats on state-managed lands. A fifth state (Missouri) is also known to be exploring a multi-species Habitat Conservation Plan to address the impacts of forest management practices on state-owned lands on the covered bats. As with other activities, the primary mechanism by which changes in forestry will interact with wind energy development will be by changing the number of bats that are available to be killed at wind energy sites, but it is unknown whether these changes will increase (by improving the quality of habitat) or decrease the number of bats available to be killed at wind energy sites. As such, the cumulative effects of forestry and wind energy on covered bats is unknown.

Economic Growth

As much as the states in the Plan Area share common agricultural bases and urbanization patterns, there are markedly different industries at play among the states (Table 5-2).

Energy production and transmission is a major economic driver. As clearly illustrated by the need to develop the MSHCP, the search for renewable energy has led to rapid development of wind energy

facilities across the region. There are significant coal resources and surface mining operations in southern Indiana, Illinois, and Missouri. Much of eastern Ohio has historically been reliant on a coal-based economy. Hydraulic fracturing has produced an oil and natural gas boom in eastern Ohio. The Ohio Department of Natural Resources maintains a running count of well pad construction activities (http://oilandgas.ohiodnr.gov/shale accessed on 29 July 2015). From 2011 to 25 July 2015, a total of 1,572 wells have been drilled in the Utica and Marcellus shale formations (Utica: 1,543, Marcellus: 29) in the state of Ohio. In a heavily forested region such as Appalachia, some forest clearing is associated with well drilling activities in the Utica and Marcellus formations. In adjacent Pennsylvania, well-pads in the Marcellus formation average 5.5 acres in size and each well pad serves an average of three wells (Drohan *et al.* 2012). Small, but marketable oil and gas resources are scattered through all states. If oil/gas prices recover Marathon Oil, which has recently obtained the lease to over 100,000 acres in Michigan, may also begin extraction of Crude Oil in the Upper Peninsula using hydraulic fracturing. Hydraulic fracturing has also led to expanded commercial sand mines in Wisconsin (http://dnr.wi.gov/topic/Mines/ISMMap.html). Other important industries include technology, transportation, and shipping along the Great Lakes, Ohio, and Mississippi systems.

These economic drivers are expected to pose a threat to covered bats, primarily through removal of bat habitat as project sites develop or indirectly through the expansion of suburban housing and development of municipal infrastructure and other developments such as shopping centers. The impact mechanisms and effects will be generally similar to the impacts described for covered bats for construction of wind energy facilities (see Section 4.1, *Biological Resources*). It is important to note that project proponents are responsible for addressing impacts to Indiana and northern long-eared bats under the ESA to ensure their action will not jeopardize the continued existence of the species. Impacts to listed species associated with coal mining are addressed under a 1996 Biological Opinion issued by the Service. This Biological Opinion requires the development of Species-Specific Protection Measures that are incorporated in each mine's permitting requirements and thus enforced by the Office of Surface Mining. Similarly, a separate HCP effort is underway that will address most impacts associated with gas and oil infrastructure in Ohio.

Impacts from Alternatives

It is likely that all alternatives will have cumulative interaction with other region-wide impacts that are leading to declines in the covered bats. The greatest of these effects is WNS. The most obvious interaction between WNS and wind energy is a decline in the number of bats that will be killed at wind turbines. All take estimates were based on pre-existing mortality surveys and most of these occurred prior to WNS-induced population declines. Fewer bats flying through wind farms will lead to lower realized mortalities. Similarly, changes in bat populations caused by other factors (such as changes in habitat) will also increase or decrease the number of bats that are killed at wind energy sites simply by changing the number of bats flying through wind energy facilities.

A realistic analysis of the cumulative effects associated with the MSHCP requires an understanding of concepts of compensatory and additive mortality. The concept of compensatory mortality is used to recognize that some of the bats killed at wind energy facilities will die of other causes prior to the next reproductive season. Because WNS can kill 90 percent of the Myotis in a hibernacula, it is likely that many (but not all) of the bats killed at wind energy sites during fall are a form of compensatory mortality. Many of these bats will be killed by WNS regardless of their fate at wind energy sites. Conversely, most bats killed at wind energy sites during spring should be considered additive mortality as these bats have survived the most dangerous season (winter) and have very low

mortality rates during other periods of time (Boyles et al. 2007). Because the actual levels of compensatory versus additive mortality are unknown, it must be recognized that some component of this mortality is additive and thus does add cumulatively to other impact factors acting on these populations. The Service cannot legally issue a permit that jeopardizes the survival of a listed species. As such, it is assumed that population viability analyses (which are currently in draft form) for the Covered Species reveal that the application of the mitigation measures (which add bats back into the population) are enough to offset the cumulative effects of those bats killed under the permit(s).

Alternative A— Midwest Wind Energy MSHCP

Under this approach cumulative effects are considered at the regional scale and include analysis of interactions among multiple wind energy projects. The MSHCP is likely to encourage continued regional development patterns, as multiple potential wind energy projects within the Plan Area have been delayed since the recognition that wind energy posed a risk to the Indiana bat. This issue became more widespread as more bats (including the northern long-eared bat) have suffered rapid declines from WNS. Covering multiple facilities under one or multiple similar permits will tie conservation, mitigation, and conservation efforts together across the entire region. Development of a consistent method of mortality assessment will allow fine-tuning of adaptive management actions across multiple projects and jurisdictions. This also will lead to conservation measures that will offset population-level effects of mortality that occurs at permitted facilities.

Alternative B—Reduced Permit Duration

Under this approach cumulative effects are considered at the regional scale with interactions among multiple wind energy projects. Reducing the number of facilities covered by the permit means two-thirds of future developments could potentially be developed without the restrictions of the MSHCP. Those facilities excluded from the MSHCP will either have to 1) seek separate permits under ESA, 2) avoid take of listed species, or 3) take the risk of operating without regard to the potential for take. In other aspects this is similar to Alternative A. Those facilities operating under the permit will be responsible for conducting (or contributing to) conservation measures that offset the population-level effects of mortality that occur at permitted facilities.

Alternative C—Increased Cut-In Speed

Under this approach cumulative effects are considered at the regional scale and include analysis of interactions among multiple wind energy projects. Alternative C will kill less bats but will also generate less power (because the turbines are turned off for longer periods of time). The differences between Alternative C and Alternative A are decreases in both generated current and bat mortality. The approach of Alternative C also changes the economic decision-point for an owner/operator to enroll in the MSHCP, therefore a greater number of facilities may choose to seek separate permitting or operate without regard for potential take. Alternative C is expected to be especially beneficial to migratory bats (see Chapter 4) by reducing spring mortality when the incidental take could include reproductive females. Mortality among these spring migrants likely contains the highest proportion of additive mortality (*i.e.,* the bats being killed are unlikely to die from other causes). Those facilities operating under the permit will be responsible for conducting (or contributing to) conservation measures that offset the population-level effects of mortality that occur at permitted facilities.

Alternative D—No-Action

Under this approach cumulative effects are considered on a project-specific basis. This may lead to a greater abundance of facilities that increase the risk of mortality and operate with reduced or no curtailment strategies. The risk of enforcement (for taking listed bats) may cause some facilities to not be built, may be delayed in operation, may operate under a strategy aimed at avoiding take, or address potential take under either an Incidental Take Statement or Incidental Take Permit. In these cases, take will be reduced (see Chapter 4). The lack of standardized mortality surveys also will impair the ability to use adaptive management among sites. There will be a substantial risk of wind energy development in areas where bats concentrate, which has the potential to increase risk of mortality to bats that could be killed due to collisions with wind turbines and barotrauma. A detailed analysis of potential mortality is included in Chapter 4. Alternative D allows continued development of wind energy projects in high risk areas that are either excluded from development under the MSHCP or are subject to increased curtailment.

