Programmatic Biological Opinion/Conference Opinion for Transportation Projects in the Range of the Indiana Bat, Northern Long-Eared Bat, and Tricolored Bat

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ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ALIS	Accident Location Information System
AMM	Avoidance and Minimization Measure
BA	Biological Assessment
BO	Biological Opinion
BMP	Best Management Practice
BUG	Backlight Uplight and Glare
CFA	Conservation Focus Area
CO	Conference Opinion
DBH	Diameter at Breast Height
DOT	Department of Transportation
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FLMA	Federal Land Management Agency
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
GPS	Global Positioning System
HCP	Habitat Conservation Plan
HEA	Habitat Equivalency Analysis
HPS	High Pressure Sodium
ILF	In-lieu Fee
IPaC	Information for Planning and Consultation
ITS	Incidental Take Statement
LAA	Likely to Adversely Affect
MSE	Mechanically Stabilized Earth
NE	No Effect
NEPA	National Environmental Policy Act
NLAA	Not Likely to Adversely Affect
NLEB	Northern Long-Eared Bat
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRDA	Natural Resource Damage Assessment
NYSDEC	New York State Department of Environmental
P1	Priority 1 hibernaculum
P2	Priority 2 hibernaculum

P3	Priority 3 hibernaculum
P4	Priority 4 hibernaculum
P/A	Presence/Absence Survey
PBO	Programmatic Biological Opinion
PCO	Programmatic Conference Opinion
POC	Point of Contact
PPV	Peak Particle Velocity
RND	Reproduction, Numbers, and Distribution
ROW	Right-of-Way
RPU	Representation Units
RTP	Recreational Trails Program
RU	Recovery Units
SOP	Standard Operating Procedure
SSA	Species Status Assessment
TCF	The Conservation Fund
TCB	Tricolored bat
TOY	Time-of-Year
USACE	U.S. Army Corps of Engineers
Service	U.S. Fish and Wildlife Service
WNS	White-Nose Syndrome
YR	Year Round

UNITS LIST

Acoustics

kHz	Kilohertz
dBA	Decibel A Scale
in/sec	inches / seconds
cm/sec	centimeters / seconds

Area

ha	hectare
sq ft	square feet
sq m	square meters

Dendrometry

DBH	Diameter at Breast Height

Force

PSI	Pound Force per Square Inch

Length/Distance

Imperial

ft	feet
in	inch

Metric

cm	centimeter
m	meters
km	kilometer

Temperature

°C	Celsius
°F	Fahrenheit

GLOSSARY

Note: The following definitions are to be used for the purposes of this programmatic consultation only. Please coordinate with the local Service Field Office, as needed, for further clarification on these terms and their definitions.

Action – As defined in the Endangered Species Act 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.”

Action area – The “action area” is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action.” Further clarification is provided by the national consultation FAQs at: https://www.fws.gov/glossary/action-area.

Active season – Period of time outside of the hibernation season when bats are active on the landscape. This varies by geographic location. Refer to the Service’s Range-wide Bat Survey Guidelines[1] for specific dates.

Bridge – A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads. A bridge typically uses structural components and elements in the deck, superstructure and substructure (abutments and piers) to support dead and live loads.

Critical habitat – Specific areas within the geographical area occupied by the species at the time of listing that contain physical or biological features essential to conservation of the species and that may require special management considerations or protection; and Specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. https://www.fws.gov/media/critical-habitat-fact-sheet.

Culvert – A structure comprised of one or more barrels or cells, beneath an embankment and designed structurally to account for soil-structure interaction. These structures are hydraulically and structurally designed to convey water, sediment, debris, and, in many cases, aquatic and terrestrial organisms through roadway embankments. Culvert barrels have many sizes and shapes and have inverts that are either integral or open, i.e., supported by spread or pile-supported footings. A culvert typically has soil materials (i.e., backfill) between the travel way (e.g., road or rail or trail) and actual culvert structure (i.e., barrels, cells). To support dead loads and live loads (e.g., cars, trucks, trains, pedestrians, etc.), the culvert consists of those barrels or cells (typically concrete, metal, or plastic material), backfill, and soil bedding underneath the culvert. In comparison, a bridge typically uses structural components and

[1] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines

elements in the deck, superstructure and substructure (abutments and piers) to support those dead and live loads.

Documented habitat – is defined as an area that has been documented to be used by the Indiana bat, Northern long-eared bat (NLEB), or Tricolored bat (TCB) and is a subset of a known maternity colony home range (see definition below). This subset of habitat is defined because there are different AMMs within this area for this programmatic consultation.[2]

Documented habitat includes:

1. Any suitable habitat[3] within 0.25 miles (0.4 km) of a capture or acoustic detection location;
2. Any suitable habitat within 0.25 miles (0.4 km) of an identified roost tree;
3. Any suitable habitat within 0.25 miles (0.4 km) of roost tree/area predicted based on radio telemetry biangulation/triangulation.

Ground Disturbance – any activity that compacts or disturbs the ground. Ground disturbance activities include, but are not limited to, grading and backfilling. Activities are often performed using heavy equipment (excavators, backhoes, bulldozers, trenching and earthmoving equipment, etc.) and heavy trucks (large four-wheel drive trucks, dump trucks, and tractor trailers). Contact the local Service Field Office, as needed, to assist in determining if and how ground disturbance may affect bat hibernacula.

Hibernacula – caves, cave-like structures (which include but are not limited to: rock formations, abandoned or active mines, and railroad tunnels), or associated sinkholes, fissures, or other karst features where bats hibernate in winter. Hibernacula tend to have the volume and complexity to help buffer the environment against rapid and extreme changes in outside temperature.

Hibernating range – includes the portion of the range where the species hibernates in the winter, stages and swarms outside of hibernacula in the spring and fall and migrates to summer home ranges.

Hibernation – when bats are in extended periods of torpor during winter months. The state of torpor is interrupted by brief periods of arousal when the bats' body temperatures return to normal for a few hours, at which time the animals may groom or drink water but do not typically leave the hibernaculum (Hibernate or Migrate - Bats (U.S. National Park Service) (nps.gov)).

Inactive season – Period of time inside of the hibernation season, when bats are in a state of inactivity characterized by lower body temperature, slower breathing, and lower metabolic rate (***torpor***). This

[2] We do not use the larger estimated maternity colony home ranges for the different AMMs because in most cases we do not expect maternity colonies to concentrate their roosting and foraging activities directly alongside roads and rails.
[3] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines

varies by geographic location. Refer to the Service's Range-wide Bat Survey Guidelines[4] for specific dates.

Invasive – Under Executive Order 13112, as amended by Executive Order 13751, invasive species means, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health.

Karst – Karst topography is a landscape created by groundwater dissolving sedimentary rock such as limestone that often includes features such as caves, sinkholes, springs, and sinking streams. http://www.watersheds.org/earth/karst.htm Coordinate with the local Service Field Office on recommended best management practices for karst in your state.

Lighting – Refers to roadway and bridge, culvert, or structure lighting, and **not** vehicle headlights, signal lighting and/or railroad crossing signals.

Maternity colony – a gathering of pregnant female bats as they prepare to give birth. Maternity colony size varies by species (see Section 4.1 and 4.2 for further details).

Maternity colony home range (Indiana bat) – Areas that include maternity, foraging, roosting, and commuting habitat for the Indiana bat, typically occurring within 5 miles (8 km) of a mist-net capture or acoustic detection, or within 2.5 miles (4 km) of a roost.

- 5 miles (8 km) from capture/detection points is used to account for the entire potential range. It is calculated by multiplying the typical foraging distance (2.5 miles [4 km]) by two – the capture/acoustic detection location could be at the edge of the home range and the direction(s) the bat(s) may fly are unknown. A 5-mile buffer encompasses 50,265 acres.
- 2.5 miles (4 km) from roost trees is the standard threshold used to delineate the typical foraging distance of Indiana bats (Butchkoski and Hassinger 2002, Murray and Kurta 2004). A 2.5-mile buffer encompasses 12,566 acres.

Maternity colony home range (NLEB) – Areas that include maternity, foraging, roosting, and commuting habitat for the NLEB, typically occurring within 3 miles (4.8 km) of a mist-net capture or acoustic detection, or within 1.5 miles (2.4 km) of a roost.

- 3 miles (4.8 km) from capture/detection points is used to account for the entire potential range. It is calculated by multiplying the typical foraging distance (1.5 miles [2.4 km]) by two – the capture/acoustic detection location could be at the edge of the home range and the direction(s) the bat(s) may fly are unknown. A 3-mile buffer encompasses 18,086 acres.

[4] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines

- 1.5 miles (2.4 km) from a roost tree is the standard threshold used to delineate the typical foraging distance of NLEBs (Sasse and Pekins 1996, Jackson 2004). A 1.5-mile buffer encompasses 4,524 acres.

Maternity colony home range (TCB) – Areas that include maternity, foraging, roosting, and commuting habitat for the TCB, typically occurring within 3 miles (4.8 km) of a mist-net capture or acoustic detection, or within 1.5 miles (2.4 km) of a roost.

- 3 miles (4.8 km) from capture/detection points is used to account for the entire potential range. It is calculated by multiplying the typical foraging distance (1.5 miles [2.4 km]) by two – the capture/acoustic detection location could be at the edge of the home range and the direction(s) the bat(s) may fly are unknown. A 3-mile buffer encompasses 18,086 acres.
- 1.5 miles (2.4 km) from a roost tree is the threshold we use to delineate the typical foraging distance of TCBs (Service 2022b). A 1.5-mile buffer encompasses 4,524 acres.

Pup season – The period of time when females are close to giving birth (two weeks prior to birth) and young (pups) are non-volant (i.e., unable to fly). [Refer to the Service's Range-wide Bat Survey Guidelines[5] for specific dates.]

Road/rail surfaces – road surface is defined as the actively used (e.g., motorized vehicles) driving surface and shoulders (may be pavement, gravel, etc.), and rail surface is defined as the edge of the actively used rail ballast.

Structure - refers to buildings (i.e., non-bridge and non-culvert), including but not limited to homes, barns, or sheds slated for demolition, rest stops, welcome centers, picnic shelters, kiosks, ticket stations and platforms at rail stations, vehicle inspection pits, storage facilities, and structures at weigh stations.

Suitable summer habitat (Indiana bat, NLEB, TCB) – this encompasses habitat both within and outside of documented habitat. For additional details regarding each species' potential suitable summer habitat, refer to the description in the Service's Range-wide Bat Survey Guidelines.

Torpor – a state of lowered physiological activity typically characterized by reduced metabolism, heart rate, respiration, and body temperature (Merriam-Webster Dictionary, 2023).

Year round (YR) active range – includes the portion of the NLEB and TCB range where bats remain active on the landscape and feed year-round; and may include short bouts of winter ***torpor*** during colder periods.

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[5] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines

1. INTRODUCTION

Since 2016, the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and Federal Transit Administration (FTA) [Transportation Agencies] have collaborated with the U.S. Fish and Wildlife Service (Service) to develop a section 7(a)(1) program for two federally listed bat species, the Indiana bat (*Myotis sodalis*) and the Northern long-eared bat (*Myotis septentrionalis*) (NLEB) that would help meet their 7(a)(2) responsibilities. As part of this effort, we initially developed a conservation strategy for the Indiana bat that was then incorporated into a Range-wide Programmatic Biological Consultation for common types of transportation projects that State or local Departments of Transportation conduct with Federal funding and/or approval. Following the listing of the NLEB (February 16, 2016), we added the NLEB to the programmatic consultation. On September 14, 2022, the Service proposed to list the tricolored bat (*Perimyotis subflavus*) (TCB) as an endangered species. As a result, FHWA, FRA, and FTA have requested to conference on the TCB and include this conference in the programmatic consultation. The purpose of the consultation is three-fold:

- To provide a consistent, streamlined process for Endangered Species Act (ESA) consultation that is required when these projects may affect the Indiana bat, NLEB, or TCB;
- To avoid and minimize impacts to the Indiana bat, NLEB, and TCB; and
- To provide compensatory mitigation measures for unavoidable impacts to the Indiana bat and NLEB from transportation project delivery and contribute to the recovery of this species.

The Service and Transportation Agencies undertook revising this Programmatic Biological Consultation in a complex environment. Concurrent to this effort, the Service was developing a revised standing analysis and implementation plan for the NLEB and TCB. The original PBO predates the standing analysis and is focused on transportation projects. In contrast, the standing analysis addresses a much broader suite of activities. These differences, and the fact that the Service and Federal agencies can take a variety of approaches when developing a programmatic consultation or standing analysis document (including factors such as differences in analytical approaches, covered activities, and adaptive management) resulted in some differences between the PBO and standing analysis. That said, both documents are based upon the best scientific and commercial data available and are consistent with the ESA and its implementing regulations. As warranted, the Service anticipates continuing to periodically revise the PBO and standing analysis. We will endeavor to resolve any discrepancies between the two documents as part of future revisions. In the meantime, Transportation Agencies and others have the option of using this PBO or the standing analysis or consulting individually on a project.

This consultation does not cover all types of projects that the Transportation Agencies fund or approve. The November 28, 2016, BA[6] originally defined the full scope of, and criteria applicable to, projects that may rely upon the findings and streamlined processes of this Programmatic Biological and Conference Opinion (PBO) herein for compliance with section 7(a)(2) of the ESA (16 USC 1536). Transportation

[6] https://www.fws.gov/sites/default/files/documents/biological-assessment-for-federal-highway-administration-indiana-and-northern-long-eared-bats-2016-12-07%20.pdf

activities described in the original BA have been expanded at the request of FHWA (see Consultation History). Separate section 7 consultation is required for projects that are outside the scope and criteria of the proposed action[7] or for projects that may affect other federally listed species and/or their designated critical habitat.

The Service encourages the Transportation Agencies to use this programmatic consultation if applicable. If not, the Transportation Agencies may consult individually on a project or use another applicable programmatic consultation for projects they fund or approve. Likewise, for transportation projects that involve Federal Land Management Agencies (FLMAs), the Transportation Agencies may use this programmatic consultation, or if needed, consult individually on a project, or use another applicable programmatic consultation developed by the FLMA (e.g., programmatic consultations established for the Service National Wildlife Refuges, U.S. Department of Agriculture Forest Service lands). In addition, projects funded by the Federal Recreational Trails Program or other federal grant programs may use this programmatic consultation, if applicable.

State or local transportation projects without any Federal involvement (e.g., no federal funding, no federal authorization [including federal permits], or not carried out by a federal agency), may not use this PBO. However, they may use AMMs described within this document to help design projects to avoid and minimize adverse effects to Indiana bats, NLEBs, and TCBs, via a section 7 process outside of this PBO. Coordinate with the local Service Field Office for additional assistance.

1.1 Programmatic Consultation Process

Programmatic consultations increase the efficiency of ESA section 7 consultations by addressing multiple actions on a program, regional, or other basis, and may also expedite permitting processes for such actions. This multi-state transportation programmatic consultation applies to future projects within a transportation program (FHWA, FRA, FTA) that the Transportation Agencies may fund, authorize, or approve within the geographic range of, and habitats suitable for, the Indiana bat, NLEB, and TCB (herein also referred to as "covered bat species") that are consistent with the programmatic action, including its conservation measures, as described in the BA and this document.

The location, number, timing, and combination of effects to bats from the program of transportation projects covered under this programmatic consultation are unknown. Therefore, this programmatic consultation analyzes the aggregate of effects expected to result from its implementation. In other words, we consider whether an individual of the covered bat species may be affected by one or more projects within the transportation program covered under this programmatic consultation. We do not

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[7] There may be instances where specific actions are at the discretion of the local Service Field Office and approved on a case-by-case basis if the effects of the action do not exceed the impacts as anticipated in this PBO.

expect that all the covered projects will affect an individual bat(s), but as stated earlier, at a program level, we cannot identify which project(s) might.

We expect individual bat(s) may be adversely affected by the implementation of the transportation program when projects occur within the species area of influence (AOI), **and** within suitable or documented habitat. The NLEB and TCB AOIs are generated by models based on occurrence data and species-specific occurrence predictions within their historic ranges. The Service believes that there is enough certainty to conclude the species may be present in the action area when the likelihood of model occurrence is equal to or greater than 50% (Service 2024). At present the Indiana bat AOI is not a range-wide model. Rather, it is derived from habitat and survey data collected by the Service's Field Offices in states in which the species is known to occur. We acknowledge that not all areas identified in a species AOI are suitable habitat, which is why project proponents must then further identify if they are within suitable habitat in the AOI. In summary, because this is a programmatic consultation, we consider whether an action within the program of transportation projects may affect an individual of one of the covered species. We are not analyzing the impacts of projects on an individual project basis.

Projects within the transportation program that are within the scope of this programmatic consultation include those that result in "no effect" (NE) or may affect for the Indiana bat, NLEB, or the TCB. Consultation is not required for actions resulting in no effects to federally listed species. The purpose of highlighting actions with no anticipated effects is to provide clear and consistent guidance for projects that meet the definition of "no effect" to the covered bat species, which minimizes use of staff time and resources from both the Transportation Agencies and the Service on projects without any potential to adversely affect the Indiana bat, NLEB, or the TCB. This consultation also provides advance Service concurrence on projects with "may affect, not likely to adversely affect" (NLAA) determinations, subject to a 14-calendar day project-level evaluation period by the Service. For projects with "may affect, likely to adversely affect" (LAA) determinations, it is the opinion of the Service that the project is not likely to jeopardize the continued existence of either of the three covered bat species, subject to a 30-calendar day project level evaluation period (see details below).

Below, we describe NE, NLAA, and LAA categories of projects, and the corresponding project-level processes for using this consultation to comply with ESA section 7.

Projects Not Likely to Adversely Affect Indiana bat, NLEB, or TCB

Section 5.6 of the PBO summarizes the characteristics of transportation projects that are NLAA Indiana bats, NLEBs, or TCBs. These projects may rely on this consultation with no additional site-specific consultation between the Transportation Agencies, State Departments of Transportation (DOTs working on behalf of Transportation Agencies as non-federal designated representatives), and the Service. Rather, there is a short "check-in" with the local Service Field Office. Transportation Agencies and/or State DOTs representatives will either complete the Assisted Determination Key in the Information for

Planning and Consultation (IPaC) System[8] or send a Project Submittal Form to the local Service Field Office prior to project commencement (as described in the User's Guide).[9] Transportation Agencies and/or State DOTs will ensure that all submitted projects are within the scope of and adhere to the criteria of the Program.

Upon receipt of an effects determination letter (through the IPaC Assisted Determination Key process) or Project Submittal Form, Service Field Offices may check for program consistency and request additional information that is necessary to verify such consistency. Service Field Offices have 14 calendar days (as described in the User's Guide) to notify Transportation Agencies and/or State DOTs if they determine a particular project does not meet the criteria for a NLAA. If Transportation Agencies and/or State DOTs are not notified by the Service, they may proceed under programmatic consultation. This verification period is not intended as another level of review. The presumption is that the vast majority of submitted projects fall correctly within the programmatic consultation. The 14 calendar days are intended to provide Service Field Offices an opportunity to apply local knowledge to NLAA projects, and they may identify a small subset of projects as potentially having unanticipated impacts.

Projects Likely to Adversely Affect Indiana bats, NLEB, or the TCB

Section 7 of the PBO also summarizes the characteristics of transportation projects that are LAA Indiana bats, NLEBs, or TCBs. These projects may rely on this consultation in a similar manner to projects that are NLAA the three covered bat species, described above; however, a response from the local Service Field Office is required. Transportation Agencies and/or State DOTs will either complete the IPaC Assisted Determination Key or send a Project Submittal Form (Appendix B of the User's Guide) to the local Service Field Office with sufficient time for review as described below. The Project Submittal Form:

- Describes the proposed action (e.g., type of action, location, involved Federal agencies);
- Verifies that the project is within the scope of the programmatic range-wide consultation;
- Provides a quantification of impacts (e.g., acres of tree removal/trimming and/or number of bridges, culverts, or structures with adverse effects), and timing of impacts;
- Identifies all proposed AMMs that will avoid, minimize, and compensate, as applicable for the project's impacts.

The Service Field Offices will respond within 30 calendar days[10] (instead of 135 calendar days) to consultation requests that are accompanied by an LAA Consistency Letter (through the IPaC Assisted Determination Key process) or a complete Project Submittal Form. However, if a project requires formal consultation for other listed species or designated critical habitats that are not the subject of this PBO,

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[8] https://ecos.fws.gov/ipac/

[9] https://www.fws.gov/media/users-guide-range-wide-programmatic-consultation-indiana-bat-and-northern-long-eared-bat

[10] 30-day time period begins when the Service Field Office receives the effects determination letter (through the IPaC Assisted Determination Key process) or complete Project Submittal Form.

the Transportation Agencies should coordinate with the local Service Field Office because other consultation procedures and timelines may apply.

For projects that are LAA the Indiana bat, NLEB, or TCB, the Service Field Office will respond to an effects determination letter (through the IPaC Assisted Determination Key process) or complete Project Submittal Form to:

- Verify that all applicable conservation measures are included in the project proposal;
- Verify that the project is consistent with the programmatic sideboards for activities within the scope of the programmatic consultation;
- Document the site-specific level of authorized incidental take; and
- Identify any project-specific monitoring and reporting requirements, consistent with the monitoring and reporting requirements for the program as a whole (see Section 8.3).

Projects with Additional Information Needs

The Transportation Agencies, State DOTs, and/or the Service may determine that a proposed project requires additional site-specific information to determine whether the proposed project conforms to this consultation. Such projects will require Transportation Agencies and/or State DOTs to coordinate with the local Service Field Office(s) to make a final determination pursuant to ESA's section 7(a)(2), *supra*. If a project "may affect" any other federally listed or proposed species, or critical habitat, additional consultation (or conference for proposed species and critical habitats, if applicable) is required.

1.2 Adaptive Management

Since the original PBO in 2016, the Transportation Agencies and the Service have reviewed new information and feedback from users regarding the species' ecology, conservation, project effects, and program implementation to adaptively manage how the programmatic consultation is working to serve its three main purposes: streamline the consultation process, avoid and minimize impacts to contribute to the recovery of the covered bat species, and provide compensatory mitigation for unavoidable impacts to the Indiana bat and NLEB.

The Transportation Agencies and the Service established points of contact (POCs) that have the responsibility to manage the ongoing implementation of this programmatic consultation. The POCs coordinate the monitoring, reporting, and adaptive management at the programmatic scale (i.e., technical assistance on implementation of the programmatic consultation, analyses of data, decision-making on modifications, and reporting out to management). The POCs may also stipulate areas of the programmatic consultation for more active data gathering as circumstances warrant.

The programmatic consultation does not have an expiration date, but the POCs from the Transportation Agencies and the Service conduct annual reviews of the programmatic consultation and track incidental take of the covered bat species at a program scale. Standard consultation reinitiation conditions apply (e.g., new information on species or effects). Additional information may warrant changes to the programmatic consultation, either for the entire range of the species or specific geographic areas. Examples include, but are not limited to, additional occurrence data related to the proximity of bat roosts to roads; bat use of specific bridge and culvert types; or new information on portions of the species range where bats remain active year-round. Although the agencies will consider changes to the consultation on an annual cycle, such changes may occur at any time the agencies mutually agree is appropriate. At any time, the Transportation Agencies or the Service may withdraw from participating in the programmatic consultation if determined it is failing to serve the intended purposes.

The POCs from the Service and the Transportation Agencies frequently coordinate to:

- Assess information received from the field and new relevant research over the preceding year and determine, by consensus, whether such information warrants changes to the programmatic consultation;
- Evaluate the effectiveness of the annual tracking and reporting processes;
- Evaluate the effectiveness of the program to streamline the consultation process and conserve the covered bat species; and
- Discuss and resolve any issues related to the program.

Monitoring

Monitoring implementation of this programmatic consultation begins with the Service's IPaC Assisted Determination Key Letters or Project Submittal Forms, from which Service Field Offices will enter key information into the Service's EcoSphere System. The POCs from the Service and the Transportation Agencies will evaluate this information (see Section 8.3 Monitoring and Reporting Requirements) at least annually and make any needed minor modifications to the programmatic consultation by mutual agreement among the agencies. Examples of the kinds of modifications expected include but are not limited to updating the IPaC Assisted Determination Key, Project Submittal Forms, and the User's Guide/Appendices.

The POCs may also use input from end users to make more substantive changes to the programmatic consultation (e.g., revising the impact avoidance and minimization measures [AMMs]) when appropriate). Substantive, technical information may prompt such changes and may or may not require a reinitiation of the consultation.

Monitoring the outcome of compensatory mitigation measures is required according to the guidelines in Section 3.2 regardless of who is responsible for implementing compensation measures. Transportation Agencies or their representatives will monitor the outcome of compensatory mitigation measures. For projects electing to use an in-lieu fee (ILF) mechanism or conservation bank to accomplish the compensatory mitigation, the ILF or conservation bank managing organization becomes responsible for monitoring and reporting the success of compensatory mitigation measures.

Reporting

For purposes of ESA section 7 compliance, the Transportation Agencies and/or State DOTs must either complete the IPaC Assisted Determination Key or provide the local Service Field Office a complete Project Submittal Form, or an analog that supplies the same data, for each project included in this programmatic consultation. Service Field Offices will follow SOPs to enter specific data pertaining to each project into the Service's EcoSphere System. The User's Guide describes these SOPs and other details regarding this process and is available on the Service's website.[17]

POCs from the Transportation Agencies and the Service will continue to coordinate to compile the project-specific information collected for each project into an annual report. The annual report will allow the POCs to track the number of projects, project effects on the species, acres of habitat affected, bats affected at bridges/culverts/structures, and amount and type of mitigation, if applicable. The annual report will also be used for adaptive management as described above.

1.3 Consultation History

The 2018 PBO was amended on March 23, 2023, in response to the reclassification of the NLEB, and has also been revised to address new information from annual reporting data, feedback from users, and the 2022 proposed rule to list the TCB as an endangered species. The proposed action has been modified to include transportation activities beyond 300 ft (91.4 m) from the edge of the road or rail ballast, as identified in this PBO; activities within regions of the NLEB and TCB's range where the species is active year-round; and to update AMMs for the Indiana bat, NLEB, and TCB. This current PBO is based upon the prior effects analyses, a new analysis for the TCB, as well as additional information provided in telephone conversations, meetings, and other sources of information cited throughout. An addendum to the PBO has been developed to identify the specific modifications to the Amended 2018 PBO. Also, a complete decision file for this consultation is on file with the Service.

August 2012	FHWA and the Service (Regions 3, 4, and 5) signed a scope of work to collaborate on a pilot effort to develop a regional conservation strategy for Indiana bats to help expedite the consultation process related to transportation projects. The purpose was to complete an informal programmatic consultation and conservation framework and tools.
December 2013	FHWA and the Service team met in Harrisburg, PA, to discuss the programmatic consultation.
February 2014	FRA joined the programmatic consultation.
April 2014	FHWA and the Service team met in Frankfort, KY, to discuss the programmatic consultation.
August 2014	The scope of work was modified to include the NLEB in the programmatic informal consultation.
September 2014	FHWA and the Service team met in Boston, MA, to discuss the programmatic consultation.

March 2015	FHWA and the Service team met in Bloomington, MN, to discuss the programmatic consultation.
March 2015	FHWA and the Service agreed to add a suite of projects that “may affect, likely to adversely affect” in the programmatic consultation. This addition resulted in the need to revise the BA, and for FHWA to initiate formal consultation upon completion of the revised BA.
April 2015	The Service listed the NLEB as a threatened species on April 2, 2015
April 2015	The Range-Wide Biological Assessment for Transportation Projects for Indiana Bat and NLEB jointly developed by the Service, FHWA, and FRA was completed for the programmatic informal consultation and the Service subsequently provided concurrence.
November 2015	FHWA and the Service team met in Boston, MA, to discuss revision of the BA and the addition of the formal component of the range-wide programmatic consultation.
November 2015	FTA joined the programmatic consultation.
January 2016	The Service published a final species-specific rule (81 FR 1900) pursuant to section 4(d) of the ESA for the NLEB (50 CFR §17.40(o)), which became effective February 16, 2016.
May 2016	FHWA/FRA/FTA and the Service completed the revised BA. FHWA/FRA/FTA subsequently initiated formal consultation with the Service. The Service completed the range-wide programmatic biological opinion (BO) May 20, 2016.
June to October 2016	FHWA/FRA/FTA and the Service gathered comments from the users implementing the May 2016 BA.
November 2016	FHWA/FRA/FTA and the Service completed a revised BA that added clarifying language and requirements dated November 28, 2016.
December 2016	FHWA/FRA/FTA reinitiated formal consultation. The Service issued a revised BO dated December 16, 2016.
Jan. to Dec. 2017	FHWA/FRA/FTA and the Service gathered feedback/comments from the users implementing the December 2016 BO.
January 2018	FHWA/FRA/FTA submitted a request for a BO revision.
February 2018	The Service issued a revised BO dated February 5, 2018.
March to Dec. 2020	FHWA/FRA/FTA and the Service gathered feedback/comments from the users implementing the February 2018 BO.
March 2022	The Service proposed reclassifying NLEB as an endangered species on March 23, 2022.
September 2022	The Service issued a proposed rule to classify the TCB as an endangered species on Sept 14, 2022.
November 2022	The Service reclassified NLEB as an endangered species on November 30, 2022.
December 2022	FHWA/FRA/FTA submitted a request for a BO revision.
March 2023	The Service issued an amendment to the 2018 BO to include the reclassification of the NLEB from threatened to endangered.

August 2024	FHWA/FRA/FTA submitted a request to reinitiate consultation for the Indiana bat and NLEB, and formal consultation for the TCB.
December 2024	The Service issued a revised PBO for the Indiana bat and NLEB; and a Conference Opinion (CO) for the TCB

1.4 Biological Opinion

A BO is the document that states the opinion of the Service as to whether a Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat (50 CFR §402.02). "To jeopardize the continued existence of a listed species" 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 the species. "Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR §402.02).

This PBO addresses the Limited Range-wide Program for the Transportation Agencies for the Indiana bat, NLEB, and the TCB.

2. DESCRIPTION OF THE PROPOSED ACTION

2.1 Introduction

Federal agencies must consult with the Service when any project or action they authorize, fund, or carry out may affect a listed species or designated critical habitat. 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." Federal agencies request technical assistance from the Service to identify the listed species that ***may be present*** in the proposed action area. The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."[11]

The historic ranges of the NLEB and TCB are extensive and include widespread suitable habitat. Given declines in their populations, the Service is uncertain where the species' currently ***may be present*** on the landscape. To better understand the species distribution, the Service has modeled the landscape across the historic ranges to establish where they believe NLEB or TCB ***may be present***. The Service is using a modeled probability of occurrence of the species equal to or greater than 50% to establish a "***may be present"*** threshold. Based on this model, the Service is only requiring section 7 consultations

[11] Further clarification is provided by the national consultation FAQs at https://www.fws.gov/glossary/action-area

for non-wind energy projects where any part of the projects' action area has a modeled probability of occurrence of the species equal to or greater than 50%.

