United States Department of the Interior

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MEMORANDUM

To: Assistant Regional Director, Division of Ecological Services, Great Lakes Region, U.S. Fish and Wildlife Service, Bloomington, MN

From: Field Supervisor, Missouri Ecological Services Field Office, Columbia, MO KAREN HERRINGTON Digitally signed by KAREN HERRINGTON Date: 2022.02.18 10:05:36 -06'00'

Date: February 18, 2022

CC: Wildlife and Sport Fish Restoration Chief, Great Lakes Region, U.S. Fish and Wildlife Service, Bloomington, MN,

Natural Resource Section Chief, Kansas City District
U.S. Army Corps of Engineers, Kansas City, MO

Subject: Biological Opinion and Conference Opinion on the U.S. Fish and Wildlife Service's approval of a Habitat Conservation Plan and the issuance of an associated Endangered Species Act Section 10(a)(1)(B) Permit (Missouri Department of Conservation, Bat Habitat Conservation Plan).

The U.S. Fish and Wildlife Service (Service) Ecological Services Program (ES) proposes to issue an incidental take permit (ITP) under §10(a)(1)(B) of the Endangered Species Act (ESA) for incidental take resulting from implementing the Habitat Conservation Plan (HCP) for the Missouri Department of Conservation's (MDC) Bat HCP). The MDC submitted an HCP and requested coverage for incidental take resulting from implementing the fifty-year HCP across the state of Missouri. Covered Activities in the HCP are funded in part through the issuance of federal grants from the Service's Wildlife and Sport Fish Restoration Program (WSFR). The HCP also covers take that may occur during MDC management on certain U.S. Army Corps of Engineers (USACE) lands. This memorandum transmits the U.S. Fish and Wildlife Service's (Service) final biological opinion (BO).

The biological opinion reviews the effects of implementing the HCP on the federally listed

gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and northern long-eared bat (*Myotis septentrionalis*), as well as the little brown bat (*Myotis lucifugus*) and the tricolored bat (*Perimyotis subflavus*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C., 1531 et seq.). The project will not affect designated critical habitat (DCH) for the Indiana bat because no covered activities will occur within 20 acres of any DCH. There is no DCH for any of the other covered bat species.

After reviewing the status and environmental baseline of the covered species and analysis of the potential effects of the Proposed Action to the species, the Service concludes that the Proposed Action is not likely to jeopardize the continued existence of gray, Indiana, northern long-eared, little brown, and tricolored bats.

Furthermore, we do not anticipate any effects to the following federally listed species and DCH in Missouri because the species or DCH are in places and locales not targeted by the project (e.g. caves, MO and MS Rivers, federal lands outside of U.S. Army Corps of Engineers):

Scientific Name	Common Name	Where Listed	ESA Listing Status	Determination for this Biological Opinion
Scaphirhynchus albus	Pallid sturgeon	Wherever found	Endangered	No effect
Noturus placidus	Neosho madtom	Wherever found	Threatened	No effect
Lampsilis higginsii	Higgins eye (pearlymussel)	Wherever found	Endangered	No effect
Quadrula fragosa	Winged Mapleleaf	Wherever found, except where listed as an experimental population	Endangered	No effect
Lampsilis rafinesqueana	Neosho Mucket	Wherever found	Endangered	No effect
Somatochlora hineana	Hine's emerald dragonfly DCH	DCH	DCH	No effect
Antrobia culveri	Tumbling Creek cavesnail	Wherever found	Endangered	No effect
Antrobia culveri	Tumbling Creek cavesnail DCH	DCH	DCH	No effect
Cambarus aculabrum	Benton County cave crayfish	Wherever found	Endangered	No effect
Cottus specus	Grotto Sculpin	Wherever found	Endangered	No effect
Corynorhinus townsendii ingens	Ozark big-eared bat	Wherever found	Endangered	No effect
Myotis sodalis	Indiana bat DCH	DCH	DCH	No effect

Because of intensive survey protocols implemented prior to any actions and other nondiscretionary avoidance and minimization measures discussed at length in the HCP as

well as MDC's Forest Land Management Guidelines and resource policy manuals for Habitat Management and Fire Management Policy, we have determined that covered activities of the HCP may affect, but are not likely to adversely affect the following listed species:

Scientific Name	Common Name	Where Listed	ESA Listing Status	Determination for this Biological Opinion
Amblyopsis rosae	Ozark cavefish	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Etheostoma nianguae	Niangua darter	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Etheostoma nianguae	Niangua darter DCH	DCH	DCH	May Affect, Not Likely to Adversely Affect
Notropis topeka (=tristis)	Topeka shiner	Wherever found, except where listed as an experimental population	Endangered	May Affect, Not Likely to Adversely Affect
Lampsilis abrupta	Pink mucket (pearlymussel)	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Epioblasma florentina curtisii	Curtis pearlymussel	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Potamilus capax	Fat pocketbook	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Leptodea leptodon	Scaleshell mussel	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Quadrula cylindrica cylindrica	Rabbitsfoot	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Cumberlandia monodonta	Spectaclecase mussel	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Epioblasma triquetra	Snuffbox mussel	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Plethobasus cyphyus	Sheepnose mussel	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect

Scientific Name	Common Name	Where Listed	ESA Listing Status	Determination for this Biological Opinion
Danaus plexippus	Monarch butterfly	Wherever found	Candidate	May Affect, Not Likely to Adversely Affect
Nicrophorus americanus	American burying beetle	Wherever found, except where listed as an experimental population	Threatened	May Affect, Not Likely to Adversely Affect
Somatochlora hineana	Hine's emerald dragonfly	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Faxonius peruncus	Big Creek crayfish	Wherever found	Candidate	May Affect, Not Likely to Adversely Affect
Faxonius peruncus	Big Creek Crayfish DCH	DCH	DCH	May Affect, Not Likely to Adversely Affect
Faxonius quadruncus	St. Francis River crayfish	Wherever found	Candidate	May Affect, Not Likely to Adversely Affect
Faxonius quadruncus	St. Francis River Crayfish DCH	DCH	DCH	May Affect, Not Likely to Adversely Affect
Cryptobranchus alleganiensis bishopi	Ozark Hellbender	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Cryptobranchus alleganiensis alleganiensis	Eastern Hellbender Missouri DPS	Missouri DPS	Endangered	May Affect, Not Likely to Adversely Affect
Calidris canutus rufa	Red knot	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Asclepias meadii	Mead's milkweed	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Geocarpon minimum	Geocarpon	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect

Scientific Name	Common Name	Where Listed	ESA Listing Status	Determination for this Biological Opinion
Boltonia decurrens	Decurrent false aster	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Lindera melissifolia	Pondberry	Wherever found	Endangered	May Affect, Not Likely to Adversely Affect
Platanthera leucophaea	Eastern prairie fringed orchid	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Helenium virginicum	Virginia sneezeweed	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Platanthera praeclara	Western prairie fringed orchid	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect
Physaria filiformis	Missouri bladderpod	Wherever found	Threatened	May Affect, Not Likely to Adversely Affect

The MDC staff are experts in the biology of threatened and imperiled species residing in Missouri and are highly familiar with the habitat requirements and ranges of federally listed species. Therefore, HCP covered activities that could conflict with the natural activities or habitat requirements of these species will not be undertaken. Prior to any HCP covered activity, occurrences of any federally listed or proposed species are determined by checking the MDC's Natural Heritage Database. If listed species are present, then nondiscretionary avoidance and minimization policies are followed and staff experts on the species are consulted in order to avoid adversely affecting individuals and their populations. The MDC has committed to the use of the following nondiscretionary, avoidance and minimization criteria as a part of the implementation of the HCP, which will reduce the likelihood of taking the above listed species to a wholly discountable (i.e., extremely unlikely) or insignificant level:

- Missouri Department of Conservation. 2014. *Missouri Forest Management Guidelines: Recommendations for Well-Managed Forests*
- Missouri Department of Conservation. 2016b. *Resource Policy Manual. Category: Habitat Management. Fire Management Policy, 10.6. Guidance for the Application of Prescribed Fire for Natural Community Management on Department Lands.*

Despite comprehensive avoidance and minimization efforts implemented by MDC, it is possible that the following listed species may still be affected by the implementation of covered activities described in the HCP. However, the level of impact is not anticipated to rise to the level of take over the course of the 50-year permit.

Ozark cavefish, Niangua darter, Niangua darter DCH, Topeka shiner, Pink mucket, Curtis

pearlymussel, Fat pocketbook, Scaleshell mussel, Rabbitsfoot, Spectaclecase mussel, Snuffbox mussel, Sheepnose mussel, Big Creek crayfish, Big Creek Crayfish DCH, St. Francis River crayfish, St. Francis River Crayfish DCH, Ozark Hellbender, Eastern Hellbender Missouri DPS:

Listed aquatic species and their DCH may occur adjacent to some project areas, and project activities may cause temporary, insignificant behavioral responses (flight, movement) by some individuals of the fish, crayfish and amphibian species while the activities are in progress, or may cause temporary, insignificant turbidity increases to streams near some project areas. Listed mussel species and their DCH may experience temporary and insignificant increases in turbidity resulting from prescribed fire. These temporary affects to aquatic listed species are insignificant (i.e., should never reach the scale where take occurs in a single event, nor cumulatively over the entire permit term).

Red Knot: Red Knot primarily utilize river and shorelines as they migrate through Missouri. Covered activities may potentially occur within areas of suitable stopover migratory habitat for Red Knot. However, such activities would be temporary in nature, disturb a relatively small area, and result in highly localized effects. There is a chance of occasional, temporary disturbance to birds that are foraging in project areas; however, birds could easily move a short distance to less disturbed areas. Thus, such temporary disturbance would be discountable and insignificant. Because any project-related effects would be localized to a relatively small area, such activities are not likely to adversely affect designated Red Knot.

American burying beetle, Hine's emerald dragonfly, Monarch Butterfly: Listed insects may occur on or near some project areas. Project design and implementation will require avoidance of preferred habitats; therefore, negative impacts are anticipated to be insignificant. Prescribed fire and tree removal will serve to stimulate and restore prairie, glade, and woodland habitats which the monarch depends upon. Project activities may cause minor and temporary behavioral responses by some individuals while the activities are in progress. Such behavioral responses would be insignificant and are not anticipated to rise to the level of take in a single event, nor cumulatively over the course of the permit term, as most of the projects executed under the HCP will not reoccur at the same location during the permit term (e.g. timber stand improvement on a mature forest stand). The HCP covered activities will not jeopardize the monarch population.

Mead's milkweed, Geocarpon, decurrent false aster, pondberry, eastern prairie fringed orchid, Virginia sneezeweed, western prairie fringed orchid, Missouri bladderpod: Listed plant species may be temporarily or insignificantly exposed to trampling or stepping upon during the implementation of covered activities. Any trampling that may occur would be extremely rare and the effects would be temporary. Conversely, many of the listed plant species in MO will benefit greatly from increased and enhanced management activities in their preferred habitats especially the prairie and glade obligates (e.g. eastern & western prairie fringed orchids, Mead's milkweed, geocarpon), and other species currently suffering from competition (e.g. pondberry) for limited sun and nutrient resources.

If you have any questions or comments on this BO, please contact Karen Herrington, Field Supervisor, at (573) 234-2132.

Attachment

Biological Opinion and Conference Opinion for the Issuance of an Incidental Take Permit for the Gray Bat, Indiana Bat, Northern Long-eared Bat, Little Brown Bat, and Tricolored Bat.

Associated with the Habitat Conservation Plan for the Missouri Department of Conservation's habitat and public access management activities across the state of Missouri

February 18, 2022
U.S. Fish and Wildlife Service
Missouri Ecological Services Field Office

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1.0 Description of the Proposed Action

As defined in the ESA section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas." The following is a summary of the proposed action and a detailed description can be found in the Habitat Conservation Plan (HCP) for Bats from the Missouri Department of Conservation (MDC).

1.1 Incidental Take Permit and Habitat Conservation Plan

The U.S. Fish and Wildlife Service, Ecological Services program (ES) proposes to issue an incidental take permit (ITP) under §10(a)(1)(B) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq. [ESA]) for incidental take resulting from implementing the fifty-year HCP for MDC across all of the state of Missouri, (Figure 1. Action Area:). The HCP was submitted by MDC (the Applicant) as part of their ITP application and describes how the Applicant will minimize and mitigate incidental impacts to the Covered Species, including the gray bat (*Myotis grisescens),* Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), little brown bat (*Myotis lucifugus*), and tricolored bat (*Perimyotis subflavus*).

Specifically, the primary proposed federal action is the potential issuance of the fifty-year ITP and includes the incidental take authorization, along with the associated conservation measures, adaptive management, and monitoring provisions in the HCP, that would go into place upon issuance.

1.2 Wildlife and Sport Fish Restoration Program of the U.S. Fish & Wildlife Service

The U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program (WSFR) is also party to this biological opinion (BO) through the issuance of annual funding grants to MDC. WSFR is allocating Federal Aid to the MDC for habitat and public access management on MDC-managed lands. The Federal funding is another nexus for this consultation in addition to the issuance of the ITP.

1.3 U.S. Army Corps of Engineers Management Agreement

The U.S. Army Corps of Engineers (USACE) delegated authority to MDC manage certain USACE lands across the state of Missouri as described in Table 1. The MDC is seeking take coverage under this HCP and ITP including take which may be incurred while managing USACE land. Additional take coverage beyond these amounts is not being sought or provided to

the USACE by other means. The USACE's delegation of management of their lands to MDC constitutes a federal action and is therefore included here.

1.4 The MDC Bat HCP

The MDC manages land for the purpose of promoting fish and wildlife habitat, enhancing and maintaining forest health, and providing recreational opportunities. Several of MDC's forest management activities, primarily tree removal and prescribed fire, have the potential to adversely affect listed bats (e.g., timber harvest could result in the removal of roost trees or foraging habitat). As a result, MDC seeks to avoid, minimize, and mitigate for potential effects on bats while continuing to manage forests to provide long-term habitat benefits for bats and other wildlife. Forest management practices and other related MDC activities have the potential to incidentally take the covered species. To provide for the continuance of these activities while minimizing the potential for take of the covered species, MDC has developed the MDC Bat HCP.

The primary goal of the MDC Bat HCP is to obtain authorization for incidental take of the five covered species for specific activities, called covered activities, as administered by MDC. Covered activities have been grouped into three major categories: habitat management, public access and asset management, and HCP implementation. Habitat management activities include prescribed fire and tree removal. Prescribed fire is an important forest management practice conducted for the purpose of enhancing and maintaining wildlife habitat and improving recreational and hunting opportunities. Prescribed fire also creates roost trees and foraging habitat for bats. Tree removal ultimately accomplishes two major management objectives: namely, opening the canopy to allow new trees to grow and managing existing habitat to improve the quality of the timber and/or wildlife habitat within the stand. Public access and asset management activities are necessary to maintain infrastructure (e.g., buildings, roads) needed to administer MDC lands and to allow for public access. Take can occur as a result of tree removal during construction, maintenance, and repair of facilities, vehicle operation, and demolition of structures. Implementation of the HCP conservation strategy may result in incidental take during monitoring (e.g., result of direct handling of bats).

Additional MDC activities conducted on covered lands that are not covered or permitted under the MDC Bat HCP may be regulated under their own environmental compliance processes, including ESA compliance. These activities not addressed by the HCP include MDC technical assistance without a nexus to funding (i.e., a cost share), application of approved pesticides/herbicides, utilities accesses, recreational activities, collection of down and dead firewood, and research by individuals or organizations not affiliated with MDC.