Cumulative Impact Summary – Covered Bats

As indicated above, it is likely that all four alternatives under consideration will add cumulatively to other factors that are impacting the covered bats. Because the cumulative actions would occur additively over time and in equal degree to any of the four alternatives, the true differentiating factor between the alternatives when including cumulative impacts are the alternatives themselves (i.e., the impact discussion/comparison of covered bats in Section 4.1). Therefore, the alternative with the least potential effect on covered bats when incorporating potential cumulative effects would be Alternative C, followed by Alternatives, A, B and D. Conservation measures undertaken under the MSHCP are also designed to offset the population level effects of the bats killed at wind energy sites, and in many cases are expected to do so by reducing other factors that are acting cumulatively on these bats.

5.3.1.3 Other Rare, Endangered, Threatened and Candidate Species

Agricultural trends in the Plan Area may affect non-covered Federal and state-listed species by prompting conversion of grassland and savanna to cropland. Water quality degradation and aquatic habitat degradation also result from conversion of permanent vegetation to cropland, which could affect special-status species of wetland and aquatic habitats, including fish and macroinvertebrates. Population and economic growth trends may affect species whose habitats are in and near the metropolitan areas of the Plan Area. As development in metropolitan areas may occur in any habitat, including wetlands when mitigation is provided, regional trends may affect the hundreds of special-status animals and plants in the Plan Area.

A substantial acreage of grassland has the potential to be affected by regional trends to which may be added impacts due to wind energy development. The MSHCP build-out model indicates that wind energy development under the MSHCP may affect 1,673 acres of core grassland over the 45 years of the permit term. Due to the availability of cropland in the Plan Area, where development is logistically easier, wind energy facilities in the Plan Area are rarely constructed in forests and rarely in wetlands or aquatic habitats (see Erickson *et al.* 2014), where development will be more difficult due to practical and regulatory constraints. Therefore, wind energy development is not predicted to substantially contribute to adverse cumulative impacts on forested, wetland, or aquatic habitats.

Trends of population and economic growth leading to more development are expected to increase the number of individuals of non-covered Federal and state-listed bird and bat species which collide

with buildings, power lines, vehicles, vehicles, and tall towers in the Plan Area, a fatality rate estimated at over 700 million birds per year across the United States (Erickson *et al.* 2005). At the full 33,000 MW build-out, an estimated 130,680 small birds will be killed annually by wind turbines using Erickson *et al.*'s (2014) 3.96 birds/MW/year rate for the Corn Belt ecoregions (Erickson's Prairie Biome) where most wind energy facilities in the Plan Area are expected to be constructed. In Erickson *et al.*'s analysis (2014), these species, the majority being migratory, represented 62.7 percent of fatalities at 116 wind facilities across the United States. At full build-out a smaller number of large birds (many of them migratory) will experience fatalities, likely in proportion to current fatality rates (e.g., diurnal raptors 7.8 percent and waterfowl 2.7 percent of all fatalities) (Erickson *et al.* 2014). Smallwood (2013) believes previous calculated fatality rates are low and calculated a rate of 11.1 birds/MW/year, using data from 71 facilities across the country. Even if the fatality rate due to wind turbine collisions is higher than previous estimates, the annual fatality rate due to wind energy development is minor compared to fatalities from other sources (e.g., collisions with buildings).

Multi-bird fatality events associated with lighting of wind turbines during inclement weather may contribute disproportionately to the total number of bird fatalities in migratory periods (U.S. Fish and Wildlife Service 2013). The phenomenon of migrating birds being killed in large numbers at lighted towers has been known for decades (Erickson *et al.* 2005). The effects of multi-bird fatality events for the local population of an uncommon bird species, however, is extremely difficult to determine (NRC 2007).

To the extent that agriculture, population, and economic growth trends in the Plan Area continue, it will result in loss of habitat and new construction, which affects non-covered Federal and state-listed species. The impact mechanisms and effects associated with development related to population, economic, and agriculture trends will be generally similar to the impacts described for other non-covered Federal and state listed species for construction of wind energy facilities (see Section 4.1, *Biological Resources*). Non-covered Federal and state-listed species will also be provided some protection under the Federal ESA and state statutes, which will minimize the impacts from the cumulative impact trends. Wind energy development is expected to have a minor effect compared to those larger trends on non-covered Federal and state-listed species.

Alternative A—Midwest Wind Energy MSHCP

To the extent that population, agriculture, and economic growth promotes the conversion of habitat to cropland, loss of habitat in and near metropolitan areas, and greater road construction and vehicle use in the Plan Area, cumulative impacts under Alternative A are expected to result in reductions in populations of some non-covered Federal and state-listed species, especially those of grasslands and savannas. Under Alternative A, however, wind energy development will not occur in or near breeding or critical habitat for Covered Species, and for other non-covered Federal and state protected species that share the same habitats as Covered Species. Effects on state-listed species will vary depending on the degree of protection and enforcement afforded to these species by the individual states.

Alternative B—Reduced Permit Duration

Under Alternative B wind energy development will not occur in or near breeding or critical habitat for Covered Species and other non-covered Federal and state protected species that share the same habitats during the first 11,000 MW of wind energy facility development. This will avoid, minimize and mitigate the effects of wind energy development on non-covered Federal species and, to the

extent required by individual states, state-listed species as well. In the subsequent 22,000 MW of development, wind energy facilities could add to consequences of regional trends unless individual ITPs are obtained which avoid, minimize and mitigate wind energy development impacts to non-covered Federal and state-listed species.

Alternative C—Increased Cut-In Speed

Increased cut-in speed under Alternative C is not expected to have a large effect on non-covered Federal and state-listed species as curtailment is focused on the conservation of bat species. It may have a small beneficial effect on protected bird species because of the reduced turbine operating hours during the spring and fall migration.

Alternative D—No Action

Under Alternative D, wind energy development could occur anywhere in the Plan Area, including in and near breeding and critical habitat for non-covered Federal and state-listed species, compounding issues caused by regional trends in population, agriculture and economic growth (U.S. Fish and Wildlife Service 2015). See Chapter 2 for further details on wind development in the Plan Area under Alternative D. Effects may be the greatest in grassland and savanna habitat, which are more readily developed in the Plan Area than forests, wetlands, and aquatic habitats. Effects of wind energy development will be reduced under Alternative D if individual ITPs are obtained for non-covered Federal species. In reality, wind energy facility operators may choose to not obtain an ITP and risk violation and subsequent enforcement action. Impacts to state-listed species will vary according to each state's endangered species legislation and whether they will take enforcement actions.

Other Protected Bats

Section 5.3.1.2 above provides a review of cumulative effects on the Covered Species that can be generalized to most other protected bats. With the notable exception of the big brown bat, which is a human commensal, changes in the rural landscape caused by factors including economic development, changes in agriculture, and urbanization are the major challenges facing these other protected bats (Table 5-1). In many cases, WNS remains the most important factor with a cumulative effect both among and between species. Notable exceptions to this trend are the evening bat which hibernates in trees and whose susceptibility to WNS is unknown, and big-eared bats whose hibernation tactic may lead them to select sites that are not optimal for the growth of the fungus that causes WNS (Johnson *et al.* 2012). Urbanization is a challenge for most bats, with the exception of the big brown bat which dominates the urban landscape (Duchamp *et al.* 2004) and forages in the surrounding agricultural landscapes.

Impacts for the alternatives can be generalized for all bat species. Two activities associated with Alternative A are predicted to greatly reduce cumulative effects on other listed bats. First, the process of excluding areas where bats concentrate also protects multiple other listed bats that share the same areas, especially caves. Second, conservation measures aimed at the Covered Species will likely include protection of caves in these areas that harbor other protected bats. Similarly, conservation efforts associated with other ESA compliance efforts for the Covered Species are expected to be beneficial to multiple species of bats.