The Service has determined that the action area for this programmatic consultation, hereby referred to as the "action area" is comprised of all lands within the range of the Indiana bat, and lands that meet the Service's ***"may be present"*** threshold for the NLEB and TCB that are affected directly or indirectly by the project's components described in the Description of the Proposed Action. Absent of site-specific species surveys or other site-specific data, we infer from the Service's modeling that bats are occupying these action areas for the basis of our biological assessment.

For the sake of this consultation, the action area for individual projects analyzed by this programmatic consultation will be referred to as "project action area."

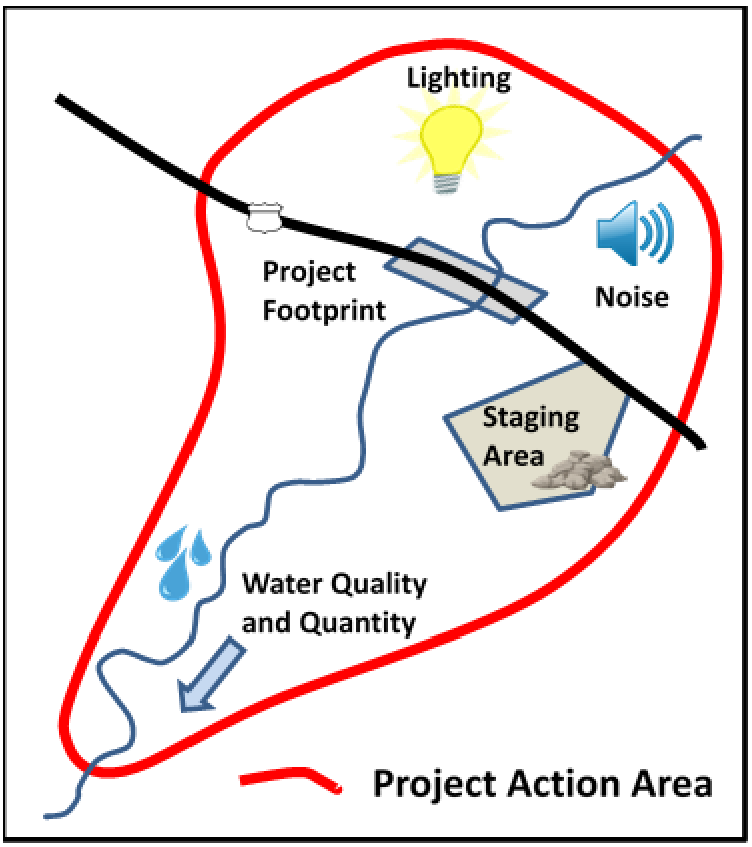

Figure 1. Project Action Area

The proposed action is the implementation of limited transportation projects funded or authorized by the Transportation Agencies. Section 2.1 provides a brief general overview of the Transportation Agencies, an estimation of the extent of annual project activity for all the Transportation Agencies combined, and a description of the projects that are outside the scope of this programmatic consultation. Sections 2.2 through 2.8 provide detailed descriptions of various types of covered projects.

Section 2.9 describes measures that are also part of the proposed action, including the AMMs that apply to all projects, as appropriate, to reduce potential impacts to the species. Section 2.10 describes the compensatory mitigation measures that apply to covered projects that adversely affect the Indiana bat and NLEB.

FHWA provides stewardship over the construction, maintenance, and preservation of the Nation's highways, bridges, and tunnels. FHWA also conducts research and provides technical assistance to Federal, State, Territorial, Tribal, and local agencies to improve safety, mobility, and livability, and to encourage innovation. FHWA strives to advance environmental stewardship and streamlining for FHWA-funded projects through the application of the National Environmental Policy Act (NEPA) (P.L. 91-1970) and related environmental laws and regulations.

FHWA also oversees the following programs: The Federal-Aid Highway Program provides the financial resources and mechanism to assist States and local public agencies in constructing, preserving, and improving transportation for the movement of people and goods. The Federal-Aid Highway Program funds are authorized by Congress; tax dollars are allocated and distributed by FHWA directly to the State DOT, as a direct-recipient for Federal-aid projects or local public agencies, as sub-recipients, for "eligible" activities. 23 USC §327 - Surface Transportation Project Delivery Program and 23 USC §326 - Categorical Exclusions assignment allows the Secretary of Transportation to assign, and a State to assume, the Secretary's responsibilities under NEPA and other environmental laws (including ESA Section 7 consultation) for highway projects, railroad, public transportation, and/or multimodal projects for certain project types as described in their Memorandums of Understanding (MOU). Under these programs, a State shall assume responsibility and be subject to the same procedural and substantive requirements as would apply if that responsibility were carried out by the Secretary for their assigned projects. As such, States operating under the Surface Transportation Project Deliver Program and the Categorical Exclusion program are also included under this programmatic consultation and may rely upon the findings and streamlined processes of the PBO for compliance with section 7(a)(2) of the ESA (16 USC 1536). These states are responsible for their actions for respective assigned projects as outlined in their MOUs.

The Federal Lands Highway Program provides financial resources and technical assistance to support a coordinated program of public roads that service the transportation needs of Federal and Tribal lands. Relevant FLMAs include: the Bureau of Indian Affairs, Bureau of Land Management, Bureau of Reclamation, Surface Deployment and Distribution Command, US Forest Service, U.S. Fish and Wildlife Service, National Park Service (NPS), and the USACE. Also overseen by FHWA, is the Recreational Trails Program (RTP). The RTP is a grant program administered by each state for motorized and non-motorized trails and trail-related infrastructure. RTP grants may be used for the maintenance and restoration of existing trails; development and rehabilitation of trailside and trailhead facilities and trail links; construction of new trails (with restrictions for new trails on Federal lands); among other uses.

FRA is responsible for working with stakeholders to develop cohesive goals and policies for maintaining and improving U.S. freight and passenger rail networks, including approximately 760 railroads. The agency conducts strategic investment to accommodate growing travel and freight demands and provides leadership in national and regional system planning and development. FRA implements Federal environmental laws and policies related to railroads and provides information and resources for environmentally sound planning and development.

FTA provides financial and technical assistance to local public transit systems improving, expanding, operating, and maintaining transit service. Project sponsors are responsible for managing their programs in accordance with Federal requirements, including NEPA and other environmental requirements. FTA is responsible for working with sponsors of transit projects to ensure compliance.

Transit projects include capital facilities to support a variety of modes such as buses, subways, light rail, commuter rail, monorail, passenger ferry boats, trolleys, inclined railways, and people movers. Public transit projects are generally located in urban areas and include fixed and varied bus route services; operating and maintenance facilities; stations and parking structures; and linear fixed route bus rapid transit and rail lines.

Annual Project Activity for Included Transportation Agencies

Across the range of the Indiana bat, NLEB, and TCB, there are an average of approximately 80,000 road miles (128,748 km) and 3,000 to 6,000 rail miles (4,828 to 9,656 km) per State. On an annual basis, the number of existing road and rail miles undergoing maintenance or improvements will largely be influenced by available funding. Maintenance and improvement projects are expected to occur on only a fraction of a percent of the total infrastructure network annually.

A sample of State DOTs and FHWA Division Offices estimated the annual acreage of cleared trees from the edge of the road surface out to 300 ft (91.4 m) (Table 1).

- The average annual tree clearing per State within 0 to 300 ft (0 to 91.4 m) from edge of road surface is 320 acres (129.5 hectare [ha]).
- The average annual tree clearing per State within 0 to 100 ft (0 to 30.5 m) from edge of road surface is 140 acres (56.7 ha).
- The average annual tree clearing within a State from 100 to 300 ft (30.5 to 91.4 m) from edge of road surface is 180 acres (72.8 ha).
- Based upon projects that used the PBO from 2017-2021, approximately 242 acres of the Indiana bat habitat cleared, resulted in take of Indiana bats; and that approximately 743 acres of NLEB habitat cleared, resulted in take of NLEB. This is total acreage over these 4 years.

The average annual acreage of trees cleared per State beyond 300 ft (91.4 m) from the edge of the road/rail surface was not included in the original BA or PBO. This information has not been consistently tracked per state and is not easily estimated. With transportation agencies providing this information for projects coordinated under the present PBO, estimates will be available in the future. However, for any given project addressed in this programmatic consultation, the maximum acreage of habitat removal is approximately 20 acres (8.1 ha) per 5-mile (8 km) section of road/rail, unless a local Service Field Office confirms, on a case-by-case basis, that the effects do not exceed the impacts as anticipated in this PBO. (e.g. the amount of tree removal still maintains sufficient roosting and foraging habitat within the home range of the covered bat species).

Table 1. Estimated Average Annual Acres of Cleared Suitable Habitat

Distance from road/rail surface	Average Annual Acres (ha)/State	Acres (ha)/Indiana bat range (22 States)	Acres (ha)/NLEB range (37 States + D.C.)	Acres (ha)/TCB range (39 States + D.C.)
0-100 ft (0-30.5 m)	140 acres (56.7 ha) total	3,080 acres (1,246 ha)	5,320 acres (2,153 ha)	5,600 acres (2,266 ha)
100-300 ft (30.5-91.4 m)	180 acres (72.8 ha) total	3,960 acres (1,603 ha)	6,840 acres (2,768 ha)	7,200 acres (2,914 ha)
Outside 300 ft (91.4 m)	unknown	unknown	unknown	unknown
TOTAL 0-300 ft (0-91.4 m)	320 acres (129.5 ha)	7,040 acres (2,849 ha)	12,160 acres (4,921 ha)	12,800 acres (5,180 ha)

Bat Species' Individual Home Range in Relation to Project Size

The individual NLEB home range (roosting and foraging area) has been minimally estimated at 148.8–173.7 acres (Owen et al. 2003, Lacki et al. 2009), with maternity colony home ranges being larger. Individual Indiana bat home ranges may be several hundred to thousands of acres in size (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Jachowski et al. 2014, Kniowski and Gehrt 2014, Divoll and O'Keefe 2018). The individual home range for two lactating female TCBs roosting in trees in Wisconsin was documented as 420 acres (170 hectares) and 642 acres (260 hectares) (Wisconsin DNR 2018). However, the home range for male TCBs can be much larger than TCB reproductive females. For example, the home range for a single male TCB in central Indiana was 1,349 acres (546 hectares) (Helms 2010).

For all three species, core roosting areas are smaller than foraging areas, with roosts often clustered in space. Size of both foraging and core roosting areas likely varies depending on habitat quality. For example, larger home ranges may be necessary to meet a bat's needs in less suitable habitat. The maximum acreage of habitat removal (20 acres [8.1 ha] per 5-mile (8 km) section of road/rail) for any given project addressed in this programmatic consultation represents less than 10% of an individual home range for the Indiana bat and TCB, and 15% of the individual NLEB home range, as reported above.

Typically, Indiana bat and NLEB colonies have larger home ranges than individual bats, with areas of overlapping core roosting and foraging areas, and areas that do not overlap. This consultation is intended to cover projects with smaller impacts to any given maternity colony. The 20-acre (8.1 ha) limit of habitat removal is not expected to result in alterations to Indiana bat, NLEB, or TCB normal behavioral patterns for a given maternity colony in most instances. Some projects may exceed 20 acres (8.1 ha) per 5-mile (8 km) section of road/rail if the action's effects do not exceed the impacts as anticipated in this PBO and are verified by a local Service Field Office.

Not all acres of habitat cleared will cause adverse effects to the Indiana bat, NLEB, or TCB for the following reasons:

- The acreage estimates are based on the acreage of all trees cleared.
- However, not all the trees cleared are suitable habitat for the covered bat species.
- Absent survey data, Transportation Agencies infer species presence in suitable habitat, yet not all suitable habitat is occupied by the covered bat species.
- Transportation Agencies will primarily clear trees within 0 to 100 ft (0 to 30.5 m) of the road/rail surface outside the time-of-year (TOY) restrictions. Based upon recent projects (2017-2021), Transportation Agencies estimate that 90% of the projects will implement tree clearing outside the TOY restrictions (pup season and winter torpor).
- Tree clearing in suitable habitat for the NLEB and TCB in Zone 1 of their YR active ranges will implement an additional TOY restriction during winter torpor (December 15 – February 15).
- Based upon recent projects (2017-2021), Transportation Agencies estimate projects will involve, on average, less than 2 acres (0.8 ha) per project of tree removal/trimming in a widely dispersed arrangement across the ranges of the covered bat species.

The proposed action includes multiple transportation actions. Some of those actions need no further consultation and some need additional consultation with a local Service Field Office.

Transportation actions that are outside the scope of this programmatic consultation include:

- Activities <0.5 miles (0.8 km) from an Indiana bat, NLEB, or TCB hibernaculum that cause stressors to the covered bat species, as described in the BA/BO (i.e., involve slash pile burning, ground disturbance, vibrations, noise above existing background levels, temporary or new/additional permanent lighting, tree removal/trimming, or bridge, culvert, or structure activities).
- Activities that alter the entrance or environment of a known Indiana bat, NLEB, or TCB hibernaculum.
- Projects that include raising the road profile above the tree canopy in documented habitat for the Indiana bat, NLEB, or TCB.
- Percussive activities within suitable habitat (not related to tree removal/trimming or bridge, culvert, or structure work) that involve noise/vibration above existing background levels when conducted beyond 100 ft (30.5 m) of the road/rail surface during the pup season.
- Percussive activities within suitable habitat (not related to tree removal/trimming or bridge, culvert, or structure work) that involve noise/vibration above existing background levels when conducted beyond 100 ft (30.5 m) of the road/rail surface in Zone 1 of the NLEB or TCB YR active ranges between December 15 and February 15.

- Activities that involve tree removal/trimming of more than 20 acres (8.1 ha) of Indiana bat, NLEB, or TCB suitable habitat per 5-mile section of road/rail.[12]
- Activities that involve tree removal/trimming within documented habitat for the Indiana bat, NLEB, or TCB during the pup season.
- Activities that involve tree removal/trimming of suitable habitat for the NLEB or TCB in Zone 1 of their YR active ranges between December 15 and February 15.
- Activities that involve tree removal/trimming outside documented habitat for the Indiana bat, NLEB, or TCB beyond 100 ft of the road/rail surface during the pup season.
- Activities that involve the removal/trimming of trees >9 in. diameter at breast height (DBH) (22.9 cm) outside documented habitat for the Indiana bat, NLEB, or TCB within 100 ft of the road/rail surface during the pup season.
- Activities involving the exclusion (temporary or permanent) of Indiana bats, NLEBs, or TCBs from a bridge, culvert, or structure.[13]
- The removal, replacement, and/or alteration[14] of a bridge, culvert, or structure during the winter hibernation period (inactive season) when a colony of hibernating Indiana bats, NLEBs, or TCBs are observed using the bridge, culvert, or structure.
- The removal, replacement, and/or alteration of a bridge or culvert between December 15 – February 15 (in Zone 1 of the NLEB or TCB YR active ranges) when use of the bridge or culvert by the NLEB or TCB is assumed, or signs of use by these species has been observed.
- The removal, replacement, and/or alteration of a bridge, culvert, or structure in the active season that will disturb a large number of covered bat species (>5) using the bridge, culvert, or structure.
- The removal, replacement, and/or alteration of a bridge, culvert, or structure that has documented use by a large number of covered bat species (>5), in which suitable roosting habitat is no longer available within the bridge, culvert, or structure once construction/replacement is complete.[15]

[12] Unless a local Service Field Office confirms, on a case-by-case basis, that the effects of the action do not exceed the impacts as anticipated in this PBO (e.g., the amount of tree removal still maintains sufficient roosting and foraging habitat within the home range of the covered bat species).

[13] Coordinate with your local Service Field Office and follow Acceptable Management Practices for Bat Control Activities in Structures guidance document at White-nose Syndrome Conservation and Recovery Working Group 2015) available at: https://s3.us-west-2.amazonaws.com/prod-is-cms-assets/wns/prod/9b1e25d0-7893-11e8-a1ee-971f7a38735d-wns_nwco_amp_1_april_2015_0.pdf

[14] The alteration of a bridge, culvert, or structure also includes rehabilitation, which is defined in 23 CFR 650.405 as the project requirements necessary to perform the major work required to restore the structural integrity of a bridge as well as the work necessary to correct major safety defects (except as noted in 23 CFR 650.405(c) under ineligible work.)

[15] For instances where a bridge, culvert, or structure has documented use by a large number of covered bat species (>5), coordination with the local Service Field Office is recommended to determine if suitable roosting habitat is still available.

2.2 Road/Rail Construction

New construction activities can be associated with highway, railway, and transit projects that conform to the description of projects included in the proposed action (see Section 2.2 of the PBO). Primary project objectives may include mobility and/or safety improvements. Examples of rail improvements include a new siding track, a second mainline track, or a new rail maintenance access road. Examples of roadway projects include new general-purpose lanes, realignments, bypass routes, interchanges, bicycle/pedestrian trails and facilities, and new sidewalks. Public transportation projects range from linear bus or rail alignments to fixed capital facilities such as parking lots, transit centers, rail stations parking garages, and vehicle maintenance and/or storage facilities. Widening or replacing aging bridges could occur for highway, railway, and transit projects.

Several activities and components of transportation are described within the roadway, rail, and transit construction category, such as staging area establishment, culvert extension and installation, and drainage system installation and enhancements. Blasting may also be required when expanding the road, rail, or transit corridor. Blasting is further described in the Slide Abatement section.

Unique components of highway construction include stormwater treatment facility construction, paving, painting, illumination, and signing. Roadway construction that is designed to increase mobility often occurs in urban areas. In these cases, very little undeveloped or undisturbed property is affected and most of the impacts would occur in the existing rights of way. New highway interchange construction could occur in areas that are highly developed or within areas that are becoming increasingly developed, but do not typically occur in rural areas. Unique components of transit construction include construction of parking lots and garages; installation of electric power systems above and/or below the track bed; rail signals and ancillary facilities, such as traction power substations; construction of bus and rail stations/terminals; and operating and maintenance facilities.

Transit projects tend to be constructed in urban areas with some projects reaching to the suburban fringe. Some road construction is designed to improve the safety of the highway system. These projects include installation of sidewalks, slope flattening (which often require culvert extensions), and alignment modifications. Slope flattening and clear zone maintenance reduces hazards for automobiles that inadvertently leave the roadway. The clear zone is the total roadside border area that is available for safe, unobstructed use by errant vehicles. Slope flattening typically involves the placement and removal of fill material on existing cut slopes. Slopes are flattened to make them more traversable and improve site distance. Slope and ditch repair involves re-grading ditches and slopes to the current safety standards and design slopes. It may also include filling in or repairing sides of the ditches where necessary. Alignment modifications may include adding auxiliary lanes (e.g., truck climbing and acceleration lanes), channelization (new turn lanes), on- and off-ramp extensions, or realigning an intersection to improve the sight distance. If a new lane is added, an alignment modification of the adjacent road may be necessary to maintain continuity of the roadway.

Alignment modifications may also straighten curves or approaches to bridges. Alignment modifications could range in length from a few hundred feet to a couple thousand feet for curve realignments, or up to a few miles for realigning a major section of roadway. Truck lanes, turn lanes, and acceleration lanes typically average between 10 and 12 ft (3 and 3.7 m) wide. Sidewalk widths vary from 5 to 10 ft (1.5 to 3 m) wide, depending on jurisdiction and intended use. Road realignments and widenings often range between 0.25 and 5.0 miles (0.4 and 8 km) in length. New interchanges and interchange improvements are also common safety projects.

Staging Areas

Staging areas are used for delivery and storage of construction materials and equipment, contractor office and storage trailers, and employee parking. These areas would be similar across road, rail, and transit projects and are typically contractor-selected and permitted. These areas are often fenced and located near project construction. Temporary fencing prevents machinery and equipment, materials storage, and construction activity from intruding into adjacent properties, wetland and stream buffers, and shoreline areas. Office trailers, placed on temporary foundations, are often connected to available utilities including power, telephone, water, and sewer as needed. Connecting to these utilities may include installing poles for power lines and excavating trenches to place water and sewer pipelines. After construction is complete, staging areas are restored, if appropriate, and disconnected from any utilities.

Depending on site conditions, construction staging areas vary in size and may require vegetation clearing, grubbing, grading or excavation to level the site, and installing drainage improvements. Extensive alterations to establish a staging area, such as blasting, are extremely unlikely. Cleared vegetation is often hauled offsite, mulched, and redistributed, or less commonly piled and burned onsite. Excess material (e.g., soil, rock, debris) is disposed of at offsite areas or reused as appropriate in construction. Conveyance systems for the movement of stormwater from a collection point to an outfall can consist of drainage pipes and stormwater facilities (e.g., ponds, vaults, and catch basins), using gravity or pumps to move the stormwater. Temporary driveways and access roads may be established from staging areas to the existing roadway network. Some staging areas may also be equipped with wheel washes that clean truck tires to reduce tracking dirt and dust offsite. Additional dust control is provided via water trucks and street sweepers.

Staging, fueling, and storage areas are typically located in areas that minimize potential effects to sensitive areas. Specialized best management practices (BMPs) are employed around concrete-handling areas to prevent water contamination from uncured cement entering water bodies or stormwater facilities. Temporary erosion and sediment control measures are implemented prior to ground disturbance on these sites. Examples include marking clearing limits, establishing construction access, controlling runoff flow rates (e.g., sediment ponds, check dams), installing sediment controls and soil stabilization (silt fence, coir blankets, temporary seeding), protecting slopes, protecting drain inlets, and preventing/containing contaminant spills.

Offsite Use Areas

Offsite use areas are necessary for rail and roadway projects and mainly consist of borrow material and waste disposal sites. Depending on the project, they can be owned by the State DOT or another public or private entity. They are typically permitted separately from the project and are contractor selected. Common activities associated with material sites include vegetation removal, excavation, rock crushing, and blasting.

Project-specific locations include such areas as staging areas, access roads, borrow areas, and waste disposal areas for project-related activities. These types of project-related activities may or may not occur within the project limits of construction and are often carried out by State DOT contractors.

For projects included in this programmatic consultation, State DOTs and their contractors: 1) shall adhere to all applicable Transportation Agency contract requirements; 2) comply with all State and Federal laws concerning activities in those offsite areas; and 3) implement the applicable AMMs listed in this document. Contractors must provide documentation to State DOTs and Transportation Agencies when requested to demonstrate compliance with Federal contracting requirements and all State and Federal laws.

If a new or existing staging or access area or a new or existing pit is used outside of a project's construction limit, such offsite areas must also meet the requirements for coverage under the programmatic. Projects that do not meet these criteria will not be covered under this programmatic consultation and will require individual consultation with the local Service Field Office.

Site Preparation

Site preparation applies to rail and roadway projects and begins with vegetation removal, which may be permanent or temporary. Permanent conversion of a vegetated area into a developed area includes clearing vegetation then grubbing out the roots. Temporary vegetative clearing includes cutting vegetation but maintaining the root mass to allow for regrowth. Removed vegetation is disposed of similarly to staging area vegetation clearing. Preliminary earthwork consists of stripping topsoil from an area and either removing earth or placing and compacting earth for roadway prism construction or slope construction. The earth may be moved from or to another section on the same project, or it may come from or be disposed off-site. Completed cut or fill prisms may then be covered by any number of treatments, such as rock base and pavement, rock stabilization and riprap, or mulch and seeding. Drainage and utility work often accompany excavation and embankment. Impacts to wetlands and other sensitive areas are first avoided and minimized as much as possible, then mitigated when unavoidable. Utility work includes excavation to install new utility poles or trench excavation to install underground utilities. This work can be completed in forested areas.

Temporary road construction is often necessary for equipment access and involves similar site preparation activities as conducted for permanent roads. However, these roads are often unpaved, either constructed by grading, laying fabric and quarry spalls, or construction mats. Compaction is minimized so the materials can be removed, and the site restored and replanted following construction. A variety of temporary construction BMPs are used for site preparation, including silt fences, berms, fiber wattles, storm drain inlet protection, straw bale barriers, check dams, and detention or siltation ponds. Erosion control measures are installed and operational before commencement of ground-disturbing activities. Areas where vegetation should be preserved are clearly marked or fenced. If work is conducted at night, temporary lighting is utilized.

Culvert Installation

Culverts include small concrete and box girders that do not qualify as bridges due to their size. Typically bridges less than 20 ft (6.1 m) wide are referred to as either culverts or crossing structures. Conventional culverts include, but are not limited to, concrete, corrugated metal, timber, and polyvinyl chloride (PVC) piping. Culvert installation may occur independently or as part of a larger road improvement project. Culvert replacements also may occur as part of larger rail improvement projects. Proper culvert sizing is determined by consulting hydraulics manuals and fish passage guidance. Average culvert lengths range between 18 and 200 ft (5.5 and 61 m). Culvert replacements typically require less than one month to complete. Typical culvert replacements involve removing vegetation at the outlet and inlet area, removing existing pavement and roadbed to extract the existing culvert, placing the new culvert, backfilling, and replacing the pavement, installing armoring and headwalls, re-vegetating if necessary, and if flow is present, dewatering the work area and establishing a flow bypass prior to initiating work, then rewatering the work area once in-water work is complete. In-water construction typically occurs during low-flow months or during dry periods.

Bridge Construction

Bridge construction may be a component of a larger roadway or rail construction project or a stand-alone project. There are multiple types of bridges, including but not limited to concrete slab, concrete arch, concrete box girder, concrete T beam, steel beam, pre-tensioned concrete beam, post-tensioned concrete beam, steel truss, and timber trestle. Bridges can span wetlands, streams, and other water bodies, as well as roadways and other transportation infrastructure. Some bridges span the stream systems they are crossing, while others have piers in the channel. The number of piers in the channel varies by bridge. Most new bridges are designed to span as much of the river as possible, and to provide the least amount of construction that is practicable on the system. Many bridge piers are now drilled shafts, eliminating shallow footings that are susceptible to scouring.

Bridge replacements tend to be long-term projects requiring one or more years to complete. Installation of new bridges may require construction of a detour bridge. Occasionally, half of the new bridge is constructed adjacent to the old bridge and acts as the detour bridge while the original is removed and replaced. Occasionally, only the superstructure of railway bridges is replaced. Most bridge replacements use the same alignment or are constructed near the old alignment. Temporary bridges may be built as construction platforms. Often, in-water work is generally timed to minimize impacts to sensitive aquatic species. Some sedimentation of the waterway may occur during pile driving and removal. Bridge removal can also result in sediment and small concrete chunks entering the water.

Major bridge replacement construction activities often include:

- Clearing and grading for road widening;
- Clearing and grubbing of existing streamside vegetation;
- Construction of stormwater facilities;
- Excavation for new bridge abutments;
- Construction of bridge columns/piers/abutments;
- Concrete pouring;
- Pile installation and removal;
- Bridge demolition;
- Riprap placement; and/or
- Paving with asphalt or concrete.

Piles are installed using several different methods. Pile driving involves the use of an impact pile driving hammer, which is a large piston-like device that is usually attached to a crane. The power source for impact hammers may be mechanical, "air steam," diesel, or hydraulic. In most impact drivers, a vertical support holds the pile in place while a heavy weight or ram moves up and down, striking an anvil which transmits the blow of the ram to the pile. In hydraulic hammers, the ram is lifted by fluid, and gravity alone acts on the down stroke. A diesel hammer, or internal combustion hammer, carries its own power source, and can be open-end or closed-end. An open-end diesel hammer falls just under the action of gravity. A closed-end diesel hammer (double acting) compresses air on its upward stroke and can therefore run faster than open-end hammers. Impact hammers can drive at a rate of approximately 40 strikes per minute.

Vibratory hammers can also be used to both install and remove piling. A vibratory hammer is a large, mechanical device, mostly constructed of steel (weighing 5 to 16 tons) that is suspended from a crane by a cable. A vibratory pile driving hammer has a set of jaws that clamp onto the top of the pile. The pile is held steady while the hammer vibrates the pile to the desired depth. Because vibratory hammers are not impact tools, noise levels are not as high as with impact pile drivers. However, piles that are installed with a vibratory hammer must often be "proofed." Proofing involves striking the pile with an impact hammer to determine the load bearing capacity of the pile and may involve multiple impacts. If this is the case, noise will be elevated to that associated with impact pile driving. To remove piles, the hammer is engaged and slowly lifted with the aid of a crane, extracting the piling from the sediment.

Cofferdams are often installed to create an isolated work area, which can be dewatered for bridge and culvert installations or improvements. Cofferdams may consist of large casings (hollow cylinders) or created out of sheet piles. Cofferdams are generally installed with vibratory hammers. The exception to the use of vibratory hammers is when the substrate consists of very hard material, such as bedrock. In such cases, impact pile driving may be necessary. In other situations, other construction methods are used, such as stacked Jersey barriers with an impermeable liner, and sandbag/impermeable liner barriers, among others. These are accomplished typically by using a crane or excavator (Jersey barrier) or placed by hand (sandbags).

Bridges can be removed using several methods, including: (1) dismantled over water from adjacent bridge deck or approach; (2) dismantled over the water and lowered onto a barge and barged out to a dismantling site; (3) dismantled over water and sections removed by crane; and (4) falsework (temporary structures) can be built under and around the bridge, and the bridge dismantled by sections. Bridge removal methods are selected based on a number of factors, including bridge type, bridge size, size of the river, the location within the system, the topography, and the amount of access to the bridge and the banks. Since many older bridges have bridge piers in the system, these also need to be removed. Concrete piers can be removed by demolition using a hoe ram (as long as pieces do not enter the water); removed by a vibratory hammer; they can be cut off two ft (0.6 m) below the ground level; or a temporary cofferdam can be constructed, and the material can be hydraulically removed (Table 2). The bridge demolition method will be determined by site and project-specific conditions.

Table 2. Bridge Removal Technique Examples

Bridge Type	Construction Method	Access Method
Steel or Timber	(a) Remove bridge in segments with or without dropping pieces into water.	(a) Work from shore via crane arm or other heavy equipment.
		(b) Work from adjacent bridge deck or bridge approach.
		(c) Work from temporary platform or false work erected within the water.
		(d) Lower bridge or segments onto barge. Barge material to shore.
Concrete	(a) Remove bridge in segments without dropping pieces into the water. Frequently concrete slabs may be removed via saw cutting.	(a) Work from shore via crane arm or other heavy equipment.
		(b) Work from adjacent bridge deck or bridge approach.
		(c) Work from temporary platform or false work erected within the water.
		(d) Lower bridge or segments onto barge. Barge material to shore.
Piers	(a) Leave the piers in place.	N/A
	(b) Piers located out of water – cut at ground level and remove.	(a) Work from shore via heavy equipment.
	(c) Piers located out of water – removed with hoe ram.	(a) Work from shore via heavy equipment.
	(e) Piers located in water – use vibratory hammer to lift and remove.	(a) Work from shore via crane arm or other heavy equipment.
		(b) Work from adjacent bridge deck or bridge approach.
		(c) Work from temporary platform or false work erected within the water.
		(d) Lower piers or segments onto barge. Barge material to shore.
	(f) Piers located in water – cut or break off at or below surface level (dependent upon substrate).	(a) Work from shore via crane arm or other heavy equipment.
		(b) Work from adjacent bridge deck or bridge approach.
		(c) Work from temporary platform or false work erected within the water.
		(d) Lower piers or segments onto barge. Barge material to shore.