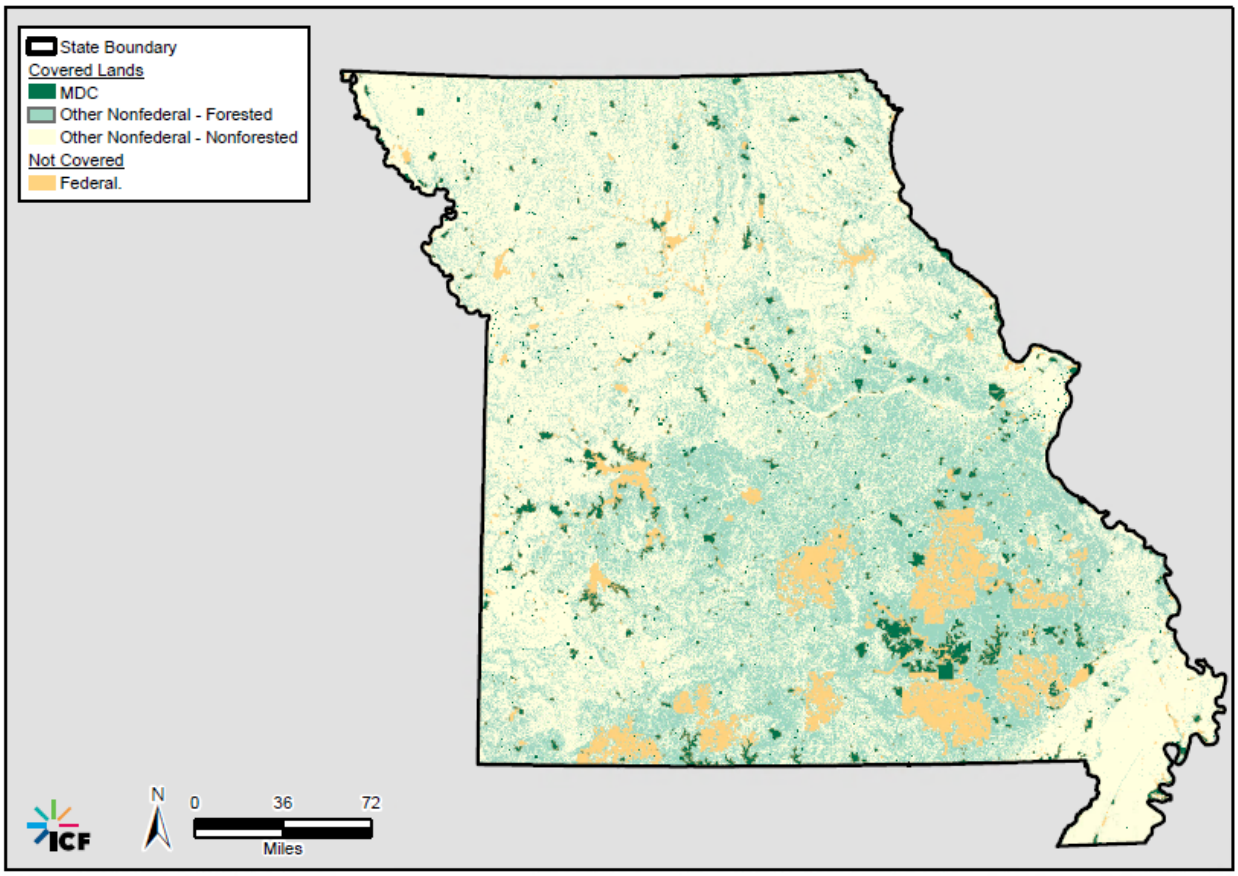

Figure 1. Action Area: Map of Covered Lands adopted from the MDC HCP.

1.5 Action Area

Figure 1. Action Area:). Lands within the plan area are defined broadly as the state of Missouri, and covered lands include those lands owned and managed by MDC as well as those lands where MDC conducts operations in support of its mission to promote fish and wildlife habitat, enhance and maintain forest health, and provide recreational opportunities. There are approximately 1 million acres of MDC-owned and/or managed lands within the approximately 42 million acres of public and private land potentially covered under the MDC Bat HCP. Although MDC-owned lands represent a relatively small proportion of the potentially covered lands, most of the covered activities will occur on MDC lands.

1.5.1 Federal Lands Managed by MDC

The Action Area also includes approximately 178,000 acres of land leased to and managed by MDC on behalf of the U.S. Army Corps of Engineers (USACE). Each of the USACE programs under which MDC manages land is described below, along with an accounting of the specific sites and the general activities it conducts.

Table 1. USACE Lands Managed by MDC Included in the HCP

USACE Program	MDC Activities	Land Managed by MDC (acres)	Notes
Missouri River Fish and Wildlife Mitigation Project	Habitat management, site operations and maintenance, law enforcement	20,482	Managed by MDC under contract with the USACE as described in the Performance Work Statement to Develop and Maintain Features of the Missouri River Fish and Wildlife Mitigation Project.
License for Fish and Wildlife Activities Around USACE Reservoirs	Habitat management, agricultural leases	144, 292	Called "Management Lands" by MDC. Managed under 25-year licenses with USACE.
Upper Missouri Conservation Area	Prescribed burning only	13,086	Managed by MDC under a Cooperative Agreement with USACE called the "General Plan."
Total		**177,860**	

1.5.2 Nonfederal, non-MDC lands

Approximately 41.4 million acres of land addressed under the MDC Bat HCP are non-MDC, non-federal lands, of which 14.7 million acres are forested. Actions on both forested and non-forested lands are covered, but most covered activities involve actions on forested land where there is potential foraging, roosting, maternity colony, and swarming habitat for the covered bat species. The non-MDC, non-federal lands (e.g. private, municipal, county, and other state-

owned lands) covered by this HCP must meet certain criteria, such as enrollment in landowner support programs including cost share with landowner agreements and state forestry programs.

1.6 Conservation Strategy

The conservation strategy for the MDC Bat HCP is designed to fully offset impacts from covered activities on covered bats through avoidance, minimization, and mitigation as defined in biological goals, objectives, and conservation measures (Table 2, adopted from the HCP). The conservation strategy focuses on minimizing negative effects on bats and bat habitat from forest management, initiating beneficial actions, and mitigating for unavoidable impacts. It is built on biological goals and objectives and their associated conservation measures.

A summary of the conservation measures follows in Table 2, adopted from the HCP, and a more detailed description of the Project's conservation measures can be found in the HCP (see Chapter 5 – Conservation Strategy).

Table 2. Biological Goals, Objectives, and Resulting Conservation Measures (adopted from the HCP)

Goal	Objective	Conservation Measures
Biological Goal 1: Maintain a mosaic of contiguous or semi-contiguous natural lands to provide foundational habitat for covered bats.	Objective 1.1: Sustainably manage 700,000 acres of forest and woodlands across MDC lands beginning in year 1 and continuing throughout the permit term.	Maintenance and acquisition of forested lands as part of the MDC system, the continued practice of sustainable forestry and habitat management on MDC lands, and the protection of MDC lands as managed forests that results in the removal of these lands from the development stream.
	Objective 1.2: Sustainably manage over 200,000 acres of ecologically appropriate open habitats across MDC lands beginning in year 1 and continuing throughout the permit term.	Maintenance and acquisition of open habitats as part of the MDC system, the continued practice of habitat management on MDC lands, and the protection of MDC natural lands that results in the removal of these lands from the development stream.
	Objective 1.3: Conduct prescribed burning in forests and woodlands each year to increase native biological diversity and enhance forest regeneration, wildlife habitats, and ecological community types that benefit bats.	Implementation of 10,000 acres of prescribed fire on MDC lands in areas that would benefit bats.
Biological Goal 2: Support land stewardship and bat conservation on lands not owned/managed by MDC.	Objective 2.1: Promote bat-friendly management practices on private and other nonfederal land in the plan area.	Updating and promotion of the Missouri Forest Management Guidelines; the development and implementation of a communication plan (by year 5) and associated public outreach efforts related to bats, forestry, and WNS; implementation of the technical assistance and cost-share programs; and incorporation of the bat conservation measures described in this chapter into these programs.
Biological Goal 3: Enhance, maintain, and restore roosting and foraging habitat for covered bats.	Objective 3.1: Minimize impacts and improve habitat for covered bats by implementing roost tree retention guidelines in all forest habitat on covered lands.	Enhanced snag retention, maternity roost retention, patch retention, den-tree retention, super-canopy tree retention, snag creation, and additional measures for even- and uneven-aged stand management.
	Objective 3.2: Protect all known roost trees using 150-foot buffer.	Updating known roost data per natural heritage database, delineate buffer areas, and implementation of forestry restrictions within the buffer between April 1 and August 31.

Goal	Objective	Conservation Measures
	Objective 3.3: Establish priority bat management zones (PBMZs) to protect bats and promote high-quality bat habitat in areas of known or potential bat activity.	Establishment of 31 PBMZs for a total of 28,613 acres. These PBMZs will be targeted on concentration of maternity colonies and will be distributed as feasible throughout the state. Each species will have a minimum of 7,000 acres of PMBZs, each of which is a minimum of 100 acres in size. The PBMZs will be managed to benefit the target species by implementing forest management actions to achieve the species-specific habitat conditions. Within the PBMZs, removal of trees equal to or greater than 9 inches diameter at breast height will be prohibited between April 1 to August 31 and prescribed fires will be avoided between May 1 and July 31.
Biological Goal 4: Protect and enhance subterranean habitat and bats using that habitat.	Objective 4.1: Assess and, if necessary, improve 10 entrances to known subterranean habitat on MDC lands annually beginning in year 1 and continuing for the duration of the permit term.	Determination of the status of entrances around occupied caves and mines, trimming vegetation around entrances and removing other obstructions as needed, and maintaining entrances over time.
	Objective 4.2: Implement bat management zones around known entrances to subterranean habitat.	Implementation of a 20-acre buffer around the 275 identified caves on MDC lands within which habitat will be managed to provide old-growth forest conditions, and activities associated with this management will be restricted between March 15 and April 30 and September 15 and October 31. In addition, activities within ¼ mile of all hibernacula will be limited to reduce the potential for noise or other disturbance during the winter season. At 1 and 2 priority hibernacula for covered species, harvest activities will be restricted in the spring and fall within five miles. Around the Sodalis Nature Preserve, within 10 miles, harvest activities will be limited to the winter.
	Objective 4.3: Maintain physical barriers at subterranean sites on MDC lands over the course of the permit term and gate additional sites as needed.	Documentation of sites with existing physical barriers, prioritization of sites in need of physical barriers (including those on private lands where opportunity allows), installation of physical barriers at sites without barriers where they are determined to be beneficial, and maintenance of existing and future physical barriers.

Goal	Objective	Conservation Measures
Biological Goal 5: Avoid and minimize other effects from covered activities on covered species.	Objective 5.1: Implement bat-friendly management measures within burn plans beginning year 1 of the plan.	Development of burn plans and the implementation of these burn plans on modeled habitat during the spring and fall in areas where bats may be present.
	Objective 5.2: Implement bat-friendly construction and demolition measures throughout the permit area.	Implementation of seasonal guidelines on tree removal associated with road and trail construction, the maintenance of speed limits, investigation into additional speed restrictions near hibernacula, and bat-friendly demolition practices.
	Objective 5.3: Provide training to new MDC staff to recognize and avoid potential roost trees.	Bat-specific training as part of the on-boarding process for new staff.
	Objective 5.4: Incorporate bat-friendly best management practices (BMPs) into the Professional Timber Harvester (PTH) training.	Development of bat-friendly BMPs and their integration into the PTH training.
Biological Goal 6: Promote survival and recovery of bats affected by white-nose syndrome (WNS).	Objective 6.1: Update MDC's WNS action plan by year 5.	Development of an updated action plan for MDC.
	Objective 6.2: Collaborate with researchers to identify ways to ameliorate the impacts of WNS through treatment or habitat management.	Provision of technical assistance, permitting, and other collaborative efforts that could help treat WNS.

2.0 Status of the Species

The following summaries offer a brief description of the species' biology adopted from the HCP and other sources. For a more in-depth discussion of each species characteristics, range in Missouri and on MDC lands, ecology, population trends, and seasonal habitat use, see the HCP appendices specific to each species.

2.1 Gray Bat

This section presents the biological or ecological information relevant to formulating this BO. Appropriate information on the species' life history, its habitat and distribution, and other data on factors necessary to its survival are included to provide background for analysis in later sections. This analysis documents the effects of past human and natural activities or events that have led to the current range-wide status of the species. Portions of this information are also presented in listing documents, the recovery plan (USFWS 1982), the 2009 5-year review (USFWS 2009) and available literature.

The gray bat was originally listed as an endangered species by the Service in 1976. There is no designated critical habitat for the gray bat. The gray bat is the largest member of its genus in the eastern United States. Its forearm measures anywhere from 40-46 mm, and it weighs from 7 to 16 grams, but more typically in the 8 to 11 gram range (USFWS 1982). It is distinguished from all other bats within its range by its uni-colored dorsal fur; all other eastern bats have distinctly bi or tri colored fur on their backs (USFWS 1982). Following molt in July or August gray bats are dark gray, but they often bleach to chestnut brown or russet between molts, which is especially apparent in reproductive females during May and June (Photo 1; USFWS 1982). The wing membrane connects to the foot at the ankle unlike in most Myotis where the membrane connects at the base of the first toe (USFWS 1982). The presence or absence of a notch in the claws and forearm length are the most reliable methods of identifying the species (Sasse et al. 2019).

2.1.1 Range and Distribution

The gray bat occurs in limited geographic range in limestone karst areas of the southeastern United States. Hibernating populations are concentrated in caves throughout Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. The summer range extends eastward from eastern Oklahoma and very southeastern Kansas, across Illinois and Indiana and out to southwestern Virginia, western North Carolina, and northwest section of Georgia. Historically, some populations occurred in northwestern Florida which are now considered locally extirpated, and there have been rare cases of foraging gray bats observed in the very northeastern county in

Mississippi (Sherman and Martin 2006). There is only one record of a single gray bat hibernating in Pendleton County, West Virginia.

The overall geographic range and distribution has changed relatively little since the gray bat was first listed as endangered in 1976. In particular, the number of occupied hibernacula has changed relatively little. Missouri, Arkansas, Tennessee, Alabama and Kentucky historically had the highest estimated numbers of hibernating bats, and continue to support the largest number of bats in hibernacula. Of the 5,306,905 bats counted during 2019 hibernacula surveys, approximately 28% were found to hibernate in Tennessee, 25% in Alabama, 22% in Arkansas, 15% in Missouri, and 10% in Kentucky. Given the small number of preferred occupied sites, gray bats are particularly vulnerable to impacts from natural and anthropogenic stressors.

2.1.2 Life History and Habitat Use

Gray bats are found throughout karst areas of the southeastern United States where they primarily roosts in caves, and occasionally in human-made structures such as concrete box culverts, dams, abandoned mines, and bridges (Timmerman and McDaniel, 1992; Johnson et al. 2002; Gerdes et al. 2016; Powers et al. 2016; Sasse et al. 2019). Males and females hibernate together in large colonies for approximately 6 to 7 months in few caves throughout Alabama, Arkansas, Kentucky, Missouri, and Tennessee. Gray bats are considered regional migrants, with average migrations of 200 km (124 mi) (Gerdes et al. 2016). However, some bats have been known to migrate as far as 775 km (481 mi). In the spring, gray bats migrate to caves used as separate bachelor and maternity colonies (Decher and Choate 1995). Spring migration typically takes place between mid-March to late May, which may vary based on latitudinal gradients and annual weather patterns (Tuttle 1976). Fall migration usually occurs from early August to mid-November (Tuttle, 1976; Gerdes, 2016) (Table 1). Very few studies have attempted to document spring and fall migratory pathways, and little is known about bat movements between summer and winter caves (but see LaVal et al. 1977; Thomas and Best, 2000; Moore et al. 2017).

2.1.2.1. Winter Hibernation

After the summer maternity period, gray bats migrate to their winter hibernacula. Bats spend time at transient (stop-over) caves between summer and winter grounds. Transient roosts are likely utilized by bats migrating long distances, while bats migrating short distances might make direct movements to hibernacula. The duration spent at transient locations by individual gray bats is unknown. However, in Missouri, recordings from bat detectors placed at transient caves during the migratory period show that transient caves are used over several weeks each spring and fall (USFWS unpublished data 2021).

Permanent identification bands, which are placed on the forearms of bats and can be recovered or resighted in the future, have helped establish the start and end points of individuals moving from winter and summer caves. Band return data show that gray bats are generally philopatric to a hibernaculum (i.e., they return annually to the same hibernaculum) (Colatskie et al. 2018). Once bats have arrived at their winter roost in the fall, during a several week swarming period, bats fly in and out of cave entrances from dusk to dawn, and males mate with females. Females delay fertilization by storing the sperm and become pregnant once they ovulate in the spring (Guthrie and Jeffers 1938). Fat supplies are replenished as the bats forage prior to hibernation. Females immediately enter hibernation after copulation (Tuttle 1976). Generally, female bats mate and begin winter torpor during mid-September to mid-October (USFWS 1982). Juveniles and adult males tend to enter hibernation several weeks later than adult females but most are in hibernation by mid-November. Hibernation lasts six to seven months (Tuttle 1976).

Gray bats hibernate in caves and mines with cold, stable microclimates. Most winter caves are deep and vertical, and provide large volume below the lowest entrance and act as cold air traps. There are few vertical caves within the range of the gray bat that meet these specifications, which likely contributes to the gray bat's use of a very limited number of hibernacula (Tuttle 1976). It is estimated that 98% of gray bats hibernate in just 15 caves (USFWS 2009). They form large, dense clusters, ranging in size from a few hundred to over a million individuals per cave.

2.1.2.2. Summer Roosting and Foraging

Adult females are thought to emerge in late March and early April, followed by juveniles of both sexes and adult males, and begin migrating to their summer roosts (Guthrie and Jeffers 1938). Gray bats have high site fidelity to their sites, which is evidenced by the buildup of guano piles in caves over many years or decades. Along the way, they use transient stop over sites which include caves, trees (Samoray et al. 2020), dams, and artificial structures such as concrete bridges (Sasse 2019). In spring, when fat reserves and food supplies are low and females are pregnant, migration is probably hazardous (Tuttle 1976). Consequently, mortality may be higher in the early spring, immediately following emergence (Tuttle 1976).