Impacts of the alternatives on other protected bats will be substantially lower than the impacts due to WNS for those species that are less sensitive to the disease (all except Rafinesque's big-eared bat,

Ozark big-eared bat, and the evening bat). Thus, the protected bat species could suffer catastrophic population declines once the species is infected regardless of wind energy development. Urbanization, agricultural practices, and other forms of economic development have more substantial effects on other protected bats because of the widespread habitat loss associated with these activities. These impacts, however are partly buffered when project proponents comply with either the Federal ESA (in the case of gray, Ozark big-eared, and any other bats that become listed during the permit duration) or state equivalents. Direct mortality associated with wind energy development combined with these other factors will likely have a substantial cumulative effect on the tri-colored, big brown, and evening bat due to the large number of fatalities involved, the widespread nature of these species, and the sensitivity of the tri-colored bat to WNS. Development of wind energy under any of the alternatives is unlikely to have a substantial effect on the gray, Rafinesque's big-eared, or Ozark big-eared so long as that development is excluded from the karst areas (*i.e.,* occurs under Alternatives A or C) where these bats congregate. Development in these areas may still occur for those facilities that do not accept the conditions of the MSHCP or for whom no coverage is available including those developed under Alternatives B and D.

Table 5-1. Cumulative Impacts Matrix for Species of Rare and Endangered Bats Not Covered by the Multi-Species Habitat Conservation Plan

Species of bat	Impacts of WNS	Impacts of Urbanization	Changes in Agriculture	Impacts of Economic Development[1]	Cumulative Impacts
Gray bat	Moderate Negative	Substantial Negative	Substantial Negative	Substantial Negative	Substantial Negative
Ozark big-eared bat	Minor Negative	Substantial Negative	Minor Negative	Substantial Negative	Substantial Negative
Big brown bat	Moderate Negative	Substantial Positive	Substantial Positive	Minor Negative	Positive or Negative
Eastern small footed bat	Substantial Negative	Substantial Negative	Minor Negative	Substantial Negative	Substantial Negative
Evening bat	Minor Negative	Substantial Negative	Minor Negative	Substantial Negative	Substantial Negative
Tri-colored bat	Substantial Negative	Minor Negative	Substantial Negative	Substantial Negative	Substantial Negative
Southeastern bat	Moderate Negative	Substantial Negative	Substantial Negative	Substantial Negative	Substantial Negative
Rafinesque's big-eared bat	Minor Negative	Substantial Negative	Substantial Negative	Substantial Negative	Substantial Negative

[1] Includes all segments of the energy industry, including wind energy.

5.3.1.4 Other Wildlife Species

Population, agriculture, and economic growth trends in the Plan Area affect other wildlife species in ways similar to the non-covered Federal and state-listed species, discussed above. While other wildlife use MGIN core habitat and corridors, the majority of other wildlife in the Plan Area also occur in agricultural and developed areas, either using cropland and developed lands or using habitat remnants in the agricultural and developed matrix. Other wildlife in the forested regions at the northern, eastern, and southern edges of the Plan Area are subjected to forestry practices and

recreational activity which may increase with economic growth. The extent of effects in these areas depends on the ownership, with Federal, state and some county forestland being managed to benefit other wildlife, while much county and private forestland may not be managed to benefit other wildlife. Although populations of other wildlife are larger and more secure over the long term than rare and protected species, numbers of individuals killed or displaced by habitat loss due to these trends is projected to be greater than for rare and protected species because there are simply more non-protected wildlife species and, generally, more individuals of each non-protected species.

To the extent that agriculture, population, and economic growth trends in the Plan Area continue, it will result in construction of new buildings, infrastructure and roads, conversion of habitat to cropland, and increased use of vehicles, all of which eliminate habitat and displace and kill wildlife. The impact mechanisms and effects associated with development related to population, economic, and agriculture trends will be generally similar to the impacts described for other non-covered Federal and state-listed species for construction of wind energy facilities (see Section 4.1, *Biological Resources*). Given the small footprint of wind energy development compared to the footprint of these regional trends, wind energy development is expected to add only slightly to the effects of these other trends on other wildlife.

Alternative A—Midwest Wind Energy MSHCP

To the extent that population, agriculture, and economic growth promote the conversion of habitat to cropland, loss of habitat in and near metropolitan areas, and greater road construction and vehicle use in the Plan Area, cumulative impacts under Alternative A could result in reductions in populations of other wildlife, especially those of grasslands and savannas. Under Alternative A, however, wind energy development will give consideration to bird species protected under the MBTA, which include many common and widespread bird species in the Plan Area that could be killed by collisions at wind energy facilities, such as horned lark. Also, the locations of Covered Lands were purposefully sited outside floodplain areas along the Mississippi and Illinois rivers to minimize the potential for impacts on important bird and bat migratory routes. Thus Alternative A will benefit migratory bird species more than Alternative D and 3 because of the siting of wind energy facilities and explicit inclusion of MBTA-protected species in a permit under the MSHCP.

Alternative B—Reduced Permit Duration

Under Alternative B, MBTA species will receive consideration at wind energy facilities during the first 11,000 MW of wind energy facility development. This will avoid, minimize, and mitigate the effects of wind energy development on MBTA species. In the subsequent 22,000 MW of development, wind energy facilities will have an effect similar to Alternative D, but this will not measurably add to the effects of regional trends.

Alternative C—Increased Cut-In Speed

Increased cut-in speed under Alternative C is not expected to have a large effect on any other wildlife species except bats, although some bird species may receive a small beneficial effect because of the reduced turbine operating hours during the spring and fall migration.

Alternative D—No Action

With the exception of birds protected under the Migratory Bird Treaty Act (MBTA), under Alternative D, no protection is afforded other wildlife, but neither is protection afforded to other

wildlife under Alternatives A–C. To the extent that regional trends continue as expected, wind energy development will add only slightly to the effects of regional trends.

Migratory Tree Bats

Section 5.3.1.2 above provides a review of cumulative effects on the Covered Species that can be generalized to most other bats. With the exception of the silver-haired bat, migratory tree bats do not hibernate in caves, and thus are at minimal risk from WNS (Table 5-2); individuals may become infected and succumb but the fungus is unlikely to spread rapidly among these bats that hibernate in open environments and rarely interact with each other. Migratory tree bats are capable of roosting in suburban yards and readily forage along fencerows in broken landscapes (Walters *et al.* 2007). For these species, mass mortality at wind energy sites is the greatest current threat.

Impacts for all four alternatives can be generalized for all bat species. Three activities associated with Alternative A have the potential to greatly reduce cumulative effects on covered migratory tree bats. First, the process of excluding potential migratory corridors such as the banks of large rivers and the Great Lakes will help protect migratory tree bats. Second, conservation measures aimed at the Covered Species are likely to include protection and enhancement of forest habitats that may be used by migratory tree bats. Third, widespread use of operational curtailment under the MSHCP will protect many individuals, and mortality monitoring at these sites may provide insight into other valuable methods to reduce take. Impacts of the proposed activities on migratory tree bats under any of the alternatives is the most substantial threat facing migratory tree bats in the region. Broadly speaking, these species are tolerant of the types of disturbance and habitat loss associated with a variety of developments, but the long-term effects of sustained mortality at wind energy facilities is likely to have substantial detrimental effects. These effects are lowest under Alternative C and also partly offset by Alternatives A and B.

Bats face a number of challenges associated with the rapidly changing landscape of the Midwest. Development of the MSHCP will help minimize those effects associated with development of wind energy within the region. For the Covered Species, the MSHCP reduces impacts below the level of a variety of other regional trends. For most other protected bats, development of wind energy facilities under the MSHCP will likely have only limited effects and may help offset some region-wide trends by developing and protecting key bat habitats. Direct mortality associated with wind energy facilities in concert with other challenges faced by evening and tri-colored bats is predicted to have a substantial cumulative effect on these species. Finally, development of wind energy is predicted to result in substantial mortality to migratory tree bats which combined with other challenges could lead to substantial declines of these species.