Isolation of the work area and stream is often required on bridge replacement projects and may require the use of cofferdams, sandbag berms, temporary culverts, or flumes depending on site conditions. Bridge replacement projects often require column construction within stream channels which typically involves the isolation of the column location using a large diameter steel sleeve that is driven into the stream substrate. All work, including excavation for the footing, placement of forms, and pouring of the concrete, would then be completed within the sleeve at each column location. This technique helps minimize construction impacts by isolating the work from the stream.

Bridge replacements may require more than one construction season, due to multiple factors such as project complexity or if the in-water work may be limited to certain periods to minimize impacts to sensitive aquatic species. Often, work on the out-of-water portions or behind cofferdams will occur year-round.

Roadway Construction

Roadway construction activities generally include installation of the roadway itself, and associated structures such as retaining walls, noise walls, and stormwater treatment.

A roadway embankment is a raised area of fill often used in roadway approaches. The construction of roadway embankment consists of building up soil or rock to create a new ground surface at the elevation needed for the new roadway or associated structures. Roadway embankments slope outward; therefore, the higher the embankment, the wider the surface area needed at the base. To avoid future settlement, rollers and hauling equipment thoroughly compact each layer of soil or rock. Retaining walls are used to support the embankment fill area where other constraints may exist along the alignment. Once final grading is achieved, the roadway is paved, striped, and signed. Guardrails may also be installed if applicable. More detail on paving is provided in the Maintenance, Preservation, and Facilities Improvements section.

Retaining walls are used to minimize the footprint width of the roadway cut or fill. Because retaining walls can be nearly vertical, they allow for a much smaller footprint than an earth slope. They can be used to support the roadway when the roadway is higher than the surrounding ground and can also be used in situations where the road is lower than the surrounding ground. In this case, the retaining wall supports the adjacent soil and prevents soil from slumping onto the roadway. Retaining walls are also used in areas where there is a high possibility of erosion, such as near a bridge abutment or water. The walls must have an area of free drainage between the retained soil and the back of the retaining wall to prevent water pressure from developing and adding to the soil loads. The drainage is usually provided by placing a layer of clean gravel and drainage pipes against the back of the retaining wall. There are a variety of wall types (soldier pile, mechanically stabilized earth [MSE], soil nail, among others). The type used depends on the structure it supports, the ground slope being retained, and available area.

Noise walls are mitigation measures designed to reduce noise impacts on sensitive receivers. They are typically precast panels or cast-in-place walls. They can be cast in a wide variety of patterns to improve their aesthetics. On bridges, noise walls may be cast into the traffic barrier. Noise walls are constructed to withstand the forces of wind and seismic loads.

Stormwater facilities are typically constructed to collect and treat stormwater runoff from impervious surfaces such as roads and bridges. The type of stormwater facility constructed will depend on the topography, profile of the road or bridge segment, availability of land, and availability and proximity of an outfall site for collected and treated water. A variety of approaches are utilized, such as bioswales, constructed stormwater wetlands and ponds, vaults, and where possible, infiltration and dispersion.

Rail and Transit Second Mainline, Siding, and Turnout Track Construction

New track installation generally requires additional subgrade preparation and earthwork. These improvements may also require additional right-of-way (ROW) and construction easements. Sidings are a second/alternate track that provides passing opportunities for trains moving in the opposite direction as well as slower trains moving in the same direction. These improvements are similar to mainline track reconstruction, but require additional clearing, grubbing, subgrade preparation, and earthwork. They may also require additional ROW and construction easements. Subgrade work involves placing new rock ballast, compacting and leveling, and laying track once final grade is achieved. Track turnouts are placed in areas needing passing sections, or when there is a potential safety risk such as during the construction of grade crossings. Reconstruction of turnouts may require easements for the construction pads.

Rail and Transit Access Road, Fencing, and Drainage Improvements

Access roads are generally 10 ft (3 m) wide, run parallel to the railroad, and are typically gravel surfaced. Construction is similar to temporary construction access roads, but these roads provide long-term access to the rail or transit system for maintenance. Construction of access roads includes clearing, grading, and associated drainage work. Fencing requires the installation of fence posts, which require less than 10 cubic ft (0.28 cubic m) of excavation at each fence post site.

Equipment

General equipment associated with roadway, railway, or transit construction includes, but is not limited to dump trucks, front-end loaders, cranes, asphalt grinders, paving machines, compaction rollers, bulldozers, chainsaws, vibratory and impact pile drivers, barges, explosives, excavators, rock crusher (if blasting is used for on-site fill) track or pneumatic drill, graders, jack hammers, stingers, wire saws, air compressors, traffic control devices, generators, and other heavy equipment.

Post Construction

Following road, rail, and transit construction, the site(s) are stabilized and restored using a variety of techniques. All exposed areas are typically mulched and seeded with an approved herbaceous seed mix and/or planted with woody shrub vegetation and trees (if appropriate) during the first available planting season. Temporary access road material is removed, and the area is restored to a more natural grade and stabilized through seeding and planting. Wetland and stream mitigation activities can occur at any point in the project, depending on site location. Common activities include wetland creation (excavation and fill removal), wetland restoration, enhancement (invasive[16] plant removal and replanting with native species), stream channel reconstruction, and aquatic habitat enhancements (adding gravel and woody material).

2.3 Safety and Mobility

Safety and mobility projects may occur within both rural and urban environments. Projects in this category that conform to the description of projects included in the proposed action (see Section 2.2 of the PBO) are designed to improve safety, traffic flow, and operations on existing road, railway, or transitway corridors. Work described in this section is intended to focus on those safety and mobility improvements that typically, by themselves, do not require new significant road or railway construction.

Intelligent Transportation System highway projects typically include installing or repair/replacement of fiber-optic cables, traffic cameras, variable message signs, traffic information signs, weather stations, positive train control systems, and highway advisory radio systems. Highway safety projects may also include installation or repair of sidewalks, guardrail and curbing, concrete jersey barriers, and impact attenuators. Additional safety projects include signal and illumination improvements, raised (island) or painted channelization, tree removal/trimming from the clear zone, shrub cutting from the road prism when encroaching on sight distance, and rumble strip grinding. Channelization is the separation of conflicting traffic movements with the use of new turn lanes (mentioned in Road/Rail Construction section), traffic islands, or pavement markings.

Occasionally, dead or dying trees or trees susceptible to wind damage may create a hazard if they are in danger of falling into the ROW. Hazard tree removal/trimming occurs as highway maintenance but is often included within a larger safety improvement project. DOTs may combine safety projects with pavement preservation projects or complete them separately. These activities typically have limited or no vegetation impacts (e.g., installation of a Jersey barrier or raised channelization), and consist of activities described in other transportation project categories.

Railroad Grade Separation

At-grade intersections of rail lines, roadways, and transit can result in safety issues and traffic and rail/bus (freight and passenger) delays. At-grade crossing improvements of a rail or transit line and an intersecting roadway include roadway work adjacent to tracks, improvement of roadway approaches to the railroad crossing, new sidewalks, curb and/or shoulder work to tie into existing crossings, and new pavement markings and signage. Some at-grade crossings require more extensive improvements to

[16] Under Executive Order 13112, as amended by Executive Order 13751, Invasive species means, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health.

meet safety and design requirements which may involve culvert and drainage ditch improvements, adjacent roadway re-alignment shifting the roadbed further from the railroad, or new medians. At-grade crossings may require easements or new ROW to meet design standards.

Rail and transit safety improvements may also include new crossing gates, including four-quadrant gates with vehicle-detection equipment installed within the four quadrants. Four-quadrant gates involve replacing existing pedestals, signals, and gates. In most cases, it requires construction of additional pedestals, signals, and gates in the crossing quadrants where none currently exist. At some crossing locations, like farm-to-farm crossings, a two-gate system may be installed. This would also require new pedestals, signals, and gates where none currently exist.

2.4 Maintenance, Preservation, and Facilities Improvements

Bridge Repair, Retrofit, and Maintenance

Bridge repair, retrofit, and maintenance activities are implemented to prolong the use and function of bridges, ensure motorist safety, and protect the environment. Whether a bridge is repaired, rehabilitated, or replaced, depends on the age of the bridge and damage that may occur to a bridge (e.g., from a storm event, earthquake, or vehicle or boat collision). The length of stream and/or wetland potentially affected by bridge repair and maintenance depends upon the scale of the bridge project and the required actions. Culvert and bridge replacement activities are described in the road/rail construction narrative.

Seismic retrofit activities are not temperature and/or time sensitive and may occur anytime throughout the year, while joint replacement and bridge deck replacement are temperature dependent activities, limited to the warmer months. Bridge scour repair work tends to occur during low-water times of year, and bridge painting may only occur late spring through fall when temperatures are high enough to allow the paint to dry properly. Bridge maintenance projects can be long-term, lasting more than one construction season.

Scour Repair Projects

Scour at bridge piers can become a major safety issue for some bridges. Repair of scoured bridge piers can include construction of temporary cofferdams around affected piers to isolate work areas; concrete or gabion repair to footing, columns or abutments; placement of riprap at scour locations; placement of concrete mattresses along bridge piers; or installation of concrete armor tetrapods (four-legged, interlocking concrete structures). A-JACKS are also used for direct bridge scour repair, especially where there is a low bridge with a limited hydraulic opening and when hauling rock is cost prohibitive.

Concrete mattresses consist of flat, continuous blocks of cured concrete (closed cell) or contain voids in which stream gravel can be placed (open cell). The concrete blocks are linked together with steel or synthetic cable. To install a concrete mattress, the streambed must be excavated at the leading and trailing edges to avoid undermining the device. The mattress is placed on geotextile or filter fabric with an excavator, and earth anchors are often used to secure it. The A-JACKS system is composed of cured concrete pieces resembling “jacks” that are assembled into a continuous, interlocking, yet flexible matrix. This matrix provides protection against high-velocity flow. The use of A-JACKS is an alternative to riprap placement and may avoid the need for streambed excavation. A-JACKS are typically secured together with steel cable. Placement typically requires an excavator which is operated from the stream bank whenever possible. Concrete armor tetrapods are similar in function but differ in shape.

Construction of temporary access fills may be required to provide a working platform for machinery. Working platforms are usually constructed of light, loose riprap matched to the material necessary for the repair. The platform material is then repositioned as the machinery backs away from the work site. Installation methods vary on a site-specific basis. In navigable waters, access from a barge may be required. Whenever possible, equipment, such as excavators, will operate from stream banks, bridges, or temporary work platforms to avoid in-channel operation. If in-channel equipment operation is necessary, aquatic spider excavators are often used, especially if access to the site is difficult, as they are small, relatively light, and have rubber tires to minimize substrate disturbance. Aquatic spiders are typically used in small streams, because the size of rock they can pick up is limited. Sometimes materials can be placed directly on the streambed with little to no excavation; in other instances, excavation is necessary to key in materials. Often, stream flow and anticipated erosion will determine specific aspects of design such as anchoring.

Seismic Retrofit Projects

Many bridges are undergoing or have undergone seismic retrofits. Retrofits can involve any of the following depending on the bridge type: (1) removing and replacing bolts and or rivets with high-strength connections; (2) installation of concrete catcher blocks at piers (not typically pre-cast, but constructed using steel-reinforced forms filled with concrete poured on site); (3) installation of pier sleeves (collars) to the depth of the spread footing; and (4) installation of longitudinal restrainers, transverse girder restrainers, and/or transverse deck restrainers which are typically installed under the bridge as looped steel cables or bolts. No fill or pile driving is required for their installation. Longitudinal restrainers prevent abutting spans from being pulled apart during an earthquake. Transverse restrainers pin abutting spans together, preventing them from being sheared apart vertically or laterally during an earthquake.

Deck Repair and Replacement Projects

Bridge deck repair and replacement is another activity that occurs regularly. Removal may involve traditional mechanical methods such as jackhammers, concrete saws, and cold-milling (grinding), or hydro-demolition (hydro-milling). Hydro-demolition uses a high-pressure water jet stream (up to 20,000 pounds per square inch) to remove unsound concrete. Concrete debris is contained and then removed with vacuum equipment. Deck repair can involve either partial-depth or full-depth patching. Partial-depth replacement repairs surficial damage to the travel surface by cleaning and filling voids with a suitable material (e.g., concrete, asphalt). In general, when full-depth patching occurs, a temporary form is held against the underside of the deck and material fills the void from above. Longer bridges have finger joints that must be repaired and replaced as needed.

Maintenance Projects

Bridge maintenance activities may include washing, painting, debris removal from bridge piers, guardrail repairs, lighting and signage repairs, and structural rehabilitation. Such activities generally include work such as repairing damage or deterioration in various bridge components; cleaning out drains; repairing expansion joints; cleaning and repairing structural steel; sealing concrete surfaces; concrete patching; and sanding and painting. Bridge painting involves washing the bridge with highly pressurized water or abrasive sand blasting to remove all corrosion, and then applying a minimum number of coats of paint. Paint must be applied when temperatures are above 40°F and it is not raining. Steel bridges also require rivet replacement and crack stabilization. These activities are often added to a bridge painting contract. Debris removal can be accomplished in a variety of ways depending on the type and quantity of debris, and the size and configuration of the bridge. Hand removal is possible in some instances, although the use of mechanical aids, such as chainsaws, winches, and heavy equipment, are often necessary. Structural rehabilitation may include replacement or repair of degraded steel superstructure, repair to bridge approaches, or repair or replacement of bridge rail. Work is typically conducted in a stepwise fashion, moving from one section of the bridge to the next, rather than on the entire bridge at once.

Equipment

Commonly used equipment for bridge repair and maintenance includes backhoes, bulldozers, excavators, barges, dump trucks, front-end loaders, scaffolding, drapes, generators, cranes, impact and vibratory pile drivers, drilling rigs, concrete saws, traffic control devices, compressors, and other heavy equipment. The equipment operates most frequently from the bridge deck, a work barge in navigable waters, or temporary false work hung beneath the bridge deck, although in rare instances equipment may be required to operate from the bank to remove debris or repair bridge abutments and supports.

Drainage System Repair and Maintenance

Drainage System Repair and Maintenance activities include all work necessary to maintain roadside ditches and channels, cross culverts and pipes, catch basins and inlets, and detention/retention basins. Drainage features function to keep the highway free from excess water that could create an unsafe condition. Thus, drainage facilities are cleaned periodically to permit free flow and to avoid erosion and damage to roads and other infrastructure. The extent of the area to be affected by drainage system repair and maintenance activities depends upon the size of the drainage channel or ditch and the specific actions required.

Drainage system repair and maintenance work may occur throughout the year depending on the weather and the specific project; however, most work is scheduled to occur during the summer, during low-water flow or dry conditions. Work may occur at any time of day or night, seven days a week. Most activities are completed within a few hours in any given location. However, some projects may take from one to five working days to complete. Roadside ditches are impacted by the accumulation of sediments, debris, vehicles that leave the roadway, and slides. Regular maintenance is required to remove built up sediments, debris or blockages, re-slope the sides, and maintain capacity. Material that is removed is recycled when possible or placed at suitable disposal sites.

Cross culverts convey water from one side of the highway to the other. These can become blocked by debris, sediment, vegetation, beaver-deposited materials, or slide materials. Occasionally, scouring within the system can result in blocking the culvert with rock or gravel. Blocked culverts can result in flooding over the roadway, or in severe cases, the culvert and the roadway can blow out. Regular removal of debris, sediment, and vegetation can help eliminate the problem. All of these obstructions must be removed regularly. Sometimes temporary diversions, such as sandbag berms, are installed to allow for culvert cleaning in a dewatered environment.

Catch basins and inlets are part of the highway storm drain system. Sediment accumulates within these structures, necessitating regular cleaning. Material is removed by manual clearing methods or by using a vacuum truck. Solids are tested and disposed of at an approved disposal facility. Solids may be recycled as fill material when suitable. Otherwise, they will be disposed of at an approved disposal facility. Liquids may be decanted at an approved decant facility. Regular cleaning improves water quality and minimizes sediments that enter the natural stream systems. Retention/detention facilities are used to contain runoff and remove sediments. Over time, sediments build up and must be removed to maintain capacity and filtration. Backhoes or other equipment remove the sediment build up, normally during dry conditions.

Other typical activities include excavation of debris and sediment from ditches and detention/retention basins, minor grading and reshaping along ditches and at storm drain outfalls and inlets, and repair of damaged culverts. Removal of newly constructed beaver dams is often necessary when the dams impact the effectiveness of storm drainage facilities.

Equipment

Commonly used equipment includes dump trucks, front-end loaders, backhoes, bulldozers, double drum dragline, vacuum truck, culvert rodder (trailer-mounted water jet system), water tank truck, truck-mounted attenuator, other heavy equipment, and hand tools, such as shovels and rakes. The equipment generally operates from the road prism, although in rare instances equipment may be required to operate outside of the developed road prism.

Pavement Preservation

Pavement preservation consists of patching, repairing, and replacing roadway surfaces and pavement. These include three types of pavements: (1) asphalt, (2) chip seal, and (3) concrete. If the existing pavement is in good condition, it may be covered with a new layer of asphalt. Repair of badly deteriorated pavement could require grinding of existing pavement or replacement of the road foundation material prior to repaving. This typically involves grinding off and replacing the existing asphalt pavement.

Most paving occurs during May through September. Activities may occur seven days a week, taking place either during daylight hours, night hours, or both, depending on traffic volumes. Project duration depends on the size of the area being paved and could take from 1 to 120 working days to complete. Pavement preservation through chip sealing (alternately termed bituminous surface treatment) involves the application of hot liquid asphalt and a layer of crushed rock on an existing asphalt surface. The application of bituminous surface treatment is a temperature- and weather-sensitive activity. These projects may include a rock crushing operation to produce the necessary aggregate.

Hot-mix asphalt paving is also a temperature- and weather-sensitive activity. Typically, the existing pavement is ground down (cold milling) and replaced, or simply overlaid with new asphalt. Cold milling creates dry pavement grounds that are hauled to a dumpsite, spread along the road shoulders, or recycled into new pavement. Profile grinding is another optional method of removing the pavement surface. All asphalt paving projects involve the use of an asphalt plant area where asphalt is mixed with crushed rock to produce the new hot-mix asphalt, as well as occasionally crushing of rock for the pavement materials.

Preservation of existing Portland Cement Concrete Pavement is typically accomplished by removal and replacement of the existing Portland Cement Concrete Pavement, the placement of additional dowel bars into the existing pavement or grinding of the existing surface. The removal results in concrete rubble that is typically hauled to a dumpsite. This is often accompanied by profile grinding as is the placement of additional dowel bars. Profile-grinding employs a series of diamond saws cooled by water that cut away the pavement. This creates pavement slurry that requires disposal at a dumpsite. Since paving may result in a slightly higher road surface, manholes, inlets, and guardrails may need to be raised or replaced. Guardrail raising involves the removal of existing guardrail, installation of taller posts, and reinstallation or replacement (depending on condition) of the rail.

Culverts may also require extension, repair, or installation as part of pavement preservation projects. Repair or replacement of worn or damaged culverts prevents damage to the roadbed from water saturating the roadbed fill material. Culverts require maintenance when at least 25% of their capacity is restricted by debris, sediment, or vegetation.

A paving project may also include installation of roadside signs, guideposts, and raised pavement markers; guardrail improvements, fence installation and repair; and paint striping. For most projects, installation of road signs, guideposts, and fencing involves minor amounts of excavation and vegetation removal. However, installation of very large signs, including concrete footings and steel supports, can potentially disturb substantial areas. Trenching may also be required to run utilities from existing sources to lighted signs. Paint striping may be completed with oil-based or latex-based paints, self-adhesive strips, or inset durable lane strips. Painting must be conducted in dry weather.

Equipment

Commonly used equipment for pavement preservation includes heavy trucks, asphalt grinders, pavers, chip spreaders, rock crushing operations, asphalt plants, front end loaders, compaction rollers or tampers (both vibrating and static), guardrail post drivers, small trucks and backhoes, and traffic control devices.

Facilities Preservation and Rail Reconstruction

Facilities preservation is the preservation, maintenance, and expansion of weigh stations, rest areas, rail facilities, and road maintenance facilities. Activities at these facilities may include expansion of buildings and parking areas; septic system expansion or alteration; paving, painting, striping, and signage; vegetation alteration and removal (including trees); and erosion and sediment control practices. Improvements to existing roadway facilities occur year-round depending on the weather and rarely involve expanding the building footprint.

Rail station work includes construction of new station facilities, new platforms with free-standing canopies, and new parking lots. This work is very similar to road facilities activities described previously. Rail reconstruction work includes using a track renewal train to install new rail and concrete ties along an existing mainline track, as well as resurfacing of the stone ballast, renewal of crossing surfaces and approaches, and upgrade of signals and crossing warning systems.

Equipment

Commonly used equipment for facilities preservation and rail reconstruction includes dump trucks, front-end loaders, asphalt grinders, paving machines, generators, traffic control devices, track renewal trains, and other heavy equipment.

2.5 Slide Abatement

Slide abatement typically involves removing slide debris from the roadway, stabilizing the slide areas, and repairing roads damaged by slides. The natural occurrence of landslides and other erosive slope processes is generally dependent on the geologic conditions, vegetation growth, antecedent groundwater conditions, and significant climatic or geologic events in a specific area. Original construction methods or other human factors may also influence landslide occurrence. Most landslides occur during the winter or during periods of heavy rainfall. The area affected by activities under slide abatement varies depending upon the scale of the material that is present on the roadway and that must be removed. The area affected will generally include the managed road prism/ROW but could include surface waters or wetlands in some instances.

The underlying cause of a slide is determined before permanent stabilization occurs. Permanent slide stabilization is often sought immediately following an event. For existing unstable slope problems, particularly those involving wet ground conditions, repairs are normally programmed for summer months when conditions are dryer. Stabilization methods that provide support include buttresses/berms/shear keys, retaining walls, and ground improvement. Buttresses are large, shaped piles, commonly constructed with coarse, angular, strong rock. Often buttresses must be keyed into stable material beneath the failure zone requiring significant excavations that sometimes result in tree removal/trimming. Berms are constructed of earthen materials near the toe of the landslide to provide a counterweight to the forces driving failure.

Immediate clean-up of slides that directly impact highways is imperative, and may occur at any time of year, any time of day or night. Work may take from a few days to more than 120 working days, depending on the magnitude of the slide. Construction of temporary access fills and roads may be required to provide a working platform or access for machinery. Working platforms are usually constructed of light, loose riprap matched to the material necessary for the repair. The platform material is then repositioned as the machinery backs from the work site.

Landslides, rockfall, debris flow, slope erosion, and settlement are different unstable slope categories described below.

Landslide

Landslide is defined as the vertical and horizontal displacement of a soil or rock mass, under the influence of gravity, within a slope or embankment. Generally, landslides can be divided into two categories based on failure geometry: (1) circular (or rotational) which refers to all landslides having a concave upward, curved failure surface and involving a backward rotation of the original slide mass; and (2) translational slides in which the surface of rupture along which displacement occurs is essentially planar. The rate of movement of landslides can vary from very slow moving to very rapid.

A variety of retaining wall types are used to provide landslide support. These walls may consist of large, reinforced masses, referred to as gravity walls, or they may consist of reinforcing anchors secured to a rigid wall face (e.g., soil nail wall, solider pile, tie-back wall). Ground improvement seeks to improve the shear resistance of the failing material by replacing or injecting high-strength materials into the ground (e.g., stone columns, pressure grouting). Landslides involving near-surface failure zones may also effectively incorporate vegetation to improve shallow stability and reduce surface erosion. Subsurface drilling, sampling, and testing of the earthen materials are usually necessary to develop these designs.

Rockfall

Rockfall is the fall of newly detached segments of bedrock of any size from a cliff or steep slope. Movements are very rapid to extremely rapid and may not be preceded by minor movements.

Rockfall and rockfall hazard mitigation involves stabilization, containment, avoidance, or some combination of these approaches. Stabilization measures include removing unstable material, reinforcing it with rock anchors and possibly shotcrete, and/or improving subsurface drainage by installing drains. Shotcrete is wet or dry mix concrete applied through a pneumatic hose. Wet mix concrete is pre-mixed with water, and dry mix incorporates water with the concrete at the point of discharge.

Debris Flow

Debris flow is a rapidly moving fluid mass of rock fragments, soil, water, and organic debris with more than half of the particles being larger than sand size. Generally, debris flows occur on steep slopes or in gullies, entrain debris and grow in volume as they move, and can travel long distances. Debris flows typically result from unusually high rainfall or rain-on-snow events.

Slope Erosion and/or Failure

Slope erosion and/or failure is the wearing-away of a soil mass by water, wind, or weathering. On slopes, this process can result in the overland flow of water in a dilute sheetwash, or the development of rills. Along streams or rivers, the process can entail the undercutting of adjacent stream/riverbanks.

Settlement

Settlement is the vertical displacement of a soil mass not associated with a horizontal movement within a slope or embankment. Generally, the movement is slow. Settlement usually results from poor foundation conditions, or loss of support from internal erosion (i.e., piping [culvert] failures).

Many of the treatments used for landslides are also applied to settlement if the settlement results in horizontal movement. If there is no horizontal movement associated with settlement, the response is typically limited to pavement patching and repairs.

Blasting

Blasting may be required when expanding the transportation footprint or as part of the stabilization efforts to remove unstable material. The scale of blasting operations can vary from breaking up a boulder or trimming an unstable overhang, to large-scale removal operations that involve thousands of cubic yards of material. The size and spacing of charges are largely dependent on the work objectives and the geologic structure of the rock. There are two general types of blasting: production and controlled. Production blasting uses widely spaced, large explosive charges that are designed to fragment a large amount of burden (the rock that lies between the existing slope face and blasthole). Controlled blasting uses more tightly spaced and smaller explosive charges to remove smaller amounts of burden. This technique can remove material along the final slope face, or it can be used prior to production blasting to create an artificial fracture along the final cut slope.

Holes are drilled into the rock to set explosives. Drilling may be done with hand equipment by workers suspended on ropes to crane-supported drill platforms. In some cases, drill access may require establishing small access roads to position a track-mounted drill rig. Soil and unconsolidated rock on top of the blasting surface is removed prior to blasting. Blasting mats may be required to contain flying rock, especially when blasting occurs adjacent to sensitive areas such as aquatic systems. Containment can also include installing anchored wire mesh.

Temporary earthen or rock berms that function as heightened ditches or proprietary rockfall protection fences located close to the blasting area are also commonly used to contain rolling debris or minimize movement of blasted material. These structures are typically placed at the toe of landslides and are located to avoid impacts to stream or wetlands and designed to keep debris out of sensitive areas. Rock berms can also be permanent structures. Berms or fences are typically within the road prism; therefore, impacts to vegetation are minimal.

Debris flows are typically removed from the roadway through methods including ditch cleaning, catchment enlarging, and placement of concrete barriers. If debris flows occur consistently at a specific location, rockfall barriers such as anchored wire mesh may be used. Slope erosion will at times create overhanging rock and undercut "danger" trees. This material may be removed with a long-boom excavator. Typically, slide clean-up involves removing the debris from the roadway and patching the pavement if damage has occurred. In some cases, the road foundation or guardrail may be partially damaged and require replacement. Slide debris is often stockpiled or disposed of at existing gravel pits, quarry sites or waste areas. In some cases, existing privately owned sites are available and interested in receiving the debris. Suitable slide material may be used as fill for other maintenance or construction activities.

If slope failures enter creeks, the material is left in the creek if removing it would create greater harm. Permanent repairs to unstable slopes are mostly conducted outside (above) water bodies. However, sometimes the slope must be rebuilt and retaining walls or riprap may be used within the Ordinary High-Water Mark, and woody material may be incorporated, if appropriate. Culvert repair or cleaning may also be necessary for slide abatement.

Equipment

Commonly used equipment includes dump trucks, front-end loaders, excavators, hoe rams, track or pneumatic drills, bulldozers, pile drivers, explosives, chainsaws, traffic control devices, air compressors, cranes, and other heavy equipment, such as tree chippers and grinders. Equipment will generally be operated from the road prism, although in rare instances equipment may be operated outside the developed road prism to remove material and stabilize adjacent slopes. Equipment/vehicle operation is not typically required in surface waters or sensitive habitats (e.g., wetlands, streams, rivers), although operation within such habitats may be unavoidable to complete a site-specific project in a timely manner or to reduce impacts on riparian vegetation or other terrestrial or aquatic species, habitats, or resources.

2.6 Bank Stabilization, Flood Damage, and Sinkhole Repair

Bank Stabilization and Flood Damage Repair

Bank stabilization and flood damage repair involves the direct protection of embankments at bridges, culverts, and roadway sections from erosive forces of flowing water. High-water flows during floods, spring runoffs, or high tides can cause erosion of the bank to the point that the adjoining highway road prism is undermined. Other flood or high tide damage can include clogged culverts and deposition of debris along transportation corridors. Weather, flooding, or changes in the river or stream morphology often precipitate these activities. The erosion repair area will vary depending upon the size of the stream and the extent of the streambank or channel that is located adjacent to a road, bridge, or culvert.

Emergency work can occur throughout the year as soon as possible after or during the storm event. Work may last from 1 to 120 working days depending on the size of the repair and amount of work that is required. Construction of temporary access fills and roads may be required to provide a working platform or access for machinery. Working platforms are usually constructed of light, loose riprap matched to the material necessary for the repair. The platform material is then repositioned as the machinery backs from the work site.

Immediate repairs normally involve protection or reconstruction of the highway road prism including repaving, and associated infrastructure such as culverts and utilities. Flood debris removed from roads requires disposal at designated disposal sites. Clogged culverts often require cleaning or may need to be upgraded to a larger size to prevent further flow restrictions. Emergency repairs typically involve the placement of riprap by an excavator, or end-dumping of riprap when conditions are unsafe for an excavator. In cases where the emergency is not immediate, but imminent, and some planning time is available, natural channel design methods may be used to protect stream banks.