Early in the spring, males and females may share a common roost. However, pregnant females tend to congregate in a single maternity cave as they come closer to parturition, and separate from non-reproductive females and males (USFWS 1982). Maternity colonies are typically large, often with thousands to individuals per colony, with some colonies estimated to have more than 100,000 individuals. Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer of rivers or reservoirs (rarely more than 4 km) over which the bats feed (Tuttle, 1976b). Birth to one young occurs between late May and early June (Tuttle 1975). Growth rates of non-volant young are positively correlated with colony size (Tuttle 1975), because increasing numbers of bats clustering together reduce the thermoregulatory cost per

individual (Herreid 1963). Growth rates are also affected positively by higher ambient cave temperatures and porous or domed ceilings at roosts. Though growth rates vary, most young begin to fly within 20-25 days after birth. Where colonies have been reduced in size as a result of roost disturbance this time may be increased to 30-35 days (Tuttle 1975), and in severely reduced colonies, the young sometimes die before learning to fly (Tuttle 1975). The young are typically seen flying by early to mid-July (USFWS 1982).

Gray bats have a propensity for hunting over large areas in the summer (362.2 ± 24.9 [SE] km2; Moore et al. 2017), given their ability for strong, fast flight (an average wing load of 8.0g/m2). Inexperienced and new to flight, young often feed and take shelter in forested areas close to the roost (USFWS 1982). Also, whenever possible, gray bats of all ages fly in the protection of forest canopy between caves and feeding areas. Such behavior provides increased protection from predators such as screech owls. Forested areas surrounding caves and between caves and over-water feeding habitat clearly are advantageous to gray bat survival (Tuttle 1979). Additionally, gray bat feeding areas have not been found along sections of river or reservoir where adjacent forest has been cleared (LaVal et al. 1977).

2.1.3 Population Status and Threats

2.1.3.1. Species Population Status

The population of the gray bat has increased significantly in hibernacula since they were listed in 1976 (USFWS 1982), and a population trend analysis conducted by the Missouri Field Office in 2020 indicates that gray bats range-wide are stable and increasing. Table 3 provides survey count data from the 15 most populous hibernacula across the range of the species from 2010 to 2019, which includes both Priority 1 designated caves (see the 1982 Recovery Plan for more information) as well as other important caves that support large overwintering populations, called Biologically Significant hibernacula. The current range-wide population estimate for the gray bat based on winter surveys of hibernacula is 5,306,905.

2.1.3.2. Threats

Climate change is an emerging threat to the gray bat, primarily because temperature is an essential feature of both hibernacula and maternity roosts. Potential impacts of climate change on temperatures within Indiana bat hibernacula were reviewed by V. Meretsky (pers. comm., 2006 in USFWS 2007). Climate change may be implicated in the disparity of population trends in southern versus northern hibernating populations of Indiana bats (Clawson 2002), but Meretsky noted that confounding factors are clearly involved. Potential impacts of climate change on hibernacula can be compounded by mismatched phenology in food chains (e.g., changes in insect availability relative to peak energy demands of bats) (V. Meretsky, pers. comm., 2006 in USFWS 2007). Changes in maternity roost temperatures may also result from climate change,

and such changes may have negative or positive effects on development of gray bats, depending on the location of the maternity colony. The effect of climate change on gray bat populations is a topic deserving additional consideration.

Lastly, there is growing concern that the gray bat (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of gray bats has been documented at an operating wind farm. The Service is actively working with wind farm operators to avoid, minimize, and mitigate incidental take of bats.

2.2 Indiana Bat

This section presents the biological and ecological information relevant to formulating this BO. Appropriate information on the species' life history, habitat and distribution, and other data on factors necessary to survival are included to provide background for analysis in later sections. Portions of this information are also presented in listing documents, the recovery plan (USFWS 1983), and the draft revised recovery plan (USFWS 2007) and available literature.

The Indiana bat was originally listed as an endangered species by the Service in 1967. Listing was due to long-term population decreases across the range of the species. Range-wide estimates from 2019 totaled 537,297 bats (USFWS 2019), a two-thirds decrease from the 1960 estimated population. Missouri is currently the most populous state for Indiana bats containing 36 percent of the 2019 population estimate (195,157) (USFWS 2019). Thirteen winter hibernacula (11 caves and two mines) in six states were designated as critical habitat for the Indiana bat in 1976 (USFWS 1976). Six of these hibernacula are in Missouri. No critical habitat will be affected by the HCP because no covered activities will occur within 20 acres of DCH; therefore, there will be no further discussion of Indiana bat critical habitat in this biological opinion.

2.2.1 Range and Distribution

The Indiana bat ranges from the northeast United States to the Midwest, reaching its western range limit in Iowa, Missouri, and Oklahoma (Figure 2. Indiana Bat Current Range (delineated by outer red line) and Recovery Units). In winter, the range of the species is restricted to areas with caves or underground mines. Large wintering populations (more than 50,000 individuals) are found in Indiana, Illinois, Kentucky, and Missouri with smaller hibernacula occurring in 24 additional states. White-nose syndrome (WNS) has decimated hibernating populations in the Appalachian and Northeast recovery units.

During summer months, the Indiana bat is considered a "tree bat" because it roosts in forests, woodlands, and savannas as opposed to caves and mines. Therefore, the summer range of the Indiana bat is more widespread with distribution of individuals varying across the landscape. The summer range extends from the Eastern Sea Board to the edge of the High Plains with the

highest summer occurrences in Northern Missouri, Illinois, Indiana and Southern Iowa and Michigan. Bat densities do not correlate solely to tree density, cooler summer temperatures can also affect summer distribution and reproductive success of Indiana bats (Johnson et al. 2002). Relatively warmer regions of the Midwest and higher elevations in the eastern portion of the range are less suitable for Indiana bats (Johnson et al. 2002, Loeb and Winters 2013).

The current revised recovery plan (USFWS 2007) delineates recovery units based on population discreteness, differences in population trends, and broad level differences in land-use and macro-habitats. There are currently four recovery units for the Indiana bat: Ozark-Central, Midwest, Appalachian Mountains, and Northeast. The project falls within the Ozark-Central Recovery Unit (OCRU).

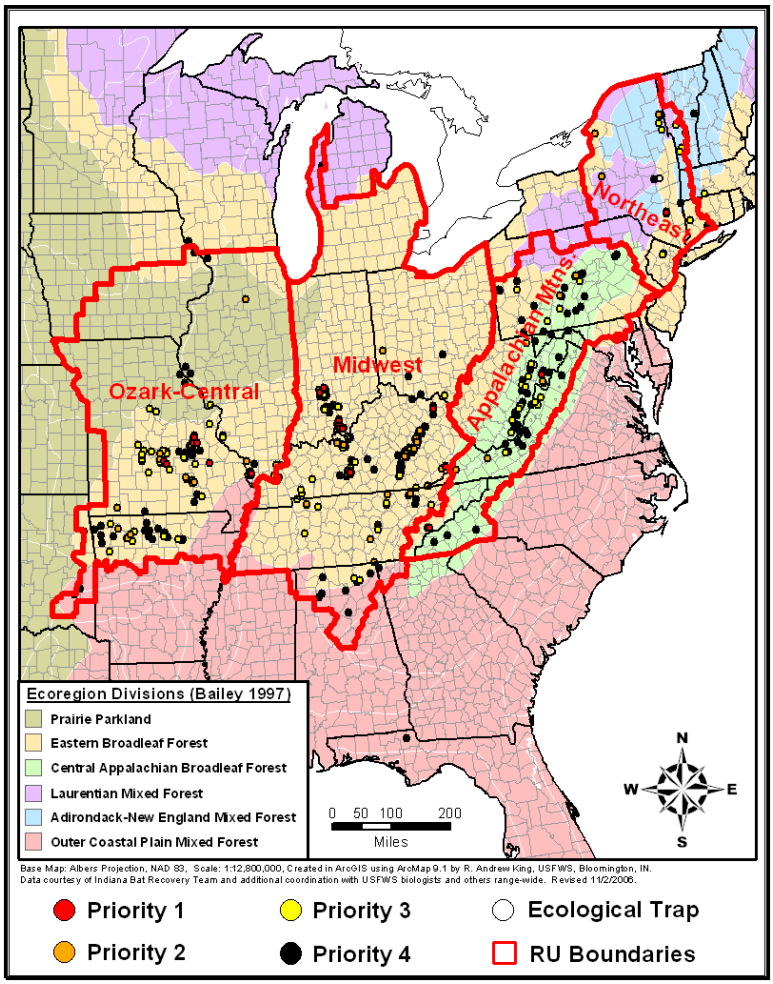

Figure 2. Indiana Bat Current Range (delineated by outer red line) and Recovery Units

2.2.2 Life History and Habitat Use

Indiana bats are exposed to risk at during the following key stages: *spring migration*, *summer habitat use*, and *fall migration*. A generalized chronology of the annual cycle in Indiana bats is

found in Figure 3. Note that this figure depicts peaks for each phase of annual chronology but does not capture outliers.

While there is variation based on weather and latitude, generally bats begin winter torpor in mid-September through late-October and begin emerging in April. Females depart shortly after emerging and are pregnant when they reach their summer area. Birth of young occurs between mid-June and early July and then nursing continues until weaning, which is shortly after young become volant (able to fly) in mid- to late-July. Migration back to the hibernaculum may begin in August, peak in September, and continue into October.

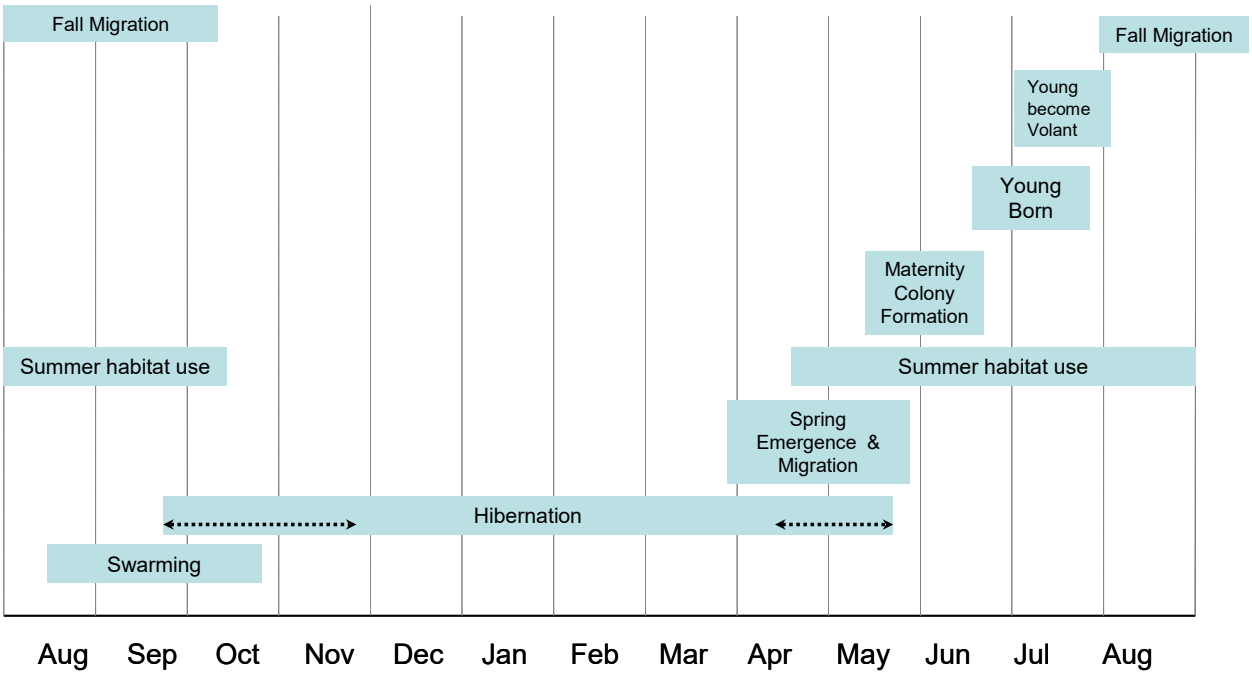

Figure 3. Generalized Indiana Bat Annual Chronology

2.2.2.1. Spring migration

In spring, Indiana bats emerge from hibernation. Female Indiana bats emerge first, generally late March and through April, and most males emerge later. The timing of annual emergence varies, depending in part on latitude and annual weather conditions. Most reproductive females appear to initiate migration to their summer habitat quickly after emerging from hibernation. Females migrate to their traditional roost sites, where they find other members of their maternity colony. Most documented maternity colonies have 50 to 100 adult female bats; average colony size of 80 adult females (Whitaker and Brack 2002) is a widely used estimate. However, we estimate the average colony size in the Project Area is approximately 60 adult females (Kurta 2005).

2.2.2.2. Summer habitat use

Female Indiana bats exhibit strong site fidelity to summer roosting and foraging areas; that is, they return to the same summer range annually to bear their young. Female Indiana bats form maternity colonies in forested areas where they bear and raise their pups. Maternity colony habitats include riparian forests, bottomland and floodplain habitats, wooded wetlands, and upland forest communities. Maternity roost sites are most often under the exfoliating bark of dead trees that retain peeling bark (Kurta 2005, Lacki et al. 2009, Timpone et al. 2010). Live trees, especially shagbark hickory, are also used if they have flaking bark under which the bats can roost (Callahan et al. 1997, Sparks 2003, Brack et al. 2004). Primary roosts, those used frequently by large numbers of female bats and their young, are usually large diameter snags (dead trees) (Callahan et al. 1997, Kurta and Rice 2002, Whitaker and Brack 2002). Roost trees are often in mature mostly closed-canopy forests, but in trees with solar exposure (i.e., sunlight on the roost area for at least part of the day) – these may be in canopy gaps in the forest, in a fence line, or along a wooded edge (Vonhof and Barclay 1996).The home range of a maternity colony is the area within a 2.5-mile radius (i.e., 12,560 acres) around documented roosts or within a 5-mile radius (i.e., 50,265 acres) around capture location of a reproductive female or juvenile Indiana bat or a positive identification of Indiana bat from properly deployed acoustic devices and acceptable analysis of data. Based on data provided in the Indiana bat draft revised recovery plan (USFWS 2007), a maternity colony needs at least 10% suitable habitat (i.e., forested habitat that provides adequate roost sites and foraging areas) to exist at a given point on the landscape.

Male Indiana bats may be found throughout the entire range of the species. Males appear to roost singly or in small groups, except during brief summer visits to hibernacula. Males have been observed roosting in trees as small as 3 inches dbh, but the average roost diameter for male Indiana bats is 13 inches (USFWS 2007).

Indiana bats forage over a variety of habitat types but prefer to forage in and around the tree canopy of both upland and bottomland forest, along roads, or along the corridors of small streams. Menzel et al. (2005) found that females foraged significantly closer to forests, roads, and riparian habitats than agricultural land and grasslands. Womack et al. (2012) documented selection by reproductive females of forests with higher canopy cover but more open mid-stories caused by management via prescribed fire. Bats forage between dusk and dawn at a height of approximately 6-90 feet above ground level and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects (Humphrey et al. 1977).

Fecundity is low with female Indiana bats producing only one pup per year in late June to early July (USFWS 2007). Young bats can fly at about four weeks of age. The sex ratio of the Indiana bat is generally reported as equal or nearly equal (Hall 1962; Myers 1964; LaVal and LaVal 1980; Humphrey et al. 1977).

2.2.2.3. Fall migration

Cohesiveness of maternity colonies begins to decline after young bats become volant (Kurta et al. 1996). That is, the bats tend to roost together in the same roosts less frequently and at lower densities. A few bats from maternity colonies may commence fall migration in August, although at many sites some bats remain in their maternity colony area through September and even into October. Members of a maternity colony do not necessarily hibernate in the same hibernacula, and may migrate to hibernacula that are over 300 kilometers (km) (190 miles (mi)) apart (Kurta and Murray 2002, Winhold and Kurta 2006).

Indiana bats arrive at their hibernacula in preparation for mating and hibernation as early as late July; usually adult males or non-reproductive females make up most of the early arrivals (Brack 1983). The number of Indiana bats active at hibernacula increases through August and peaks in September and early October (Cope and Humphrey 1977, Hawkins and Brack 2004, Hawkins et al. 2005). Return to the hibernacula begins for some males as early as July, but most females arrive later.

2.2.3 Population Status and Threats

2.2.3.1. Species Population Status

The population of the Indiana bat has decreased significantly from an estimated 808,000 in the 1950s (USFWS 2007). Based on censuses taken at all hibernacula, the current total known Indiana bat population in 2019 is estimated to number approximately 537,297. Recent population estimates by recovery unit are displayed in Figure 4. Indiana Bat Population Estimates by Recovery Unit from 2001 to 2019.