Table 5-2. Cumulative Impacts Matrix for Species of Migratory Tree Bats Not Covered by the Multi-Species Habitat Conservation Plan

Species of bat	Impacts of WNS	Impacts of Urbanization	Changes in Agriculture	Impacts of Economic Development[1]	Cumulative Impacts
Eastern red bat	Minor Negative	Neutral	Minor Negative	Substantial Negative	Substantial Negative
Hoary bat	Minor Negative	Neutral	Neutral	Substantial Negative	Substantial Negative
Seminole bat	Minor Negative	Neutral	Minor Negative	Substantial Negative	Substantial Negative
Silver-haired bat	Minor Negative	Neutral	Minor Negative	Substantial Negative	Substantial Negative

[1] Includes all segments of the energy industry, including wind energy.

5.3.1.5 Fish and Other Aquatic Species

Population, agriculture and economic growth trends in the Plan Area will result in increased land clearing for cropland, new buildings, other infrastructure, and roads. This in turn will increase the total amount of precipitation leaving the land and entering rivers, lakes, streams, and ponds of the Plan Area. Since the 1980s, total precipitation in the Plan Area has been increasing and coming in larger storm events (Pryor *et al.* 2014). This trend combined with increasing runoff from the land results in more frequent water level changes in water bodies, which contributes to the erosion of stream beds, stream banks, and shorelines. Under these conditions, key elements of aquatic habitat are lost, such as submerged and bank vegetation, gravel and sand bottoms, and bottom-dwelling invertebrates forming part of the base of the food chain. Greater runoff from land also adds sediment and pollutants to water bodies. This stimulates excessive growth of algae and some aquatic plants, which crowds out other species of aquatic life. One of the greatest threats to macroinvertebrates stems from the introduction of suspended and deposited fine sediments into surface waters. Overall, regional trends in population, agriculture, economic growth, and precipitation increasingly adversely affect the water quality and aquatic habitat of water bodies throughout the Plan Area.

To the extent that agriculture, population, economic, and precipitation trends in the Plan Area continue, it will result in construction of new buildings, infrastructure and roads, conversion of habitat to cropland, and increased vehicle use, all of which can impact surface water quality and aquatic species and habitat. The impact mechanisms and effects (e.g., sedimentation) associated with development related to population, economic, and agriculture trends will be generally similar to the impact mechanisms and effects described for fish and other aquatic resources for construction of wind energy facilities (see Section 4.1, *Biological Resources*); however, the effects for wind energy facilities will be more confined and not as spatially intensive. Moreover, wetland and aquatic habitat protection laws enacted under the Clean Water Act, Rivers and Harbors Act, and Federal floodplain legislation prohibit direct impacts to wetlands, aquatic habitats, and floodplains. Development, including wind energy development, are typically required to use best management practices to control erosion on construction sites and prevent sediment and pollutants from leaving construction sites and entering water bodies. To the extent that best management practices are followed during construction, and bare soil is stabilized and vegetated during operations, wind

energy development is expected to add insignificantly to the cumulative impacts caused by regional trends. In addition, the small footprint of wind energy development compared to the footprints of these regional trends is expected to be minor.

5.3.2 Water Resources

5.3.2.1 Surface Waters

Potential impacts to surface waters from construction of wind energy facilities and infrastructure include increased sedimentation, accidental petro-chemical spills, vegetation removal around surface waters and increased water temperatures, water withdrawals, alteration of overland runoff and natural drainage systems, and installation of crossing structures (*i.e.,* culverts and bridges) due to the construction of new access roads. Prior to impacting surface waters, project proponents are required to comply with all applicable state and Federal laws protecting surface waters, including CWA Section 404. Potential surface water impacts from operations include water quality impacts related to accidental petro-chemical spills, and vegetation maintenance and herbicide and pesticide use.

Decommissioning and reclamation at wind energy sites could occur, is described in Chapter 2, *Proposed Action and Alternatives*. Decommissioning of wind energy sites could have short-term degradation impacts on surface waters while the project infrastructure is removed. However, the reclamation process following decommissioning is expected to result in beneficial effects on surface waters. Reclamation includes restoring the project site to the approximate pre-development condition or to conditions similar to those surrounding the facility. The reclamation process will likely result in restoring surface waters that were impacted by project construction. The extent of restoring surface waters to pre-development conditions will depend on the success of the reclamation process.

The surface water impact mechanisms will not differ between alternatives. The main difference between the alternatives is the location in which wind energy facilities and infrastructure occur and therefore where surface waters could be affected. Under Alternative D, construction could occur anywhere within the eight states. Under Alternatives A–C, construction could occur anywhere within the Covered Lands.

The past, present, and reasonably foreseeable future actions included in this cumulative impacts analysis could affect surface waters. For example, past agricultural practices, such as clearing, draining, and filling, have impacted surface waters throughout the study area. Similarly, suburban sprawl can result in the channelization and rerouting of streams, resulting in a degradation of stream water quality and function. The impact mechanisms and types to surface waters from these activities will be similar to those occurring from construction and operation of wind energy facilities (see Chapter 4.2, *Water Resources*). To the extent that the cumulative impacts projects occur within the same watershed as the wind energy facility, there could be a cumulative effect to surface waters on a watershed scale. Cumulative impacts are expected to be minimized through compliance with state and Federal laws and regulations that protect surface waters (e.g., CWA Section 404). Project proponents implementing projects that require impacts to surface waters (e.g., installing a culvert, channelizing) will have to obtain a Section 404 permit, which will require avoidance and minimization of surface water impacts and compensatory mitigation.

5.3.2.2 Floodplains

Potential impacts to floodplains from construction of wind energy facilities and infrastructure include loss and degradation from land disturbing activities, decreased floodwater storage capacity and conveyance, and decreased floodwater retention. If constructing within a floodplain, project proponents are required to comply with relevant Federal and local laws, including National Flood Insurance Program (NFIP)-participating community floodplain management regulations in FEMA-mapped 100-year floodplains. Potential impacts to floodplains from operations include altering floodplain functions due to vegetation maintenance (trimming, mowing, and herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance.

Decommissioning of wind energy sites could have short-term degradation impacts on floodplains while the project infrastructure is removed. However, the reclamation process following decommissioning will result in beneficial impacts to floodplains. Reclamation typically includes restoring the project site to the pre-development condition or to conditions similar to those surrounding the facility. The reclamation process could result in restoring floodplain and floodplain functions that were lost as a result of project construction. The extent of restoring floodplain functions to pre-development conditions will depend on the success of the reclamation process.

The floodplain impact mechanisms will not differ between alternatives. The main difference between the alternatives is the location in which wind energy facilities and infrastructure will occur and therefore where floodplains could be affected. Under Alternative D, construction could occur anywhere within the eight states. Under Alternatives A–C, construction could occur anywhere within the Covered Lands.

The past, present, and reasonably foreseeable future actions included in this cumulative impacts analysis could affect floodplains. For example, past agricultural practices that attempt to maximize crop acreage and thus encroach upon floodplains have impacted floodplains throughout the study area. Similarly, suburban sprawl can result in development in floodplains, resulting in a loss of floodplains functions on local or regional scale. The impact mechanisms and types to floodplains from these activities will be similar to those occurring from construction and operation of wind energy facilities (see Chapter 4.2, *Water Resources*). To the extent that the cumulative impacts projects occur within the same watershed as the wind energy facility, there could be a cumulative loss of floodplain function on a watershed scale. Cumulative impacts are expected to be minimized through compliance with local and Federal laws and regulations that protect floodplains (e.g., NFIP-participating community floodplain management regulations). Project proponents implementing projects that require construction within the 100-year floodplain will have to comply with any applicable community floodplain regulations. Also, if the project involved a Federal action, the project is required to comply with EO 11988, Floodplain Management, which requires Federal agencies to document that there is no practicable alternative prior to taking action that will encroach on a 100-year floodplain.

5.3.2.3 Wetlands

Potential impacts to wetlands from construction of wind energy facilities and infrastructure include loss and degradation from land disturbing activities, reduced wetland habitat, degraded water quality, and decreased wetland stormwater and floodwater storage capacity. Prior to impacting wetlands, project proponents are required to comply with all applicable state and Federal laws protecting wetlands, including CWA Section 404. Potential wetland impacts from operations include

degradation from vegetation maintenance (trimming, mowing, and herbicide use), road maintenance, use of equipment and vehicles, and other associated facility maintenance.