Bank stabilization techniques include placing riprap, gabion baskets, or natural channel design features to protect and restore eroded banks. Riprap armoring is constructed of angular rock placed on the stream bank. Riprap placement varies and may extend to the top of the bank or extend up the mean annual peak flow line but can be placed up to one foot above the 100-year flood level. Woody and herbaceous plantings are used above this level. For banks with grades steeper than 2:1, riprap is not suitable. Bank grading may be required prior to stabilizing the bank. If necessary, a rock or earthen berm may be constructed to catch rocks dumped (end-dumped) from trucks before they enter the stream. A riprap bedding layer (gravel filter blanket or geotextile) is installed to prevent underlying soils from washing through the riprap during high water.

Installation methods vary on a site-specific basis. In navigable waters, access from shore or a nearby structure is common; however, barges may be utilized. Whenever possible, equipment, such as excavators, will operate from stream banks, bridges, or temporary work platforms to avoid in-channel operation. Sometimes, materials can be placed directly on the streambed with little to no excavation. In other instances, excavation is necessary to key in materials. Often stream flow and anticipated erosion will determine specific aspects of design such as anchoring. Anchoring may be required for structures that include large woody debris. Several techniques exist including wood or steel piling, earth anchors, or rock overburden.

Sinkhole Repair

Sinkholes are depressions or holes in the ground or road surface caused by surface layer collapse. They can be formed gradually or suddenly by either natural erosive processes or human-related causes such as abandoned mine collapse or water withdrawals. Sinkholes are frequently associated with karst[17] landscapes and could result in damage to transportation infrastructure. Sinkhole repair involves stabilizing the area through excavating or flushing (with water) loose material and creating either a permeable or impermeable plug with fill placement, then restoring the roadway embankment and pavement surface.

Sinkhole repair methods within a natural infiltration zone focus on allowing infiltration to continue. This consists of using clean, graded native limestone as fill material in layers of decreasing size, separated by Class-4 geotextile to prevent the migration of layers and more evenly distribute water flow. Within the road ROW, these layers would be carefully compacted prior to road reconstruction. Concrete can be selectively applied, more commonly in non-infiltration areas. Larger rock is placed first and then coarse aggregate is applied to fill the voids between the rocks. Concrete is then layered on top to form an impermeable plug. If present, native clay material is placed on top of the concrete or geotextile. Native soil materials are then placed on top of the plug and the roadway is restored.

Equipment

Commonly used equipment includes backhoes, barges, bulldozers, excavators, dewatering equipment, pile drivers, dump trucks, front-end loaders, cranes, chainsaws, generators, traffic control devices, and other heavy equipment.

2.7 Transportation Enhancements

Transportation enhancements may include projects such as bicycle/pedestrian paths, bus shelter installation, historic bridge or railroad depot rehabilitation, construction of overlooks, viewpoints, historical markers, and wildlife passage facilities. Construction activities associated with projects like these were previously described in the bridge maintenance and new highway construction sections.

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[17] Karst topography is a landscape created by groundwater dissolving sedimentary rock such as limestone that often includes features such as caves, sinkholes, springs, and sinking streams (http://www.watersheds.org/earth/karst.htm). Coordinate with the appropriate Service Field Office on recommended best management practices for karst in your state.

Although overlooks, viewpoints, and historical marker pullouts may include the expansion of roadway surfaces, such expansion is typically small in scope compared to major road improvements (new travel lanes, passing lanes, among others).

2.8 Other Common Activities

Geotechnical Drilling and Hazardous Waste Sampling

Subsurface sampling and testing to determine soil characteristics are often important steps in the engineering design process. Such sampling and testing may be associated with all programs/categories described. Subsurface sampling is accomplished by drilling test holes up to 300 ft (91.4 m) deep or digging soil pits up to 8 ft (2.4 m) deep. A slide repair project, for instance, may require two to three test holes to check for stability. A drill rig can be mounted on a variety of transportation vehicles including trucks, tractors, skids, and barges. The drill is typically 5 to 10 in (25.4 cm) in diameter. The drill shaft is lubricated using a mixture of bentonite (a natural, inert clay material) and water. The fluid is filtered and recycled back through the drilling operation.

When drilling is done off the roadway, impacts are minimized as much as possible through the selection of an appropriate sized and mounted drill rig, and limited vegetation removal. Normally, herbaceous, and woody vegetation is cut back as necessary for drill access and not grubbed, and trees are rarely removed. Subsurface sampling for hazardous materials may also be necessary for each program/category. It is very similar to subsurface sampling for geotechnical purposes. Durations will vary for these activities depending on the number of bore holes and substrate composition. Typically, one to several bore holes can be drilled in a day and most sampling is accomplished within a week.

Herbicide Application

Herbicide application to control invasive[18] plant species is sometimes used in, but not limited to, areas within the project limits designated by the State DOT and Transportation Agency such as planting areas, erosion control seeding areas, bark mulch areas, roadside bark mulch rings, preservation areas, mitigation areas, and along established roadside. Herbicides are generally applied to green or growing tissue and prior to seed production but may be applied during fall regrowth periods. Herbicides used for invasive plant species control at environmental mitigation sites are often used in conjunction with mechanical and biological control. These control methods are also used near plantings to reduce competition from surrounding vegetation. The herbicide is typically applied directly to plant roots and foliage by wicking, spraying from a backpack sprayer, injecting, or by applying to cut stumps. Aerial (aircraft) application is not included in the proposed action. While herbicide is not applied directly to soil or water, it can be applied to plants in wetland mitigation sites or riparian areas. Application of

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[18] Under Executive Order 13112, as amended by Executive Order 13751, Invasive species means, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health.

herbicides is in accordance with the National Pollution Discharge Elimination System aquatic noxious and nuisance weed permits and all applications are in accordance with the U.S. Environmental Protection Agency product label requirements. Appropriate buffers are applied between application sites and surface waters to avoid drift or overspray. Aquatic applications may be used in wetland mitigation sites. Herbicide application timing depends on the species being targeted, with most treatment occurring in the spring, early summer, and fall.

2.9 Indiana Bat, NLEB, and TCB Avoidance and Minimization Measures

Project sponsors implement standard measures as part of other environmental compliance processes (e.g., USACE wetland permitting), and many of these measures reduce potential effects on the covered bat species. These include:

- Wetland avoidance/minimization and compensatory mitigation;
- Dust control;
- Clearly delineating vegetative clearing limits; and
- Compliance with State water quality standards through Storm Water Pollution Prevention Plans, which include erosion and sediment control, spill control, runoff detention, and treatment.
- Compliance with Federal Clean Water Act standards, such as 404 water quality certification and 404 removal/fill permit

In addition, specific AMMs related to the covered bat species will be implemented where applicable. AMMs included in the analysis, when implemented, are expected to reduce potential impacts of the stressors. In some cases, impacts will be reduced to levels that are insignificant (i.e., unable to meaningfully measure, detect, or evaluate) or discountable (extremely unlikely to occur) and therefore, NLAA. In other cases, adverse effects will be unavoidable even with the application of AMMs, but impacts will be minimized.

AMMs for Programmatic Informal

Unless presence/absence (P/A) surveys in suitable habitat document that Indiana bat, NLEB, and TCB are not likely to be present, the following AMMs are <u>REQUIRED</u>, as applicable, for the range-wide programmatic <u>informal consultation</u>.

All NLAA Projects

<u>General AMM 1.</u> Ensure all operators, employees, and contractors working in areas of Indiana bat, NLEB, or TCB suitable habitat are aware of all Transportation Agency environmental commitments, including all applicable AMMs.

Lighting[19]

Lighting AMM 1. Direct temporary lighting away from suitable habitat during the active season.[20]

Lighting AMM 2. When installing new/additional permanent lighting or replacing existing permanent lights, use downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting); or for those Transportation Agencies using the Backlight Uplight and Glare (BUG) system developed by the Illuminating Engineering Society,[21] the project should be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable.

Tree Removal/Trimming

Note: The word "trees" as used in the AMMs refers to trees that are suitable habitat for each species within their range.

Tree Removal/Trimming AMM 1. Modify all phases/aspects of the project (e.g., temporary work areas, alignments) to the extent practicable to avoid tree removal/trimming in excess of what is required to implement the project safely.

Tree Removal/Trimming AMM 2. Ensure tree removal/trimming is limited to that specified in project plans and ensure that contractors understand clearing limits and how they are marked in the field (e.g., install bright colored flagging/fencing prior to any tree removal/trimming to ensure contractors stay within clearing limits).

Tree Removal/Trimming AMM 3. Ensure tree removal/trimming is limited to the inactive season, occurs within 100 ft of the road/rail surface, and is outside of documented habitat for the Indiana bat, NLEB, and TCB.

Bridges, Culverts, and Structures[22]

The following Bridge, Culvert, and Structure AMMs are REQUIRED for the range-wide programmatic consultation, as applicable, unless one or more of the following criteria apply:

- The bridge, culvert, or structure is 1,000 ft (305 m) or more from suitable bat habitat in areas **outside of the TCB range** (i.e., Indiana bat and NLEB only); or

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[19] See glossary for definition.
[20] This would be year-round in portions of the NLEB and TCB ranges (see Figures 9 and 10).
[21] http://www.escolighting.com/PDFfiles/BUG_rating.pdf
[22] This category "structures" is intended to capture manmade structures that may provide bat roosting or hibernation habitat that are neither bridges, culverts or crossing structures. They may include but are not limited to rest areas, offices, sheds, outbuildings, barns, and parking garages.

- The culvert does not meet the minimum dimensions provided in the Service's range-wide bat survey guidance;[23] or
- A bridge, culvert,[24] or structure bat assessment[25] has occurred and documented no signs of use by the Indiana bat, NLEB, or TCB;[26] or
- Documentation from the local Service Field Office confirms that Indiana bats, NLEB, and TCBs are not using bridges, culverts, or structures within the action area.[27]

Note: If there are safety concerns associated with assessments of bridges, culverts, or structures, please coordinate with the local Service Field Office for further assistance.

Bridge, Culvert, and Structure AMMs – Large Number of Covered Bats (>5); or Assuming Presence of Covered Bat Species

Inactive Season (in the hibernating range)

Bridge, Culvert, and Structure AMM 1a. Perform bridge, culvert or structure removal, replacement, and/or alteration activities during the winter hibernation period[28] (inactive season) unless a hibernating colony of bats is present.[29] If hibernating bats are observed using the bridge, culvert, or structure, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Bridge, Culvert, and Structure AMM 1b. Coordinate with the local Service field office to ensure suitable roosting habitat is still available within the bridge, culvert, or structure once construction/replacement is complete (when assessment documents use by a large number of covered bat species, >5). Suitable roosting sites may be incorporated into the design of a new bridge, culvert, or structure.

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[23] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

[24] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

[25] Refer to Appendix D – Bridge, Culvert, and Structure Bat Assessment Form Guidance from the User's Guide or current Service structure assessment guidance for acceptable assessment practices and validity length of bridge, culvert, and structure bat assessments: https://www.fws.gov/media/users-guide-range-wide-programmatic-consultation-indiana-bat-and-northern-long-eared-bat

[26] E.g., P/A surveys, roosting potential, guano testing, emergence survey, etc.

[27] Required documentation may be project specific or geographically based.

[28] Coordinate with the local Service Field Office for appropriate dates.

[29] If a hibernating colony of bats other than Indiana bat, NLEB, or TCB is observed, please coordinate with the local Service Field Office and appropriate State agency.

Winter Torpor Period (in Zone 1 of the NLEB or TCB YR active ranges)
Bridge, Culvert, and Structure AMM 2. Avoid bridge or culvert removal, replacement, and/or alteration activities between December 15 – February 15[30]. If activities must be performed during this period, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Active Season (in the hibernating and YR active ranges)
Bridge, Culvert, and Structure AMM 3a. Ensure bridge, culvert, or structure removal, replacement, and/or alteration activities conducted during the active season will not disturb roosting Indiana bats, NLEBs, or TCBs using the bridge, culvert, or structure.

The following types of bridge or culvert work can generally be conducted with the presence of bats:
- Above bridge deck or culvert work where construction equipment or materials do not extend to the underside of deck or within the culvert where bats may be located (e.g., materials won't drip down to underside of deck or within the culvert) and does not include vibration or noise above existing background levels, including general traffic (e.g., road line painting, wing-wall work).
- Below bridge deck or culvert work that is conducted away from roosting bats and does not involve vibration or noise above existing background levels, including general traffic (e.g., wing-wall work, some abutment, beam end, scour, or pier repair).

Bridge, Culvert, and Structure AMM 3b. Ensure suitable roosting habitat is still available within the bridge, culvert, or structure once construction/replacement is complete (when assessment documents use by a large number of covered bat species, >5). Suitable roosting sites may be incorporated into the design of a new bridge, culvert, or structure.

Bridge, Culvert, and Structure AMMs – Small Number of Covered Bats (≤5)

Inactive Season (in the hibernating range)
Bridge, Culvert, and Structure AMM 4. Perform bridge, culvert, or structure removal, replacement, and/or alteration activities during the winter hibernation period (inactive season)[31] unless a hibernating colony of bats is present.[32] If hibernating bats are observed using the bridge, culvert, or structure, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

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[30] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.
[31] Coordinate with the local Service Field Office for appropriate dates.
[32] If a hibernating colony of bats other than Indiana bat, NLEB, or TCB is observed, please coordinate with the local Service Field Office and appropriate State agency.

Winter Torpor Period (in Zone 1 of the NLEB or TCB YR active ranges)

Bridge, Culvert, and Structures AMM 5. Avoid bridge or culvert removal, replacement, and/or alteration activities between December 15 – February 15[33]. If activities must be performed during this period, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Active Season (in the hibernating and YR active ranges)

Bridge, Culvert, and Structure AMM 6. Ensure bridge, culvert, or structure removal, replacement, and/or alteration activities conducted during the active season will not disturb roosting Indiana bats, NLEBs, or TCBs using the bridge, culvert, or structure.

The following types of bridge or culvert work can generally be conducted with the presence of bats:

- Above bridge deck or culvert work where construction equipment or materials do not extend to the underside of deck or within the culvert where bats may be located (e.g., materials that may drip down to underside of deck or within the culvert) and does not include vibration or noise above existing background levels, including general traffic (e.g., road line painting, wing-wall work).
- Below bridge deck or culvert work that is conducted away from roosting bats and does not involve vibration or noise above existing background levels, including general traffic (e.g., wing-wall work, some abutment, beam end, scour, or pier repair).

Hibernacula

Hibernacula AMM 1. For projects located within karst areas, on-site personnel will use best management practices,[34] secondary containment measures, or other standard spill prevention and countermeasures to avoid impacts to the possible hibernacula. Where practicable, a 300 ft (91.4 m) buffer will be employed to separate fueling areas and other major contaminant risk activities from caves, sinkholes, losing streams, and springs in karst topography.

AMMs for Programmatic Formal

Unless P/A surveys in suitable habitat document that the Indiana bat, NLEB, and TCB are not likely to be present, the following AMMs are REQUIRED, as applicable, for the range-wide programmatic formal consultation.

[33] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.

[34] Coordinate with the local Service Field Office on recommended best management practices for karst in your state.

All LAA Projects

General AMM 1. Ensure all operators, employees, and contractors working in areas of Indiana bat, NLEB, or TCBs suitable habitat are aware of all Transportation Agency environmental commitments, including all applicable AMMs.

Lighting[35]

Lighting AMM 1. Direct temporary lighting away from suitable habitat during the active season.[36]

Lighting AMM 2. When installing new/additional permanent lighting or replacing existing permanent lights, use downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting); or for those Transportation Agencies using the BUG system developed by the Illuminating Engineering Society,[37] the project should be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable.

Tree Removal/Trimming

Note: The word “trees” as used in the AMMs refers to trees that are suitable habitat for each species within their range.

Tree Removal/Trimming AMM 1. Modify all phases/aspects of the project (e.g., temporary work areas, alignments) to the extent practicable to avoid tree removal/trimming in excess of what is required to implement the project safely.

Tree Removal/Trimming AMM 2. Ensure tree removal/trimming is limited to that specified in project plans and ensure that contractors understand clearing limits and how they are marked in the field (e.g., install bright colored flagging/fencing prior to any tree removal/trimming to ensure contractors stay within clearing limits).

Tree Removal/Trimming AMM 3. Not applicable to LAA (see Informal Consultation AMMs above).

Tree Removal/Trimming AMM 4. Avoid conducting tree removal/trimming outside documented habitat for the Indiana bat, NLEB, or TCB beyond 100 ft of the road/rail surface during the pup season.

Tree Removal/Trimming AMM 5. If removing/trimming trees outside documented habitat for the Indiana bat, NLEB, or TCB within 100 ft of the road/rail surface during the pup season, all trees removed/trimmed must be <9 in (22.9 cm) DBH.

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[35] See glossary for definition.
[36] This would be year-round in portions of the NLEB and TCB ranges (Figures 9 and 10).
[37] http://www.escolighting.com/PDFfiles/BUG_rating.pdf

Tree Removal/Trimming AMM 6. Avoid conducting tree removal/trimming within documented habitat for the Indiana bat, NLEB, or TCB during the pup season.

Tree Removal/Trimming AMM 7. Avoid conducting tree removal/trimming of suitable habitat for the NLEB and/or TCB in Zone 1 of their YR active ranges between December 15 – February 15[38].

Bridges/Culverts and Structures[39]

The following Bridge, Culvert, and Structure AMMs are REQUIRED for the range-wide programmatic consultation, as applicable, unless one or more of the following criteria apply:

- The bridge, culvert, or structure is 1,000 ft (305 m) or more from suitable bat habitat in areas **outside of the TCB range** (i.e. Indiana bat and NLEB only); or
- The culvert does not meet the minimum dimensions provided in the Service's range-wide bat survey guidance;[40] or
- A bridge, culvert,[41] or structure bat assessment[42] has occurred and documented no signs of use by the Indiana bat, NLEB, or TCB;[43] or
- Documentation from the local Service Field Office confirms that Indiana bats, NLEBs, and TCBs are not using bridges, culverts, or structures within the action area.[44]

Note: If there are safety concerns associated with assessments of bridges, culverts, or structures please coordinate with the local Service Field Office for further assistance.

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[38] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.

[39] The category "structures" is intended to capture manmade structures that may provide bat roosting or hibernation habitat that are neither bridges, culverts or crossing structures. They may include but are not limited to rest areas, offices, sheds, outbuildings, barns, and parking garages.

[40] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

[41] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

[42] Refer to Appendix D – Bridge, Culvert, and Structure Bat Assessment Form Guidance from the User's Guide or new Service structure assessment guidance for acceptable assessment practices and validity length of bridge, culvert, and structure bat assessments: https://www.fws.gov/media/users-guide-range-wide-programmatic-consultation-indiana-bat-and-northern-long-eared-bat.

[43] E.g., P/A surveys, roosting potential, guano testing, etc.

[44] Required documentation may be project specific or geographically based.

Bridge, Culvert, and Structure AMMs – Large Number of Covered Bats (>5) or Assuming Presence of Covered Bat Species

Bridge, culvert, and structures activities with the potential to adversely affect a large number of covered bat species (>5) is outside the scope of this programmatic consultation and requires project-specific consultation guidance with the local Service Field Office; therefore, there are no AMMs for this scenario in this programmatic.

Bridge, Culvert, and Structure AMMs – Small Number of Covered Bats (≤5)

Inactive Season (in the hibernating range) – Not applicable to LAA (see Informal Consultation AMMs above)

Winter Torpor Period (in Zone 1 of the NLEB and TCB YR active ranges)
Bridge, Culvert, and Structures AMM 5. Avoid bridge or culvert removal, replacement, and/or alteration activities between December 15 – February 15[45]. If activities must be performed during this period, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Active Season (in the hibernating and YR active ranges) – Not applicable to LAA (see Informal Consultation AMMs above)

Hibernacula

Hibernacula AMM 1. For projects located within karst areas, on-site personnel will use best management practices,[46] secondary containment measures, or other standard spill prevention and countermeasures to avoid impacts to the possible hibernacula. Where practicable, a 300 ft (91.4 m) buffer will be employed to separate fueling areas and other major contaminant risk activities from caves, sinkholes, losing streams, and springs in karst topography.

2.10 Compensatory Mitigation Measures Conservation Goal

The Transportation Agencies came to the Service with a goal of developing a section 7(a)(1) program that would also help meet their 7(a)(2) responsibilities. Therefore, the Transportation Agencies' conservation goal for this consultation is to avoid and minimize effects to the Indiana bat, NLEB, and TCB and contribute to the recovery of these species. For instances where all practicable AMMs are

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[45] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.
[46] Coordinate with the local Service Field Office on recommended best management practices for karst in your state.

implemented, yet adverse effects to the Indiana bat and NLEB are still reasonably certain to occur, the Service and the Transportation Agencies have developed compensatory mitigation measures and priorities to offset the adverse impacts to these species. Compensatory mitigation is not required for TCB at this time; however, the compensatory mitigation measures for the Indiana bat and NLEB will likely also benefit the TCB. The Transportation Agencies will implement appropriate and practicable compensatory mitigation as described herein for adverse effects to Indiana bats and NLEBs. The Service and the Transportation Agencies jointly developed these measures as part of the proposed action after considering the effects of the action and the conservation and recovery needs for the species, including actions identified in the Draft Recovery Plan (first revision) for the Indiana bat (Service 2007) and the subsequent 5-year reviews for the Indiana bat (Service 2009, 2019).

Conservation Pathways (Options)

Transportation Agencies have several pathways (options) to compensate for adverse impacts to the Indiana bat and NLEB, and to further the conservation of these species. The conservation pathways include: (1) ILF programs, (2) conservation banks, and (3) local conservation sites.

Range-wide In-lieu Fee Program

Transportation Agencies may use any Service-approved range-wide Indiana bat and/or NLEB ILF program. The Conservation Fund (TCF), in coordination with the Service, developed a range-wide ILF mitigation program for compensation of adverse effects to and furthering the conservation of Indiana bat and NLEBs. TCF serves as the Program Administrator. They receive the compensation fees, administer the ILF program, and are responsible for ensuring that implementation is consistent with the requirements of this or any other consultation for which ILF may be an appropriate conservation measure (https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-lieu-fee-program-instrument).

State, Regional, Recovery Unit-Specific ILF Program

Transportation Agencies may use any Service-approved regional or local Indiana bat and/or NLEB ILF program. These programs may operate at the State, regional level, or recovery unit level.

Conservation Banks

Transportation Agencies may use any Service-approved Indiana bat and/or NLEB conservation bank appropriate for the action area of a project(s).

Local Conservation Sites

Transportation Agencies may work directly with local Service Field Offices to select specific mitigation projects for their individual transportation projects or programs. If a mitigation project provides more habitat than necessary to compensate for a single project's impacts, Transportation Agencies may use the excess acres for future projects so long as that is clearly documented in the authorization to utilize specific mitigation projects.

3. COMPENSATORY MITIGATION MEASURES AND CONSERVATION FOCUS AREAS

The Transportation Agencies will have flexibility in selecting conservation pathways to meet the jointly agreed upon compensatory mitigation requirements in this consultation. This approach allows for a wide range of ecological conditions and opportunities across the range of the Indiana bat and NLEB. The amount of appropriate compensatory mitigation is determined from the compensatory mitigation ratios (Table 3) in conjunction with the formula identified in Table 4 (Calculation of Impact Acres and Compensatory Mitigation).

On May 15, 2023, the Service published a revised Mitigation Policy and an Endangered Species Act Compensatory Mitigation Policy to provide guidance to Service personnel in formulating recommendations and requirements to action agencies so that they may avoid, minimize, and compensate for action caused impacts to species and their habitats, and uses thereof (81 FR 31000, May 15, 2023). The primary intent of the revised Mitigation Policy is to apply mitigation in a strategic manner that ensures an effective linkage with conservation strategies at appropriate landscape scales. The Service has adhered to the revised Mitigation Policy and prioritized the compensatory mitigation and conservation actions within this PBO based on the effects of the transportation program on Indiana bats and NLEBs and the conservation needs of the species. The goal is to implement the highest priority compensatory actions for a project where practicable. In some circumstances, the Service may determine that a lower priority compensatory measure may provide a higher conservation value for Indiana bats and/or NLEBs in a given area or circumstance.

Service Field Offices have established Conservation Focus Areas (CFAs) based upon knowledge of Indiana bat and NLEB locations. The purpose of establishing CFAs is to identify key areas in each State on which to focus conservation efforts. Transportation Agencies or conservation entities should consolidate compensatory mitigation requirements from multiple projects into larger CFAs to provide greater ecological benefits for Indiana bats and NLEBs, when practicable.

3.1 Conservation Focus Areas Establishment

State-specific CFAs will likely incorporate the different Indiana bat and NLEB habitat types (e.g., Summer Habitat CFAs, Winter Habitat CFAs). Collectively, the State-specific CFAs should consist of large preservation areas in key landscapes for Indiana bat and NLEB conservation and recovery.

The following criteria should be considered when delineating broader State-specific CFAs in support of the conservation goals and mitigation priorities identified in these guidelines. Ideally, CFAs should:

- Be contiguous with one or more protected public or private lands that are known to support Indiana bat and NLEB populations;
- Currently support populations of Indiana bats and NLEBs that are expected to contribute to long-term conservation efforts for the species;
- Contain adequate suitable habitat to support conservation efforts for Indiana bats and NLEBs;
- Provide opportunities for future protection, restoration, enhancement, and/or creation of additional summer and/or winter Indiana bat and NLEB habitat; and/or
- Contain conditions that are generally expected to contribute to the persistence of Indiana bat and NLEB populations and habitat into the future as determined by the local Service Field Office.

The compensatory mitigation priorities listed below focus on actions which are most beneficial to the species and ensure that effects considered in this consultation (i.e., impacts to individual bats and their summer roosting habitat) are adequately offset. Compensatory mitigation efforts will follow the highest priority option practicable unless there is a biological reason to select a lower priority option. Compensatory mitigation efforts should focus on protecting larger blocks of habitat (generally 50 acres [20.2 ha] or larger within maternity colony home ranges) and enhance and enlarge existing habitat blocks or provide connectivity across the landscape to achieve meaningful conservation.

COMPENSATORY MITIGATION PRIORITY 1

Protect/Restore Summer Habitat

- Summer habitat compensatory mitigation must be focused within a maternity colony home range (see Figure 2).[47]
- Summer habitat compensatory mitigation must focus on protecting larger blocks of occupied habitat, associated buffer areas, and connecting corridors. Compensation may include protection/restoration of roosting habitat, foraging habitat, or corridors. When protection or restoration of corridors is used, the corridors must connect habitat patches of at least 20 acres (8.1 ha) of suitable habitat to ensure the corridors provide meaningful connectivity (Figure 2).
    - **Protection /Preservation** of suitable forested habitat within the maternity colony home range should focus on protecting forest within or adjacent to forest blocks with documented captures, roosts, telemetry, or acoustic detections, when this type of information is available.
    - **Restoration** of forested habitat should focus on expanding forest patches within the maternity colony home range with documented captures, roosts, telemetry, or acoustic detections. Restoration of summer habitat can meet compensatory mitigation requirements only where the forest cover within the maternity colony is less than 30%.

[47] See glossary for distances. This distance may be larger or smaller for colonies with radio telemetry information that provides more detail on estimated home ranges, core roosting areas, foraging areas, and/or commuting areas.

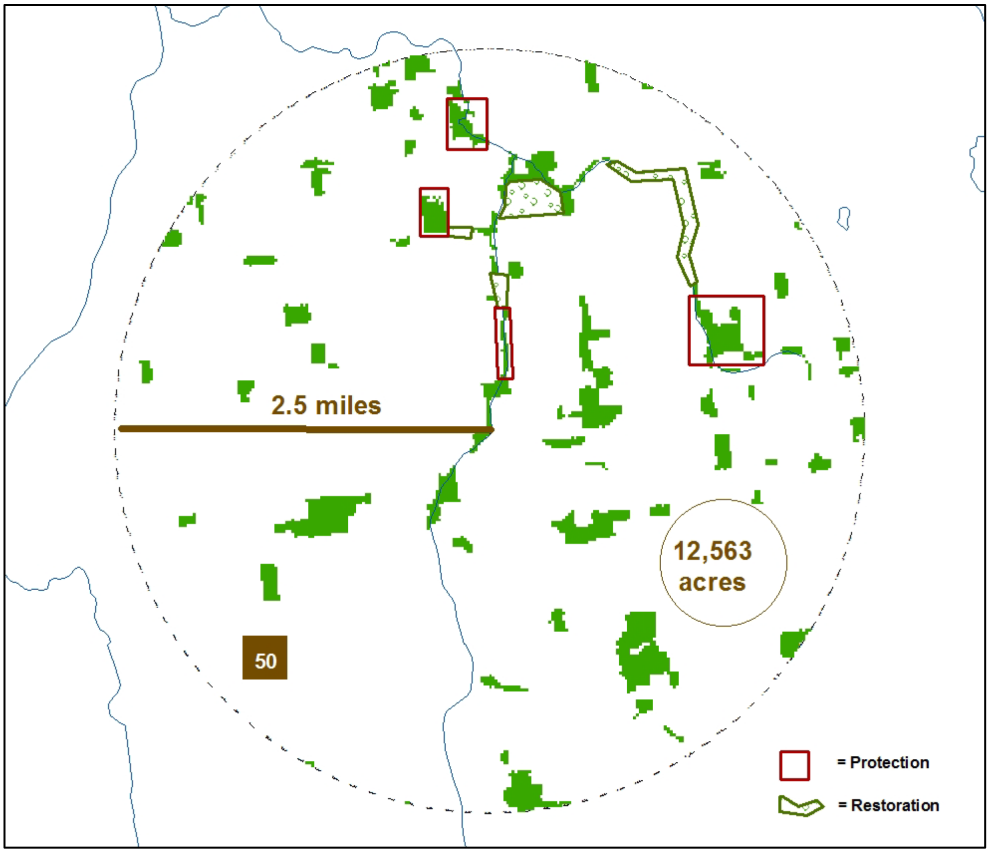

Figure 2. Example of Protection and Restoration within an Indiana Bat Maternity Colony Home Range.

COMPENSATORY MITIGATION PRIORITY 2

Protect/Restore Staging/Swarming Forested Habitat

- Compensatory mitigation must occur within a roughly 5-mile (8 km) radius around the opening of Indiana bat Priority 1 (P1) hibernaculum or Priority 2 (P2) hibernaculum (Figure 3).[48] Compensatory mitigation must occur within a roughly 5-mile radius around the opening of a NLEB large hibernaculum.[49]
- Staging/swarming mitigation can include either protection alone or restoration with protection of the restored site. Protection areas will consist of existing forested habitat suitable for foraging Indiana bats and NLEBs. Restoration will consist of planting roosting trees native to the area of the hibernaculum. Restoration should take precedence over protection around hibernacula where suitable forest habitat is limited as determined by the local Service Field Office.