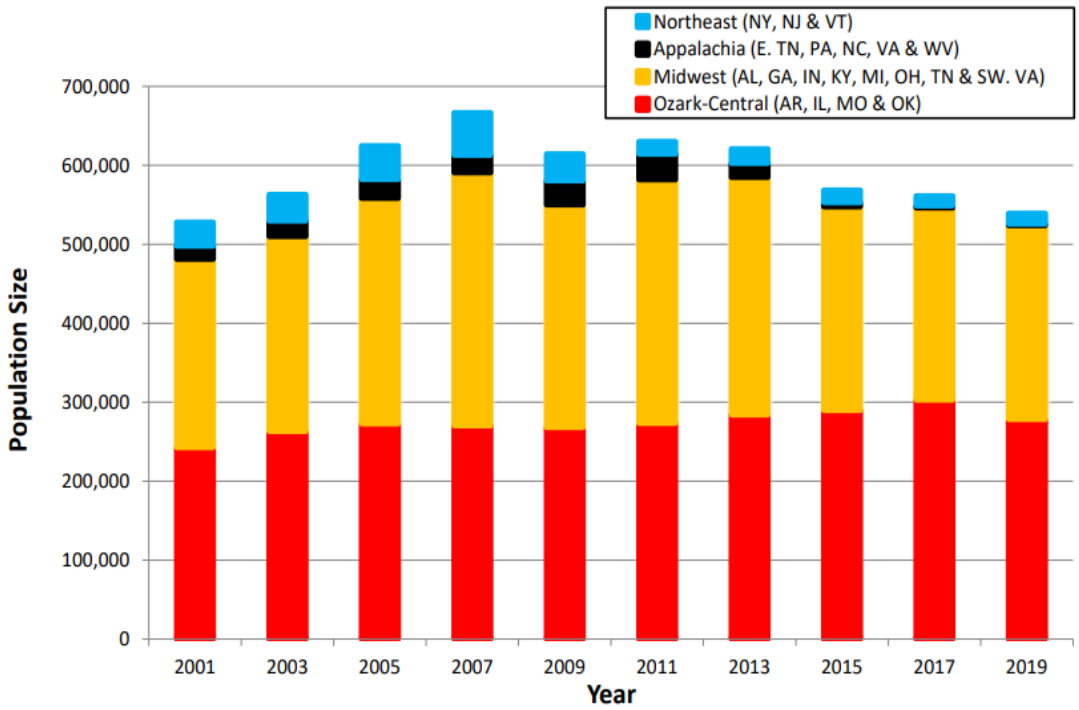

Figure 4. Indiana Bat Population Estimates by Recovery Unit from 2001 to 2019

2.2.3.2. Status within the Ozark-Central Recovery Unit

The Indiana bat populations in the Ozark-Central Recovery Unit (OCRU) have declined significantly since 1990 but has been relatively stable from 2009 to 2017 (USFWS 2017, 2019). Prior to 2012, the majority of hibernating bats in the OCRU were assumed to overwinter in Pilot Knob Mine in Missouri. Dramatic declines in the hibernating population at this site occurred since the early 1980s from an original estimation of approximately 100,000 in the 1970s to an estimation of 1,678 in the 2000s. The discovery of the Sodalis Nature Preserve (SNP) population in Hannibal, Missouri has increased the baseline size of the population in the OCRU, but not the overall trend across the range of the species. Based on observations by private cavers, the site has been occupied by Indiana bats since the 1970s. Therefore, these bats are not considered to be bats that moved from Pilot Knob Mine following a partial collapse of the mine. In 2017, SNP housed approximately 197,000 hibernating Indiana bats. The most recent survey in 2019 showed the first signs of a WNS-caused decline in this population with the count being approximately 180,000 hibernating Indiana bats. The current 2019 population estimate for the OCRU is approximately 271,965.

2.2.3.3. Threats

The reasons for listing the Indiana bat were summarized in the original Recovery Plan (USFWS 1983) including: declines in populations at major hibernacula despite efforts to implement cave protection measures, the threat of mine collapse and the potential loss of largest known

hibernating population at Pilot Knob Mine, Missouri, and other hibernacula throughout the species range were not adequately protected. Although several known human-related factors have caused declines in the past, they may not solely be responsible for recent declines. Documented causes of Indiana bat population decline include: 1) human disturbance of hibernating bats; 2) improper cave gates and structures rending them unavailable or unsuitable as hibernacula; and 3) natural hazards like cave flooding and freezing. Suspected causes of Indiana bat declines include: 1) changes in the microclimate of caves and mines; 2) dramatic changes in land use and forest composition; and 3) chemical contamination from pesticides and agricultural chemicals. Current threats from changes in land use and forest composition include forest clearing on private and public land within the summer range, woodlot management and wetland drainage by landowners, and other private and municipal land management activities that affect the structure and abundance of forest resources.

The greatest current threat to Indiana bats is white nose syndrome (WNS). WNS was first documented in New York in February of 2006 and has since been confirmed in 20 states and 4 Canadian Provinces (www.whitenosesyndrome.org/resources/map). It is currently unknown if WNS is the primary cause or a secondary indicator of another pathogen, but it has been correlated with erratic behavior such as early or mid-hibernation arousal that leads to emaciation and mortality in several species of bats, including the Indiana bat (http://whitenosesyndrome.org/; www.fws.gov).

Overall mortality rates, primarily of little brown bats, have ranged from 90 to 100 percent in hibernacula in the northeastern United States. It is currently estimated that 5.7 to 6.7 million bats have died from WNS in infected regions (www.whitenosesyndrome.org/about-white-nose-syndrome). Apparent losses of 685 Indiana bats in Hailes Cave and 12,890 (previous population was 13,014) Indiana bats in the Williams Preserve Mine in New York were documented during the first winter WNS was observed at each site. Additionally, Indiana bat surveys conducted at hibernacula in New York during early 2008 estimated the population declined 15,662 bats, which represents 3.3% of the 2007 revised range wide population estimate. Overall, the biennial Indiana bat population surveys indicate a 4% decline since 2017 and 19% decline since 2007 when WNS was first discovered. The number of confirmed cases of WNS has increased significantly in the Ozark-Central Recovery Unit since 2011 (www.whitenosesyndrome.org/resources/map) and if trends continue, it is likely that additional reductions in the Indiana bat population will occur in this region. However, the impacts of WNS have been less pronounced in Missouri populations of Indiana bats, when compared to little brown bats and northern long-eared bats.

Climate change is also an emerging threat to the Indiana bat, primarily because temperature is an essential feature of both hibernacula and maternity roosts. Potential impacts of climate change on temperatures within Indiana bat hibernacula were reviewed by V. Meretsky (pers. comm., 2006

in USFWS 2007). Climate change may be implicated in the disparity of population trends in southern versus northern hibernating populations of Indiana bats (Clawson 2002), but Meretsky noted that confounding factors are clearly involved. Potential impacts of climate change on hibernacula can be compounded by mismatched phenology in food chains (e.g., changes in insect availability relative to peak energy demands of bats) (V. Meretsky, pers. comm., 2006 in USFWS 2007). Changes in maternity roost temperatures may also result from climate change, and such changes may have negative or positive effects on development of Indiana bats, depending on the location of the maternity colony. The effect of climate change on Indiana bat populations is a topic deserving additional consideration.

Lastly, the Indiana bat (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of Indiana bats has been documented at multiple operating wind turbines/farms. The Service is actively working with wind farm operators to avoid, minimize, and mitigate incidental take of bats.

2.3 Northern Long-eared Bat

This section presents the biological and ecological information relevant to formulating this BO. Appropriate information on the species' life history, its habitat and distribution, and other data on factors necessary to its survival are included to provide background for analysis in later sections. Portions of this information are also presented in listing documents (USFWS 2016d), the final Biological Opinion on the 4(d) rule (USFWS 2016e), and available literature.

The northern long-eared bat was proposed for federal listing as endangered on 2 October 2013. On 2 April 2015, the species was given a proposed listing of threatened with an interim 4(d) rule, which was finalized on 14 January 2016 (USFWS 2016f). No critical habitat has been proposed for the species.

2.3.1 Range and Distribution

The northern long-eared bat ranges across much of the eastern and north central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993; Caceres and Pybus 1997; Environment Yukon 2011). In the United States, the species range reaches from Maine west to Montana, south to eastern Kansas, eastern Oklahoma, Arkansas, and east through the Gulf States to the Atlantic Coast (Whitaker and Hamilton 1998; Caceres and Barclay 2000; Amelon and Burhans 2006). The species range includes the 37 states (plus the District of Columbia). Historically, the species has been most frequently observed in the northeastern United States and in Canadian Provinces, Quebec and Ontario, with sightings increasing during swarming and hibernation (Caceres and Barclay 2000). However, throughout the majority of the species range it is patchily distributed, and historically

was less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

Although they are typically found in low numbers in inconspicuous roosts, most records of northern long-eared bat are from winter hibernacula surveys (Caceres and Pybus 1997). More than 780 hibernacula have been identified throughout the species range in the United States, although many hibernacula contain only a few (1 to 3) individuals (Whitaker and Hamilton 1998). Northern long-eared bats are documented in hibernacula in 29 of the 37 States in the species' range. Other States within the species' range have no known hibernacula (due to no suitable hibernacula present, lack of survey effort, or existence of unknown retreats).

The current range and distribution of northern long-eared bat must be described and understood within the context of the impacts of WNS. Prior to the onset of WNS, the best available information on northern long-eared bat came primarily from summer surveys (primarily focused on Indiana bat or other bat species) and some targeted research projects. In these efforts, northern long-eared bat was very frequently encountered and was considered the most common myotid bat in many areas.

Overall, the species was considered to be widespread and abundant throughout its historic range (Caceres and Barclay 2000). WNS has been particularly devastating for northern long-eared bat in the Northeast, where the species was believed to be the most abundant (Herzog and Reynolds 2012, Turner et al. 2011, Langwig et al. 2012). Similarly, there are data supporting substantial declines in northern long-eared bat populations in portions of the Midwest due to WNS. In addition, WNS has been documented at more than 100 northern long-eared bat hibernacula in the Southeast, with apparent population declines at most sites. We expect further declines as the disease continues to spread across the species' range.

2.3.2 Life History and Habitat use

2.3.2.1. Migration

Typical of most bat species in the eastern United States, northern long-eared bats migrate between winter hibernacula and summer roosting habitat. When female northern long-eared bats emerge from hibernation, they migrate to maternity colonies. The distance and routes traveled from winter hibernacula to summer roosting areas is not definitively known, but the species is considered to migrate shorter distances than the Indiana bat (USFWS 2014). The annual chronology of the Northern long-eared bat is similar to the generalized Indiana bat chronology in Figure 3, spring migration from winter hibernacula usually occurs between mid-March and mid-May, whereas most fall migration from summer roosting areas back to winter hibernacula occurs from mid-August through mid-October. During migration, northern long-eared bats are often observed roosting on the side of stone buildings in Kansas (Sparks et al. 2000).

2.3.2.2. Summer habitat use

Suitable summer habitat for northern long-eared bat consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts, as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure.

Northern long-eared bat roost in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically ≥3 inches dbh). Northern long-eared bat are known to use a wide variety of roost types, using tree species based on presence of cavities or crevices or presence of peeling bark. Northern long-eared bat have also been occasionally found roosting in structures like barns and sheds (particularly when suitable tree roosts are unavailable).

Northern long-eared bat maternity colonies exhibit fission-fusion behavior (Garroway and Broders 2007), where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007). As part of this behavior, northern long-eared bats switch tree roosts often (Sasse and Pekins 1996), typically every 2 to 3 days (Foster and Kurta 1999; Owen et al. 2002; Carter and Feldhamer 2005; Timpone et al. 2010). Northern long-eared bat maternity colonies range widely in size, although 30-60 may be most common (USFWS 2015). Northern long-eared bat show some degree of interannual fidelity to single roost trees and/or maternity areas. Males are routinely found with females in maternity colonies. Northern long-eared bat use networks of roost trees often centered around one or more central-node roost trees (Johnson et al. 2012). They also include multiple alternate roost trees and male and non-reproductive female northern long-eared bat may also roost in cooler places, like caves and mines (Barbour and Davis 1969; Amelon and Burhans 2006).

A maternity colony typically consists of 30 to 60 individuals, although colonies containing up to 100 individuals have been observed (Whitaker and Mumford 2009). The number of individuals within a maternity colony decreases as the maternity season progresses, as fewer bats roost together during the post-lactation stage than during the pregnancy stage. Northern long-eared bats show low fidelity to roosts, switching every 2 to 3 days (Sasse and Pekins 1996, Timpone et al. 2010).

Females are pregnant when they arrive at maternity roosts and produce a single young per year, as is typical for the genus *Myotis* (Asdell 1964, Hayssen et al. 1993, Sparks et al. 1999, Krochmal and Sparks 2007). Parturition typically occurs between late May and early June (Caire et al. 1979, Krochmal and Sparks 2007, Whitaker and Mumford 2009).

Juveniles become volant between late June and early August (Caire et al. 1979, Sasse and Pekins 1996, Krochmal and Sparks 2007). As is the case with other species of bats in North America, mortality for northern long-eared bat is high during the first year (Caceres and Pybus 1997). Northern long-eared bats have been observed roosting in areas of increased solar heating, which increases their developmental rate and reduces the need to lower their body temperature and metabolic rate (i.e. enter a state of torpor) (Lacki and Schwierjohann 2001).

2.3.3 Population Status and Threats

2.3.3.1. Species Population Status

Prior to the onset of WNS (see below), the species was abundant throughout much of the eastern United States and thus, was not a focus of detailed demographic studies. USFWS estimated the U.S. population in 2016 to be 6,500,000 individuals (adults and juveniles), including 428,923 in Missouri (USFWS 2016b). Populations are now in a period of catastrophic decline across most of the range (USFWS 2016b). Francl et al. (2012) documented a 77 percent decline in summer capture rates of northern long-eared bats in West Virginia and adjacent areas of Pennsylvania in the two years following the arrival of WNS.

As part of the listing process, USFWS completed an analysis of 103 hibernacula in 12 states and found an average rate of 92 percent decline in population with northern long-eared bats having been extirpated from 68 sites (USFWS 2016b). Observations at fall swarming sites indicates that these declines are both a result of increased adult mortality and lower recruitment following the arrival of WNS (Reynolds et al. 2016). Frick et al. (2017) found no evidence of population stabilization at sites where WNS has been present for 10 years, which suggests extinction in the wild is a distinct possibility.

2.3.3.3. Threats

No other threat is as severe and immediate for the northern long-eared bat as WNS. It is highly unlikely that northern long-eared bat populations would be declining so dramatically without the impact of WNS. Since the disease was first observed in New York in 2007 (later biologists found evidence from 2006 photographs), WNS has spread rapidly in bat populations from the Northeast to the Midwest and the Southeast. Population numbers of northern long-eared bat have declined by 99 percent in the Northeast, which along with Canada, has been considered the core of the species' range. Although there is uncertainty about how quickly WNS will spread through the remaining portions of this species' range, it is expected to spread throughout the entire range. In general, the Service believes that WNS has significantly reduced the redundancy and resiliency of the northern long-eared bat.

Climate change is also an emerging threat to the northern long-eared bat, primarily because temperature is an essential feature of both hibernacula and maternity roosts. Potential impacts of

climate change on temperatures within Indiana bat hibernacula were reviewed by V. Meretsky (pers. comm., 2006 in USFWS 2007). Climate change may be implicated in the disparity of population trends in southern versus northern hibernating populations of Indiana bats (Clawson 2002), but Meretsky noted that confounding factors are clearly involved. Potential impacts of climate change on hibernacula can be compounded by mismatched phenology in food chains (e.g., changes in insect availability relative to peak energy demands of bats) (V. Meretsky, pers. comm., 2006 in USFWS 2007). Changes in maternity roost temperatures may also result from climate change, and such changes may have negative or positive effects on development of Indiana bats, depending on the location of the maternity colony. The effect of climate change on northern long-eared bat populations is a topic deserving additional consideration.

Lastly, the northern long-eared bat (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of northern long-eared bat has been documented at multiple operating wind turbines/farms. The Service is actively working with wind farm operators to avoid, minimize, and mitigate incidental take of bats.

2.4 Little Brown Bat

This section presents the biological and ecological information relevant to formulating this BO. Appropriate information on the species' life history, its habitat and distribution, and other data on factors necessary to its survival are included to provide background for analysis in later sections. Portions of this section are adopted from MDC's HCP (ICF 2021) and the draft Species Status Assessment for Tricolored Bats (USFWS 2021).

The little brown bat is not a federally listed, proposed, or candidate species, but it is currently undergoing a Discretionary Status Review on the National Listing Workplan. The USFWS anticipates determining if the species warrants listing under the ESA in 2023 (USFWS 2016c) and anticipates completion of a species status assessment in 2021. Currently, no federal critical habitat, conservation plans, or recovery plans exist for this species.