Decommissioning of wind energy sites could have short-term degradation impacts on wetlands while the project infrastructure is removed. However, the reclamation process following decommissioning will result in beneficial wetland impacts. Reclamation typically includes restoring the project site to the pre-development condition or to conditions similar to those surrounding the facility. The reclamation process could result in restoring wetland and wetland functions that were lost to project construction. The extent of restoring wetland functions to pre-development conditions will depend on the success of the reclamation process.

The wetland impact mechanisms will not differ between alternatives. The main difference between the alternatives is the location in which wind energy facilities and infrastructure will occur and therefore where wetlands could be affected. Under Alternative D, construction could occur anywhere within the eight states. Under Alternatives A–C, construction could occur anywhere within the Covered Lands.

The past, present, and reasonably foreseeable future actions included in this cumulative impacts analysis could affect wetlands. For example, past agricultural practices, such as clearing, draining, and filling, have impacted wetlands throughout the study area. Similarly, suburban sprawl can result in the filling of wetlands, resulting in a loss of wetland functions on local or regional scale. The impact mechanisms and types to wetlands from these activities will be similar to those occurring from construction and operation of wind energy facilities (see Chapter 4.2, *Water Resources*). To the extent that the cumulative impacts projects occur within the same watershed as the wind energy facility, there could be a cumulative loss of wetland function on a watershed scale. Cumulative impacts are expected to be minimized through compliance with state and Federal laws and regulations that protect wetlands (e.g., CWA Section 404). Project proponents implementing projects that require filling wetlands are required to obtain a Section 404 permit, which mandate avoidance and minimization of wetland impacts and compensatory mitigation.

5.3.3 Geology and Soils

The primary potential impacts to geology and soil resources from the alternatives include land disturbance, soil erosion, stormwater runoff, and ground destabilization. The identified trends—population shifts, falling farmland values, and economic growth—all contribute to similar types of impacts to geology and soil resources due to construction associated with changes in land use and with infrastructure development. The magnitude of the potential impacts to geology and soils is roughly proportional to the area of land disturbance. The area of land disturbance from wind energy development is projected to be several orders of magnitude smaller than the likely area of land disturbance from the broader development trends in the eight state Plan Area, therefore the contribution of wind energy development to the cumulative impacts on geology and soils is expected to be minor. Because all of the alternatives involve the construction of up to 33,000 MW of new wind energy capacity within the Plan Area, the cumulative impacts are similar among the alternatives. Therefore, impacts from the alternatives when added to impacts from the identified trends are expected to result in minor cumulative impacts on geology and soils.

5.3.4 Climate Change

Emissions of greenhouse gases (GHGs) become well-mixed in the atmosphere and are transported globally where they affect the global climate. Some of the changes in the global climate include extreme weather events; higher temperatures and heat waves; and precipitation changes. These changes in the global climate could affect the ability of ecosystems to support plant and animal life and buffer against extreme events such as wildfire, floods, and storms. This, in turn, has the potential to alter the impacts of the Proposed Action on natural resources. However, it is anticipated that these changes in potential impacts would be minor.

Because it is not possible to attribute a particular climate effect at a particular location to GHGs emitted from a specific source, climate impacts of a project are, by nature, cumulative impacts. Emissions of GHGs during construction will be very low in the context of total GHG emissions across the Plan Area. To the extent that the electricity produced by wind energy projects will displace power that otherwise will have been generated by combustion of fossil fuels, the emissions of GHGs that will have been produced by fossil-fuel power plants will be avoided. This net reduction in GHG emissions could have a beneficial effect on climate change. The quantity of emissions actually reduced will depend on future trends in electrical demand and energy prices, and the electrical load characteristics and power plant dispatching procedures of the regional electric grid. Any wind energy-related reduction in GHG emissions will add to the beneficial climate effects expected from the August 2015 Clean Power Plan, state and city climate action plans, and continuing efforts in the industrial, commercial, and transportation sectors to increase energy efficiency and reduce GHG emissions. Therefore, impacts from the alternatives when added to impacts from the identified trends could result in a minor beneficial effect on cumulative impacts of climate change.

5.3.5 Air Quality

Construction of wind energy facilities and infrastructure involves the use of heavy equipment that generates emissions of air pollutants. Because a wind energy project typically comprises a number of small, dispersed sites, construction is estimated to be short-term at any one location. Because construction will occur over the long term as wind energy facilities are developed, the emissions will be spread over the entire construction period and the emissions occurring in any one year are expected to be relatively small. As a result of this dispersal of emissions geographically and temporally, construction emissions from wind energy facilities are not likely to make a substantial contribution to cumulative impacts on long-term air quality in the region.

Wind energy facilities generate very low emissions during the operation period and are unlikely to contribute to cumulative air quality effects in the areas around the facilities. On a regional scale, to the extent that the electricity produced by wind energy projects displaces power that otherwise will have been generated by combustion of fossil fuels, the emissions of criteria pollutants, volatile organic compounds, and hazardous air pollutants that will have been produced by fossil-fuel power plants will be avoided. This reduction in emissions could lead to beneficial cumulative impacts in the Plan Area. The quantity of emissions actually reduced depends on future trends in electrical demand and energy prices, and the electrical load characteristics and power plant dispatching procedures of the regional electric grid. Therefore, impacts from the alternatives, when added to impacts from the identified trends, could result in beneficial cumulative impacts on air quality.

5.3.6 Noise

All alternatives will result in the construction and operation of up to 33,000 MW of wind energy capacity in the Plan Area. Construction of new wind energy development associated with all alternatives will create temporary and localized noise effects over the course of 15 years to construct up to 33,000 MW of new wind energy capacity.

Cumulative noise effects for either construction or operation will depend upon whether other reasonably foreseeable noise producing projects are very close in proximity to wind energy facilities. For example, future transportation projects such as new highways or rail systems typically have noise "footprints" (noise impact contours) on the order of a few hundred feet at most. Consequently, other factors such as available land often rule out the possibility of cumulative noise impacts. Therefore, impacts from the alternatives, when added to impacts from the identified trends, could result in negligible cumulative impacts on noise.

5.3.7 Visual Resources

All alternatives will result in the construction and operation of up to 33,000 MW of wind energy capacity in the area of visual effect (AVE). Construction of new wind energy facilities associated with all alternatives will create temporary changes in views of and from affected locations within the AVE over the course of 15 years to construct up to 33,000 MW of new wind energy capacity. Construction activities will create views of heavy equipment and associated vehicles into the viewshed of sensitive receptors, recreation areas, scenic byways, and from other sensitive visual resource areas. This could result in cumulative considerable impacts from construction activities when factored with development trends that are converting agricultural lands to suburban and industrial development, resulting in a great deal of construction occurring in the AVE that is clearing vegetation, altering landforms, and converting land uses in view of sensitive visual receptors and when seen from sensitive visual resource areas and from unprotected lands. Recommended Mitigation Measure VIS-1 will lessen temporary visual impacts caused by construction activities for wind energy facilities constructed under the MSHCP for Alternatives A through C, but will not reduce them to a less-than-substantial level.

Once in operation, all alternatives will contribute to a cumulative considerable impact on visual character and scenic quality where no turbines exist by introducing strings of tall, human-made industrial-looking structures that tower over the surrounding landscape into the viewshed of the AVE. In addition, adding more turbines to areas where existing turbines are already present will compound pre-existing visual impacts. Wind energy facilities will also introduce power lines, transformers, access roads, substations, and ancillary features that will alter views within the AVE. This will result in cumulative considerable impacts from construction activities when factored with development trends that are converting agricultural lands to suburban and industrial development, resulting in a great deal of landscapes that are altered from natural to developed landscapes or by compounding the amount of development and infrastructure present in the AVE that will be in view of sensitive visual receptors and seen from sensitive visual resource areas and from unprotected lands. Implementation of AMM GEN 10 requires the burial of some transmission lines and aids in reducing visual impacts associated with wind energy facilities in operation under the MSHCP. In addition, site restoration following decommissioning will aid in restoring the visual environment at those locations after operations cease. Implementation of recommended Mitigation Measures VIS-2 through VIS-4 will further lessen visual impacts to the existing visual character and scenic quality of views within the AVE but not to a less-than-substantial level.