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[48] Refer to the Indiana bat Recovery Plan for details of P1 and P2 hibernaculum.https://ecos.fws.gov/ServCat/DownloadFile/45796?Reference=44940

[49] Refer to the NLEB Species Status Assessment for details of ”large“ and ”small“ hibernaculum. https://www.fws.gov/node/5021236

- Both protection and restoration mitigation sites must be located within roughly 1,000 ft (305 m) of existing forested staging and swarming habitat or connected to existing habitat by a forested corridor.
- Staging/swarming compensatory mitigation can occur in specific cases within 5-mile (8 km buffer) around Indiana bat Priority 3 (P3) hibernaculum and Priority 4 (P4) hibernaculum or a NLEB small hibernaculum where: (1) suitable forest within a 5-mile (8 km) radius around P3 hibernaculum or P4 hibernacula is extremely limited as determined by the local Service Field Office, or (2) Indiana bats and NLEBs have shown resistance to white-nose syndrome (WNS) by persisting several years after WNS was recorded at the hibernaculum.

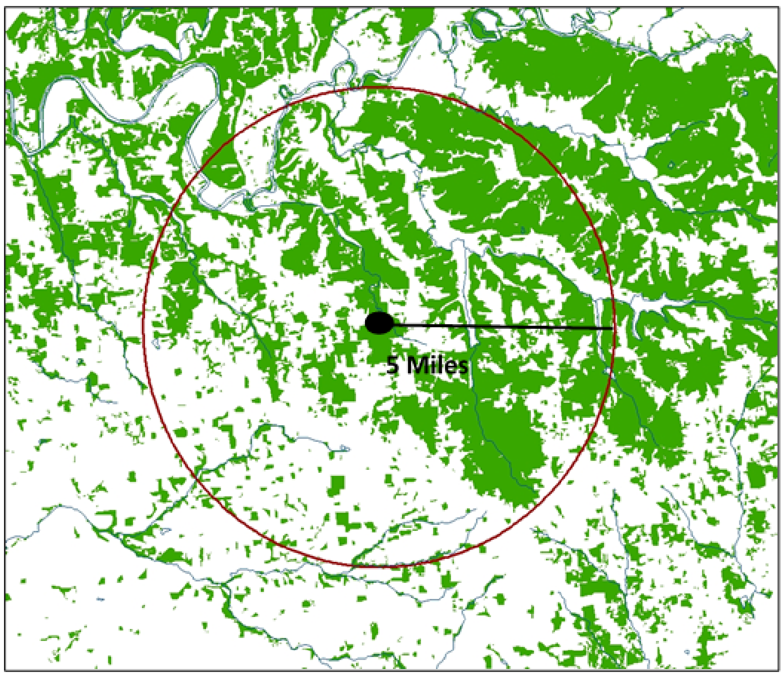

Figure 3. Five-mile (8 km) Buffer Around a Hibernaculum that is Suitable for Protection and Restoration of Staging/Swarming Habitat.

Protect/Manage Hibernacula[50]

- Protection of hibernacula can occur at any occupied Indiana bat and/or NLEB hibernaculum subject to a known, existing threat. A known, existing threat is defined as the occurrence of one or more un-gated entrances, an entrance which is unstable and in danger of collapse, or other threats (e.g., contaminants) that can be successfully alleviated.

[50] Note that because of the sensitivity of hibernacula and the complexity of hibernaculum mitigation projects, mitigation involving hibernacula will require more extensive coordination with the local Service Field Office and Indiana bat experts.

- In specific cases, restoration of a degraded, occupied hibernaculum can count towards offsetting impacts where, for example, changes to air or water flow have made the hibernaculum less suitable.
- The conservation value of a particular hibernaculum proposed for protection depends on circumstances applicable to that particular site. Therefore, standard multipliers are not provided and must be determined on a case-by-case basis. Factors that influence the value of a particular protection site include, but are not limited to: (1) the relative significance of the site to the conservation and recovery of Indiana bats and NLEBs; (2) the quality of the habitat; (3) the level of protection afforded; (4) the degree of risk to the site without the proposed mitigation measure; and (5) the site's position within the landscape (e.g., proximity to CFAs).

COMPENSATORY MITIGATION PRIORITY 3[51]

Protection of Suitable Indiana Bat and/or NLEB Habitat to Expand/Connect CFAs

- If justified biologically and consistent with the rationale for the State-specific CFA, the local Service Field Office may allow for compensation in the form of protection of currently unoccupied Indiana bat and/or NLEB habitat. This option can only be implemented when higher priority conservation options are not available within the three-year compensation time frame.
- Preservation/restoration of habitats in areas that would connect or expand CFAs would be considered in circumstances where the conservation benefits to Indiana bats and NLEBs can be clearly identified and documented in coordination with the Service.

Applied Research

- Applied research projects may be included in this conservation program only when it is determined by the Service to be the highest practicable compensatory action available, or if the research is expected to provide a higher conservation value to the Indiana bat in a given area or circumstance. Applied research can yield specific information that will improve some aspect of the compensatory mitigation actions of this programmatic or overall conservation of the species. For example, surveys can be used to identify previously unknown maternity colonies, and research studies can focus on ways to better protect hibernacula, such as more effective gating. In addition, research studies could lead to a better understanding of the causes and potential spread of WNS, or the effectiveness of management actions aimed at minimizing the spread of WNS (i.e., an adaptive management approach).

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[51] Several factors may preclude the implementation of Compensatory Mitigation Priority 1 or Compensatory Mitigation Priority 2 actions; therefore, each Transportation Agency and local Service Field Office should collaborate to define state-specific Compensatory Mitigation Priority 3 actions should they be necessary.

3.2 Compensatory Mitigation Calculation Method

The Indiana bat and NLEB mitigation ratios and rationale are described below and shown in Table 3.

Table 3. Compensatory Mitigation Ratios for Indiana Bat or NLEB.

Project Location	**<30% Forest Cover (within County)**		**≥30% Forest Cover (within County)**	
	Active Season* (pup season)	**Inactive Season***	**Active Season* (pup season)**	**Inactive Season***
≤100 ft (0-30.5 m) edge of road/rail ballast – **outside documented habitat**	1.5 (2.0)	NLAA	1.25 (1.75)	NLAA
≤100 ft (0-30.5 m) edge of road/rail ballast – **within documented habitat**	2.25	1.75	2	1.5
100-300 ft (30.5-91.4 m) edge of road/rail ballast – **outside documented habitat**	2.25	1.75[52]	2	1.5[53]
100-300 ft (30.5-91.4 m) edge of road/rail ballast – **within documented habitat**	2.25	1.75	2	1.5
Beyond 300 ft (30.5-91.4 m) edge of road/rail ballast – **outside documented habitat**	3.0	2.5[54]	2.75	2.25[55]
Beyond 300 ft (30.5-91.4 m) edge of road/rail ballast –**within documented habitat**	3.0	2.5	2.75	2.25

*Consult with your local Service Field Office to determine appropriate timeframes.

The Service developed compensatory mitigation ratios to offset the adverse effects of actions on the Indiana bat and NLEB, and to guide conservation for the species. Several factors were considered when developing the mitigation ratios.

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[52] Compensatory mitigation is not required for the NLEB when the action area includes tree removal/trimming in undocumented habitat 100-300 ft (0-30.5 m) of the road/rail ballast during the inactive season.
[53] Compensatory mitigation is not required for the NLEB when the action area includes tree removal/trimming in undocumented habitat 100-300 ft (0-30.5 m) of the road/rail ballast during the inactive season.
[54] Compensatory mitigation is not required for the NLEB when the action area includes tree removal/trimming in undocumented habitat beyond 100 ft (30.5 m) of the road/rail ballast during the inactive season.
[55] Compensatory mitigation is not required for the NLEB when the action area includes tree removal/trimming in undocumented habitat beyond 100 ft (30.5 m) of the road/rail ballast during the inactive season.

Compensatory mitigation ratios involved ranking the impact of a project on the species. Each box of the matrix was ranked from highest to lowest in terms of significance of the adverse effect, which allowed for determination of minimum and maximum mitigation ratios.

The percent likelihood of an Indiana bat roost occurrence within a certain distance of pavement (0 to 100 ft [0 to 30.5 m] = 3.5%; 100 to 300 ft [30.5 to 91.4 m] = 8.7%; and further than 300 ft [30.5-91.4 m] = 87.8%) was first considered (i.e., lower percent of occurrence equals a decrease in significance of the effect). See Section 5.2 for more information on this analysis.

Next, the timing of the habitat removal was considered (i.e., direct effects vs. indirect effects). Finally, percent forest cover/habitat availability was considered (i.e., less habitat equals increased risk to fitness of a maternity colony). By comparing these factors, the Service discerned a hierarchy of effects and assigned ratios.

The Service used the Ohio (Service Field Office and Ohio DOT) habitat equivalency analysis (HEA) model to generate base multipliers that were applied to the rankings. HEA is a methodology used to estimate the appropriate level of compensation for impacts to natural resources. It is most commonly applied to natural resource damage assessment claims (Dunford et al. 2003). More recently it has been employed to estimate migratory bird and endangered species habitat impacts and the appropriate compensation (Jeff Gosse, Service, pers. comm. 2016). Since "all roosting habitat" is considered within the programmatic consultation, the upper and lower bounds of mitigation were established using ratios of 3.0:1 and 1.25:1, respectively, as determined by the Ohio HEA model for "all roosting habitat" type impacts.

These ratios also reflect the nature of projects and general quality of habitat expanding out from the edge of road or rail ballast. Habitat closer to roads and railways has been, and continues to be, modified, and seldom reaches sufficient maturity to be suitable as maternity roosting habitat. This does not exempt the fact that roosting habitat and occasionally maternity roosting habitat may occur closer to roads and railways. These ratios are consistent with the range of mitigation implemented for individual projects across much of the range of the species. Multipliers were adjusted by rounding to the nearest quarter to account for the increase/decrease in adverse effects on the species and intermediate steps were established using quarter steps. Thus, the mitigation ratios for the programmatic consultation are: 3.0, 2.75, 2.5, 2.25, 2.0, 1.75, 1.5, and 1.25:1.

Determination of Compensatory Mitigation

Project proponents can use Table 3 to determine the amount of compensatory mitigation needed to offset project impacts. The project's impact(s) should be divided into the action or impact types (by location) and then quantified to yield the acreage of impact for each action. Due to the potential for Indiana bats and NLEBs to occur within overlapping habitats, the "stacking" of mitigation acreage within a project is allowed, but each stacked acre may be used to satisfy the acreage obligation associated with the project by only one user, even if the stacked acre is used to mitigate for impacts to only one species (see example in the Compensation Planning Framework (Exhibit C) of The Conservation Fund Range-wide Indiana bat/NLEB ILF Program (https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-lieu-fee-program-instrument).

For impacts of less than 0.5 acre (0.2 ha) where it may be difficult to make an area measurement, but where compensatory mitigation is appropriate because of the quality of the habitat, Transportation Agencies should either estimate the area of canopy cover or count each suitable roost tree and multiply by 0.09 acre (0.04 ha)/tree to determine the acreage of suitable habitat loss (this is referred to as the Single Tree Method). Small area impacts lend themselves particularly well to advance mitigation through a crediting system. For impacts involving the loss or alteration of blocks of forested habitat, the acreage of the impact is determined by identifying the perimeter and area of the impact with global positioning system (GPS) or geographic information system (GIS) technology (i.e., the Habitat Block method).

Once the acreage of habitat loss has been determined for each action using the Single Tree and/or Habitat Block method(s), the impact information should then be inserted into Table 3 and multiplied by the appropriate ratio to yield the amount of mitigation required for each action or impact type. This may require applying multiple habitat types and more than one ratio in Table 3 depending on the size and complexity of the project and the habitat in the project area.

The local Service Field Office will assist project proponents in determining compensatory mitigation as necessary.

Table 4. Calculation of Impact Acres and Compensatory Mitigation

Action / Impact Type	Impact Acres	Compensatory Mitigation Ratio	Compensatory Mitigation Acres
Habitat Loss			
Select the Action/Impact Type based on location of the project from edge of pavement; documented occurrence information		Please see Table 3 to select appropriate multiplier based on location and timing of impact.	
Mitigation Measures			
Purchase, protect, restore, or conserve hibernacula	Value determined on a case-by-case basis. Factors considered in value determination made include, but are not limited to: habitat type, habitat quality, landscape position.		
Research related project			
Summer habitat protection or restoration	(acres of impact) (ratio from Table 3) = Total compensatory mitigation acres		
Generic ILF Contribution Example	(acres of impact) (ratio from Table 3) ($/mitigation acre) (X% management fee, if applicable) = Total ILF contribution[56]		

Timing of Mitigation Compliance

Implementing compensatory mitigation using any mechanism is preferable in advance of the impacts to avoid any temporal delays in conservation for the species. If a conservation bank or ILF option is chosen to compensate for adverse effects to Indiana bats, the purchase of species conservation credits and/or ILF contributions must occur prior to construction of a transportation project included under this programmatic consultation. The one exception will be projects determined to be emergency and/or projects that do not require a letting prior to construction. In these cases, purchase of credits and/or ILF contributions shall be completed within three months of completion of the project. This timeframe allows for accurate compilation of the acres of habitat affected as a result of the emergency project and processing of finances.

All required mitigation projects shall be implemented **within three years** after the receipt of aggregate mitigation fees sufficient to implement an ILF project of 50 acres or more[57] within the applicable service

[56] The actual ILF cost will be established by the individual ILF program(s). In this example, the dollar amount is based on each State's average value of farm real estate as published annually by the USDA in the Land Values and Cash Rents document which is subject to change. Last released by the USDA in June 2023. Available at: https://www.nass.usda.gov/Publications/Highlights/2023/2023LandValuesCashRents_FINAL.pdf
[57] The ILF Program Sponsor may, but is not obligated to, propose for approval and implement ILF mitigation projects of less than 50 acres.

area.[58] This timeframe allows for the purchase and protection of habitats, initiation of restoration and/or enhancement of habitats, and research related projects.

Protection in Perpetuity

There are two options for permanently protecting spring, summer, fall, and/or winter habitat:

- Purchase or otherwise acquire fee title interest in one or more land parcels that meet the intents and priorities of this Conservation Program; or
- Secure perpetual conservation easements and associated land management agreements on one or more land parcels that meet the intents and priorities of this Conservation Program.

Easement or fee simple lands shall include all surface and, where practical, mineral rights to the property and clear and unencumbered ownership of these rights. Easement or fee simple mitigation lands will retire property rights that are threats to bats (i.e., timber harvest, development, intensive recreational use, among others). The applicant or project proponent shall pay for all fees and/or other costs associated with title work, recording, transferring, surveying, and/or acquiring of the easement or property. Compensatory mitigation measures that involve land acquisition or easement require the transfer of the property (or easement) to a conservation organization approved by the Service. A long-term management fund should accompany the transfer that is sufficient to provide perpetual management for the conservation of Indiana bats and must include any other funds identified by the receiving conservation organization that may be necessary for that entity to accept title or easement (e.g., contaminants surveys, fencing, trash removal, invasive species, monitoring) to the property.

Inter-State Mitigation

Projects involving impacts to Indiana bats and/or NLEBs in more than one state should coordinate with the Service Field Offices for each state to determine the appropriate compensation approach. Transportation Agencies may choose the specific compensatory mitigation mechanism. In some cases, an applicable ILF or conservation bank may already be established for the multistate project.

Mitigation Implementation and Monitoring

Implementation

Forest Habitat Restoration

[58] Service area refers to the geographic area within which Authorized Users may compensate for unavoidable impacts to Indiana bats and/or their habitats under an ILF program. Service areas of the TCF Range-wide Indiana bat/NLEB ILF Program are identified in Section VI.C and Exhibit B of the ILF Instrument.

Indiana bats and NLEBs are known to use many species of trees for roosting and foraging (see Table 4 of the draft recovery plan for a list of Indiana bat roost tree species, Service 2007 and Service 2022). A restoration project will include the following unless otherwise approved by the Service:

- Include each of three categories of trees: softwoods, hardwoods, and cottonwood (*Populus deltoides*) where native. The percentage of each category can be determined by the individual restoration goals and the site conditions. Each category of trees should be included in the mix, if native to the site/area;
- Use trees native to the restoration site and that are locally adapted where practicable;
- Generally, plant seedlings using a minimum density of 544 trees per acre (8 x 10) spacing; and
- Follow Natural Resources Conservation Service (NRCS) planting guidelines (see Conservation Practice Standard 612 Tree and Shrub Establishment) for site preparation, weed control, and type of trees (e.g., bare root seedlings) that are most suited to the restoration site.

Forest Habitat Protection

- Sites will be protected sufficiently to ensure the persistence of key components of Indiana bat habitat including but not limited to mature and senescent trees; wetlands, streams or other water sources; and functional travel corridors; and
- Sites will be protected to preclude activities that will harm or disturb maternity colonies or staging/swarming Indiana bats including but not limited to development, intensive management (e.g., controlled burning except under a plan specific to protecting or improving habitat for Indiana bats and/or NLEBs), and intensive recreation (e.g., off-road vehicle use or paved trails).

Winter Habitat Protection or Restoration

- A plan will be developed in conjunction with and authorized by the local Service Field Office detailing the goal(s), measurable objectives, specific actions to achieve those objectives, and identified risks of any project involving work at a hibernaculum;
- A qualified bat biologist in coordination with the local Service Field Office will supervise any protection or restoration of a hibernaculum; and
- All protocols relevant to WNS or other disease transmission will be adhered to.

Monitoring

The following are guidelines for monitoring compensatory mitigation habitat under this range-wide programmatic consultation. Variations are permissible to account for the geographic location of the compensatory mitigation and/or the specific characteristics of the restoration site. Site monitoring is required to ensure that compensatory mitigation was implemented according to the guidelines.

Forest restoration sites will be monitored/assessed:

- To provide initial confirmation that the site was planted using an appropriate species mix (the local Service Field Office will provide review and recommendations concerning the species mix).
- To confirm at least a 70% survival rate of planted species at 3 years and again at 7 years or to confirm a minimum stand density of planted and volunteer native trees equal to at least 70% of the planted density (e.g., planting on 8 x 10 spacing = 544 trees / acre and 70% is 381 native trees per acre).
- To determine whether in year 7, invasive species threaten the function of the restoration site as Indiana bat habitat. If so, these invasives must be eradicated to remove that threat between years 7 and 10.

Forest protection sites will be monitored/assessed:

- To ensure all mitigation requirements have been addressed in the mitigation plan prior to acceptance of the site as compensatory mitigation.

Winter habitat mitigation sites (Cave Gating) will be monitored/assessed:

- To determine whether the newly installed gate is affecting egress/ingress and/or swarming behavior of Indiana bats and/or NLEBs at the entrance of the cave. This should be done by a qualified bat biologist using night-vision equipment during fall migration and fall swarming in the first autumn after the gate is installed. Baseline information regarding bat use should be collected prior to the installation if it is not already documented. If monitoring suggests the new gate is affecting bat behavior, coordination with local Service Field Office is required to take corrective action to resolve the issue.
- To establish the security of the gate digital photographs will be taken of the cave entrances and gates as part of a security inspection that will occur at least yearly in September or October – any identified breaches in gate security will be reported to the Service within 48 hours.
- To document the effectiveness of the gate, where practical speloggers and dataloggers should be installed inside the gate and checked annually between April 1 and May 31.

Other winter habitat mitigation sites (e.g., restoring air flow, repairing structural problems, addressing flooding or contaminants issues) will be monitored/assessed:

- To document that the mitigation action (e.g., stabilizing a mine entrance) was completed according to specifications.
- To regularly evaluate the structural or functional integrity of the action.
- To verify the implementation or function of any other essential components of the mitigation as determined by the local Service Field Office.

All compensatory habitat mitigation sites will be monitored/assessed:

- To provide an initial assessment/confirmation that the habitat slated for protection is suitable based on Service guidelines for summer foraging or roosting habitat; spring swarming/fall staging habitat, or winter habitat protection.
- To ensure easement holders will submit annual easement monitoring reports to the appropriate Service Field Office.
- To confirm that the compensation is extant and that the compensatory mitigation requirements (e.g., site is being adequately protected) are being met in year two, and at year five after the site's establishment. The monitoring may be done by site visits or remote sensing.
- To assess if maternity colonies (and/or hibernacula population, if applicable) are extant at the compensatory mitigation location(s). The monitoring program will be outlined in the banking instrument or ILF agreement. The Service and Transportation Agencies will use the monitoring information to evaluate the effectiveness of the conservation strategy and determine if the conversation strategy should be revised. Note that if the maternity colonies or hibernacula populations are no longer extant at the conservation sites, the compensatory mitigation completed or in-progress will not be affected (voided), provided the sites followed the appropriate site establishment and protection criteria.

4. STATUS OF THE SPECIES AND CRITICAL HABITAT

Per ESA section 7 regulations (50 CFR 402.14(g)(2)), it is the Service's responsibility to "evaluate the current status of the listed species or critical habitat" during formal consultation. Below, we provide an overview of the biology and conservation needs of the Indiana bat, NLEB, and TCB and summarize relevant information regarding the status and distribution of the species that is pertinent to the "Effects of the Action" section (e.g., a description of the annual life cycle, spring emergence habitat, fall swarming habitat).

The NLEB and Indiana bat are both temperate, insectivorous, migratory bats that in general hibernate in caves and mines in the winter and spend summers in wooded areas. TCBs are a widely distributed, small insectivorous bat that hibernates in caves and other subterranean habitats during the winter and primarily roosts in foliage of live and dead trees in the spring, summer, and fall. The key stages in their annual cycle are: hibernation, spring staging and migration, pregnancy, lactation, volancy/weaning, fall migration, and swarming. While varying with weather and latitude, generally all 3 species will hibernate between mid-fall through mid-spring each year. In the southern portion of the NLEB and TCB range, these species exhibit shorter torpor bouts and remain active and feed year-round (YR active range – see Figure 9). Spring migration likely runs from mid-March to mid-May each year, as females depart shortly after emerging from hibernation and are pregnant when they reach their summer area. Young are born between late May or early June, with nursing continuing until weaning, which is shortly after young become volant in mid- to late-July. Fall migration is likely to occur between mid-August and mid-October.

4.1 Indiana Bat and NLEB Life History and Biology

The following is a brief description of various components of life history and biology. See the various "Resource" descriptions throughout the document for more detailed information.

Summer Habitat and Ecology

Suitable summer habitat for the Indiana bat and NLEB consists of a wide variety of forested/wooded habitats with variable amounts of canopy cover where they roost, forage, and travel. This includes forests and woodlots, as well as linear features such as fencerows, riparian forests, and other wooded corridors. This habitat may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. NLEBs are a forest -interior species typically associated with upland forests with generally more canopy cover than Indiana bats. NLEBs seem to be focused in mature forests (Caceres and Pybus 1997) with occasional foraging over forest clearings, water, and along roads (Van Zyll de Jong 1985). However, most NLEB hunting occurs on forested hillsides and ridges, rather than along riparian areas preferred by the Indiana bat (Brack and Whitaker 2001, LaVal et al. 1977).

Many species of bats, including the Indiana bat and NLEB, consistently avoid foraging in or crossing large open areas, choosing instead to use tree-lined pathways or small openings (Patriquin and Barclay 2003, Yates and Muzika 2006). Wing morphology of both species suggests they are adapted to moving in cluttered habitats. Thus, isolated patches of forest may not be suitable for foraging or roosting unless the patches are connected by a wooded corridor.

Maternity Colonies and Roosts

Upon emergence from the hibernacula in the spring, females seek suitable habitat for maternity colonies. Coloniality is a requisite behavior for reproductive success. NLEB maternity colonies range widely in size, although 30-60 adult females may have been most common pre-WNS (Service 2014). Maternity colonies are smaller after WNS declines. In Kentucky, recent exit counts for WNS-impacted northern long-eared bat maternity colonies averaged <4 bats per roost in Mammoth Cave National Park (Thalken et al. 2018) and <6 bats per roost in the Robinson Forest experimental forest reserve (Arant et al. 2022), with maximum counts of 40 and 24 individuals, respectively. The highest exit counts observed post-WNS in the Fernow Experimental Forest (FEF) in West Virginia were 5 in 2015 and 7 in 2016 (Kalen et al. 2022), in contrast to the maximum pre-WNS exit count of 48 reported for northern long-eared bat colonies in the FEF by Johnson et al. (2012). Maternity colonies have been extirpated, while other colonies have been reduced in colony size (although we expect that remaining colonies will continue to occupy their prior home ranges because of their high site fidelity).

Indiana bat maternity colonies also vary greatly in size, with most documented maternity colonies containing less than 100 adult females. Indiana bats show a high degree of interannual fidelity to single roost trees and/or maternity areas. NLEBs also exhibit site fidelity but more to general areas, and they use many more roost trees (Service 2014) and a wide variety of tree species. Unlike Indiana bats, male NLEBs are routinely found with females in maternity colonies. Maternity colonies of both species use networks of roost trees often centered around one or more primary (Indiana bat) or central-node (NLEB) roost trees. Indiana bat maternity colonies use a minimum of 8-25 trees per season (Callahan et al. 1997; Kurta et al. 2002), but only 1-3 of these are primary roosts used by the majority of bats for some or all of the summer (Callahan 1993, Callahan et al. 1997). NLEB roost networks also include multiple alternate roost trees, Johnson et al. (2012) found colonies used 3-16 trees, and male and non-reproductive female NLEBs may also roost in cooler places, like caves and mines (Barbour and Davis 1969, Amelon and Burhans 2006).

Roost tree preferences vary between the two species. Indiana bats are known to use a wide variety of tree species (≥5 in [12.7 cm] DBH) based on presence of cracks, crevices, or presence of peeling bark. A typical Indiana bat primary roost is located under exfoliating bark of a dead ash, elm, hickory, maple, oak, or poplar, although any tree that retains large, thick slabs of peeling bark may be suitable. Primary Indiana bat roosts usually are in trees that are in early-to-mid stages of decay and have high solar exposure. NLEBs are known to use a wider variety of roost types than Indiana bats, and they also differ by typically preferring to roost within closed, intact forest stands. NLEBs roost in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically ≥3 in [7.6 cm] DBH), and maternity trees are typically larger (≥9 in [22.9 cm] DBH). Indiana bats and NLEBs (more frequently) have also been occasionally found roosting in man-made structures like barns and sheds (particularly when suitable tree roosts are unavailable).

Reproduction

Male and female Indiana bats and NLEBs swarm and mate around cave and mine entrances in early fall, between mid-August to November. In the NLEB YR active range, it is unclear if NLEBs swarm in this similar manner, and there is some evidence (presence of reproductive males in the spring) that breeding occurs in late winter and into early spring (G. Jordan, Service, pers. comm. 2023).

Young Indiana bats and NLEBs are typically born in late-May or early June, with females giving birth to a single offspring from June to early July. Lactation then lasts 3 to 5 weeks, with pups becoming volant (able to fly) between early July and early August (Service 2022a).

Migration

Males and non-reproductive females may summer near hibernacula or migrate to summer habitat some distance from their hibernaculum. Indiana bats are known to often migrate hundreds of kilometers from their hibernacula (Service 2007). In contrast, NLEBs are not considered to be long-distance migrant (typically 40 to 50 miles [64.4 to 80.5 km]). Migration is an energetically demanding behavior for the NLEB and Indiana bat, particularly in the spring when their fat reserves and food supplies are low, and females are pregnant.

Winter Habitat and Ecology

Suitable winter habitat (hibernacula) for both species includes underground caves and cave-like structures (e.g., abandoned or active mines, railroad tunnels, and other locations where bats hibernate in winter). There may be other landscape features being used by NLEBs during the winter that have yet to be documented. Generally, both species hibernate from November to April depending on local weather conditions (November/December to March in southern areas and as late as mid-May in some northern areas). However, the bats are swarming near their hibernacula, feeding and mating, within the two months prior to entering hibernation.

There are regions of the NLEB's range (YR active range) where the species remains active and feeds year-round and exhibits shorter torpor bouts (See Figure 9). Typical sites for NLEB hibernacula – caves or mines – are non-existent in at least some portions of this YR active range (e.g., in the coastal plains of North Carolina, South Carolina and Georgia) (Jordan 2020); in these areas NLEBs have been documented in trees, bridges, and culverts.

Hibernacula for NLEBs typically have significant cracks and crevices for roosting; relatively constant, cool temperatures (0-9°C [32-48.2°F]]); and high humidity and minimal air currents. Specific areas where they hibernate have such high humidity, that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible.

Caves that meet temperature requirements for Indiana bats are rare. Most Indiana bats hibernate in caves or mines where the ambient temperature remains below 10°C (50.0°F), but infrequently drops below freezing (Hall 1962, Myers 1964, Henshaw 1965, Humphrey 1978). Caves that historically sheltered the largest populations of hibernating Indiana bats were those that provided the largest volumes and structural diversity, thus ensuring stable internal temperatures over wide ranges of external temperatures, with a low likelihood of freezing (Tuttle and Kennedy 2002).

Indiana bats generally hibernate in large clusters, sometimes with other species, with densities of 300 to 484 bats per square foot (Service 2007). NLEBs tend to roost singly or in small groups (Service 2014), with hibernating population sizes ranging from just a few individuals to around 1,000 (Service unpublished data). NLEBs display more winter activity than other cave species, with individuals often moving between hibernacula throughout the winter (Griffin 1940, Whitaker and Rissler 1992, Caceres and Barclay 2000). Both NLEBs and Indiana bats have shown a high degree of philopatry to the hibernacula used, returning to the same hibernacula annually.

Spring Staging and Fall Swarming Habitat and Ecology

Upon arrival at hibernacula in mid-August to mid-November, NLEBs and Indiana bats "swarm," a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in caves during the day. Swarming continues for several weeks, and mating occurs during the latter part of the period. After mating, females enter directly into hibernation but not necessarily at the same hibernaculum where mating occurred. A majority of bats of both sexes hibernate by November.

After hibernation ends typically in late March or early April, most NLEBs and Indiana bats migrate to summer roosts. Females emerge from hibernation prior to males. Reproductively active females store sperm from autumn copulations through winter. Ovulation takes place after the bats emerge from hibernation in spring. The period after hibernation and just before spring migration is typically referred to as "staging," a time when bats forage and a limited amount of mating occurs. This period can be as short as a day for an individual, but not all bats emerge on the same day.

In general, NLEBs and Indiana bats use roosts in the spring and fall similar to those selected during the summer. Suitable spring staging/fall swarming habitat is found in forested/wooded habitats where they roost, forage, and travel, which is most typically within 5 miles (8 km) of a hibernaculum. This includes forested patches 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. Isolated trees are considered suitable habitat when they exhibit the characteristics of a suitable roost tree and are less than 1,000 ft (305 m) from the next nearest suitable roost tree, woodlot, or wooded fencerow.