2.4.1 Range and Distribution

The little brown bat is widely distributed across North America and is known to inhabit areas from central Alaska to central Mexico (Harvey et al. 1999). Prior to arrival of WNS, the largest colonies were found in the northeastern and Midwestern U.S., where some hibernacula contained tens to hundreds of thousands of individuals (Kunz and Reichard 2010). The southern edge of their distribution is limited by the lack of caves, whereas the northern edge of the range is likely defined by a limited number of suitable hibernacula and the longer length of the hibernation season (Humphries et al. 2002, Humphries et al. 2006). Like the Indiana bat, little brown bats migrate between subterranean habitats in winter to trees and a wide variety of anthropogenic

structures during summer (Humphrey and Cope 1976). Most little brown bats stay within 62 miles (100 km) of their hibernacula, although some make longer migrations.

2.4.2 Life History and Habitat Use

2.4.2.1. Migration

Like many bats in the eastern United States, little brown bats migrate between winter hibernacula and summer roosting habitat. The annual chronology of the little brown bat is similar to the generalized Indiana bat chronology in Figure 3, spring migration occurs in parallel with staging with most bats moving from the hibernacula to the summer range in April and May; while fall migration occurs in late July through early August. Little brown bats have not been radio-tracked during migration in Missouri, although extensive banding efforts in the 1960s and 1970s provided some state-specific data (LaVal and LaVal 1980). Of approximately 1,600 banded little brown bats, only eight were found at both the hibernacula and a summer roost. Six bats made short migrations of approximately 25 miles (40.23 Km), but two migrated approximately 150 miles (241.40 Km). Myers (1964) banded 4,427 little brown bats in Missouri and adjacent states, 20 of which provided information on migration. Average migration distance was 94.3 miles (151.76 Km) with extremes of 18 (28.97 Km) and 240 miles (386.24 Km). These and other studies (Griffin 1940, Griffin 1945, Davis and Hitchcock 1965, Barbour and Davis 1969, Fenton 1970, Humphrey and Cope 1976) suggest many little brown bats migrate relatively short distances, but migrations of more than 100 miles are not unusual. This movement pattern produces an area of high summer density around important hibernacula, but scattered summer colonies in far-removed areas.

2.4.2.2. Summer habitat use

Most little brown bats in Missouri likely roost in buildings and other anthropogenic structures such as bridges and bat boxes, but in natural situations species roosted in tree cavities and under exfoliating bark (Boyles et al. 2009). The ability to use a variety of summer habitats is also key to understanding a large and diverse geographic range (Bergeson et al. 2015). Bats using the interface between developed lands (that provide roosts) and undeveloped lands and water (that provide foraging habitat) tend to be healthier and have higher reproductive rates (Coleman and Barclay 2011).

Most known maternity colonies are in anthropogenic structures and prior to WNS contained many bats, such as colonies of at least 700 bats in Lewis County and 2000 bats in Sullivan County (Boyles et al. 2009). Like the Indiana bat, female little brown bats use warm roosts (Burnett and August 1981). In other areas little brown bats select roost trees that are large, dead or dying trees with substantial solar exposure (Crampton and Barclay 1998, Bergeson et al. 2015). Little brown bats make frequent use of cracks and hollows in trees as well as under sloughing bark (Crampton and Barclay 1998, Bergeson et al. 2015).

Barbour and Davis (1969) noted that females are pregnant when they arrive at maternity roosts in early- to mid-April, with individuals arriving throughout May and into June. In Indiana (Krochmal and Sparks 2007), females in one colony gave birth to a single pup between 3 June and 15 July. These pups began fluttering at 2 days of age, could complete coordinated wing strokes by 15 days and could fly by 21 days. Thus, most pups were flying by mid-July. Maternity colonies begin to break up as soon as the young are weaned in July and few remain by September (Barbour and Davis 1969).

2.4.3 Population Status and threats

2.4.3.1. Population Status

Until the arrival of WNS, little brown bats were one of the most common bat species in North America and abundant throughout most of their range. Their geographic distribution ranges from Alaska to northern Florida and into southern California. They are absent from the middle plains region (e.g., New Mexico, Texas, southern Florida). Little brown bats are extremely vulnerable to WNS, which has resulted in sharps declines in populations, especially along their eastern range. As the disease spreads geographically and regionally, population collapse has been observed and, in some cases, local species extinction has been predicted, suggesting that even limited take may have the potential for population-level effects (MidAmerican Energy Company [MEC] 2018, Frick et al. 2010, Ingersoll et al. 2013). The rangewide population of little brown bats is estimated to be 19,356 individuals as of 2020.

Die-offs of little brown bats at hibernacula have been associated with declines in summer activity (Dzal et al. 2011). Research has shown that severe declines in populations which cause population bottlenecks can trigger a rapid evolutionary response, and it has been predicted that little brown bat populations affected by WNS will stabilize due to this response within 11 years of WNS exposure (Maslo and Fefferman 2015). Empirical research has also shown increasing survival rates after exposure to WNS, and that stabilization in populations may be due to increasing survival rather than immigration (Maslo et al. 2015). Colatskie (2017) found evidence of stabilization in Missouri as well. Additionally, even individuals affected by WNS have shown recovery from wing damage and infection (Dobony et al. 2011, Fuller et al. 2011).

2.4.3.2. Threats

Tinsley (2016) reviewed potential threats to the little brown bat and determined WNS is the greatest threat faced by the species; without WNS it is unlikely the little brown bat would be a conservation priority. Other stressors of importance include deaths from other diseases, losses at wind energy sites, environmental contaminants, and loss and adverse modification of both summer and winter habitat. Like other bats, the little brown bat is frequently the subject of persecution by people. Because little brown bats can form large maternity colonies, they are often the target of exclusion efforts (Cope et al. 1991). As with other bats, chemical

contamination may kill bats directly or lead to sublethal effects that eventually lead to death or reduced reproduction (Clark et al. 1978, Clark et al. 1980, Clark et al. 1982, Eidels et al. 2016).

Climate change is also an emerging threat to the little brown bat, primarily because temperature is an essential feature of both hibernacula and maternity roosts. Potential impacts of climate change on temperatures within Indiana bat hibernacula were reviewed by V. Meretsky (pers. comm., 2006 in USFWS 2007). Climate change may be implicated in the disparity of population trends in southern versus northern hibernating populations of Indiana bats (Clawson 2002), but Meretsky noted that confounding factors are clearly involved. Potential impacts of climate change on hibernacula can be compounded by mismatched phenology in food chains (e.g., changes in insect availability relative to peak energy demands of bats) (V. Meretsky, pers. comm., 2006 in USFWS 2007). Changes in maternity roost temperatures may also result from climate change, and such changes may have negative or positive effects on development of Indiana bats, depending on the location of the maternity colony. The effect of climate change on little brown bat populations is a topic deserving additional consideration.

Lastly, the little brown bat (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of little brown bats has been documented at multiple operating wind turbines/farms.

2.5 Tricolored Bat

This section presents the biological and ecological information relevant to formulating this BO. Appropriate information on the species' life history, its habitat and distribution, and other data on factors necessary to its survival are included to provide background for analysis in later sections. Portions of this section are adopted from MDC's HCP (ICF 2021) and the draft Species Status Assessment for Tricolored Bats (USFWS 2021).

The tricolored bat is not a federally listed, proposed, or candidate species, but it is currently undergoing a Discretionary Status Review on the National Listing Workplan. A petition to list the tricolored bat as threatened was received by the Service on June 16, 2016. On December 20, 2017, the Service found that the petition presented substantial scientific or commercial information indicating that the petitioned actions may be warranted. The Service commenced a review (known as a 12-month finding) to determine if listing of the tricolored bat is warranted 82 C. F. R. 60362 (December 20, 2017). The USFWS anticipates determining if the species warrants listing under the ESA in 2023 (USFWS 2016c) and anticipates completion of a species status assessment in 2021. Currently, no federal critical habitat, conservation plans, or recovery plans exist for this species.

2.5.1 Range and Distribution

Tricolored bat are known from 39 States (from New Mexico north to Wyoming and all states to the east), Washington D.C., 4 Canadian Provinces (Ontario, Quebec, New Brunswick, Nova Scotia), and Guatemala, Honduras, Belize, Nicaragua and Mexico. The species current distribution in New Mexico, Colorado, Wyoming, South Dakota and Texas is the result of westward range expansion in recent decades (Geluso et al. 2005; Adams et al. 2018; Hanttula and Valdez 2021,) as well as into the Great Lakes basin (Kurta et al. 2007; Slider and Kurta 2011). This expansion is largely attributed to increases in trees along rivers and increases in suitable winter roosting sites, such as abandoned mines and other human-made structures (Benedict et al. 2000; Geluso et al. 2005; Slider and Kurta 2011).

2.5.2 Life History and Habitat Use

2.5.2.1. Migration

Tricolored bats are an obligate hibernator with populations in subtropical regions hibernating even in the absence of severe winters (McNab 1974). In Missouri, tricolored bats are the first species to enter hibernation and the last to exit, with an average beginning date of mid-October and an average ending date of mid-April (LaVal and LaVal 1980). It is likely that tricolored bats hibernate in the majority of Missouri's caves (LaVal and LaVal 1980, Boyles et al. 2008, Colatskie 2017). In addition to caves, tricolored bats use a wide variety of other hibernacula including mines (Whitaker and Stacy 1996, Brack 2007), storm sewers (Goehring 1954), box culverts (Sandel et al. 2001), and surge tunnels at quarries (Slider and Kurta 2011). Recent evidence indicates that tricolored bats also hibernate in rock faces in neighboring Nebraska (Lemen et al. 2016) and suggests that the species may have a wider winter range than previously suspected. Hibernating tricolored bats roost mostly singly but will form small clusters and often select a roost on the walls as opposed to the ceiling of the hibernaculum (Brack 1979, Kurta 2008). Throughout most of the range, they select relatively warm, stable sites often located further from the hibernaculum entrance than other Midwestern bat species (Brack 2007). Typical microclimates used by hibernating tricolored bats in Missouri have temperatures between 45 and 52 degrees Fahrenheit (° F) (7.2 and 11.1° C), with a lower range around 35.4° F (1.9° C), and individual bouts of hibernation may last as much as 111 days (Brack and Twente 1985).

As previously noted, there is little information about tricolored bat movements, including swarming sites and hibernacula, but the species is currently believed to be a short distance regional migrant (Fraser et al. 2012; Fujita and Kunz 1984). Species engaging in regional migration travel annually from hibernaculum to summer roosting sites, and then moving among swarming locations in the autumn (Fenton 1969; Fraser et al. 2012; Hitchcock 1965). Recent research has led to some speculations that some individuals migrate farther distances than previously suspected, and that migratory behavior may differ between males and females (Davis 1959; Fraser et al. 2012). Fraser et al. (2012) investigated tricolored bat migration by conducting

stable hydrogen isotope analyses of 184 museum specimen fur samples and compared the results to published values of collection site growing season precipitation. Their results suggested that 33% of males and 16% of females collected during the postulated non-molt period were south of their location of fur growth. Fraser et al. (2012) also noted that if tricolored bats only engaged in regional migration, then evidence would be expected to show equal numbers of bats migrating north and south during the non-molt period. Respectively, Fraser et al. (2012) concluded that at least some tricolored bats, of both sexes, engage in latitudinal migration.

2.5.2.2. Summer habitat use

Maternity colonies are most likely to be found roosting in umbrella-shaped clusters of dead leaves, but may also be found in live leaf foliage, lichens, patches of pine needles caught in tree limbs, buildings, caves, and rock crevices (Humphrey 1975, Veilleux et al. 2003, Veilleux and Veilleux 2004a; b, Veilleux et al. 2004, Perry and Thill 2007). Oak (genus Quercus) and maple (Acer) trees are preferred by maternity colonies of tricolored bats presumably because the ends of the branches tend to have many leaves (Veilleux et al. 2003; 2004, Perry and Thill 2007), and thus maternity colonies are more often associated with uplands than bottomland forest. Tricolored bats vary their roost position in the canopy and landscape depending on reproductive condition; reproductive female bats roost lower in the canopy and farther from forest edges than non-reproductive females. Veilleux and Veilleux (2004b) speculated that lower position in the canopy and greater distances from the forest edge may reduce wind exposure and allow for more stable temperatures.

Gestation is typically 44 days (Wimsatt 1945), and females produce twin pups whose mass is approximately 44-54 percent of the size of the mother, a higher ratio than most Vespertilionid bats (Kurta and Kunz 1987). Young are volant at 3 weeks and act as adults around 4 weeks old (Hoying and Kunz 1998). Post-natal growth rates slow during cold snaps because the mothers cannot eat and available energy is used for thermoregulation (Hoying and Kunz 1998).

As with other species of bats, some male tricolored bats remain at hibernacula year round (Whitaker and Rissler 1992). Most males roost in the same types of leaf clusters used by female tricolored bats (Veilleux and Veilleux 2004a), although they return to the same roost for multiple days, with one individual in Arkansas roosting in the same cluster for 33 days (Perry and Thill 2007). Male bats also select roosts in the same species of trees, although males tend to use thinner and shorter trees (Veilleux and Veilleux 2004a). Males also tend to roost at lower heights than females; often 16.4 feet (5 m) from the ground (Perry and Thill 2007).

2.5.3 Population Status and threats

2.5.3.1. Population Status

Prior to the arrival of WNS, tricolored bats were rapidly increasing in population and range, especially in grassland areas like those in northwest Missouri (Benedict et al. 2000, Sparks and Choate 2000, Geluso et al. 2004). Tricolored bats were once found in virtually every cave in Missouri (Myers 1964, LaVal and LaVal 1980). WNS, however, has changed that pattern. Mortality rates for tricolored bats with WNS in the northeast are similar to that of little brown bats (Center for Biological Diversity and Defenders of Wildlife 2016). Capture rates of tricolored bats in Pennsylvania declined by 56 percent between pre-WNS years (2001-2008) and 2013 (Butchkoski and Bearer 2016), which is remarkably similar to the 53.8 percent decline observed in Missouri hibernacula (Colatskie 2017). The rangewide population of tricolored bats is estimated to be 67,898 individuals as of 2020.

2.5.3.2. Threats

White Nose Syndrome is the greatest threat faced by the species, and without WNS it is unlikely the tricolored bat would be a national conservation priority. Other stressors identified included mortality from tree removals associated with a variety of activities (logging, energy extraction, and development), closure of occupied hibernacula, deaths from other diseases, losses at wind energy sites, and environmental contaminants. These threats are like those detailed for the Indiana bat and the impacts are likely also similar for tricolored bats. Maintaining and managing forest habitat is the goal of the MDC Bat HCP, but such efforts could also result in the mortality of individual bats within stands as they are managed. The tendency of tricolored bats to occupy a wide variety of hibernacula makes them especially likely to be entombed during mine closures (Whitaker and Stacy 1996). As with the Indiana bat, chemical contamination may kill bats directly or lead to sublethal effects that eventually lead to death or reduced reproduction (Eidels et al. 2016).

Climate change is also an emerging threat to the tricolored bat, primarily because temperature is an essential feature of both hibernacula and maternity roosts. Potential impacts of climate change on temperatures within Indiana bat hibernacula were reviewed by V. Meretsky (pers. comm., 2006 in USFWS 2007). Climate change may be implicated in the disparity of population trends in southern versus northern hibernating populations of Indiana bats (Clawson 2002), but Meretsky noted that confounding factors are clearly involved. Potential impacts of climate change on hibernacula can be compounded by mismatched phenology in food chains (e.g., changes in insect availability relative to peak energy demands of bats) (V. Meretsky, pers. comm., 2006 in USFWS 2007). Changes in maternity roost temperatures may also result from climate change, and such changes may have negative or positive effects on development of tricolored bats, depending on the location of the maternity colony. The effect of climate change on tricolored bats is a topic deserving additional consideration.

Lastly, the tricolored bat (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Mortality of tricolored bats has been documented at multiple operating wind turbines/farms.

3.0 Environmental Baseline

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Below, we describe the baseline condition of the Covered Species within the Action Area.

3.1 Status of Covered Species in the Project Area

3.1.1 Habitat in the Action Area

The plan area for the MDC HCP is defined broadly as the state of Missouri. Missouri is located on the eastern fringes of the Great Plains of North America, bounded on the north by Iowa; across the Mississippi River to the east, by Illinois, Kentucky, and Tennessee; to the south, by Arkansas; and to the west, by Oklahoma, Kansas, and Nebraska. The diverse ecosystems present in Missouri provide full life cycle habitat for the covered species.