New wind energy development projects that are in operation under the MSHCP are required to coordinate on visual standards with Federal land agencies and this coordination will occur even if the MSHCP was not in place. Therefore, it is not likely that there will be unresolved conflicts with visual standards identified by a Federal land management agency (e.g., U.S. Forest Service, National Park Service). Moreover, recommended Mitigation Measures VIS-1 and VIS-3 through VIS-6 is expected to reduce visual impacts associated with wind energy facilities in operation under the MSHCP on Federal lands for better compliance with their visual resource management objectives. Therefore, wind energy facilities in operation under the MSHCP are not expected to result in cumulative considerable impacts associated with unresolved conflicts with visual standards identified by a Federal land management agency.

All alternatives will contribute to a cumulative considerable impact on daytime and nighttime views resulting from light, glare, and shadow flicker that will affect the AVE. Adding more turbines to areas where existing turbines are already present will compound pre-existing light, glare, and shadow flicker impacts. This will result in considerable cumulative impacts from operation activities when factored with development trends that are converting agricultural lands to suburban and industrial development. A great deal of landscapes will be altered from natural to developed landscapes, introducing artificial sources of light and glare, and compounding the amount of light and glare associated with development and infrastructure present in the AVE that will be in view of sensitive visual receptors and seen from sensitive visual resource areas and from unprotected lands.

AMM GEN 8 will ensure that lighting impacts associated with wind energy facilities in operation under the MSHCP are minimized. However, lighting could include interior lighting and LED lighting for security purposes that could affect sensitive receptors if not properly designed. This will result in a significant source of nighttime light and glare that could adversely affect nighttime views in the area. Recommended Mitigation Measures VIS-5 will further lessen light and glare impacts caused by project lighting associated with wind energy facilities in operation under the MSHCP. Implementation of recommended Mitigation Measure VIS-6 will reduce impacts associated with shadow flicker. However, light, glare, and shadow flicker impacts resulting from operation of new wind energy facilities under the MSHCP are cumulatively considerable when factored with existing development trends.

Independent, individual projects not in operation under the MSHCP will still need to go through and comply with the NEPA process if they are seeking an ITP. A higher degree of visual impact resulting to the existing visual character and scenic quality and from introducing new sources of light, glare, and shadow flicker could affect the AVE if inadequate mitigation is not set forth during the NEPA compliance process for those projects. Therefore, impacts from the alternatives when added to impacts from the identified trends could result in moderate cumulative impacts on visual resources.

5.3.8 Transportation

Suburban sprawl will increase the likelihood of traffic impacts during construction, associated with transport of overweight and oversize wind energy components, because transport routes in rural areas will be more likely to be in the proximity of residential neighborhoods. This may be more likely to occur in states that already have a relatively high population density and are expected to receive a considerable share of the new wind energy capacity, such as Ohio, Illinois, and Indiana.

Economic growth tends to attract workers to geographic areas where there are opportunities for employment. This could increase the likelihood of traffic impacts, depending on location of project sites relative to geographic areas of growth.

Impacts from the alternatives are more likely to be moderate at locations affected by suburban sprawl or experiencing greater economic growth. Therefore, impacts from the alternatives when added to impacts from the identified trends could result in moderate cumulative impacts on transportation.

5.3.9 Land Resources

Suburban sprawl could reduce the areas suitable for renewable energy projects based on the need to minimize adverse impacts to communities. This may be more likely to occur in states that already have a relatively high population density and are expected to receive a considerable share of the new wind energy capacity, like Ohio, Illinois, and Indiana.

Increased property values in rural areas relative to farm income are expected to increase the attractiveness of wind energy leases and easements for land owners.

Economic growth tends to attract workers to geographic areas where there are opportunities for employment. This could reduce the areas suitable for wind energy projects based on the need to minimize adverse impacts to communities.

The impacts of the alternatives on land resources will likely not be affected in magnitude by the trends above, but rather redirected to areas less affected by suburban sprawl and economic growth. Therefore, impacts from the alternatives when added to impacts from the identified trends could result in minimal cumulative impacts on land resources.

5.3.10 Public Services and Utilities

Suburban sprawl could increase the demand for public services in smaller communities and increase the likelihood that some communities may be pressed to meet those demands. Wind energy development demand for public services could compound those problems during construction, depending on project location. Fiscal revenues from wind energy development could help increase the capacity of local governments to address the increased demand. The extent to which this will happen depends, in part, on the extent of local fiscal incentives given to the wind energy industry.

Suburban sprawl could reduce the areas suitable for wind energy projects based on the need to avoid interference with telecommunication signals. This may be more likely to occur in states that already have a relatively high population density and are expected to receive a considerable share of the new wind energy capacity, like Ohio, Illinois, and Indiana.

Economic growth tends to attract workers to geographic areas where there are opportunities for employment. This could increase the likelihood of cumulative demands on public services, depending on location of project sites relative to geographic areas of growth.

Economic growth could reduce the areas suitable for wind energy projects based on the need to avoid interference with telecommunication signals.

The increase in supply of energy associated with new wind energy development could help meet increased demand for energy associated with population growth. Therefore, impacts from the

alternatives when added to impacts from the identified trends could result in slight increased cumulative demand on public services and utilities.

5.3.11 Public Health and Safety

The alternatives could affect public health and safety during construction or operations. Potential construction-related impacts include injuries to the general public and construction workers from events such as potential collisions with construction vehicles, equipment, and materials; falls from structures or falls into open excavations; and electrocution. Potential operations-related impacts include risks associated with structural failure, ice shedding, lightning strike damage, stray voltage, and exposure to fuels and fires.

Compliance with project-specific health and safety plans and applicable laws, regulations, and ordinances (such as setback distances, spacing and density standards, and access restriction) will reduce the effects or degree of those potential impacts. Additionally, due to the site-specific nature of public health and safety risks, these impacts have minimal potential to combine with public health and safety impacts from other projects. Accordingly, the Service concludes that the direct impacts from the alternatives, when combined with impacts from past, present, and reasonably foreseeable projects and actions, will result in negligible adverse cumulative public health and safety impacts.

5.3.12 Socioeconomics and Environmental Justice

Suburban sprawl could decrease or increase the likelihood of population impacts during construction of specific wind energy projects, depending on the magnitude and timing of specific investments. To the extent that suburban sprawl precedes the siting of a wind energy project, it will increase the baseline population, reducing the relative impact of population effects from the proposed project. To the extent that suburban sprawl occurs simultaneously to the siting of a wind energy project, it will add to the incoming population from the proposed project. The greatest amount of new wind energy capacity is expected in Iowa, Ohio, Indiana, and Illinois.

Increased property values in rural areas relative to farm income are expected to increase the value of income from wind energy project leases for owners of land where wind energy projects are located.

Economic growth trends will be cumulative to those fostered by the development of new wind energy facilities with impacts on employment, earnings, and output. As in the case of suburban sprawl, the degree to which these impacts will be felt by the population depends on the magnitude and timing of specific investments. To the extent that economic growth is stronger preceding the siting of a wind energy project, it will increase the baseline employment and earnings, reducing the relative impact of economic effects from the proposed project. To the extent that economic growth occurs simultaneously to the siting of a wind energy project, it will add to the employment and earnings from the proposed project. The greatest amount of new wind energy capacity is expected in Iowa, Ohio, Indiana, and Illinois.

The socioeconomic impacts of the alternatives will be of greater or lesser relative magnitude depending on the timing and location of specific projects relative to the trends discussed.