4.2 Tricolored Bat Life History and Biology

Summer Habitat and Ecology

Suitable TCB summer habitat consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may include some adjacent and interspersed non-forested habitats, such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures (Service 2021). This includes forests and woodlots containing trees with potential roost substrate (i.e., live and dead leaf clusters of leaves in live and recently dead deciduous trees or branches, Spanish moss [*Tillandsia usneoides*], clusters of dead pine needles of large live pines, and beard lichen [*Usnea trichodea*]), as well as linear features such as fencerows, riparian forests, and other wooded corridors.

TCBs will roost in a variety of tree species, especially oaks (*Quercus spp.*), and often select roosts in tall, large diameter trees. They will also roost in smaller diameter trees when potential roost substrate is present (e.g., 4-in) (Leput 2004) and have been documented roosting in trees as small as 1.7-in DBH (Veilleux et al 2003). TCBs commonly roost in the mid to upper canopy of trees, although males will occasionally roost in dead leaves at lower heights (e.g., < 16 ft [5 meters] from the ground; Perry and Thill 2007) and females will occasionally roost in Spanish moss of understory trees (Menzel et al. 1999). TCBs seem to prefer foraging along forested edges of larger forest openings, along edges of riparian areas, and over water and avoid foraging in dense, unbroken forests, and narrow road cuts through forests (Davis and Mumford 1962; Kurta 1995; Lacki and Hutchinson 1999; Ford et al. 2005; Menzel et al. 2005; Thames 2020). TCBs also roost in human-made structures, such as bridges and culverts, and occasionally in barns or the underside of open-sided shelters (e.g., porches, pavilions); therefore, these structures should also be considered potential habitat.

TCBs may roost and forage in forested areas near anthropogenic structures and buildings (e.g., suburban neighborhoods, parks, etc.) (Helms 2010; Shute et al. 2021). However, highly developed urbanized areas (e.g., parking lots, industrial buildings, shopping centers) generally devoid of native vegetation (including isolated trees surrounded by expansive anthropogenic development) are considered unsuitable habitat.

There have been instances where TCBs have been documented roosting in a variety of cracks within natural rock faces and outcrops. They have been documented within natural rock faces and outcrops often dominated by Greenhorn limestone and Graneros shale of the late Cretaceous (Lemen et al. 2016). TCBs were observed roosting in rock shelters in cliffs in Kentucky in March and May (Lacki and Hutchinson 1999). A TCB was observed roosting in a rock shelter in Pennsylvania in October (Aaron Semasko, ESI, pers. comm. 2022). Three TCBs were observed day roosting in rock shelters in April 2023 in Adair County, Oklahoma (Phillip Crawford, University of Oklahoma, pers. comm. 2023).

Maternity Colonies and Roosts

Female TCBs form maternity colonies and switch roost trees regularly (e.g., between 1.2 days and 7 days at roost trees in Indiana) (Veilleux and Veilleux 2004a, Quinn and Broders 2007, Poissant et al. 2010). Veilleux and Veilleux (2004b) documented maternity colonies consisting of 1 to 8 females and pups at tree roosts in Indiana. Perry and Thill (2007) observed an average of 6.9 adult females and pups per colony in Arkansas (range 3 to 13). In Nova Scotia, maternity colonies in tree roosts have been found to include up to 18 females (Poissant et al. 2010). Whitaker (1998) found colonies in buildings averaged 15 adult females (range 7 to 29 adult females) and Hoying and Kunz (1998) reported the largest colony on record in a Massachusetts barn (19 adult females and 37 young). Males roost singly (Perry and Thill 2007, Poissant et al. 2010). Roosts ranging from 1 to 9 adults have been observed on bridges in Minnesota between 2016 to 2019. In Minnesota, TCBs on bridges have been observed most often during the maternity roost season, and pups have been observed in one instance (Christopher E. Smith, Minnesota DOT (MNDOT), pers. comm. 2023).

Reproduction

In the hibernating range, male and female TCBs converge at cave and mine entrances beginning in early fall, between mid-August and mid-October to swarm and mate. Adult females store sperm in their uterus during the winter and fertilization occurs soon after spring emergence from hibernation (Guthrie 1933). Within the YR active range, it is unclear if TCBs swarm in this similar manner.

Between May and July, females typically give birth to two young (Allen 1921, Barbour and Davis 1969, Cope and Humphrey 1972). Young grow rapidly and begin to fly at 3 weeks of age and achieve adult-like flight and foraging ability at 4 weeks (Lane 1946; Whitaker 1998). TCBs are considered juveniles (i.e., subadults) when entering their first hibernation and most unlikely to mate their first fall (Fujita and Kunz

1984). Adults often abandon maternity roosts soon after weaning, but young remain longer (Whitaker 1998).

Migration

In the spring, TCBs disperse from their winter hibernacula areas to summer roosting habitat. Fraser et al. (2012) concluded that at least some TCBs engage in latitudinal migration that is more typically associated with hoary bats (*Lasiurus cinereus*), eastern red bats *(Lasiurus borealis*)*,* and silver-haired bats *(Lasionycteris noctivagans),* and this behavior is more common for males than for females. The maximum migration distance on record is a female TCB who migrated a straight-line distance of 243 km (151 miles) from her winter hibernaculum in southern Tennessee to a summer roost in Georgia (Samoray et al. 2019). Other migration records between winter hibernacula and summer habitat include less than 80 km (50 miles) (Barbour and Davis 1969, p. 117), 44 km (27 miles) (Samoray et al. 2019, p. 18), and 137 km (85 miles) (Griffin 1940, p. 237). Hibernaculum to hibernaculum movement up to 209 km (130 miles) has also been documented between two consecutive winters (Lutsch 2019). Within the YR active range for the TCB, there is limited data on migration distances for bats that are active year-round and do not use "traditional hibernacula" such as caves and mines.

Winter Habitat and Ecology

TCBs hibernate (i.e., reduce their metabolic rates, body temperatures, and heart rate) during the winter months in caves, cave-like formations (e.g., rock overhangs, talus cracks, etc.), abandoned mines, other anthropogenic structures (e.g., bridges, culverts), and occasionally trees (Service 2021). In the southern U.S., where caves are sparse, TCBs often hibernate in road-associated culverts (Sandel et al. 2001; Katzenmeyer 2016; Limon et al. 2018; Bernard et al. 2019; Lutsch 2019, p. 23; Meierhofer et al. 2022) and sometimes tree cavities (Newman 2020) and abandoned water wells (Sasse et al. 2011, p. 126). TCBs exhibit high site fidelity with many individuals returning year after year to the same hibernaculum (Davis 1966, Jones and Pagels 1968, Jones and Suttkus 1973, Sandel et al. 2001).

In the southern portion of the TCB range, TCBs exhibit shorter torpor bouts and remain active and feed year-round (Figure 9). In these areas, they may roost in culverts, bridges, cavities in live trees, live and dead leaf clusters, and/or Spanish moss during the winter (Sandel et al. 2001, Newman et al. 2021). TCBs selected live trees with minimal decay that contained cavities in South Carolina (Newman 2020, p. 65). The most frequently used tree species were sweetgum (*Liquidambar styraciflua*) and oaks (*Quercus* spp). Tree roost structures were in cavities with basal openings (n = 5), cavities with upper and mid-bole openings (n = 6), a hollow snag with a chimney and mid-bole opening (n = 1), Spanish moss, a leaf cluster (n = 1), and various unknown roost structures (n = 9) such as potentially hidden cavities, dead limbs, bark, or foliage (Newman et al. 2021).

LaVal and LaVal (1980) and Merritt (1987) observed TCBs in Missouri and Pennsylvania, as one of the first cave-hibernating bat species to enter hibernation in the fall and one of the last to leave in the spring. In the southern U.S., hibernation length is shorter compared to northern portions of the range and some TCBs exhibit shorter torpor bouts and remain active and feed during the winter (Layne 1992, Grider et al. 2016, Limon et al. 2018, Newman 2020, Stevens et al. 2020). The number of hibernating TCBs does not peak at caves and mines until December or later, suggesting some TCBs stay on the landscape or in alternate hibernacula and only move in to caves and mines when it gets colder (Barbour and Davis 1969, Vincent and Whitaker 2007); although, in some cases, TCB may remain on the landscape and hibernate in rock shelters (e.g., fissures in sandstone and sedimentary rock) (J.S. Johnson, Ohio University, pers. comm. 2021).

TCBs roost on cave walls and ceilings and are rarely found in cave crevices (Mumford and Whitaker 1982). TCBs will also occasionally shift roosts from one to another during the winter but arouse less frequently than other cave-hibernating bat species (Barbour and Davis 1969, Mumford and Whitaker 1982). However, in road-associated culverts in the southern U.S., TCBs exhibit shorter torpor bouts and move within and between culverts throughout the winter (Anderson et al. undated). Hibernating TCBs do not typically form large clusters, but rather roost singly or sometimes in pairs or in small clusters of both sexes away from other bats (Hall 1962, p. 29; Barbour and Davis 1969, p. 117; Mumford and Whitaker 1982, p. 169; Raesly and Gates 1987, p. 19; Briggler and Prather 2003, p. 408; Vincent and Whitaker 2007, p. 62).

TCBs hibernate in more caves and mines than any other cave-hibernating bat species in eastern North America (Sealander and Young 1955, pp. 23–24; Barbour and Davis 1969, p. 117; Brack et al. 2003, p. 65; Service 2021). TCBs may also use small caves and mines that are unsuitable to other cave-hibernating bat species (Barbour and Davis 1969, Mumford and Whitaker 1982, Hamilton and Whitaker 1979); however, hibernating TCB have been observed in greater numbers in hibernacula with stable temperatures (Briggler and Prather 2003). Raesly and Gates (1987) found TCB hibernating in 80% of the 50 locations surveyed in Pennsylvania versus little brown bats (*Myotis lucifugus*), Indiana bats, NLEBs, and big brown bats (*Eptesicus fuscus*) which were found in 56%, 16%, 16%, and 34% of potential hibernacula, respectively. Almost every cave in Indiana contained at least one TCB (Mumford and Whitaker 1982), and small numbers of TCBs have likely occupied most of Missouri's 6,400 caves (R. Perry, U.S. Forest Service, pers. comm. 2021).

TCBs have also been documented roosting in natural rock faces and outcrops (Lemen et al. 2016; White et al. 2020a; J.S. Johnson, Ohio University, pers. comm. 2021). In Nebraska, TCBs were acoustically recorded in the winter emerging from vertical rock face roosts approximately 8 ft (2.5 m) and 33 ft (10 m) high (Lemen et al. 2016, p. 9). In Ohio, Johnson (2021) found TCBs using rock crevices within rock shelters: "*Tricolored bats were exclusively found within deep, cave-like rock shelters during mid-winter where they primarily dangled from the ceiling or walls of hibernacula rather than roosting in a crevice. Although rock shelters have some resemblance to caves, they are shallower than habitats typically considered as caves and therefore lack a dark zone and internal temperatures that are protected from freezing cold. However, even shallow ledges in these habitats were buffered from daily fluctuations in temperature.*" TCBs roosting or hibernating in natural rock faces or rocky outcroppings can be adversely affected by vibration, noise, and direct impact to the slope, rocks, etc.

Prior to the arrival of WNS, hibernating TCB colonies varied between 1 and 5,300 individuals; however, 40% of hibernacula had between just 1 and 10 individuals (Figure 4). The largest TCB hibernating colony (n = 5,300) was observed in Georgia in 2010 (NABat 2021).

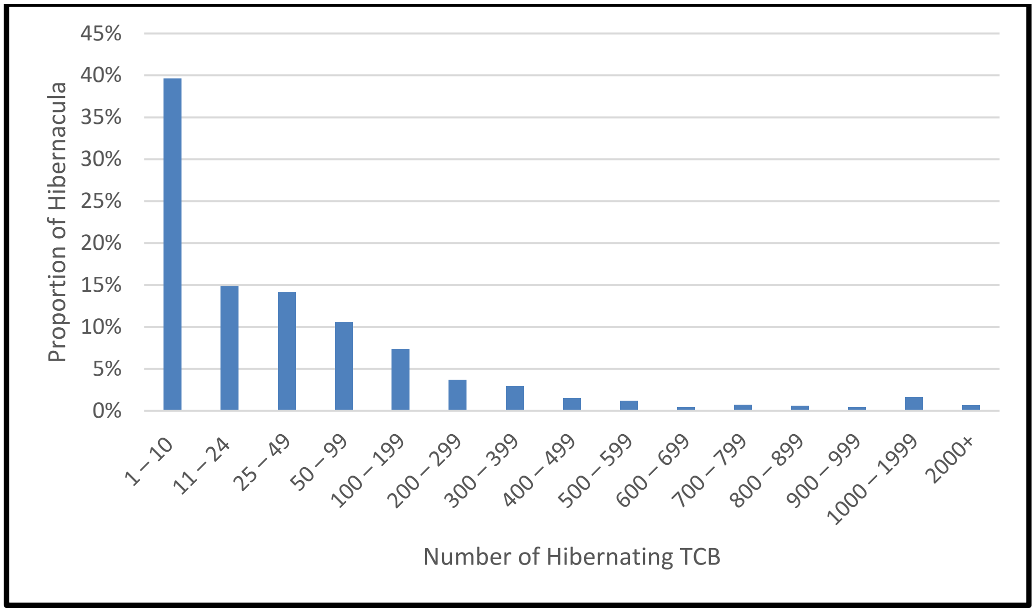


Figure 4. Total Number of Hibernating TCBs Observed During Winter Counts at Hibernacula (n=1,236) Prior to the Arrival of White-Nose Syndrome (NABat 2021; accessed February 10, 2021).

Spring Staging and Fall Swarming Habitat and Ecology

TCBs emerge from hibernation in the spring to forage in nearby riparian and forested habitats. They have been captured during spring emergence at hibernacula in Oklahoma as early as late March (ESI 2018). However, the peak of the spring-staging period for TCBs likely occurs between late April and early May (Vincent and Whitaker 2007, LaVal and LaVal 1980, Damm and Geluso 2008), with males tending to remain in hibernacula (caves and mines) longer and dispersing later than females (Davis 1966). Some individuals may stay within the vicinity of the hibernaculum during this period, while others have demonstrated a quick shift into long-distance, migratory movements (Samoray et al. 2019).

TCBs engage in "swarming" activities from August to November, which is a period when bats are day-roosting, foraging, and mating near and within hibernacula and preparing to enter winter torpor. It is unclear whether TCBs in the YR active areas engage in these swarming activities. Concentrations of TCBs around hibernacula during this time appear to peak between mid-September and mid-October. Foraging bouts and general TCB movements decrease by late October to early November for many areas throughout the range of the species.

4.3 Status and Distribution

To assess the current status of the species, it is helpful to understand the species' conservation needs which are generally described in terms of reproduction, numbers, and distribution (RND). The Service frequently characterizes RND for a given species via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the 3 Rs) (Shaffer et al. 2002, Wolf et al. 2015, Smith et al. 2018). The Service can then apply the appropriate regulatory framework and standards to these principals to address a variety of ESA-related decisions (e.g., listing status, recovery criteria, jeopardy, and adverse modification analysis). For section 7(a)(2) purposes, the 3 Rs can be translated into the RND of a species.

Indiana Bat

Indiana Bat Conservation Needs

The Indiana bat was listed as an endangered species on March 11, 1967 (Federal Register 32[48]:4001), under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). In 1973, the Endangered Species Preservation Act was subsumed by the ESA and the Indiana bat was extended full protection under this law. Critical habitat for the Indiana bat has been designated in 13 winter hibernacula (11 caves and 2 mines) in 6 states (including Hellhole Cave in Pendleton County, WV) (41 FR 41914). The Service prepared a recovery plan for the species in 1983 (Service 1983) and drafted a revised recovery plan that was made available for public comment in 2007 (Service 2007b). While it was not officially adopted (as WNS impacts were discovered during that time period and resources were shifted towards addressing this new threat), it embodies the best available scientific information, and it outlines recovery actions that are relevant to the majority of stressors for the species. In addition, 5-year reviews (Service 2009, 2019b) provide current summaries of the status of the species range-wide, including updates on threats, status of hibernacula counts, and recommended priority actions. Priority actions include: incorporating WNS into the recovery plan; monitoring status of hibernacula; monitoring status of maternity colonies; implementing the North American Bat Monitoring Program; providing for continual recruitment of high quality roosting habitat; securing permanent/long-term protection of P1 and P2 hibernacula; conducting additional research to understand the causes and potential spread of WNS; researching management actions aimed at minimizing the spread of WNS (i.e., an adaptive management approach); continuing public education/outreach efforts about WNS; and continuing to refine survey protocols.

The Indiana bat draft recovery plan (Service 2007b) delineates recovery units (RUs) based on population discreteness, differences in population trends, and broad level differences in land use and macrohabitats: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 5). To help maintain adaptive capacity for the species (representation), multiple (redundant) healthy (resilient) populations should occur in all 4 RUs. The proposed action is located within all RUs.

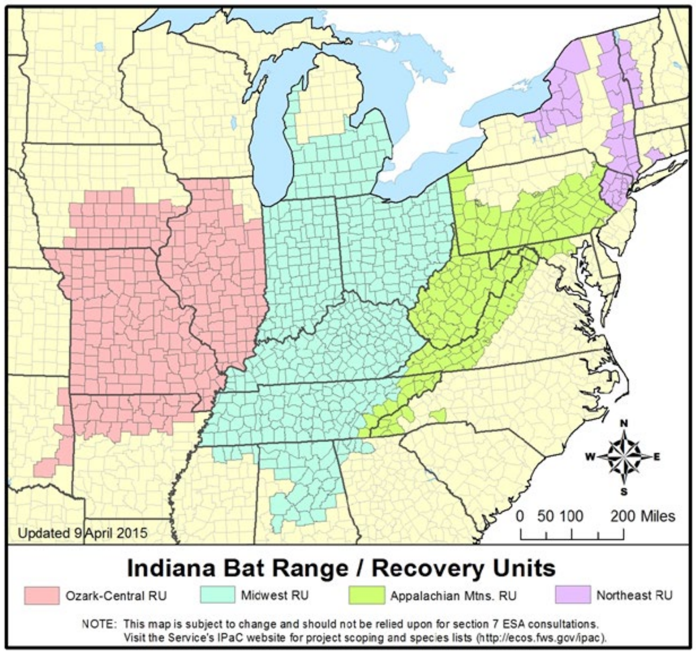


Figure 5. Indiana Bat Range and Recovery Units (Service 2022b).

Conservation and recovery of the Indiana bat will require conserving the species' ecological, behavioral, and genetic representation and providing redundancy and resiliency at the species level by conserving healthy bat populations across the species' current range and managing threats acting upon the species. This includes actions such as:

- Managing the effects of WNS;
- Conserving and managing winter colonies, hibernacula, and surrounding swarming habitat;
- Conserving and managing maternity colonies; and
- Conserving migrating Indiana bats (Service 2018).

Indiana Bat Current Condition

Now that we have described the species' basic needs, we can assess its current condition. The current range of the Indiana bat includes much of the eastern half of the United States, from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida. The species has disappeared from, or greatly declined in, most of its former range in the northeastern United States due to the impacts of WNS.

The historical summer range of the Indiana bat is thought to be similar to its modern range. However, the Indiana bat has been locally extirpated due to fragmentation and loss of summer habitat. The majority of known maternity sites have been in forested tracts in agriculturally dominated landscapes such as Missouri, Iowa, Indiana, Illinois, southern Michigan, western Ohio, and western Kentucky, as well as the Northeast, with multiple spring emergence telemetry studies.

Currently, the range-wide status of the species is still below its peak in 2007, when WNS arrived in New York (NY) (Figure 7). Declines are associated with the onset of WNS (described below) which has spread from NY south and west across the range. Impacts to Indiana bats to date are most severe in areas with the longest time since arrival of WNS (e.g., 75-99% declines in NY, WV, and PA). Most recently (2024), increases have been noted in the Midwest and Ozark-Central RUs.

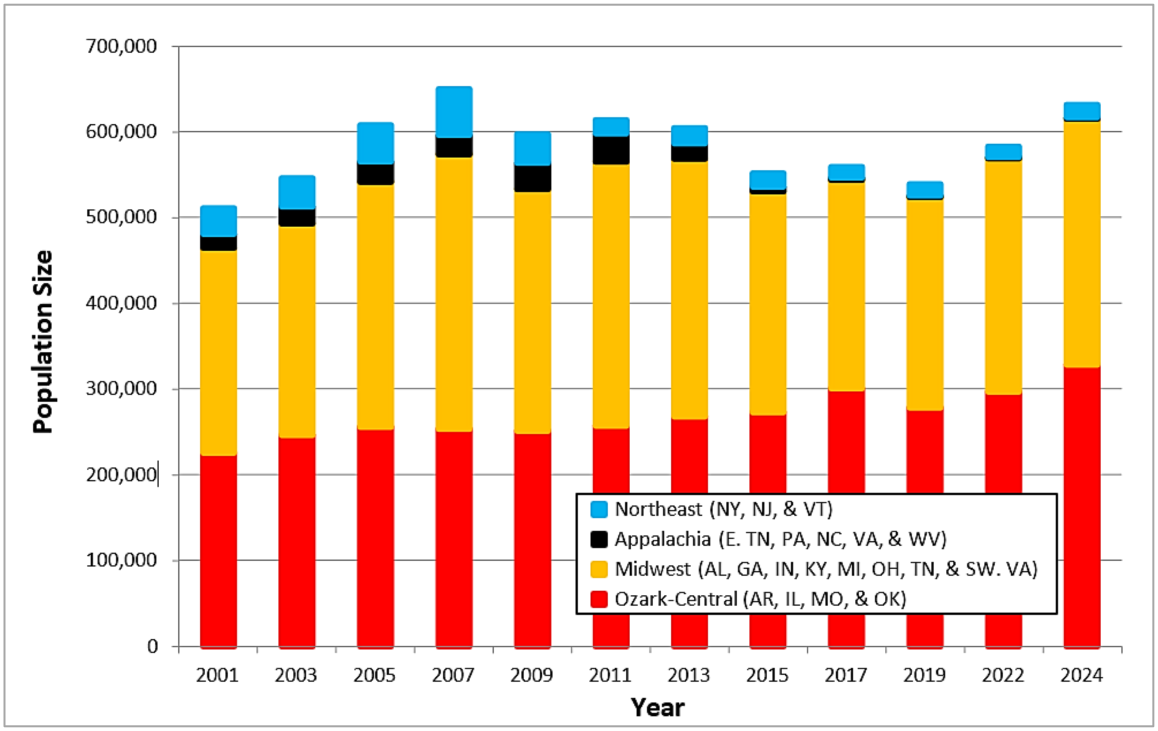


Figure 6. Indiana Bat Rus Population Estimates by RU from 2001 to 2024 (unpublished data, Service 2024).

Redundancy of populations range-wide has been reduced, especially in the Appalachian and Northeast Rus, with several hibernacula now believed to have no Indiana bats and the remaining Indiana bats have been concentrated into fewer sites. In an analysis completed by the Service for the most recent 5-year review (the most complete summary data available for the Indiana bat; surveys are generally conducted every 2 years, but surveys planned for 2021 were partial [many were cancelled due to Covid-19]), as of February 2019, 93% (12,570 of 13,510) of Indiana bats occur at 1 location in the Northeast RU and 72% (1,435 of 1,996) occur at 3 locations in the Appalachian RU (Service 2019). This concentration of individuals in a few locations puts the species at risk should adverse impacts occur at these locations. Based on winter counts range-wide, the resiliency of populations varies, with some winter populations believed to be extirpated and others with virtually no decline and even increases. The Midwest RU declined after the arrival of WNS in 2011 but has been increasing since 2017, and the Ozark-Central RU has been generally increasing since WNS arrived in 2013. We do not understand the causes of variation in mortality by site and why some sites appear to have greater survival rates. Regarding maternity colony populations, changes are not clear, however variation is expected to reflect winter observations as noted above.

From 1965 to 2001, there was an overall decline in the range-wide population of the Indiana bat (Service 2007). Despite the discovery of many new, large hibernacula during this time, the range-wide population estimate dropped approximately 57% from 1965 to 2001, which has been attributed to causes such as habitat loss/degradation, forest fragmentation, winter disturbance, and environmental contaminants. Between 2001 and 2007, the estimated range-wide population increased, from 526,030 to 664,637 Indiana bats (Service 2019). According to the *2024 Indiana Bat (Myotis sodalis) Population Status Update* (unpublished data, Service 2024), the total known Indiana bat population is estimated to be approximately 631,786, which is an 2.8% decrease from the 2007 range-wide estimate and an 8.3% increase from the 2022 range-wide estimate (unpublished data, Service 2024).

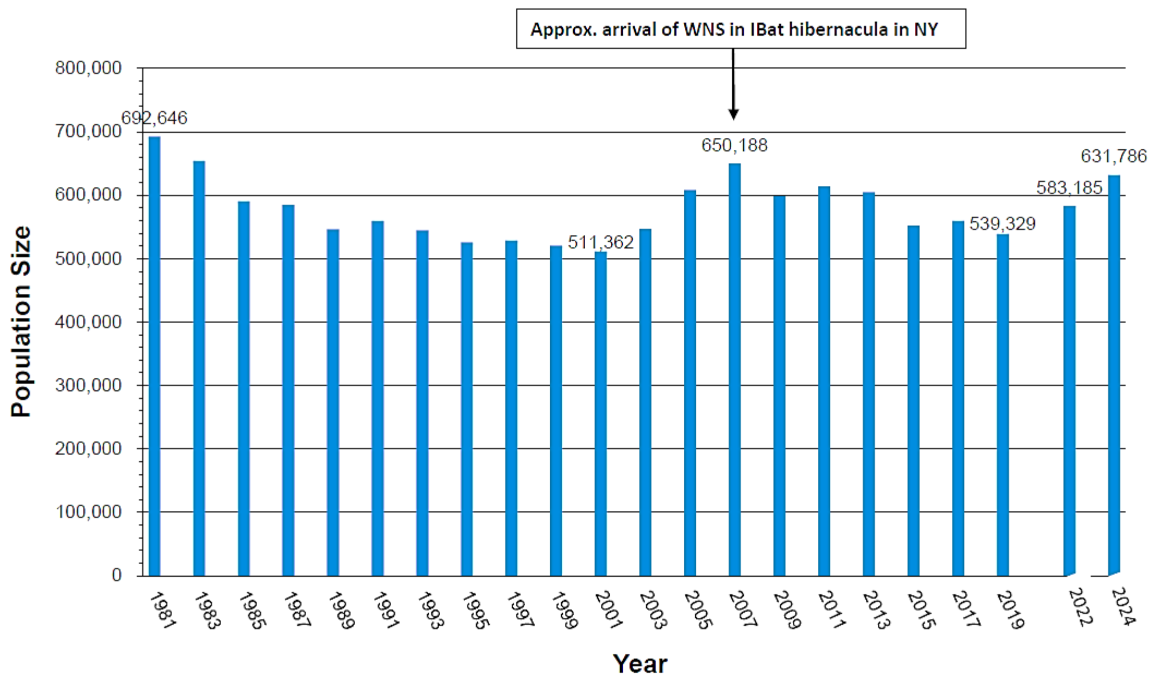


Figure 7. Indiana Bat Range-wide Population Estimates from 1981–2024 (unpublished data, Service 2024).

Northern Long-Eared Bat

Northern Long-Eared Bat Conservation Needs

The Service listed the NLEB as a threatened species on April 2, 2015 (80 FR 17974) and issued a species-specific 4(d) rule on January 14, 2016 (81 FR 1900). The Service reclassified the NLEB as an endangered species on November 30, 2022 (87 FR 73488), effective on March 31, 2023 (88 FR 4908).

The following is a brief summary of NLEB needs from the Species Status Assessment (SSA) Report (Service 2022). For survival and reproduction at the individual level, the NLEB requires access to food and water resources when not hibernating, along with suitable habitat throughout its annual life cycle. During the spring, summer and fall seasons, NLEB requires suitable foraging, roosting, traveling (between summer and winter habitat) and swarming habitat with appropriate conditions for maternity colony members; during the winter, NLEB requires habitat with suitable conditions for prolonged bouts of winter torpor. For NLEB populations to be healthy, they require a population size and growth rate sufficient to withstand natural environmental fluctuations, habitat of sufficient quantity and quality to support all life stages, gene flow among populations, and a matrix of interconnected habitats that support spring migration, summer maternity colony formation, fall swarming, and winter hibernation.

At the species level, NLEB viability requires having a sufficient number and distribution of healthy populations to ensure NLEB can withstand annual environmental and demographic variation (resiliency), catastrophes (redundancy), and novel or extraordinary changes in its environment (representation). Resiliency is best measured by the number, distribution, and health of populations across the species' range. Redundancy can be measured through the duplication and distribution of resilient populations across the species' range relative to potential catastrophic events. Representation can be measured by the number and distribution of healthy populations across areas of unique adaptive diversity.

Northern Long-eared Bat Current Condition

Now that we have described the species' basic needs, we can assess its current condition. The current range of the NLEB includes 37 States, the District of Columbia, and 13 Canadian Provinces. Geographical Representation Units (RPUs) have been identified and delineated across the NLEB's range using the following proxies: variation in biological traits, genetic diversity, peripheral populations, habitat niche diversity, and steep environmental gradients (Figure 8).