The following excerpt from the MDC HCP describes the general land forms of Missouri:

> *Missouri has a diverse topography, ranging in low relief areas within the alluvial plains of the Missouri River and the Mississippi River, to high relief areas of the St. Francois Mountains located in southeastern Missouri. The alluvial plains and limestone bluffs of the Missouri River bisect the central portion of the state, flowing from Kansas City in the west to St. Louis in the east, where it joins the Mississippi River. The Mississippi River forms the majority of the eastern border of Missouri.*
>
> *The area north of the Missouri River is known as the Northern Plains, with rolling hills that remain from the glaciation that once extended from the Canadian Shield to the*

Missouri River. The Dissected Till Plains portion of the Northern Plains region lies in the portion of the state north of the Missouri River, while the Osage Plains portion extends into the southwestern portion of the state bordering the Ozark Plateau. The Osage Plains, located in the west and south of the Missouri River, are mostly flat, stretching west to Missouri's border with Kansas.

Approximately 75% of the land in Missouri located south of the Missouri River, and parts of northern Arkansas, northeastern Oklahoma, and southern Illinois are known as the Ozark Plateau, or "the Ozarks." The portion of the Ozarks within Missouri (Missouri Ozarks) is a dissected plateau with heavily forested hills and low mountains with deep, narrow valleys. The Missouri Ozarks are further characterized by karst topography with the formation of caves, sinkholes, and spring systems. The Missouri Ozarks surround the St. Francois Mountains, including Taum Sauk Mountain, which registers the highest point in Missouri with an elevation of 1,772 feet above sea level.

The far southeastern area of Missouri is part of the Mississippi Alluvial Plain and is commonly known as the Missouri Bootheel region. The lowest elevation is located on the southwestern edge of this region at an elevation of 230 feet above sea level, where the St. Francis River flows from the Missouri Bootheel into Arkansas.

For a detailed description of topography, climate, soils, hydrology, and land cover types found in Missouri and other information contributing to the ecological baseline of the state, please see the HCP in chapter 3.

3.1.2 External Factors Affecting Covered Species in the Action Area

This section describes factors affecting the environment of the species in the Project Area. The environmental baseline includes state, tribal, local, and private actions already affecting the species or that will occur contemporaneously with the consultation in progress. Related and unrelated Federal actions affecting the same species that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the Action Area that may benefit listed species or critical habitat.

The factors affecting Covered Species in the Action Area are a subset of the threats affecting the species' range-wide and include WNS, wind energy development, and habitat conversion. For a detailed description of the above mentioned factors affecting the covered species, please see section 3.3 of the HCP, which is incorporated here by reference.

3.1.3 Status of the Covered Species within the Action Area

Gray Bat: Based on survey data from 2000 to 2019, Missouri is home to approximately 14 gray bat maternity colonies that each support at least 10,000 bats. There are likely at least 10 more

colonies that support 5,000 or more bats in the summer time, but the populations are not counted regularly and the colonies may have more or fewer than 5,000 individuals.

Indiana bat: The Missouri population of Indiana bats was estimated to be 195,157 individuals in 2019, which represents a 9% decline since 2007. Missouri has the most Indiana bats of any other state (36%), and the second highest number of occupied hibernacula (92).

Northern long-eared bat: Population declines in Missouri follow the range wide trend. Missouri populations in known hibernacula nearly disappeared between the winters of 2012/2013 and 2015/2016 (Colatskie 2017).

Northern long-eared bats are known to hibernate in 52 counties in Missouri with most of these sites located in the caves and mines of southern Missouri. The species is easily overlooked because of its tendency to hibernate in cracks and crevices inside caves and mines. Recent evidence indicates they hibernate in rock faces in neighboring Nebraska (Lemen et al. 2016). Therefore, northern long-eared bats may have a much wider winter range than previously suspected. Several Missouri hibernacula historically contained large numbers of northern long-eared bats and have received special attention from MDC. MDC lands in 16 counties contain hibernacula of the northern long-eared bat.

Records of northern long-eared bats are known from 61 counties in Missouri during the active months (April-October). Based on summer occupancy rates, the estimated pre-WNS population size in Missouri is 428,922 individuals (USFWS 2016b). Using the same methods and assumptions in the draft Species Status Assessment for northern long-eared bats (USFWS 2021, in draft), we assume that the winter population size in Missouri is now 122 individuals. This figure is only slightly lower than estimated in MDC's HCP for a Missouri statewide population of 125 individuals.

Little Brown Bat: In Missouri, the little brown bat has never been as common as Indiana, northern long-eared, or gray bats (Myers 1964, LaVal and LaVal 1980). Prior to WNS, the distribution of little brown bat could be summarized as widely scattered, but locally common, sometimes represented by hundreds of individuals in a hibernaculum. An exceptionally large concentration of 35,000 individuals was found in Pilot Knob Mine in 1958 (Myers 1964), although subsequent surveys have indicated much lower populations (LaVal and LaVal 1980, Elliott and Kennedy 2008). Missouri's winter populations, counted in hibernacula, have declined by approximately 87 percent since winter 2012/2013 (Colatskie 2017). A 2016/2017 survey found only 1,891 little brown bats in 51 of 502 hibernacula surveyed (Colatskie 2017). Notably, surveys of hibernating bats at Pilot Knob Mine are no longer conducted due to safety concerns (Elliott and Kennedy 2008, Colatskie 2017). However, fall trapping at the mine entrances suggests decreased swarming activity at the site, especially for little brown and northern long-eared bats (MDC unpub. data).

Little brown bats are known to hibernate in 61 counties in Missouri, largely in the caves and mines of southern Missouri. Important exceptions to this pattern include the hibernaculum at SNP in Hannibal, Marion County in northeastern Missouri, where little brown bats were once common. Other exceptions include some quarries in the northern portion of state and several smaller caves and quarries located along the Missouri River north of Kansas City. MDC lands in 15 counties contain hibernacula that are used by the little brown bat.

Prior to WNS, little brown bats were regularly found throughout most of Missouri in the summer. Little brown bats have been recorded in 56 counties during the active months (April-October). Using the same methods and assumptions in the draft Species Status Assessment for little brown bats (USFWS 2021, in draft), we assume that the population size in Missouri is now 800 individuals. This figure is only slightly lower than estimated in MDC's HCP for a Missouri statewide population of 748 individuals.

Tricolored Bat: Using the same methods and assumptions in the draft Species Status Assessment for tricolored bats (USFWS 2021, in draft), we assume that the winter population size in Missouri is now 12,576 individuals. This figure is only slightly higher than estimated in MDC's HCP for a Missouri statewide population of 11,748 individuals.

4.0 Effects of the Action

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

Implementation of covered activities and the conservation strategies (Chapter 5 of the HCP) designed to offset impacts from the covered activities are the two components of the proposed action that will be evaluated in terms of effects to the Covered Species.

Federally funded, authorized, and permitted covered activities in the HCP have the potential to negatively affect bats in roosting trees and caves. The effects analysis in the HCP evaluates impacts on covered bat species during forest management and public access and asset management activities, including hazard tree removal, vehicle operation, demolition of structures, and activities required by the implementation of the HCP (e.g. bat monitoring activities). The effect of vehicle operation, demolition of structures, and HCP implementation are insignificant or positive in nature.

The HCP analysis uses a habitat-based approach to quantify the potential for take of bats during implementation of management activities as the majority of potential take that will occur is from habitat management associated with tree removal and prescribed fire. To further quantify the impact of the taking, an analysis of effects on individual bats and the populations is also provided in the HCP (Table 4-13 of the HCP).

4.1 Factors Considered

This section includes an analysis of the effects of the proposed action on the species. As described in previous sections, there will be no effect to designated critical habitat. Our analysis considers the following factors:

Proximity of the action: The proposed action will affect occupied habitat of gray, Indiana, little brown, northern long-eared, and tricolored bats.

Distribution: The Action Area includes the entire State of Missouri, which accounts for nearly half of the Ozark-Central RU for Indiana bats and a sizable portion of the respective species range of gray, little brown, northern long-eared, and tricolored bats.

Timing: The federally-funded, authorized, or delegated activities will affect gray, Indiana, little brown, northern long-eared, and tricolored bats in the spring staging, maternity, swarming, and migratory stages of their life cycle from April 1 to October 31. During the inactive, winter season, all covered species hibernate in caves and mines underground. Activities conducted outside of hibernacula are unlikely to cause take during the winter. Additionally, MDC will implement a 20-acre zone around all known caves where management activities are required to minimize noise, vibration, and smoke, further limiting potential harm to covered species.

Duration: The duration of the effects will primarily be short-term. Habitat management covered in this BO will occur in the short term and are anticipated to ultimately result in beneficial effect through the creation and retention of additional preferred habitats. Hazard tree removal that involves removal of active roost trees could have short and long term effects, but likely will be only localized impacts (impacts to individuals, not a maternity colony population). Habitat removal for public access and management will be of longer duration for road maintenance and building construction, but in areas so small as to be discountable.

Disturbance frequency: Habitat management activities covered in this BO will result in a one- time disturbance to habitat and impact to individuals within the Action Area. Hazard tree removal and public access and management will result in a one-time permanent impact to individuals.

Disturbance intensity and severity: In general, intensity increases as projects impact more acres of suitable habitat or greater number of individuals. Severity is related to the type of individuals or populations impacted; severity is highest for impacts to maternity colonies, moderate for non- maternity, swarming, and staging populations, and is lowest for migratory individuals.

4.2 Impacts of the HCP Covered Activities

As a result of the covered activities, maternity roosting habitat, non-maternity roosting habitat, and staging and swarming habitat will be modified or removed during biologically significant times of the year for tree dependent bat species (Table 3). Management actions and public access and management activities covered in this BO are those that involve tree felling and prescribed burning during the active season for bats (April 1 through October 31). Habitat management can involve few acres up to several hundred acres, whereas public access and management activities typically only impact individual or small groups of potential roost trees (e.g. the removal of a few or single hazard trees).

The principle covered activity of the HCP is the management of habitat using tree removal and prescribed fire, which annually affects 64,773 acres of preferred habitat or 0.42% of the 15,563,862 acres of preferred habitat types on nonfederal lands in Missouri each year. Additional covered activities (i.e. public access and management) include the permanent removal of 11 acres per year of forested habitat, the temporary removal of up to 141 acres per year for maintenance and repair of facilities, vehicle operation by MDC employees, and demolition of structures on MDC lands. Unlike the habitat management activities described above, some of these removals are permanent and have negative impacts associated with the loss of potential roosting and foraging habitat. However, over the 50-year permit term, the permanent loss of 550 acres of habitat is insignificant when compared to 160,637 acres of fall/spring and 745,556 of forested summer habitat continuously provided by MDC lands.

4.2.1 Impacts From Tree Felling Through Habitat Management, Public Access and Management, or Tree Loss from Prescribed Fire to Tree Dependent Species (Indiana, Northern Long-Eared, Little Brown, and Tricolored Bats)

4.2.1.1. Potential Impacts During the Active Season

Impacts to bats from loss of forest would be expected to vary depending on the timing of removal, location (e.g. within or outside a home range), and extent of removal as summarized in Table 3. While bats can flee during tree removal, removal of occupied roosts (during spring through fall) is likely to result in direct injury or mortality to some percentage of bats. This percentage would be expected to be greater if flightless pups or inexperienced flying juveniles were also present. Felling roost trees during the active season may result in adverse

effects to Indiana, little brown, northern long-eared, and tricolored bats. If a bat is in the tree and a tree is cut down, the bat may either stay in the tree and potentially be crushed or fly out (adults or volant pups) during the day and be more susceptible to predation (e.g., by raptors). Belwood (2002) reported on the felling of a dead maple in a residential lawn in Ohio.

One dead adult Indiana bat female and 33 nonvolant young were retrieved by the researcher. Three of the young bats were already dead when they were picked up, and two more died subsequently. The rest were apparently retrieved by adult bats that had survived. Risk of injury or death from being crushed when a tree is felled is most likely, but not limited, to impact nonvolant pups. The risk is also greater to adults during cooler weather when bats periodically enter torpor and would be unable to arouse quickly enough to respond. The likelihood of potential roost trees containing larger number of little brown, northern long-eared, and tricolored bats is greatest during pregnancy and lactation (April-July) with exit counts falling dramatically after this time. For example, two studies found little brown and northern long-eared bats use of certain trees appears to be highest in spring, when females were pregnant, and the colony apparently splintered into smaller groups before parturition (Foster and Kurta 1999, Sasse and Pekins 1996). Indiana bat colonies also break up over time with smaller exit counts later in the summer (Barclay and Kurta 2007).

Table 3. Annual Acres of Habitat Manipulated When Covered Species Are Present (Adopted from Table ES-2 of the HCP)

	Available Fall/Spring (Total Acres)[b]	Available Summer Habitat (Total Acres)[b]	Amount of Potential Fall/Spring/Summer Habitat Impacted When Occupied (Acres/Year)		
			Habitat Management	Public Access and Management	Total
MDC Activities on MDC Lands					
Preferred Land Covers (Forest, Woodlands, Glades)[b]					
Indiana Bat	114,198	745,556	9,071	61	8,252
Little Brown Bat	154,392	745,556	9,831	65	9,896
Northern Long-Eared Bat	160,637	745,556	9,949	66	10,015
Tricolored Bat	178,174	745,556	10,281	67	10,348
Open Lands [c]					
Indiana Bat	32,348	211,190	9,058	0	9,058
Little Brown Bat	43,734	211,190	9,817	0	9,817
Northern Long-Eared Bat	45,503	211,190	9,935	0	9,935
Tricolored Bat	50,470	211,190	10,266	0	10,266
MDC Activities on Other Nonfederal Lands					
Preferred Land Covers (Forest, Woodlands, Glades)[b]					
Indiana Bat	874,208	14,818,306	8,157	< 1	7,330
Little Brown Bat	1,759,340	14,818,306	8,469	< 1	8,469
Northern Long-Eared Bat	1,563,762	14,818,306	8,400	< 1	8,400
Tricolored Bat	1,669,340	14,818,306	8,437	< 1	8,437
Open Lands [c]					
Indiana Bat	1,366,221	23,158,199	2,088	0	2,088
Little Brown Bat	2,749,515	23,158,199	2,168	0	2,168
Northern Long-Eared Bat	2,443,864	23,158,199	2,150	0	2,150
Tricolored Bat	2,608,861	23,158,199	2,159	0	2,159
Statewide Preferred Habitats (Forests, Woodlands, Glades)[b]					
Indiana Bat	988,406	15,563,862	17,227	61	**15,582**
Little Brown Bat	1,913,732	15,563,862	18,300	65	**18,365**
Northern Long-Eared Bat	1,724,399	15,563,862	18,349	66	**18,415**
Tricolored Bat	1,847,514	15,563,862	18,718	68	**18,785**

[a] Fall/Spring Habitat is a subset of Summer Habitat.

4.2.1.2 Potential Impacts During the Inactive Season

Removal of a bat primary roost tree (that is still suitable for roosting) in the winter is expected to result in temporary or permanent colony fragmentation. Smaller colonies may be expected to provide less thermoregulatory benefits for adults and for nonvolant pups in cool spring temperatures. Also, removal of a primary roost is expected to result in increased energy expenditures for affected bats. Female bats have tight energy budgets, and in the spring need to have sufficient energy to keep warm, forage, and sustain pregnancies. Increased flight distances or smaller colonies are expected to result in some percentage of bats having reduced pregnancy success, and/or reduced pup survival. Removal of multiple alternate roost trees in the winter is also expected to result in similar adverse effects.

4.2.1.3. Loss of Maternity Roosts

Indiana bats form colonies in the summer and exhibit fission-fusion behavior where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007). As part of this behavior, Indiana bats switch roosts often, typically every 2–3 days with adult female reproductive condition, roost type, and time of year affecting switching (Kurta et al. 2002, Kurta 2005). The bats' fission- fusion behavior is influenced by a number of factors, including temperature, precipitation, predation, parasitism, and the ephemeral nature of the habitability of roost sites (Carter and Feldhamer 2005). Bats need to proactively investigate new potential roost trees prior to their current roost tree becoming uninhabitable (e.g., tree falls over) (Kurta et al. 2002, Carter and Feldhamer 2005, Timpone et al. 2010).

The exact number of roost trees a colony uses at any given time (or across the season) is not known, because: 1) not every bat in a colony can be tracked; 2) not all bats can be tracked simultaneously; 3) bats are generally tracked for a short period; and 4) number of trees used by a bat is correlated with number of days it is radio-tracked (Gumbert et al. 2002, Kurta et al. 2002). On any day, a colony is dispersed among numerous trees, with many bats occupying one or more primary roosts, while individuals and small groups reside in different alternate roosts (Kurta et al. 2004). The number of alternates used on any day probably varies, but bats from one colony occupied at least eight trees on a single day (Carter 2003). Maternity colonies use a minimum of 8–25 different trees in one season (Callahan et al. 1997, Carter 2003, Kurta et al. 2002, Sparks 2003). Therefore, Indiana bats associated with a maternity colony are spread out across these multiple trees in any given day/night. However, one to three of these are primary roosts used by the majority of bats for some or all of the summer (Callahan et al. 1997).