As discussed in Section 4.12, *Socioeconomics*, the potential for disproportionately high and adverse human health or environmental effects on minority or low-income populations from the alternatives depends on the location of individual projects. To the extent that existing trends in the study area

increase or decrease the magnitude of adverse impacts, the likelihood of disproportionately high and adverse human health or environmental effects on minority or low-income populations will increase or decrease, respectively. Therefore, impacts from the alternatives when added to impacts from the identified trends could result in minor to substantial cumulative impacts on socioeconomics and environmental justice depending on the relative magnitude of the cumulative action.

5.3.13 Cultural Resources

Cumulative effects on cultural resources are indirect or secondary effects related to construction and operation of wind energy facilities, as well as any reasonably foreseeable actions undertaken in the Plan Area. Under Alternatives A through C, the specific location of future wind energy facilities that may be permitted under the MSHCP is not known; therefore, the impacts to historic properties and cultural resources cannot be determined until individual project applicants request ITP coverage. The Service has developed a draft Programmatic Agreement (PA) which outlines the process for identifying and avoiding adverse effects on historic properties and cultural resources. Implementation of this PA will ensure that potential effects, direct, indirect and/or cumulative, will be considered before an ITP is issued. However, under Alternative D, wind energy facilities will continue to be built and operated without coordination with the Service and subsequent Section 106 consultation. Accordingly, cumulative impacts to cultural resources under Alternative D may be substantial.

Chapter 6
Additional Topics Required by NEPA

This chapter addresses additional effects related to the irreversible or irretrievable commitment of resources, unavoidable adverse effects, short-term use versus long-term productivity, growth-inducing effects, and energy and natural resources consumption.

6.1 Irreversible and Irretrievable Commitment of Resources

As required under the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321 *et seq.*, Council on Environmental Quality [CEQ] Section 102; 40 Code of Federal Regulations [CFR] 1502.16), this Environmental Impact Statement (EIS) must include a discussion of any irreversible and irretrievable commitments of resources that will result from the Proposed Action—approval of the proposed Midwest Wind Energy Multiple Species Habitat Conservation Plan (MSHCP) and issuance of incidental take permits (ITPs) or Certificates of Inclusion (COIs).

Irreversible resource commitments represent a loss of future options for resource development or management. An irreversible commitment applies primarily to the use of nonrenewable resources, such as minerals, cultural resources, or fossil fuels. An irretrievable commitment of resources represents the lost production or use value of renewable resources, such as human effort or opportunities that will be lost during implementation of the MSHCP and issuance of ITPs or COIs.

The development of wind energy facilities will result in the commitment of natural and human-made resources for all alternatives. The majority of the commitment will come during the construction of wind energy facilities, but some resources will be committed for operational activities as well. In general, the commitment of resources described below will be similar for all alternatives.

Construction and operational activities associated with implementation of the MSHCP and issuance of ITPs or COIs could result in the irreversible and irretrievable commitment of material resources. Material resources that will be consumed during construction of wind energy facilities include building materials for new turbines, electrical wiring, and other facilities, and mineral resources for access roads and other uses. Fossil fuels will also be used during construction and operation. Upon decommissioning, it is possible that some of the building materials, such as steel, could be recycled and reused.

Implementation of any of the alternatives (including Alternative A, the MSHCP), will result in an irreversible or irretrievable loss of some biological resources, including the loss of vegetation, disturbance of natural habitats, and the incidental take of non-covered, Federal, and state listed species and other wildlife. Site-specific and species-specific analyses conducted at the project level could help ensure that the potential for such impacts will be avoided or minimized to the extent possible. While habitat will be affected during construction and decommissioning, the restoration of habitat required by the Best Management Practices (BMPs) and mitigation measures should reduce these impacts over time.

Construction activities associated with implementation of the MSHCP and issuance of ITPs or COIs could result in the irreversible and irretrievable commitment of cultural resources; however, these impacts will be minimized to the extent possible through execution of the Section 106 process.

Impacts to visual resources could also constitute an irreversible and irretrievable commitment; however, efforts to mitigate these impacts will be undertaken at the project level if it is determined through the Service's consistency evaluation that such measures are necessary to minimize potential impacts.

6.2 Unavoidable Adverse Effects

As described for each resource area in Chapter 4, *Environmental Consequences*, in general, there could be minor, moderate, and in some cases the potential for substantial, adverse effects associated with the implementation of the MSHCP and issuance of ITPs or COIs. Environmental effects will occur under all the alternatives, primarily associated with wind energy facility construction and operational activities. As further discussed in Chapter 4, implementation of the required mitigation measures and BMPs will, for the most part, ensure that these effects are not substantial. Unavoidable adverse impacts on wildlife, vegetation, and visual resources will likely occur at some of the future wind energy facilities; however, the magnitude of these impacts and the degree to which they could be successfully avoided, minimized, or mitigated will vary from site to site. These site-specific and species-specific issues will be further evaluated and addressed at the project level through the Service's consistency evaluation process, which is intended to ensure that the programmatic analysis addresses the resources that will be affected.

6.3 Short-Term Use versus Long-Term Productivity

The action alternatives could result in short-term and long-term impacts to physical, biological, and social resources and were analyzed in this EIS. Short-term uses of the environment associated with the development of wind energy facilities will include temporary land disturbances for construction and decommissioning activities. The impacts associated with short-term use of the environment during the construction and decommissioning phases should be minimal, provided surface-disturbing activities are kept to a minimum. If surface-disturbing activities are not kept to a minimum, the impacts associated with short-term use of the environment during the construction and decommissioning phases may be moderate. Most environmental impacts occurring during the construction of wind energy facilities should be relatively short (approximately 1 to 2 years) and should largely be addressed by BMPs and mitigation measures. Furthermore, these impacts should also be mitigated by required habitat restoration activities. However, implementation of the action alternatives will help to balance these short-term uses with long-term productivity of the physical, biological, and social environment. For example, during construction activities, short-term utilization of the labor force could result in long-term productivity of the economic environment, including employment, personal income, and tax revenue for states within the Plan Area. Additionally, as described in Section 4.4, *Climate Change*, the net reduction in greenhouse gas emissions that will occur from the development of wind energy could result in a long-term positive effect on climate change. Further, the mitigation required under the action alternatives will result in restored habitat and enhanced long-term species productivity.

6.4 Growth-Inducing Effects

The CEQ Regulations for Implementing the Procedural Provisions of NEPA require that an EIS address the effects of a proposed action, including indirect effects, which are defined at 40 CFR § 1508.8(b). Indirect effects may include "growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems." Growth-inducing effects are indirect effects of a Federal action "which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable". Direct growth-inducing effects occur if a Federal action will foster population growth, including the construction of housing; lead to urbanization of land in a remote area; or lead to substantial economic expansion or growth. Indirect growth inducement may occur where the Federal action removes impediments to growth in an area such as one with a lack of infrastructure. Examples of growth-inducing projects include construction of a road or wastewater treatment facilities.

The Federal action being analyzed in this EIS—approval of the MSHCP and issuance of ITPs or COIs—will not directly induce growth, construction, or development. However, the proposed issuance of ITPs or COIs could remove an existing obstacle to growth in the sense that the Service's authorization of the incidental take of listed species will allow for certain activities to go forward without violation of Section 9 of the Federal Endangered Species Act. The MSHCP, and issuance of subsequent ITPs or COIs, will lessen the existing constraint on development by enabling development activities to go forward in accordance with the terms of the ITP or COI in areas that otherwise will be subject to restrictions from potential take of federally listed species. Accordingly, issuance of ITPs or COIs based on the MSHCP will indirectly allow for currently undeveloped areas to accommodate wind energy development by providing a streamlined mechanism for compliance with the Endangered Species Act.

Because the development of wind energy facilities will introduce new rights of way and facilities, including right-of-way easements, those activities could contribute to an increase in related infrastructure projects in the energy or transportation sectors. This could result in associated improvements to, and expansion of, the transportation network and utility networks within and surrounding the Covered Lands. The extent to which economic growth is induced may depend on whether or not a new wind energy facility is constructed in an area that is currently undeveloped.

It is anticipated that some growth will occur regardless of approval of the MSHCP and issuance of ITPs or COIs. However, there are additional Federal, state, and local regulatory requirements that will have to be addressed by applicants before such growth can occur.