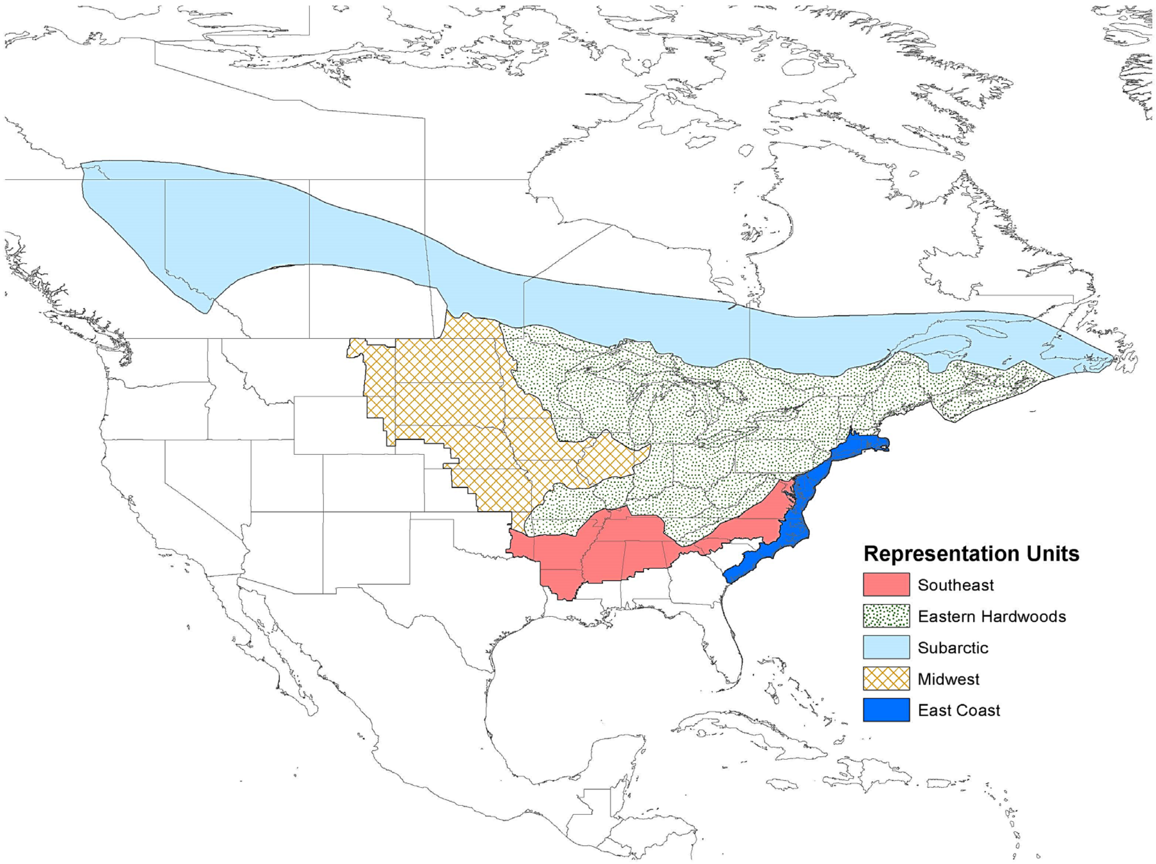


Figure 8. Range of NLEB organized into five Representation Units.

There are regions of the NLEB's range where the species is active year-round due to mild temperatures or where the species uses atypical, non-cavernicolous hibernacula (e.g., crawlspaces, basements, coal adits) (Service 2022a, De La Cruz et al. 2019). This area includes the Southeast Coastal Plain from the James River in Virginia south to the border of Georgia, and the species' entire range in Louisiana (Figure 9 or https://ecos.fws.gov/ecp/species/9045).

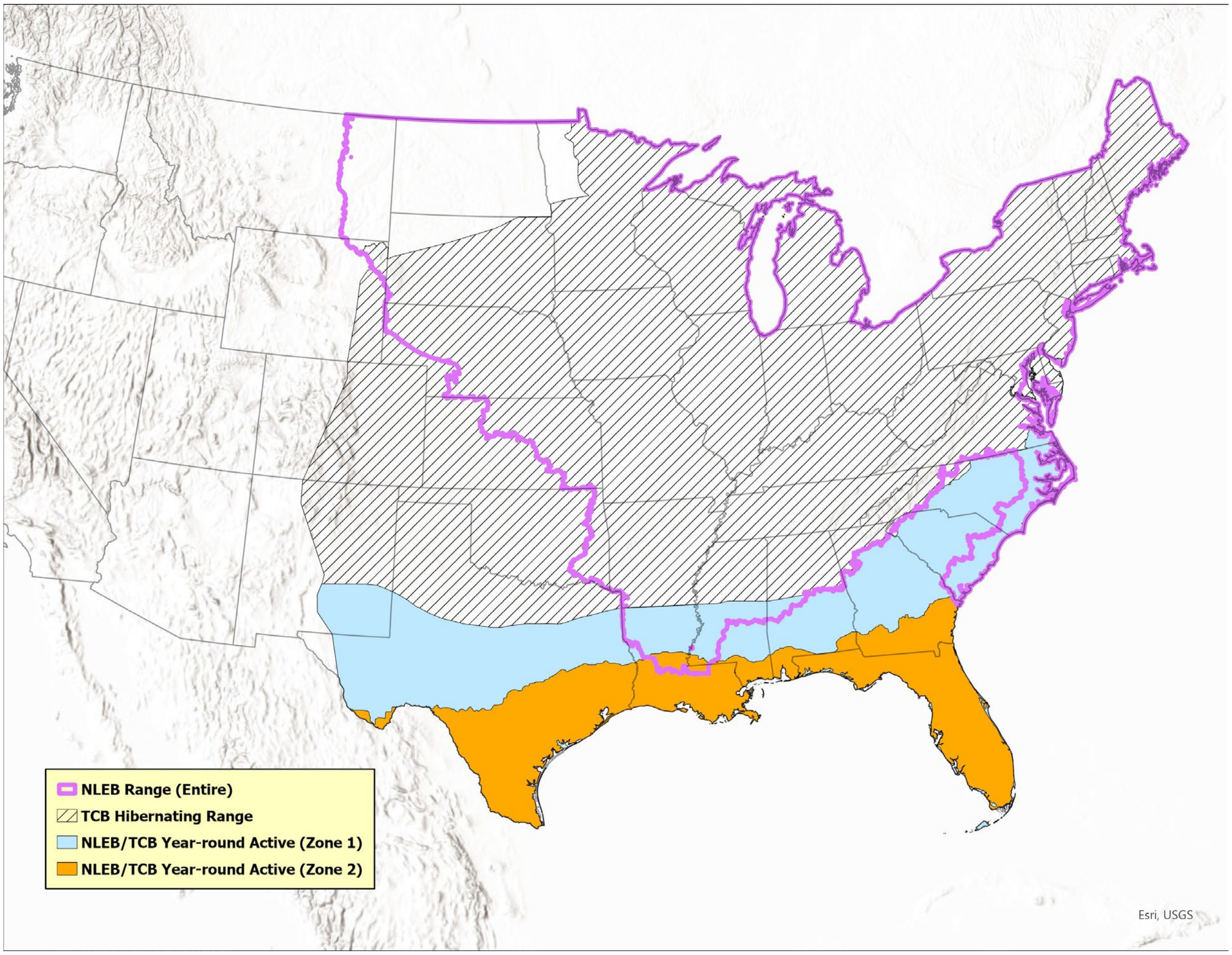


Figure 9. NLEB and TCB Hibernating Ranges and Year-Round Active Ranges[59]

Prior to the documentation of WNS, NLEBs were consistently caught during summer mist-net surveys and detected during acoustic surveys in the eastern U.S. (80 FR 17974) and were commonly encountered, especially during swarming and hibernation in eastern Canada and New England (Caceres and Barclay 2000). However, throughout the majority of the species' range it was patchily distributed and was historically less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

[59] The NLEB and TCB YR active range was defined by a team of Service biologists, where bat data was available, by cross-referencing documented "winter" activity (e.g., captures, acoustics, and culvert use) with the number of frost-free days >/= 200 (https://fws.maps.arcgis.com/home/item.html?id=edd2f5723d3a47df9c71ac8ddbf8f277). In the absence of bat data, the team of Service biologists relied on the best information available from states with data and more loosely followed the number of frost-free days line.

The NLEB continues to be distributed across much of its historical range, but there are many gaps within the range where NLEBs are no longer detected or captured, and in other areas, their occurrence is sparse. Since WNS was documented, multiple hibernacula have not reported NLEBs. Frick et al. (2015) documented the local extinction of NLEBs from 69% of sites included in their analyses (468 sites where WNS had been present for at least 4 years in Vermont, New York, Pennsylvania, Maryland, West Virginia, and Virginia).

The following is a summary from the NLEB SSA Report (Service 2022a). There are countless stressors affecting the NLEB, the primary factor influencing the viability of the NLEB is WNS. Other key factors that influence the NLEB's viability include wind energy mortality, effects from climate change, and habitat loss. Available evidence, including both winter and summer data, indicates that NLEB abundance has and will continue to decline substantially over the next 10 years under current demographic conditions. Winter abundance (from known hibernacula) has declined range-wide (49%) and across most RPUs (0–90%). In addition, the number of extant winter colonies declined range-wide (81%) and across all RPUs (40–88%). There has also been a noticeable shift towards smaller colony sizes, with a 96–100% decline in the number of large hibernacula (≥100 individuals). Declining trends in abundance and occurrence are also evident across much of NLEB's summer range. Range-wide summer occupancy declined by 80% from 2010–2019. Data collected from mobile acoustic transects found a 79% decline in range-wide relative abundance from 2009–2019 and summer mist-net captures declined by 43–77% compared to pre-WNS capture rates. Declines are anticipated to continue.

In conclusion, multiple data sources and analyses indicate downward trends in NLEB population abundance and distribution over the last 14 years. Consequently, we found no evidence to suggest that this downward trend will change in the near future. NLEB abundance (winter and summer), number of occupied hibernacula, spatial extent, probability of persistence, and summer habitat occupancy across the range and within all RPUs are decreasing. Since the arrival of WNS, NLEB abundance has steeply declined. At these low population sizes, colonies are vulnerable to extirpation from stochastic events. Furthermore, NLEB's ability to recover from these low abundances is limited given their low reproduction output (1 pup per year). Therefore, NLEB's resiliency is greatly compromised in its current condition and is projected to decline under future scenarios. Additionally, because NLEB's abundance and spatial extent are projected to decline dramatically, NLEB will also become more vulnerable to catastrophic events. NLEB's representation has also been reduced. The steep and continued declines in abundance have likely led to reductions in genetic diversity, and thereby reduced NLEB adaptive capacity. Further, the projected widespread reduction in the distribution of hibernacula will lead to losses in the diversity of environments and climatic conditions occupied, which will impede natural selection and further limit NLEB's ability to adapt. Moreover, at its current low abundance, loss of genetic diversity via genetic drift will likely accelerate. Consequently, limiting natural selection processes and decreasing genetic diversity will further lessen NLEB's ability to adapt to novel changes (currently ongoing as well as future changes) and exacerbate declines due to continued exposure to WNS, mortality from wind turbines, and impacts associated with habitat loss and climate change. Thus, even without further WNS spread and additional wind energy development, NLEB's viability is likely to rapidly decline over the next 10 years. Given the projected low abundance and the few numbers and restricted distribution of winter colonies, NLEB's currently impaired ability to withstand stochasticity, catastrophic events, and novel changes will worsen under the range of plausible future scenarios.

Tricolored Bat

Tricolored Bat Conservation Needs

On September 14, 2022, the Service proposed to list the TCB as an endangered species under the Endangered Species Act of 1973.

The following is a summary of TCB needs from the Species Status Assessment (SSA) Report (Service 2021). For survival and reproduction at the individual level, the TCB requires access to food and water resources when not hibernating, along with suitable habitat throughout its annual life cycle. During the spring, summer and fall seasons, TCB requires suitable foraging, roosting, traveling (between summer and winter habitat) and swarming habitat with appropriate conditions for maternity colony members; during the winter, TCB requires habitat with suitable conditions for prolonged bouts of winter torpor. For TCB populations to be healthy, they require a population size and growth rate sufficient to withstand natural environmental fluctuations, habitat of sufficient quantity and quality to support all life stages, gene flow among populations, and a matrix of interconnected habitats that support spring migration, summer maternity colony formation, fall swarming, and winter hibernation.

At the species level, TCB viability requires having a sufficient number and distribution of healthy populations to ensure TCB can withstand annual environmental and demographic variation (resiliency), catastrophes (redundancy), and novel or extraordinary changes in its environment (representation). Resiliency is best measured by the number, distribution, and health of populations across the species' range. Redundancy can be measured through the duplication and distribution of resilient populations across the species' range relative to potential catastrophic events. Representation can be measured by the number and distribution of healthy populations across areas of unique adaptive diversity.

Tricolored Bat Current Condition

The TCB SSA (Service 2021), described a marked decline in overall TCB population estimates. Since the arrival of WNS, TCB abundance has declined significantly and winter abundance, number of occupied hibernacula, spatial extent, and summer habitat occupancy are decreasing. WNS was identified as the primary cause and a continued threat to the species, with an estimated 89% decline in abundance by 2030.

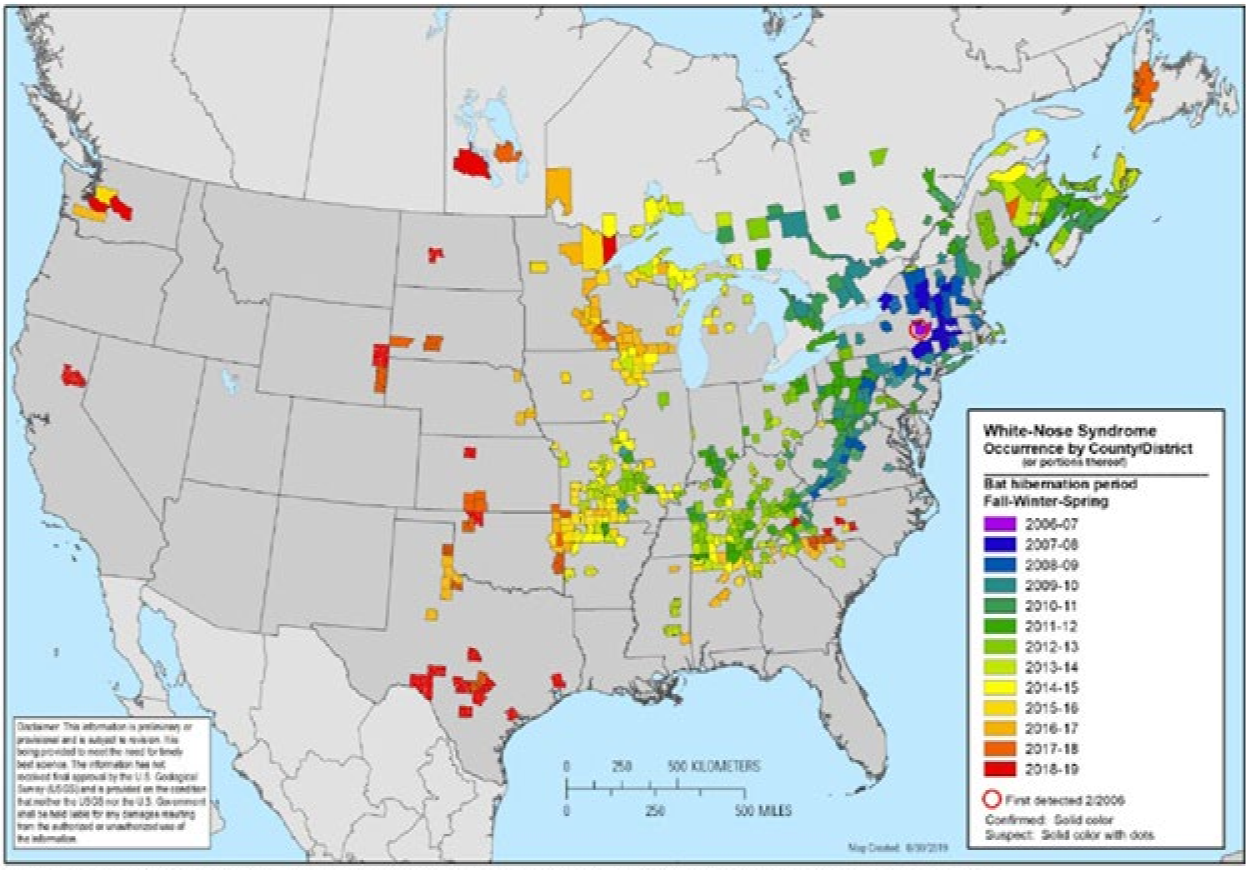
At these low population sizes, colonies are vulnerable to extirpation from stochastic events and their ability to recover from these low abundances is limited given their low reproduction output (2 pups per year). Therefore, TCB's resiliency is greatly compromised in its current condition and is projected to worsen under future stressor conditions. Additionally, because TCB's spatial extent is projected to decline, TCB will become more vulnerable to catastrophic events. The steep and continued declines in abundance have likely led to reductions in genetic diversity, thereby reducing TCB's ability to adapt to changes in its biological and physical environments. The projected widespread reduction in the distribution of hibernacula will lead to losses in the diversity of environments and climatic conditions occupied, which will impede natural selection and further limit TCB's ability to adapt. Moreover, at its current low abundance, loss of genetic diversity via genetic drift will likely accelerate. Consequently, limiting natural selection process and decreasing genetic diversity will further lessen TCB's ability to adapt to novel changes (currently ongoing as well as future changes) and exacerbate declines due to continued exposure to WNS, mortality from wind turbines, and impacts associated with habitat loss and climate change. Thus, even without further WNS spread and additional wind energy development, TCB's viability is likely to rapidly decline over the next 10 years.

TCBs have a very wide range that encompasses most of the eastern United States from Canada to Florida and west to New Mexico. TCBs are known in 39 States and the District of Columbia. TCB populations in the southeast extending west to New Mexico are active year-round due to mild temperatures during the winter and the availability of insect prey (Caceres and Barclay 2000; Grider et al. 2016; White et al. 2018; Jordan 2020) (Figure 9).

4.4 Factors Affecting the Species Needs

Indiana Bat

Threats to the Indiana bat are discussed in detail in the draft recovery plan (Service 2007b) and 5-year review (Service 2019b). Traditionally, occupied summer habitat loss/degradation during the active or inactive (winter) seasons, winter disturbance while Indiana bats are in hibernation, and environmental contaminants have been considered the greatest threats to Indiana bats. The draft recovery plan (Service 2007b) identified and expounded upon additional threats, including collisions with man-made objects (e.g., wind turbines). The 2009 5-year review (Service 2009) was the first review to include the threat of WNS, which is now considered the most significant threat to the recovery of the species. WNS has spread across the range of the Indiana bat (Figure 10) with declines varying among hibernacula. Overall, the Service finds that WNS has significantly reduced the redundancy and overall resiliency of the Indiana bat to withstand other cumulative threats. For example, Erickson et al. (2016) modeled the interaction of WNS and wind turbine mortality which resulted in a larger population impact than when considering the effects of either stressor alone. The primary issues addressed in this PBO are the loss of summer habitat, spring staging/fall swarming habitat, and any compounding effects from WNS.



Citation: White-nose syndrome occurrence map - by year (2019). Data Last Updated: 8/30/2019. Available at: https://www.whitenosesyndrome.org/static-page/wns-spread-maps.

Figure 10. White-nose Syndrome Spread Map (https://www.whitenosesyndrome.org/static-spread-map).

In addition to extrinsic factors, there are several intrinsic biological constraints affecting Indiana bats. High Indiana bat adult female survival is required for stable or increasing growth rates (Thogmartin et al. 2013). Given the significant declines in populations across much of the range, it is essential to minimize impacts to reproductive potential for surviving Indiana bats. Healthy adult females have a maximum of 1 pup per year. Thus, the ability of the species to increase reproductive success is limited. Indiana bats also show strong philopatry to their summer maternity areas, and even interannual fidelity to specific roost trees for as long as the roost trees remain suitable and standing (Kurta 2005). Because Indiana bats rely on a previously established network of roosts (fidelity), roost tree loss, regardless of whether it occurs during the active or inactive (winter) seasons, may affect the fission-fusion dynamics of their maternity colonies through colony fragmentation which is expected to result in reduced thermoregulatory benefits and either increased energy expenditures or increased use of torpor resulting in: (1) reduced recruitment and/or (2) reduced adult survival.

While forest habitat is not generally considered a limited resource across the range of the Indiana bat, the species' strong site fidelity contributes to the importance of forest where the species actually occurs. In other words, the impacts are associated with the losses of forest within the home range of

Indiana bat colonies. Further, where Indiana bat colonies remain after WNS has been present on the landscape for over 10 years magnifies the importance of that particular occupied habitat for the remaining survivors of WNS, especially in the Appalachian and Northeast RUs. So now, more than ever, identification and protection of maternity sites is imperative for even the short-term survival and eventual recovery of the species.

An impact to forest within the Indiana bat's range is one of the most important stressors attributable to transportation projects. Depending on their characteristics and location, forested areas can function as summer maternity habitat, staging and swarming habitat, migration or foraging habitat, or sometimes, combinations of more than one habitat type. Transportation projects frequently require tree clearing. Tree clearing can have a variety of impacts on the Indiana bat depending on the quality, amount, and location of the lost habitat, and the time of year of clearing. These impacts could kill or injure Indiana bats during the active season, or harm bats through changes in essential feeding, breeding, or sheltering behavior due to habitat loss during the hibernation season.

Indiana Bat Summary

Despite the continued spread of WNS across North America, winter populations in the Midwest and Ozark-Central RUs have been increasing since 2017 and these regions contain most of the specie's remaining healthy winter populations (and by extension, associated maternity colonies; FWS, unpublished data, 2024). In contrast, populations in the eastern portions of its species' range have not fared as well after the arrival of WNS and thus relatively few healthy winter populations now remain in the Northeast and Appalachian RUs. Because the species has limited reproductive potential, populations heavily impacted by WNS are not likely to quickly rebound in numbers. The underlying cause(s) of the observed regional differences in WNS impacts are still being investigated but remain uncertain at present. It is also uncertain as to what proportion of the observed winter population increases at growing sites may stem from natural reproduction versus potential immigration from other known or unknown sites. The minimum range-wide population-based recovery criterion has been met, however, many of the protection-based recovery criteria have not yet been fully achieved. Some key high-priority hibernacula are exhibiting stable population growth, but others have not had stable or sustained growth for enough years to meet some of the reclassification criteria included in the 2007 draft recovery plan (Service 2007). Overall, despite the regional differences mentioned, the species' range-wide status appears to be stable or improving.

Northern Long-eared Bat

The following paragraph is a summary from the NLEB SSA Report (Service 2022a). Unquestionably, WNS is the primary driver (or influence) that has led to the species' current condition and is predicted to continue to be the primary influence into the future. Wind energy related mortality is projected to be a more impactful influence in the future as annual mortality is projected to increase. Incidences of climatic extremes (e.g., drought, excessive summer precipitation) will likely increase, leading to increased NLEB mortality and reduced reproductive success. Although we consider habitat loss pervasive across the NLEB range, impacts to NLEB and its habitat are often realized at the individual or colony level. Also, loss of hibernation sites (or modifications such that the site is no longer suitable) can result in impacts to winter colonies.

While forest habitat is not generally considered a limited resource across the range of the NLEB, the species' strong site fidelity contributes to the importance of forest where the species actually occurs. In other words, the impacts are associated with the losses of forest within the home range of NLEB colonies. The SSA Report (Service 2022a) states that adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat. Further, where NLEB colonies remain after WNS has been present on the landscape for over 10 years magnifies the importance of that particular occupied habitat for the remaining survivors of WNS. In the coastal plain of North Carolina, there are no known cavernicolous (cave-like) hibernacula (Grider et al. 2016; Jordan 2020). Some NLEBs in this area have been swabbed and confirmed negative for the fungus *Pseudogymnoascus destructans* that causes the disease WNS (Jordan 2020). Because they are not dependent on caves or mines for hibernation, NLEBs in this area may not be susceptible to WNS, and these populations may serve as a refugium from WNS (Jordan 2020). This may also be the case for all the areas where NLEBs are active year-round. However, *P. destructans* has been detected in Louisiana and in coastal Virginia. Thus now, more than ever, identification and protection of maternity sites is imperative for even the short-term survival and eventual recovery of the species.

Northern Long-eared Bat Summary

In summary, the range-wide status of the species is declining. The primary threat of WNS continues to spread and effects are expected to continue across the range for years to come, as are other ongoing threats (e.g., climate change, wind turbines) to NLEBs and their habitats. Given the species' limited reproductive potential, populations are not likely to rebound in the near term. In short, over the past decade, WNS has increased the species' risk of extinction as the resiliency, redundancy, and representation of its remaining populations have declined and are expected to continue to decline.

Tricolored Bat

The largest threat to TCBs is the disease WNS. Since it appeared in New York in 2006, WNS has spread rapidly westward and south across the United States, killing millions of bats. TCB numbers have declined for all survey types including acoustics, mist-netting, and cave surveys. It is expected that WNS will continue to spread and TCBs will continue to decline throughout their range, although as noted in the SSA report, there is uncertainty associated with progression of WNS within TCB winter colonies at road-associated culverts in the southern U.S. (Service 2021). Other threats to TCBs include summer habitat destruction, degradation of water quality, and mortality at wind farm facilities.

Tricolored Bat Summary

The primary factors influencing TCB's viability, which have led to its current condition include WNS, wind energy related mortality, and habitat degradation.

4.5 Status of Critical Habitat

Critical habitat for the Indiana bat has been designated in 13 winter hibernacula (11 caves and 2 mines) in 6 states (including Hellhole Cave in Pendleton County, West Virginia) (41 FR 41914).

On April 27, 2016, the Service determined that it is not prudent to designate critical habitat for the NLEB (81 FR 24707) and recently reaffirmed our determination that it is not prudent to designate critical habitat for the NLEB (87 FR 73488).

No critical habitat has been designated for the TCB.

No effects to hibernating Indiana bats, NLEBs, TCBs, or Indiana bat critical habitat are anticipated from impacts to active season habitat because of the AMMs. Given that this proposed action does not affect any critical habitat, it will not be discussed further.

4.6 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 impacts to the listed species or designated critical habitat caused by the proposed action. The environmental baseline as defined in 50 CFR 402.02, 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 impacts to listed species or designated critical habitat from Federal agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Because of the programmatic nature and geographic extent of this consultation, the environmental baseline is considered the same as the range-wide status of the species and critical habitat.

5. EFFECTS OF THE ACTION

This section addresses the effects of the Action on the Indiana bat, NLEB, and TCB.

5.1 Effects Analyses Overview

This section describes the bat resource of interest for the analysis, and then examines each stressor associated with activities defined under the "Description of the Proposed Action" section to determine the effect on the Indiana bat, NLEB, or TCB from the stressor. The analysis for each resource is organized as follows:

1. **Description of Resource.**
2. **Description of Stressor(s)**. There can be one or more stressors that affect each resource.

3. **Stressor Effects**. An analysis of best available science and information pertaining to the effects of the stressor on the three covered bat species. The purpose is to define those situations that are NLAA these bats.
4. **Avoidance and Minimization Measures**. A description of the AMMs related to the specific stressor effects. AMMs included in the analysis, if adopted under appropriate circumstances, are expected to reduce potential impacts of the stressor to levels that are insignificant (the size of the impact should never reach the scale where take occurs) or discountable (extremely unlikely to occur) for NLAA projects and minimize impacts that are LAA.
5. **Stressor Summary**. A summary of project characteristics that may impact the identified resource.

5.2 Resource #1 – Forested Habitat

Resources are similar enough for Indiana bats, NLEBs, and TCBs such that all three species are discussed in each section below. Any known differences between the species are identified.

Summer Habitat

Per the Service's Range-wide Bat Survey Guidelines:

> "Suitable summer habitat for Indiana bats 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 (i.e., live trees and/or snags ≥5 in [12.7 cm] DBH that have exfoliating bark, cracks, crevices, and/or hollows), 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. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 ft (305 m) of forested/wooded habitat." (Service 2022b).

Suitable summer habitat for the NLEB is comparable to the Indiana bat in terms of summer roost selection but appears to be more flexible (Carter and Feldhamer 2005, Timpone et al. 2010), and roosting and foraging habitat are typically within closed, intact forest stands (Sasse and Pekins 1996, Foster and Kurta 1999, Lacki and Schwierjohann 2001, Owen et al 2002). Lacki et al. (2009) assessed 28 published sources and found that NLEBs demonstrated greater variability in height of roosts and stem diameter of roost trees and were more likely to roost in crevices or cavities than Indiana bats. Similarly, in northeastern Missouri, Indiana bats typically roosted in snags with exfoliating bark and low canopy cover, whereas NLEBs used the same habitat in addition to live trees, shorter trees, and trees with higher canopy cover (Timpone et al. 2010).

Suitable summer habitat for the TCB is comparable to the Indiana bat and NLEB; however, TCBs roost in live and dead leaf clusters of live and recently dead deciduous trees, Spanish moss (*Tillandsia usneoides)*, and beard lichen (*Usnea trichodea*). TCBs roost in a variety of tree species, especially oaks (Quercus spp.), and often select roosts in tall, large diameter trees. TCBs will also roost in smaller diameter trees when potential roost substrate is present (e.g., 4-in) (Leput 2004) and have been documented roosting in trees as small as 1.7-in DBH (Veilleux et al 2003). TCBs commonly roost in the mid to upper canopy of trees although males will occasionally roost in dead leaves at lower heights (e.g., < 16 ft [5 meters] from the ground) (Perry and Thill 2007) and females will occasionally roost in Spanish moss of understory trees (Menzel et al. 1999).

Female Indiana bats and NLEBs form maternity colonies in roost trees in the summer and exhibit fission-fusion behavior (Barclay and Kurta 2007, 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, both species switch roosts often, typically every 2–3 days (Foster and Kurta 1999, Owen et al. 2002, Kurta et al. 2002, Kurta 2005, Carter and Feldhamer 2005). Female TCBs also form maternity colonies in the summer months and switch roost trees regularly (e.g., between 1.2 days and 7 days at roost trees in Indiana). Female TCB exhibit high site fidelity, returning year after year to the same summer roosting locations (Allen 1921; Veilleux and Veilleux 2004a). Males roost singly (Perry and Thill 2007; Poissant et al. 2010). Bats switch roosts for a variety of reasons, including temperature, precipitation, predation, parasitism, and to make use of ephemeral roost sites (Carter and Feldhamer 2005). The need to investigate new potential roost trees prior to their current roost tree becoming uninhabitable (e.g., tree falls over), may be the most likely scenario (Kurta et al. 2002, Carter and Feldhamer 2005, Timpone et al. 2010).

Indiana bat roost trees have been described as either primary or alternate depending on the number of bats in a colony consistently occupying the roost site. In Missouri, Callahan (1993) defined primary roost trees as those with exit counts of more than 30 bats on more than one occasion; however, this number may not be applicable to small-to-moderate sized maternity colonies. Indiana bat maternity colony size can vary greatly, but typical colonies contain less than 100 adult females (Service 2007). Kurta (2005) summarized summer habitat information from 11 States and found most exit counts at primary roosts are at least 20–100 adults with a typical maximum of 60–70 adults in a primary roost at any given time. Primary roost trees are almost always located in either open canopy sites or Indiana bats are using the portion of a tree that is above the canopy cover of the adjacent trees (Callahan et al. 1997, Kurta et al. 2002). Alternate roost trees can occur in either open or closed canopy habitats. Maternity colonies use a minimum of 8–25 trees per season (Callahan et al. 1997, Kurta et al. 2002). However, not every bat in each colony can be radio-tracked continuously and simultaneously so it is unlikely that every tree used for roosting is found.

NLEB maternity colonies range widely in size, although 30-60 adult females may have been most common pre-WNS (Service 2014). However, maternity colonies are smaller post-WNS. In Kentucky, recent exit counts for WNS-impacted NLEB maternity colonies averaged <4 bats per roost in Mammoth

Cave National Park (Thalken et al. 2018) and <6 bats per roost in the Robinson Forest experimental forest reserve (Arant et al. 2022), with maximum counts of 40 and 24 individuals, respectively. The highest exit counts observed post-WNS in the Fernow Experimental Forest (FEF) in West Virginia were 5 in 2015 and 7 in 2016 (Kalen et al. 2022), in contrast to the maximum pre-WNS exit count of 48 reported for NLEB colonies in the FEF by Johnson et al. (2012).