Fidelity of Indiana bat maternity colonies to their summer range is well documented. In addition to fidelity to the general summer maternity area, roost trees, although ephemeral in

nature, may be occupied by a colony for a number of years until they are no longer available (i.e., the roost has naturally fallen to the ground) or suitable (i.e., the bark has completely fallen off of a snag). Some trees have shorter life expectancy as a roost than others (e.g., living shagbark hickories can provide suitable roosts for Indiana bat for decades while elm snags may lose their bark within a few years). Although loss of a roost (e.g., blow down, bark loss) is a natural phenomenon that Indiana bats must deal with regularly, the loss of multiple roosts, which could comprise most or all of a home range, likely stresses individual bats, affects reproductive success, and impacts the social structure of a colony (USFWS 2007).

Kurta (2005) suggested that loss of a single alternate roost at any time of year probably has little impact on Indiana bats because the colony has a minimum of 8–25 other trees from which to select, but loss of a primary roost could be detrimental. Silvis et al. (2014b) modeled impacts of removing documented roosts from an Indiana bat colony located in central Ohio where woodlands comprised 9 percent of the land cover. Bat and roost data were used to generate networks upon which roost removal simulations were conducted, and they found the likelihood of the colony splitting into multiple roosting networks depended on the connectivity of the colony. The greater the number of bats sharing secondary roosts (the greater the number of connections between roosts) increased the robustness of the colony when exposed to simulated roost loss. In 2009, only 5 percent of modeled roost loss resulted in >50 percent likelihood of colony fragmentation, whereas in 2010, 30 percent of modeled roost loss resulted in >50 percent likelihood of colony fragmentation. In both years, simulated removal of the most central roost resulted in fragmentation. They postulated the differences in the network metrics between years for Indiana bats may have been related to ecological factors such as roost quality, temperature, suitability, behavioral flexibility, or simply the result of tracking different individuals. However, they also suggested that the roosting behavior and social structure of bat maternity colonies may be inherently flexible and perhaps the differences between years such as were observed are common for the Indiana bat in each year. Silvis et al. (2014b) stated that "As the ephemerality of roost trees likely cause Indiana bat maternity colonies to experience frequent roost loss, including that of primary roosts, fission-fusion dynamics may provide a mechanism for the formation of new maternity colonies by presenting opportunities for the colony to split." Similarly, in a long-term study of an Indiana bat maternity colony in Indiana, Sparks et al. (2003) found that the natural loss of a single primary maternity roost led to the fragmentation of the colony (bats used more roosts and congregated less) the year following the roost loss.

Northern long-eared, little brown, and tricolored bats also form colonies in the summer (Foster and Kurta 1999) and exhibit fission-fusion behavior (Garroway and Broders 2007) where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007). As part of this behavior, northern long-eared, tricolored, and little brown bats switch roosts often (Sasse

and Pekins 1996), typically every 2–3 days (Foster and Kurta 1999; Owen et al. 2002; Carter and Feldhamer 2005; Timpone et al. 2010). Bats switch roosts due to a variety of factors, including temperature, precipitation, to avoid predation and parasitism, and because some roost sites are ephemeral (Carter and Feldhamer 2005). Bats proactively investigate new potential roost trees prior to their current roost tree becoming uninhabitable (e.g., tree falls over) (Kurta et al. 2002, Carter and Feldhamer 2005, Timpone et al. 2010). Johnson et al. (2012) found that tricolored and northern long-eared bats form social groups among networks of roost trees that are often centered on a central-node roost. Central-node roost trees may be similar to Indiana bat primary roost trees (locations for information exchange, thermal buffering) but they were identified by the degree of connectivity with other roost trees rather than by the number of individuals using the tree (Johnson et al. 2012). Northern long eared bats and tricolored bats form smaller social groups within a maternity colony and exhibit nonrandom roosting behaviors, with some females roosting more frequently together than with others (Garroway and Broders 2007; Patriquin et al. 2010; Johnson et al. 2012). Like the Indiana bat, female little brown bats use warm roosts (Burnett and August 1981). In other areas little brown bats select roost trees that are large, dead or dying trees with substantial solar exposure (Crampton and Barclay 1998, Bergeson et al. 2015). Little brown bats make frequent use of cracks and hollows in trees as well as under sloughing bark (Crampton and Barclay 1998, Bergeson et al. 2015).

Similar to Indiana bats, northern long-eared bats exhibit fidelity to the general summer maternity area (Foster and Kurta 1999, Jackson 2004, Johnson et al. 2009, Patriquin et al. 2010, Perry 2011, Broders et al. 2013). Female tricolored bats switch roosts frequently, approximately every 4 days (± 2.5 days) in one study (Veilleux et al. 2003); and the distance between successive roosts ranges from 62.3 to 456 feet (19 to 139 m) (Veilleux et al. 2003, Veilleux and Veilleux 2004b).

Roost trees, although ephemeral in nature, may be used by a colony for a number of years until they are no longer available (i.e., the roost has naturally fallen to the ground) or suitable (i.e., the bark has completely fallen off of a snag). Some trees have shorter life expectancy as a roost than others (e.g., living shagbark hickories can provide suitable roosts for Indiana bat for decades while elm snags may lose their bark within a few years). Although loss of a roost (e.g., blow down, bark loss) is a natural phenomenon that bats must deal with regularly, the loss of multiple roosts, which could comprise most or all of a home range, likely stresses individual bats, affects reproductive success, and impacts the social structure of a colony. This section does not analyze the impact of loss of most of a home range but addresses loss of individual roosts.

Northern long-eared bats, little brown bats, and tricolored bats are flexible in their tree species roost selection and roost trees are an ephemeral resource; therefore, the species are expected to tolerate some loss of roosts provided suitable alternative roosts are available. Silvis et al. (2014a) modeled the effects of roost-loss on little brown bats and northern long-

eared bats and then Silvis et al. (2015) actually removed known roosts during the winter to investigate the effects. Once removals exceeded 20–30 percent of documented roosts (ample similar roosts remained), a single maternity colony network started showing patterns of break- up. Sociality is believed to increase reproductive success (Silvis et al. 2014a) and smaller colonies would be expected to have reduced reproductive success. Similar to the Indiana bat discussion, smaller colonies would be expected to provide less thermoregulatory benefits for adults in cool spring temperatures and for non-volant pups.

Further discussion on the impacts to each of the tree dependent covered species (Indiana, northern long-eared, little brown, and tricolored bats) can be found in section 4.3.4 of the HCP, which is incorporated here by reference.

4.2.2 Impacts from Vehicle Operations on Covered Species

MDC requested the inclusion of vehicle collision on gray bats and the other covered species as a covered activity. The best available information for the Service suggests that this is an unlikely, but not impossible, scenario that would be difficult to detect and is not quantifiable down to individual bat numbers. The HCP states that no gray bat fatalities have been documented from vehicles in the state of Missouri. Vehicle collisions have occurred with other bat species; therefore, the possibility cannot be completely ruled out. The Service believes the small amount of take that may occur based on limited information is not anticipated to have significant impacts to bat populations. In addition, the mitigation provided in this HCP is more than adequate for offsetting the limited and infrequent amount of take from vehicle collisions. In order to include gray bat as a covered species under the incidental take permit, a take surrogate must still be provided to evaluate if assumptions made are valid over the course of the 50-year permit term.

There are approximately 872 miles of road and 804 miles of trails-on MDC lands and use of these roads facilitate the management of 14,809 acres of bat occupied forested habitat annually (HCP Table 4-9). Over the course of the permit term, we anticipate the risk to covered bat species (or each individual bat species) to be 1 bat every 10 years, or 5 bats over the permit term. Vehicle collisions with bats are likely to result in mortality to individuals, although infrequently, given the period of MDC risk overlap. Take associated with vehicle operation due to habitat management activities for covered species is very low and incorporated into existing take estimates except for gray bats, which are not as dependent upon forested habitat as other covered species.

The amount of take anticipated from vehicle collisions is directly proportional to the number of acres managed in the HCP. Consequently, acres of habitat managed is an appropriate surrogate for determining the infrequent amount of take anticipated from vehicle/bat collisions. The acres surrogate is incorporated into the acres harvested for Indiana bat, northern long-eared bat, little brown bat and tricolored bat. Because gray bats are not subject to take from timber harvest, we

have included the conservative estimate of take from vehicle operations into our analysis for the species.

4.2.3 Impacts from Demolition of Structures on Covered Species

All of the covered species are known to use occasionally buildings as temporary or more lengthy roosts, especially little brown bats. MDC is seeking coverage of this potential form of take in the HCP due to presence of undesirable buildings on newly acquired lands or obsolescence of buildings on existing lands. No take for demolition is being proposed for non-MDC lands covered in the HCP. As a part of the HCP, MDC has committed to building inspections prior to demolition and the commensurate timing of demolitions in the winter to avoid impacts to roosting bats. Because of these commitments, the impacts from demolition should be wholly insignificant and discountable.

4.2.4 Impacts of the HCP Covered Activities on Gray Bats

Unlike the other covered species in the HCP, gray bats do not depend upon trees or other vegetation during the summer months, and instead are yearlong cave or other underground feature dependent (e.g. mines or other manmade structures). Consequently, covered activities such as tree removal, prescribed fire, and public access and management activities are not expected to directly impact gray bats through the loss of habitat. Gray bats can be potentially exposed to smoke and associated toxins through prescribed fire, but conservation measures in the HCP should preclude the majority of impacts from smoke to gray bats (Biological Goal 5).

As stated in the HCP and EA, impacts to gray bats are anticipated to be more than fully offset by the following:

> "The MDC Bat HCP will benefit gray bats by providing 50 years of guaranteed protection and management for a minimum of 900,000 acres of natural habitat, including 700,000 acres of preferred land covers (forests, woodlands, and glades) and 200,000 acres of open lands under MDC jurisdictions (Objectives 1.1 and 1.2). The HCP represents a commitment by the state of Missouri to maintain and manage these lands for the 50-year permit term—an important assurance at a time when some states are considering divestment of public lands. Both forests and open lands provide quality foraging habitat for gray bats. Forestry and prescribed fire activities that open the forest and allow gray bats to travel through the habitat will improve the quality of these habitats. Conservation measures outlined in this chapter will serve to greatly reduce the already limited potential for lethal take. Further, the 20-acre management area around caves and MDC's commitment to maintain these areas ensure that all caves on MDC lands remain functioning natural environments like those needed to further gray bat recovery."

The long-term protection and management of the forested habitat is expected to create higher quality bat foraging habitat for gray bats which will lead to greater survival and increased fecundity. Because gray bats do not use trees and vegetation for the breeding and rearing of young, and potential smoke exposure of gray bats inside caves and other underground roosts will be managed and minimized by the proposed conservation measures, there should be no or wholly insignificant and discountable effects to gray bats as a result of the implementation of the covered activities.

4.2.5 Impacts of Proposed Conservation Measures

The HCP incorporates a vast array of conservation measures to offset the take from the covered activities on the covered species. Important examples include:

- promotion of bat friendly forestry practices on public and private lands by MDC and private foresters;
- implementing 150' harvest buffers around known roost trees on MDC and private lands managed through cooperative agreements;
- creating and maintaining zones of optimal species summer habitat through the implementation of 28,000 acres of PBMZs;
- retaining and creating snags through specialized management and forestry training for state and private forestry professionals;
- implementation of a 10-mile protective buffer around Sodalis Nature Preserve to protect staging and swarming habitat at the largest known hibernaculum for Indiana bat; and
- creation of 20 acre old growth habitat management zones around all known and potential hibernacula on MDC lands, among other conservation measures.

The conservation measures avoid, minimize, and mitigate the impacts associated with habitat management, including tree removal and prescribed fire, as well as public access management, including permanent vegetation removal, demolition of structures, and vehicle operation. The HCP implements the conservation measures through a series of biological goals and objectives presented in Table 2, above (Adopted from Table 5-1, Biological Goals and Objectives in the HCP). The biological goals and objectives taper from statewide, landscape-level objectives (e.g. *Goal 1: Maintain a mosaic of contiguous or semicontiguous natural lands to provide foundational habitat for covered bats*) down to specific research activities to be implemented by MDC (e.g. *Objective 6.2: Collaborate with researchers to identify ways to ameliorate the impact of WNS through treatment or habitat management*). For discussion and analysis of each goal and objective, please see the HCP Chapter 5.

Overall, we consider the broad suite of conservation measures enacted under the HCP to be protective and wholly beneficial to all of the covered species throughout their entire life cycle.

4.3 Species Response to the Proposed Action

Despite avoidance and minimization measures, we anticipate that some female, juvenile, and male gray, Indiana, northern long-eared, little brown and tricolored bats may be killed, injured, or harmed during tree felling or habitat loss from habitat management or public access management activities. This is most likely to occur if a tree in which they are roosting is felled or burned during the active season. In addition, tree felling and habitat management activities such as prescribed fire scheduled during the hibernation period could also result in the further removal of roost trees, rendering them unavailable to pregnant bats that exhibit roosting area and/or roost tree fidelity following migration in the spring. However, decreases in the long-term reproductive success and viability of a maternity colony in the area are unlikely because of the remaining habitat on the surrounding landscape and the continual creation and replacement of habitat described in the conservation strategy (Chapter 5 of the HCP). Additionally, the anticipated benefits of the conservation measures proposed by MDC will help reduce impacts to covered species and provide significant, ongoing habitat for their full life cycles.

4.3.1 Gray Bat Response to the Proposed Action

Covered activities have the potential to directly and indirectly affect individual gray bats if the activity occurs during the active season from spring through fall. Gray bats are the least sensitive of the covered species to effects from habitat management and public access management activities but may have a very low likelihood of take due to vehicle collisions as described above. Further, the many conservation measures instituted under the HCP will serve to protect and enhance the habitats the species depends upon, especially MDC's commitment to protect all caves on MDC lands, including those not known to contain bats. We assume only 5 gray bats may be taken by vehicle collisions over the term of the permit.

As there will be no impacts to winter habitat or take of hibernating bats, and the estimated annual take of 0.1 gray bat represents only 0.00001% of the population present in Missouri, we conclude that the effects of take from the Project will not have State-level effects to the gray bat. Since the estimated annual take of gray bats represents only 0.0000002% of the rangewide population (5,306,905 individuals in 2019) we further conclude that the take will not have species-level impacts.

4.3.2 Indiana Bat Response to the Proposed Action

Covered activities have the potential to directly and indirectly affect individual Indiana bats when the activity occurs during the active season from spring through fall. Acres of covered activities in occupied habitat are used as a proxy for understanding impacts to individual organisms. Table 3, above, summarizes the combined effects of all covered activities when bats are present for each species. Further, the HCP assumes that up to 490 Indiana bats could be

exposed to covered in the active season with up to 35 individuals killed or injured annually. This figure represents only 0.02% of the population of Missouri, 0.01% of the Ozark/Central Recovery Unit, and 0.006% of the rangewide population estimate.

Winter effects to Indiana bat are not anticipated due to avoidance measures described in Chapter 5, Conservation Strategy, including a 20-acre buffer around all known hibernacula and all naturally occurring caves on MDC lands, and a larger buffer around the Sodalis Nature Preserve. Within this buffer, habitat management is allowed only to improve or maintain habitat for bats and only when bats are absent.

As there will be no impacts to winter habitat or take of hibernating bats, and the estimated annual take of Indiana bats represents only 0.02% of the population present in Missouri, we conclude that the effects of take from the Project will not have State-level effects to the Indiana bat. Since the estimated annual take of Indiana bats represents only 0.006% of the rangewide population (537,297 individuals in 2019) we further conclude that the take will not have species-level impacts.

4.3.3 Northern Long-eared Bat Response to the Proposed Action

Covered activities have the potential to directly and indirectly affect individual northern long-eared bats when the activity occurs during the active season from spring through fall. Acres of covered activities in occupied habitat are used as a proxy for understanding impacts to individual organisms. Table 3, above, summarizes the combined effects of all covered activities when bats are present for each species. Further, the HCP assumes that less than one (0.02) northern long-eared bat could be exposed to covered in the active season with less than one individual killed or injured annually. This figure represents only 0.002% of the population of Missouri.

Winter effects to northern long-eared bat are not anticipated due to avoidance measures described in Chapter 5, Conservation Strategy, including a 20-acre buffer around all known hibernacula and all naturally occurring caves on MDC lands.

As there will be no impacts to winter habitat or take of hibernating bats, and the estimated annual take of northern long-eared bats represents only 0.02% of the population present in Missouri, we conclude that the effects of take from the Project will not have State-level effects to the northern long-eared bat. Since the estimated annual take of northern long-eared bats represents only 0.000001% of the rangewide population (19,356 individuals in 2020), we further conclude that the take will not have species-level impacts.