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Chapter 7
List of Agencies, Organizations, and Persons to Whom Copies of the Draft EIS are Sent

7.1 The Conservation Fund

Kris Hoellen, Vice President

7.2 Planning Partners

Illinois Department of Natural Resources

Indiana Division of Fish and Wildlife

Iowa Department of Natural Resources

Michigan Department of Natural Resources

Minnesota Department of Natural Resources

Missouri Department of Conservation

Ohio Department of Natural Resources

Wisconsin Department of Natural Resources

7.3 American Wind Energy Association

John Anderson, Senior Director of Permitting Policy and Environmental Affairs

7.4 Agencies

7.4.1 Federal Agencies

National Park Service

U.S. Army Corps of Engineers

U.S. Department of Agriculture

U.S. Department of the Interior

U.S. Environmental Protection Agency

U.S. Fish & Wildlife Service

7.4.2 State Agencies

Illinois Department of Commerce

Illinois Department of Natural Resources

Illinois State Historic Preservation Office

Indiana Department of Environmental Management

Indiana Department of Natural Resources

Indiana State Historic Preservation Office

Indiana Utility Regulatory Commission

Iowa Department of Cultural Affairs

Iowa Department of Natural Resources

Iowa State Historical Preservation Office

Iowa Utilities Board

Kentucky Department of Fish and Wildlife Resources

Michigan Department of Natural Resources

Michigan Public Service Commission

Michigan State Historic Preservation Office

Michigan State Housing Development Authority

Minnesota Department of Commerce

Minnesota Department of Natural Resources

Minnesota Department of Transportation

Minnesota Division of Ecological Services

Minnesota Environmental Quality Board

Minnesota State Historic Preservation Office

Missouri Department of Commerce

Missouri Department of Conservation

Missouri Department of Natural Resources

Missouri Office of Administration

Missouri Public Service Commission

Missouri State Historic Preservation Office

Ohio Department of Natural Resources

Ohio Public Utilities Commission

Ohio State Historic Preservation Office

Wisconsin Department of Natural Resources

Wisconsin Department of Transportation

Wisconsin Public Service Commission

Wisconsin State Historic Preservation Office

7.5 Tribes

Bad River Band of Lake Superior Tribe of Chippewa Indians

Bay Mills Indian Community, Mr. Ervin Soulier

Bois Forte Band of Lake Superior Chippewa, Ms. Tara Geshick

Fond du Lac Band of Lake Superior Chippewa, Mr. Reginald DeFoe

Forest County Potawatomi Community

Grand Portage Band of Lake Superior Chippewa, Mr. Tony Swader

Grand Traverse Band of Ottawa and Chippewa Indians

Hannahville Indian Community, Mr. Lawrence Daniels

Ho-Chunk Nation

Keweenaw Bay Indian Community, Ms. Karen Karash

Lac Courte Oreilles Band of Ojibwe, Mr. Mark Thayer

Lac du Flambeau Band of Lake Superior Chippewa Indians

Lac Vieux Desert Band of Lake Superior Chippewa Indians

Leech Lake Band of Ojibwe, Mr. Richard Robinson

Little River Band of Ottawa Indians

Little Traverse Bay Bands of Odawa Indians

Lower Sioux Indian Community, Ms. Deb Dirlam

Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians of Michigan, Mr. Larry Wawronowicz

Menominee Indian Tribe of Wisconsin

Mille Lacs Band of Ojibwe, Ms. Susan Klapel

Nottawaseppi Huron Band of Potawatomi

Oneida Tribe of Indians of Wisconsin, Mr. Shad Webster

Pokagon Band of Potawatomi Indians, Mr. Walter Cox

Prairie Island Indian Community, Mr. Gabriel Miller

Red Cliff Band of Lake Superior Chippewa

Red Lake Band of Chippewa Indians, Mr. Allen Pemberton

Sac and Fox Tribe of the Mississippi in Iowa, Mr. Kelly Schott

Saginaw Chippewa Indian Tribe

Saginaw Chippewa Indian Tribe of Michigan

Sault Tribe of Chippewa Indians, Mr. Chad Abel

Shakopee Mdewakanton Sioux Community, Mr. Stanley Ellison

Sokaogon Chippewa Community of Wisconsin, Ms. Tina Van Zile

St. Croix Chippewa Indians of Wisconsin, Ms. Katie Starhia

Stockbridge-Munsee Community, Mr. Greg Bunker

Upper Sioux Community of Minnesota, Mr. Scott Wold

White Earth Nation, Ms. Monica Hedstrom

7.6 Non-Governmental Organizations

Michigan Nature Association

Midwest Bat Working Group

National Audubon Society

National Council for Air and Stream Improvement, Inc.

National Fish and Wildlife Foundation

Natural Resources Defense Council

North American Society for Bat Research

Northeast Bat Working Group

Southeast Bat Working Group

The Conservation Fund

The Nature Conservancy

The Wildlife Society

Union Neighbors United

University of Indiana

Western Bat Working Group

Wildlife Conservation Society

Wildlife Disease Association

7.7 Industry

Acciona Wind Energy

AECOM

Akuo Energy, USA

Alliant Energy Corporation

American Energy Partners: Ascent Resources – Marcellus. LLC

Apex Clean Energy

Applied Ecological Services

Arcadis

BCK Consulting

BNSF Railway Co.

BP Wind Energy North America, Inc.

Calpine Corporation

Capital Power Corporation

Civil & Environmental Consultants

Clipper Windpower Development Company, LLC

DTE Energy

Duke Energy Renewables

E&E Publishing

E.On Climate & Renewables

EDP Renewables North America, LLC

Electric Power Research Institute (EPRI)

Element Power, LLC

EverPower Wind Holdings, Inc.

HDR, Inc.

Heritage Sustainable Energy

Iberdrola Renewables, LLC

Invenergy, LLC

NextEra Energy, Inc.

Nordex USA Inc.

Stantec Consulting

Tetra Tech, Inc.

Tradewind Energy

U.S. Mainstream Renewable Power

Van Kley & Walker, LLC

We Energies

Westwood Professional Services

Widseth Smith Nolting

Wind Capital Group, LLC

Windjourney Farm, Ltd.

Xcel Energy

7.8 Individuals

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Bayard Catron

Benito Carriles

Blanca Trenche

Bob & Kathy Etling

Bourke Thomas

Brett Fletcher

Brian & Kathy Monnin

Brian Ortman

Candace Smith

Carol Hoke

Casey Kuhn

Celeste Black

Charles Weaver

Chris Monnin

Christopher Kausch

Claire Schalck

Danielle Billington

Deborah Whorley

Derek Allen

Diane Hemmert

Dori Barnhart

Dorothy Hyatt

Edna Armstrong

Elaine Long

Eugene Gonzalez

Gerry Meyer

Gwen Rosewater

Heather Beatty

Illena Takahashi

J Beverly

James Krause

James Wieboldt

Jane Weems

Jeff Jaeckels

Jeff Terry

Jennifer Barlow

Jennifer Petz

Jennifer Spires

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Jill Coumoutso

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John Gavre

Josephine Marcotty

Joy McQueen

Judy Helms

Karem Vigmostad

Karen McIntyre

Katarina Head

Katie McPherson

Kim Schertz

Kit Benedict

Kit Freudenberg

Kristoff Chester

L. Mortimer

Laura Grove

Lauren Bennett

Leo Daher

Lowe Sarah

Lu Nelson

MacKenzie Hall

Maggie Jones

Maria Berglund

Maria Powell

Marie Rollins

Mark Hedin

Markus Ohl

Mary Rose

Matt Lamoreaux

Mike Miller

Monica Jensen

Neal Hess

Nicole Graziano

Pat Rock

Patricia Kazimier

Patrick Carey

Patty Emer

Peter Schaps

R.J. Roth

Rachel Rogge

Ray & Diane Hoerth

Rich Davis

Robert & Nancy Homan

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Chapter 9
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