4.3.4 Little Brown Bat Response to the Proposed Action

Covered activities have the potential to directly and indirectly affect individual little brown bats when the activity occurs during the active season from spring through fall. Acres of covered

activities in occupied habitat are used as a proxy for understanding impacts to individual organisms. Table 3, above, summarizes the combined effects of all covered activities when bats are present for each species. Further, the HCP assumes that two little brown bat could be exposed to covered in the active season with less than one (0.12) individual killed or injured annually. This figure represents only 0.02% of the population of Missouri.

Winter effects to little brown bat are not anticipated due to avoidance measures described in Chapter 5, Conservation Strategy, including a 20-acre buffer around all known hibernacula and all naturally occurring caves on MDC lands.

As there will be no impacts to winter habitat or take of hibernating bats, and the estimated annual take of little brown bats represents only 0.02% of the population present in Missouri, we conclude that the effects of take from the Project will not have State-level effects to the little brown bat. Since the estimated annual take of little brown bat represents only 0.00001% of the rangewide population, we further conclude that the take will not have species-level impacts.

4.3.5 Tricolored Bat Response to the Proposed Action

Covered activities have the potential to directly and indirectly affect individual tricolored bats when the activity occurs during the active season from spring through fall. Acres of covered activities in occupied habitat are used as a proxy for understanding impacts to individual organisms. Table 3, above, summarizes the combined effects of all covered activities when bats are present for each species. Further, the HCP assumes that less than 35 tricolored bats could be exposed to covered in the active season with less than two (1.83) individuals killed or injured annually. This figure represents only 0.02% of the population of Missouri.

Winter effects to tricolored bat are not anticipated due to avoidance measures described in Chapter 5, Conservation Strategy, including a 20-acre buffer around all known hibernacula and all naturally occurring caves on MDC lands.

As there will be no impacts to winter habitat or take of hibernating bats, and the estimated annual take of tricolored bats represents only 0.02% of the population present in Missouri, we conclude that the effects of take from the Project will not have State-level effects to the tricolored bat. Since the estimated annual take of tricolored bat represents only 0.00003% of the rangewide population (67,898 individuals in 2020), we further conclude that the take will not have species-level impacts.

4.4 Summary of Effects of the Proposed Action

Indiana, little brown, northern long-eared and tricolored bats present in suitable forest habitat could be adversely impacted during habitat management and public access and asset

management activities during the active season. Habitat management includes prescribed fire and tree removal conducted to restore habitat. Public access and asset management activities are associated with the maintenance, construction, and repair of facilities and the use of roads that are maintained by MDC. Habitat management does not convert habitat and generally does not remove habitat for covered bats. Up to 11 acres of forested habitat may be permanently converted annually as part of public access and asset management covered activities. Vehicle collisions, though infrequent, may kill all of the covered species. Such actions are likely to adversely affect gray, Indiana, little brown, northern long-eared and tricolored bats resulting in direct take (i.e., death or injury of individuals). While these impacts have been minimized through survey and implementation of avoidance and minimization measures, they have not been fully avoided and are expected to occur.

Factors considered to evaluate the effect of the take included the timing of activities and disturbance intensity and severity. Actions conducted during the inactive season preclude direct impacts from occurring, whereas actions conducted in the active season pose a risk of direct impacts. The highest risk timeframes are the maternity and non-volant pup periods. In general, intensity increases as projects impact more acres of suitable habitat or greater number of individuals. Severity is highest for impacts to maternity colonies, which are most common with tree removal in preferred habitats and unlikely to occur in open lands. For example, extensive tree removal over a large area in preferred habitats reasonably can be anticipated to result in impacts to maternity colonies if conducted during the maternity and pup seasons (May 15-August 15). Table 4 (Adopted from Table 4-13 of the HCP) translates the effects of covered activities on the statewide population of covered species into an annual estimate of total expected mortality. Gray bats are excluded from this table as habitat and public access management activities are not expected to cause take to the species. As detailed above, we expect that gray bat may be lethally impacted at the rate of one individual every 10 years, for a total of 5 gray bats over the term of the permit.

In this BO we considered proposed conservation measures that were intended to avoid some of the most severe impacts. For example, timing of activities was used to minimize impacts from tree removal in high occupancy preferred land cover for all covered species to the greatest degree possible; much of will occur outside of April-August to minimize direct impacts to reproductive females and pups during the most sensitive stages of the annual cycle. Cumulatively, the implementation of the Biological Goals and Objectives presented in Table 2 (HCP Chapter 5) will serve to avoid, minimize, and mitigate the impacts of the covered activities such that take resulting from the covered activities is fully offset.

Table 4. Conservative Estimate of Bats Taken by Covered Activities Annually (Adopted from Table 4-13 of the HCP)

	State Population (Adult Bats)	Percent Habitat Affected When Bats Are Present	Adult Bats Exposed	Mortality Rate for Flying Bats	Adult Mortality (Bats)	Juveniles Exposed	Mortality Rate for Juvenile Bats	Juvenile Mortality (Bats)	Total Mortality (Bats)	% Annual Mortality
Indiana Bat										
Fall/Spring	195,157	0.25%	489.59	3%	14.69	0	15%	0	14.69	0.01%
Summer		0.09%	183.84	3%	5.52	91.92	15%	13.79	19.30	0.01%
Total			**673.43**	**3%**	**20.20**	**91.92**	**15%**	**13.79**	**33.99**	**0.02%**
Little Brown Bat										
Fall/Spring	748	0.19%	1.39	3%	0.04	0	15%	0	0.04	0.01%
Summer		0.10%	0.71	3%	0.02	0.36	15%	0.05	0.07	0.01%
Total			**2.10**	**3%**	**0.06**	**0.36**	**15%**	**0.05**	**0.12**	**0.02%**
Northern Long-eared Bat										
Fall/Spring	125	0.21%	0.26	3%	0.01	0	15%	0	< 0.01	0.01%
Summer		0.10%	0.12	3%	< 0.01	0.06	15%	< 0.01	0.01	0.01%
Total			**0.38**	**3%**	**0.01**	**0.06**	**15%**	**< 0.01**	**0.02**	**0.02%**
Tricolored Bat										
Fall/Spring	11,147	0.22%	23.99	3%	0.72	0	15%	0	0.72	0.01%
Summer		0.10%	10.61	3%	0.32	5.30	15%	0.80	1.11	0.01%
Total			**34.60**	**3%**	**1.04**	**5.30**	**15%**	**0.80**	**1.83**	**0.02%**

a Values presented in table have been rounded.

5.0 Cumulative Effects

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the Action Area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

All of the covered species may be affected by wind energy developments and tree clearing activities on private and other, non-MDC public land that is not permitted or authorized through an MDC private landowner program. The operation of wind turbines has been documented to cause mortality of many species of bats (Good et al. 2011, Service 2011). Thirteen wind facilities currently are operating in Missouri in 2021. An unprecedented number of wind energy developments could potentially be developed in Missouri in the near future; at least three are currently seeking an Incidental Take Permit and developing a Habitat Conservation Plan. Therefore, we expect that cumulative effects from wind projects could impact all of the covered species across the state. Impacts could be most intense in areas of high maternity use where heavy development of wind facilities is coincident with impacts from active season roost tree removal that are not avoided and minimized.

We also considered the effects of tree clearing on private and state land. This activity is reasonably certain to occur in the Action Area, and we used Forest Inventory and Analysis (FIA) data to estimate the extent of clearing on private and state forest lands that could impact populations of the covered species. Timberland data from the 2010-2015 inventory period are used in the cumulative effects analysis. For the 5-year inventory period of 2010 to 2015, approximately 87.4% of Missouri's forest land [3]was under private or state ownership (82.2% private, 4.8% state). Similarly, of forest land that is also considered timberland[4], 88% was under private or state ownership (84.0% private, 12,429,200 acres; 4.3% state, 644,400 acres). Timber harvests on private lands are less likely to follow rigorous environmental standards and BMPs than state and federal forestry actions, and therefore may continue to adversely affect the covered species. As the vast majority of timber lands in Missouri remain in private hands, we consider these potential adverse effects to the covered species to be continuous.

Habitat removal and disturbance from development of transmission and transportation infrastructure, commercial buildings, large reservoirs, and residences is occurring throughout the state. Impacts to a colony can occur at varying degrees. A single development project with a large geographic scope and high level or long duration of take without compensation could severely impact a maternity colony to the point of disbandment. With appropriate avoidance and minimization measures the likelihood of this occurring due to a single is

relatively low. However, cumulative, less severe impacts from multiple sources could affect the resilience of a maternity colony leaving it without the ability to persist.

Sawtimber[5] removal can occur statewide, but is more prevalent in the Ozark Plateau of southern Missouri. From 2010 to 2015, 873 million board feet (MBF) of sawtimber trees were removed from private and state land in Missouri. During the same time period, growth of sawtimber trees was 1,515 MBF and tree mortality was 1,060 MBF. The net change in sawtimber trees was an overall increase of 80 MBF. Tree mortality is highest in Ozark Plateau with Iron, Maries, Reynolds, Shannon, Washington, and Wayne counties having the highest levels of mortality.

Tree species composition on private and state lands in the Ozark Plateau was assumed to be similar to that of the Mark Twain National Forest (MTNF). On the MTNF, tree species groups that are documented to have the highest mortality are the white oak/red oak/hickory and white oak groups. Based on the extent of tree removal, tree species composition, and level of tree mortality on private and state lands in the Action Area, it is likely that the covered species occur on these lands and that tree removal will impact the species.

Impacts to the covered species from wind power development, habitat conversion, timber harvest, energy transmission projects, and tree disease are widespread across the state and expected to continue into the foreseeable future. Conservation efforts enacted at the local, state, and federal level on private and public lands in Missouri are serving to blunt the impact of many of these activities; however local adverse effects on the covered species are still possible. While impacts could occur to individuals or populations, we do not consider these impacts to affect the persistence or reproductive potential of Indiana bats in the Ozark-Central Recovery Unit, or to northern long-eared bats, little brown bats, or tricolored bats range-wide.

6.0 Conclusion

After reviewing the current status of Covered Species, the environmental baseline for the Action Area, the effects of the proposed actions of the HCP, and the cumulative effects, it is the Services' opinion that the issuance of the ITP, as proposed, is not likely to jeopardize the continued existence[1] of the Covered Species.

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[1] 'Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02).

Briefly, the basis for this conclusion (as detailed in the Biological and Conference Opinion) is as follows:

- Avoidance and Minimization: The HCP incorporates a diverse array of avoidance and minimization measures designed to limit the impacts to covered species including seasonal avoidance measures designed to limit the impact of timber harvest and prescribed fire during the most sensitive times of the year for covered species, specialized training for state and private foresters and landowners, and enhanced retention of potential roost trees.
- Analysis of Impacts: The impact of the take was analyzed using a hierarchal framework including the following steps: 1) effects to individuals; 2) effects to maternity colonies and hibernating populations; 3) effects to the OCRU (for Indiana bat) and the Missouri population (for gray, northern long-eared bat, little brown bat, and tricolored bat as there are no established recovery units for these species); and 4) effects to the range-wide population. Up to 5 gray bats, 1,700 Indiana bats, 1 northern long-eared bat, 6 little brown bats, and 92 tricolored bats may be taken as the result of habitat management and other covered activities during the 50-year permit term. In section 4.3, we analyzed the impacts of the taking of individuals on the maternity colonies, hibernating, and State populations to which those individuals belong. In the analysis we included the impact of the take and did not consider the offset of mitigation through the conservation measures. We concluded that take from the project does not cause an appreciable difference in the fitness of the hibernating or State populations of Covered Species. Therefore, we concluded it is unlikely the project will cause reductions in the likelihood of survival and recovery of Covered Species within the State, recovery unit or range-wide population.

- Conservation Measures: Conservation measures enacted through the HCP are extensive and wide ranging across the landscape and mitigate for impacts from the covered activities across the full lifecycle of the covered species. Of particular importance are the seasonal management restrictions put in place around Sodalis Nature Preserve in Hannibal, MO, the creation of old growth management zones at all known and potential hibernacula, known roost tree retention in harvest plans, and the creation of more than 28,000 acres of preferred maternity habitat through the adaptive PBMZ process among others.

7.0 Incidental Take Statement

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined in section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm in the definition of "take" in the Act

means an act which actually kills or injures wildlife. Such [an] 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). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The Habitat Conservation Plan submitted by MDC and its associated documents clearly identify expected impacts to Covered Species that are likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. All conservation measures described in the HCP, together with the terms and conditions described in any section 10(a)(1)(B) permit or permits issued with respect to the HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR §402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take expected under the HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit. In addition to the responsibilities of the Applicant, ES has the responsibility to monitor compliance with provisions of the HCP, and to take appropriate steps if compliance is deficient.

7.1 Amount or Extent of Take Anticipated

As described under the Effects of the Action section, incidental take of the covered species may occur in the form of injury or mortality from the removal of suitable occupied habitat. This is likely to occur if an occupied roost tree is felled during summer roosting, migration, staging, or swarming. Take may also occur if maternity colony roost trees are removed during project activities, even if the tree removal occurs during the winter when bats are not present. Prescribed burns could harm or kill individuals through burning or suffocation and through predation when they escape an area being disturbed. Demolition of structures could crush individuals or expose individuals to predation when escaping a disturbed area. Vehicle operation has the potential to result in collision that kills bats, though the probability of this occurring over the permit term is extremely low.

The Service anticipates that actual incidental take of the covered species as a result of the covered activities evaluated in this biological opinion will be difficult to quantify and detect due to the covered species' small body size, widely dispersed individuals under loose bark or in

cavities of trees, and unknown areal extent and density of the roosting and foraging populations within the state of Missouri. Monitoring to determine take of individual bats within an expansive area of forested habitat is a complex and arduous task. Unless every individual tree that contains suitable roosting habitat is inspected by a knowledgeable biologist before tree clearing activities begin, it would be impossible to know if a covered species is present in an area proposed for clearing. Inspecting individual trees is not considered by the Service to be a practical survey method and is not recommended as a means to determine incidental take. Therefore, we will use the areal extent of potential roosting and foraging habitat affected as a surrogate to monitor the level of take for Indiana, little brown, northern long-eared, and tricolored bats.

Annual take estimates in the form of acres of habitat managed or converted by MDC are presented in bold in Table 3. Annually, they include 15,582 acres of preferred habitat for the Indiana bat, 18,365 acres of preferred habitat for the little brown bat, 18,415 acres of preferred habitat for the northern long-eared bat, and 18,785 acres of preferred habitat for the tricolored bat. We note that these totals are not additive, but rather the largest figure of 18,785 acres for tricolored bat is at least partially inclusive of the preferred habitat of many of the other species. As noted in the Environmental Assessment for the HCP, the average annual amount of take acreage requested by MDC in the HCP is significantly less than the average of the last five years of take acreages requested by MDC from the USFWS in biological opinions that precede this opinion. The average amount of take acreage requested by MDC over the past five years is approximately 28,419 acres compared to a maximum of 18,785 acres in the current HCP. Consequently, the amount of take requested in the HCP represents a reduction in potential harm to the covered species when compared to prior take levels.

As described above, the gray bat is not dependent upon forested habitat to the degree that acres of habitat are not an accurate surrogate for take of the species. As a result we developed an extremely conservative estimate of the potential for take derived from vehicle collisions to the gray bat, as described in section 4.2.4, of 5 gray bats over the 50 year permit term.

Effect of the Take

By multiplying the state population of a covered species by the percent of habitat affected when bats are present, the HCP arrives at a number of adults exposed to adverse effects from the covered activities. The number of exposed bats is then multiplied by the percent of bats (3%) that are expected to be killed by adverse effects to arrive at a total mortality (as presented in table 3 for each species) After reviewing the HCP and analyzing the effects of the proposed action, the ES anticipates that no more 5 gray bats, 1,700 Indiana bats, 1 northern long-eared bat, 6 little brown bats, and 92 tricolored bats will be taken over the 50-year permit term. The number of individuals of the covered species is directly correlated to the annual acreage estimates of habitat and public access management presented in Table 3.

In this Opinion, ES has determined this level of anticipated take is not likely to result in jeopardy to the Covered Species. No critical habitat will be affected by the HCP.

7.2 Reasonable and Prudent Measures

As described above, all conservation measures described in the HCP, together with the terms and conditions described in the associated Implementing Agreement and the Incidental Take Permit issued with respect to the HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement.

7.3 Terms and Conditions

As described above, all conservation measures described in the HCP, together with the terms and conditions described in the Incidental Take Permit issued with respect to the HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement.

The ES program has the responsibility to monitor implementation of the HCP and compliance with the provisions of the Implementing Agreement and this Incidental Take Statement.

8.0 Reinitiation Notice

This concludes formal consultation on the proposed issuance of a section 10(a)(1)(B) Incidental Take Permit to the Applicant (pursuant to submission of their HCP and an ITP for MDC). As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiating.

9.0 Literature Cited

Literature cited throughout the BO is available upon request from the Missouri Ecological Field Office.