TCB maternity colonies are generally small, sometimes consisting of only a single female and her two pups. The mean maternity colony size at tree roosts ranges from a single female and pups to 4.4 in Indiana (Veilleux and Veilleux 2004) and 6.9 in Arkansas (Perry and Thill 2007). In Wisconsin, maternity colonies averaged 7.25 TCBs (range: 1–15 bats) (Wisconsin DNR 2016). In Nova Scotia, maternity colonies averaged 10 TCBs (range: 1–18) (Poissant 2009). In South Carolina, 3–4 TCBs emerged from several roosts where pregnant or lactating females were roosting (Leput 2004). As the maternity season progresses, colony sizes begin to fluctuate, females begin to disband soon after young became volant, and post-lactating females roost singly for the remainder of the summer (Veilluex and Veilluex 2004).

Maternity colony home range includes both roosting and foraging habitat and travel/commuting areas between those habitats. Observed home ranges for individual bats associated with Indiana bat maternity colonies vary widely (205.1 to 827.8 acres [83to 335 ha]) (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Kniowski and Gehrt 2014, Jachowski et al. 2014). Individual NLEB home ranges have been minimally estimated at 148.8 to 173.7 acres (60.2 to 70.3 ha) (Owen et al. 2003, Lacki et al. 2009).

Broders et al. (2006) found roosting areas of female NLEB (mean of 21.3 acres [8.6 ha]) to be larger than males (mean of 3.5 acres [1.4 ha]), though Lereculeur (2013) found no difference at a study site in Tennessee. The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 1,975 ft (602 m) with a range of 197 to 5,640 ft (60 to 1719 m) (Sasse and Pekins 1996). Work on Prince Edward Island by Henderson and Broders (2008) found female NLEB traveled approximately 3,609 ft (1,100 m) between roosting and foraging areas.

For the NLEB, Broders et al. (2006) and Henderson and Broders (2008) found foraging areas (of either sex) to be six or more times larger than roosting areas. Roosts are often in proximity to one another within their summer home range. For example, in Missouri, Timpone et al. (2010) found the mean distance traveled between roost trees was 0.42 miles (0.67 km) (range 0.03 to 2.4 miles [0.05 to 3.9 km]). In Michigan, the longest distance the same bat moved between roosts was 1.2 miles (2 km) and the shortest was 20 ft (6 m) (Foster and Kurta 1999). In Arkansas, Perry and Thill (2007) found roost trees concentrated within less than 5 acres (2 ha).

NLEB and Indiana bat maternity colonies are scattered across the ranges of the species. Indiana bat migration distances between hibernacula and summer colonies have been documented as far as 357 miles (574.5 km) in the Midwest (Winhold and Kurta 2006) and much shorter distances observed in the northeast (Service 2011). In contrast, NLEBs are not considered to be long-distance migrants (typically

40 to 50 miles [64.4 to 80.5 m]). Males or non-reproductive females may stay closer to hibernacula throughout the active season.

Pregnant or lactating female TCBs will forage between 0.43 miles (0.69 km) and 2.67 miles (4.3 km) from roost trees in Indiana and Wisconsin (Veilleux et al. 2003; Helms 2010; Wisconsin DNR 2017b; Wisconsin DNR 2018). Reported distances from summer mist-net capture locations to roost trees also fall within a similar range. Pregnant or lactating female TCBs were captured between 0.03 mile (0.05 km) and 2 miles (3.17 km) from their roost trees in Indiana, Wisconsin, and South Carolina (Veilleux et al. 2003; Leput 2004; Wisconsin DNR 2017b; Wisconsin DNR 2018). Veilleux et al. (2003) reported the mean distance from capture locations to roost trees for 19 pregnant or lactating female TCBs was 0.45 mile (0.72 km) in Indiana.

The mean distance a male TCB traveled from its roost to foraging areas was 1.9 miles (3.05 km) in Indiana (Helms 2010). Male TCBs in Tennessee traveled 7.08 miles (range: 2.4–15.2 miles) (11.4 km; 3.9–24.4 km) from roosting to foraging areas, with a single individual traveling a maximum distance of 24.4 km (15.2 mi) (Thames 2020).

Fall Swarming/Spring Emergence Habitat

Indiana bats, NLEBs, and TCBs occupy similar forest habitats in the spring and fall as in the summer but the habitat is located around winter hibernacula. Most Indiana bat activity is believed to be concentrated within 10 to 20 miles (16.1 to 32.2 km) of hibernacula in the fall (Service 2011). Limited information is available for NLEB, but they have been found up to 8.2 miles (13.2 km) from their hibernacula during the fall with 75% of roosts within 1.6 miles (2.5 km) (Lowe 2012), using habitat within that area for roosting, foraging, swarming and staging purposes. In Oklahoma, the maximum distance that TCBs traveled from a swarming site in September was 3.6 miles (5.7 km), though approximately 50% of logged locations were within 0.25 mile (0.4 km) of the hibernaculum (ESI 2018). Diurnal roost trees were located between 0.1 and 3.2 miles (0.2 and 5.1 km) from the swarming site (4 out of 10 roost trees were within 0.25 mile). In Michigan, a juvenile female TCB roosted in trees 0.5 and 1.2 miles from the swarming site (Kurta et al. 1999). In Tennessee, Tate (2020) captured 18 TCBs (4 female, 14 males) at swarming sites and tracked them to 46 roost trees. The mean distance of roost trees from swarming sites was 0.12 mile (range = 0.02-0.3 mile) (0.2 km; range = 0.03-0.43 km).

Throughout much of the TCB's hibernating range, TCBs engage in "swarming" activities primarily from August to October, a period when bats are day-roosting, foraging, and mating near and within hibernacula and preparing to enter winter torpor. Concentrations of TCBs appear to peak between mid-September and mid-October around hibernacula. Foraging bouts and general TCB movements decrease by late October to early–November for many areas throughout the range of the species.

Total numbers of TCBs observed swarming at some hibernacula during the fall swarming periods have been significantly higher compared to the number of observed TCBs during winter surveys, suggesting that some individuals are hibernating elsewhere (Barbour and Davis 1969, Mumford and Whitaker 1982, Schwartz and Schwartz 2001). However, the frequency or extent of this behavior in TCBs is generally unknown.

In the spring, bats may spend a few hours or days around hibernacula or migrate immediately to summer habitat. During spring through fall, Indiana bats, NLEBs, and TCBs may also roost in man-made structures (e.g., bridges, culverts, buildings) (see Resource #2–Artificial Roosts).

Roost Tree Locations in Proximity to Existing Roads

Road miles are near to or exceed 100,000 miles (160,934 km) in many States within the range of the NLEB and Indiana bat. Rail miles range from 3,000 to 6,000 (4,828 to 9,656 km) in a sample of States within the range. The range of the TCB is larger than that of the Indiana bat and the NLEB, thus we anticipate the number of road and rail miles to be higher. On an annual basis, the quantity of existing road and rail miles undergoing maintenance or improvements that involve tree removal/trimming in suitable habitat of the covered bats species will largely be influenced by available funding and is anticipated to represent less than 1% of the total infrastructure network.

The Service used GIS to compare distances from known Indiana bat roost trees in Ohio, Kentucky, New York, and Indiana to roads. This data covers four states, two RUs, and includes 1,351 roosts. This information is particularly relevant to assessing the likelihood of roosts occurring near roadways in the reported states, as well as range-wide. The states analyzed have some of the largest roost data sets available for Indiana bats. We also considered information from Illinois (n = 58 roosts with a mean distance of 1,276 ft (389 m) from roads) but did not have access to the data to conduct GIS analyses.

Roost data was collated by the Service from a wide variety of sources including surveys and radio-tracking studies in support of consultations, HCP development and monitoring, and academic research. Studies also included multiple spring emergence tracking of bats from their hibernacula to summer roosts. Road data was based on the best available GIS layers for that State. For New York, the Accident Location Information System was used. For Indiana, Tiger shapefile comprises the road data. In Ohio, our assumption is that road data was from the Ohio Department of Transportation shapefiles.

Table 5. Distance of Indiana Bat Roosts to Existing Road (Centerline) (Source: Service unpublished data).

State	Roosts (N)	Type	Roosts within 100 ft (30.5 m) from all roads	Roosts within 300 ft (91.4 m) from all roads	Mean distance of roosts to road (ft [km])
NY	651	All	24 (3.7%)	79 (12.1%)	2,498 ft [0.76 km]
IN	460	All	15 (3.2%)	68 (14.8%)	1,057 ft [0.32 km]
IN	119	Primary	2 (1.7%)	11 (9.2%)	1,101 ft [0.34 km]
OH	194	All	11 (5.6%)	18 (9.2%)	1,432 ft [0.44 km]
OH	33	Primary	1 (3.0%)	4 (12.1%)	1,445 ft [0.44 km]
KY	46	Female	0	5 (10.9%)	Not Available
IN/NY/OH	1305	All	50 (3.8%)	165 (12.6%)	1,831 ft [0.56 km]
All	1351	All	50 (3.7%)	170 (12.6%)	*
IN/OH	152	Primary	3 (2.0%)	15 (9.9%)	Not Available

*No KY distance data for roosts >1,000 ft (305 m) from roads.

The "Point Distance" function was used in ArcGIS to calculate distances to line segments in New York and Indiana and the "Near" function was used in Ohio. For all data, the distances to roosts are based on a shapefile that would generally be considered the centerline of roads. We understand that this may create an error (maximum distance would be maximum width of the road divided by two +/- a sub-foot difference due to projection when the layers were created). This error rate will vary depending on the type of road with much smaller error rates for the smaller roads and larger rates for the larger highways. For example, when considering a two-lane road with a road lane of 12 ft (3.7 m) and a shoulder of 3 ft (0.9 m), the roosts would be 15 ft (4.6 m) closer to the roadway edge than the roadway centerline (Table 5). Considering a 4-lane road with similar widths, the roosts would be 27 ft (8.2 m) closer to the edge than the centerline. Centerline of road would also have an error associated with its location.

There is also an error associated with the individual GPS units that collected the roost tree location data. Specifications for many GPS receivers indicate their accuracy will be within about 10 to 50 ft (3 to 15 m), 95% of the time. This assumes the receiver has a clear view of the sky and has finished acquiring satellites. Many receivers include Wide Area Augmentation System capability, which can enhance accuracy in many parts of North America. If you are moving or in areas with less than ideal conditions, you will probably find your receiver is not using Wide Area Augmentation System a large portion of the time. All things considered; you can usually expect to be within about 20 to 30 ft (6.1 to 9.1 m) of the mark with most consumer grade receivers. Even with those errors, one can demonstrate that roosts are generally not in proximity to roads (centerline or edge), particularly with the data available on primary roosts.

Table 6. Distance of Indiana Bat Roosts to Existing Road Edge (Based on 15 ft [4.6 m] width of Road and ROW combined) (Source: Service unpublished data).

State	Roosts (N)	Type	Roosts within 100 ft (30.5 m) from all roads	Roosts within 300 ft (91.4 m) from all roads	Mean distance of roosts to Road (ft [km])
NY	651	All	28 (4.3%)	79 (12.1%)	2,483 ft [0.76 km]
IN	460	All	19 (4.1%)	69 (15%)	1,041 ft [0.32 km]
IN	119	Primary	2 (1.7%)	11 (9.2%)	1,085 ft [0.33 km]

The majority (>95%) of Indiana bat roosts are located beyond 100 ft (30.5 m) from roads with a mean distance to road of 1,831 ft (558.1 m). If a given colony uses a minimum of 8–25 roosts/year and if there are ~4,000 colonies across the range, there would be 32,000-100,000 minimum total roosts used in a given year. Of these, 5% might be expected to occur within 100 ft (30.5 m) of a road. The likelihood of a primary roost being within 100 ft (30.5 m) is even lower. The majority of roosts are expected to occur near lower capacity roads, such as two-lane private, municipal, or county roads because of reduced traffic noise and disturbance, smaller ROWs, and greater likelihood of suitable roosting habitat in closer proximity to the road. However, there are some known roosts along major highways (e.g., I-69, I-81, I-57).

Although in general, NLEB tend to select roosts with canopy ranging from 44% - 56% (Carter and Feldhamer, 2005; Timpone et al., 2010) there are records of them roosting in proximity to roads. The Ohio, Virginia, and New York Field Offices recently conducted a GIS exercise that calculated the proximity of known NLEB roost trees to the edge of the road (Table 7). Additionally, Lacki and Schwierjohann (2001) tracked 15 NLEBs to 57 trees in Kentucky and found the mean distance to road for bark roosts and cavity roosts was 111.9 ft (34.1 m) and 109.6 ft (33.4 m), respectively. Because both Indiana bats and NLEBs are in the genus *Myotis;* frequently co-occur in the same habitats; and data is limited on distance of known NLEB roost trees to road/rails, we are using Indiana bats as a surrogate for NLEBs for the purpose of assessing the likelihood of roosts in proximity to roads.

Table 7. Distance of NLEB Roosts to Edge or Centerline of Road. (Source: Service unpublished data).

State	NLEB Roosts (N)	Type	Roosts within 100 ft (30.5 m) from all roads	Roosts within 300 ft (91.4 m) from all roads	Roosts beyond 300 ft (91.4 m) from all roads
OH	66	All	10 (15%)	15 (23%)	41 (62%)
VA	77	All	8 (10%)	7 (9%)	62 (81%)
NY	68	All	9 (13%)	5 (7%)	54 (79 %)

A few studies have gathered site-specific data related to proximity of TCB roosts to roads. Zirkle (2002) successfully tagged and tracked 15 individual TCBs (3 adult males, 1 juvenile male, 8 adult females, 3 juvenile females) using radio-telemetry to 55 roosts in Kentucky. The objective was to quantify the characteristics of roost sites selected by TCBs during the summer. Results identified 9 TCB roost trees within 100 ft (30.5 m) of the road, 14 TCB roost trees 100-300 ft (30.5 m) from the road edge, and 32 TCB roosts beyond 300 ft (30.5 m) of the road. Zirkle (2002) found that distances to landscape features varied depending on the individual, with distance to road: mean = 392.55 ft (119.65 m) ± 252.85 ft (77.07 m).

Schaefer (2016) captured TCBs near Lakes National Recreation Area in western Kentucky and Tennessee for two summers and tracked 15 TCBs to their day roosts, collecting habitat characteristics data at 38 roost areas. A generalized linear model on all variables measured showed that increasing tree crown depth, distance from roads, and basal area of trees were correlated with roost tree selection (Schaefer 2016). According to Schaefer, “the odds were 11% higher that a site was used for roosting with every 164 ft (50 m) increase in distance from a road."

If additional site-specific data is gathered concerning proximity of bat roosts to roads in the future, the Service and Transportation Agencies will modify the analyses.

Year-Round Active Areas

In the southern portion of its range, NLEBs and TCBs exhibit shorter torpor bouts, remain active, and feed year-round. During the winter, NLEBs and TCBs may roost in cavities of live trees, and TCBs may roost in live and dead leaf clusters, and/or Spanish moss. Both bat species have also been known to winter roost in bridges, culverts, and other structures in these areas (Sandel et al. 2001, Newman et al. 2021).

Stressors

Impacts to forest within the Indiana bat’s range is one of the most common stressors attributable to transportation projects. Therefore, transportation projects may directly impact roosting, foraging, or swarming bats or alter their habitat through changes to baseline noise, lighting, air quality, water quality conditions, and habitat removal/destruction. The following sections will discuss the potential for impacts to the Indiana bat, NLEB, and TCB forested habitat from these stressors.

Stressor #1–Tree Removal/Trimming

Stressor Introduction–Tree Removal/Trimming

Transportation projects frequently require the clearing of trees. Tree clearing can have a variety of impacts on the Indiana bat, NLEB, and TCB depending on the quality, amount, location of the lost habitat, and the time of year of clearing. Transportation projects may contribute to a variety of stressors considered under this threat and may even result in injury or death to individuals.

Stressor Effects–Tree Removal/Trimming

The effects of tree removal/trimming may include:

1. Harm from:
    - Loss of roosts;
    - Alteration of habitat around remaining roosts;
    - Loss/fragmentation/degradation of summer roosting/foraging habitat;
    - Loss/fragmentation/degradation of spring emergence/fall swarming habitat; and
    - Loss/fragmentation/degradation of forested travel corridors.
2. Direct death/injury of individual bats from removal of occupied roost trees, especially when non-volant pups or hibernating individuals are present.

Indiana bat

Loss of Documented Maternity Roosts (during the inactive season)

Effects to Indiana bats may occur even if maternity roost trees are cleared during the hibernation period (inactive season). Determination of whether roost removal in the inactive season is likely to adversely affect Indiana bats is a matter of its scale (amount) and type (alternate/primary). A small percentage (2.0%) of known primary roosts occur within 100 ft (30.5 m) of roads (Table 5, Table 6). While agencies will try to avoid removal of documented roosts (identified through radio telemetry) and trees within 0.25 miles (0.4 km) around them whenever possible (including during the inactive season), in some circumstances this cannot be avoided. The loss of documented roosts in the inactive season is anticipated to cause returning Indiana bats to expend additional resources to find suitable alternative roosts (see further discussions below).

Loss of Unknown Maternity Roosts (during the inactive season)

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 alternate roosts being 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 endure regularly, the loss of multiple roosts in the inactive season, which could comprise most or all of a home range, likely stresses individual Indiana bats, affects reproductive success, and impacts the social structure of a colony (Service 2007). This section does not analyze the impact of loss of habitat within a home range (see Loss/fragmentation/degradation of summer roosting/foraging habitat/travel corridors for that discussion) but addresses loss of individual unknown roosts.

Kurta (2004) 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 any time of year 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% of the land cover. Bat and roost data was 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% of modeled roost loss resulted in >50% likelihood of colony fragmentation, whereas in 2010, 30% of modeled roost loss resulted in >50% 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 "[a]s the ephemerality of roost trees likely causes 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.

Removal of a known or unknown Indiana bat primary roost tree (that is still suitable for roosting) in the inactive season 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 inactive season is also expected to result in similar adverse effects.

Across the entire range of the Indiana bat, the Service estimates that less than 10% of existing maternity colonies are likely to have been detected (Service 2007).[60] Therefore, some risk exists that unknown primary roosts or multiple unknown alternate roosts will be removed as part of a transportation project.

Eastern forests[61] cover approximately 384,000,000 acres (155,399,287 ha) (nationalatlas.gov 2014). Based on past presence/probable absence surveys, and when considering the theoretical number of maternity colonies across the range of the Indiana bat not all forested habitat, and not even all suitable forested habitat, is occupied by this species. Therefore, in many cases, transportation projects will impact forests that are unoccupied by Indiana bats. However, State DOTs often infer species presence rather than fund presence/probable absence surveys. Some data is available (Table 5) to help assess the likelihood of Indiana bat roosts in varying proximities to existing transportation corridors.

Roosts are an ephemeral resource, and many will not be suitable in any given year. A small percentage (2.0%) of known primary roosts occur within 100 ft (30.5 m) of roads (Table 5, Table 6). This represents a small fraction of the number of available primary roost trees across the landscape (i.e., the vast majority of trees within 100 ft (30.5 m) of roads are not primary roosts). Given the low expected probability of primary roosts in proximity to existing roads, the likelihood that a viable primary roost is located within 100 ft (30.5 m) of an existing road on any given project location within a given year, is discountable. Therefore, across the entire range of the species and across all projects conducted by State DOTs/ Transportation Agencies, loss of primary roosts within 100 ft (30.5 m) of the road/rail during the inactive season is similarly discountable.

There is a greater likelihood that alternate roosts may occur within 100 ft (30.5 m) of an existing road. However, given the location and anticipated additional alternate roosts further from the roadside, the loss of an alternate roost within 100 ft (30.5 m) of the road/rail surface during the inactive season for a given maternity colony is not anticipated to result in any discernable effects (i.e., is insignificant) to the Indiana bat.

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[60] 534,239537,297 Indiana bats in the winter of 20139. Assuming a 1:1 ratio of females to males, there are 267,120268,649 females. Assuming an average maternity colony size of 60-80 females would result in 3,339358-4,451477 maternity colonies across the landscape. As of, 2007, we were aware of 269 colonies. Assuming another 50 colonies found since then brings us to ~320 colonies or 9.5%.

[61] All forest (not modeled as suitable or unsuitable for Indiana bats or NLEB).

The percentage of Indiana bat roosts located within 100 ft (91.4 m) from roads (mean distance to road of 1,831 ft [558.1 m]) is estimated to be 3.7%, while the percentage of Indiana bat roosts located within 300 ft (91.4 m) from roads is estimated to be 12.6% (see Table 5). Extending the analysis from 100 ft (30.5 m) to 300 ft (91.4 m) increases the likelihood that a project will intersect with a primary roost or secondary roosts to the point where it is no longer discountable. Thus, tree removal/trimming beyond 100 ft (30.5 m) of the road surfaces any time of year is expected to result in adverse effects.

Loss/fragmentation/degradation of summer roosting/foraging habitat/travel corridors

The Indiana bat requires forested areas for foraging and roosting. At a landscape level, Indiana bat maternity colonies occupy habitats ranging from completely forested to areas of highly fragmented forest (Service 2007). The presence of Indiana bats has not been shown to be correlated with high forest cover at the landscape or maternity colony scale. Gardner and Cook (2002) examined land cover in 132 counties in the U.S. with Indiana bat maternity colonies and found 20.5% deciduous forest, 3.4% other forest, and 75.7% agricultural land cover. Within 2.5 miles (4 km) of maternity roosts, forest cover ranges widely from 5 to 84% (mean of 38%) in Indiana and from 4 to 31% (mean of 18%) in Ohio (Service unpublished data). Clearly, forest cover is not a completely reliable predictor of where Indiana bat maternity colonies will be found on the landscape (Farmer et al. 2002). Observed home ranges for individual bats associated with maternity colonies also vary widely (205.1 to 827.8 acres [83 to 335 ha]) (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Kniowski and Gehrt 2014, Jachowski et al. 2014). Non-reproductive females and males have less restrictions on their habitat requirements given that they do not need to rear pups. Less information is available about their home range sizes. Presumably, focusing on maternity colonies will address the most important habitat needs of the species.

We also need to consider connectivity and availability of these forest patches to the Indiana bat. The minimum size of a forest patch that will sustain Indiana bat maternity colonies has not been established. However, in highly fragmented landscapes the loss of connectivity among remaining forest patches may degrade the quality of the habitat for Indiana bat (Service 2007). Patterson et al. (2003) noted that the mobility of bats allows them to exploit fragments of habitat. However, they cautioned that reliance on already diffuse resources (e.g., roost trees) leaves bats highly vulnerable, and that energetics may preclude the use of overly patchy habitats. Racey and Entwistle (2003) discussed the difficulties of categorizing space requirements in bats because they are highly mobile and show relatively patchy use of habitat (and use of linear landscape features), but that connectivity of habitats has some clear advantages (e.g., aid orientation, attract insects, provide shelter from wind and/or predators). Murray and Kurta (2004) demonstrated the importance of wooded travel corridors for Indiana bats within their maternity habitat in Michigan; they noted that bats did not fly over open fields but traveled along wooded corridors, even though use of these corridors increased commuting distance by over 55%. Sparks et. al. (2005) also noted the importance of a wooded riparian travel corridor to Indiana bats in the maternity colony at their study site in Indiana.

Carter et al. (2002) noted that, in their southern Illinois study area, Indiana bat roosts were in highly fragmented forests, but that both the number of patches and mean patch size of bottomland hardwood forest and closed-canopy deciduous forest were higher in the area surrounding roosts than around randomly selected points (i.e., Indiana bats were using the least fragmented forest blocks available to them in that landscape). In addition, they found that the mean patch size of bottomland forest within a 1.2-mile diameter circle surrounding roosts was 88.7 acres (35.9 ha), compared to 3.7 acres (1.5 ha) around random locations. Mean patch size of closed-canopy deciduous forest was 19.5 acres (7.9 ha) around roosts compared to 8.4 acres (3.4 ha) around random locations. In both cases, the difference was statistically significant.

This analysis shows that the likelihood of Indiana bats roosting in a particular forest patch increases with the size and connectivity of that forest patch. In landscapes dominated by agriculture or other non-forested cover types, Indiana bats may use all or most available forest patches as part of their home range and may be required to stretch their home range out far beyond 2.5 miles (4 km) from roosting areas. Kniowski and Gehrt (2014) suggest longer, or more frequent commuting bouts will be required by Indiana bats in highly fragmented landscapes, with smaller, more distant suitable habitat patches, to obtain similar resources compared to landscapes with larger, more abundant habitat patches. This has been observed directly in some locations. For example, in Ohio, radio tagged bats that have moved the farthest are those in the areas with limited forested cover. Several have gone 5 to 6 miles (8 to 9.7 km), and one bat flew straight-line distance of about 7 miles (11.3 km) but may have flown approximately 10 miles (16.1 km) (K. Lott, Service, pers. comm. 2015).

In a fragmented landscape, Indiana bats may have to fly across less suitable habitat. This could pose greater risk of predation (e.g., raptors). Indiana bats consistently follow tree-lined paths rather than cross large open areas (Gardner et al. 1991, Murray and Kurta 2004). Murray and Kurta (2004) found that Indiana bats increased their commuting distances by 55% to follow these paths rather than flying over large agricultural fields. However, if these corridors are not available, Indiana bats may be forced over open areas. For example, Kniowski and Gehrt (2014) observed Indiana bats flying across open expanses of cropland >0.6 miles (1 km) to reach remote, isolated woodlots or riparian corridors.

Although researchers have found it difficult to predict where maternity colonies may occur relative to forested habitat, researchers can reliably predict that once Indiana bats colonize maternity habitat, they will return to the same maternity areas annually (Service 2007). Philopatry of Indiana bat maternity colonies to their summer range is well documented. Indiana bats likely return to the same place each year whether there is enough habitat in the immediate vicinity to support a colony or not. Given the additional energy expenditures expected in fragmented landscapes, it is unclear as to the status of colonies at the lower end of the percent forest cover spectrum. Colonies may be smaller in size in areas with reduced forest. For example, in New York, maximum exit counts were <20 bats for trees with <30% forest cover within 2.5 miles (4 km) vs. >20 bats for trees with >30% forest cover within 2.5 miles (4 km) (unpublished data, New York Department of Environmental Conservation). Areas with higher percentages of forest cover are assumed to increase chances that suitable roost trees are present in sufficient numbers to support a colony.

Kurta (2005) noted that impacts on reproductive success of Indiana bats are a likely consequence of the loss of traditional roost sites. He suggested that reduced reproductive success may be related to stress, poor microclimate in new roosts, a reduced ability to thermoregulate through clustering, or reduced ability to communicate and thus locate quality foraging areas. He further suggested that the magnitude of these impacts would vary greatly depending on the scale of roost loss (i.e., how many roosts are lost and how much alternative habitat is left for the bats in the immediate vicinity of the traditional roost sites).

The impact of shifting flight patterns and foraging areas on individual bats varies. Recovery from the stress of hibernation and migration may be slower as a result of the added energy demands of searching for new roosting/foraging habitat especially in an already fragmented landscape where forested habitat is limited. Pregnant females displaced from preferred roosting/foraging areas will have to expend additional energy to search for alternative habitat, which would likely result in reduced reproductive success (failure to carry to full term or failure to raise pup to volancy) for some females. Females that do give birth may have pups with lower birth weights given the increased energy demands associated with longer flights, or their pups may experience delayed development. These longer flights would also be experienced by pups once they become volant which could affect the survival of these pups as they enter hibernation with potentially reduced fat reserves. Overall, the effect of the loss of roosting/foraging habitat on individual bats from the maternity colonies may range from no effect to death of juveniles. The effect on the colonies could then be reduced reproduction for that year. These effects are anticipated to be relatively short-lived as Indiana bats are anticipated to acclimate to the altered landscape.

In areas with WNS, there are additional energetic demands for Indiana bats. For example, WNS-affected bats have fewer fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Reichard and Kunz 2009, Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing.

The proposed action is linear and therefore tree clearing is not anticipated to remove entire potential home ranges, rather only sections of potential home ranges. Thus, depending on the position or orientation of the roadway within a maternity colony area, impacts from tree removal/trimming can vary significantly. If an unknown (assumed) Indiana bat maternity colony home range was centered along an existing road that is proposed for widening, there would be approximately 5 linear miles[62] (8 km) to consider for potential effects. If trees were contiguous for the entire distance and clearing occurred on both sides of the road (up to 100 ft [30.5 m] on each), that would be a total of 200 ft (61 m)

[62] 2.5-mile radius around center of home range

x 26,400 ft (8,047 m) or 5,280,000 square feet (sq ft) (490,528 square meters [sq m]) (121.1 acres [49 ha]). If trees were contiguous for the entire distance and clearing occurred on both sides of the road (up to 300 ft [91.4 m] on each), that would be a total of 600 ft (183 m) x 26,400 ft (8,407 m) or 15,840,000 sq ft (1,471,584 sq m) (363.6 acres [147 ha]).

This is an unlikely scenario for three reasons. First, the area within 300 ft (91.4 m) of road/rail surfaces is not expected to be 100% forested and therefore the entire areas is not likely to be suitable habitat. Second, a maternity colony home range centered along an existing roadway is generally not considered a likely scenario because of disturbance caused by road traffic and the opening created by the road (see Stressor #2 – Noise/Vibration). While openings provide increased solar exposure needed to meet the thermoregulatory needs of female bats and their newborn pups, females likely seek sites away from roadway disturbance (e.g., forest gaps, super-canopy trees) to establish maternity colony roosts. Finally, as stated in the Description of the Proposed Action, the estimated average annual tree clearing per State within 300 ft (91.4 m) of existing road/rail surface is approximately 320 acres (129.5 ha) and the maximum proposed acreage of clearing for any given project under this programmatic is approximately 20 acres (8.1 ha) (generally per 5-mile section of road/rail)[63] [as opposed to 363.6 acres for any given project per 5 linear miles (8 km) described above].

This programmatic includes projects with up to 20 acres (8.1 ha) of tree removal per 5-mile (8 km) section of road/rail. Given the available literature on average home range sizes of individual Indiana bats (Menzel et al. 2005, Sparks et al. 2005, Watrous et al. 2006, Kniowski and Gehrt 2014, Jachowski et al. 2014) of 205.1 to 827.8 acres (83 to 335 ha), 20 acres (8.1 ha) represents 2.4-9.8% of an individual home range for an Indiana bat. Colonies have larger home ranges than individual bats with areas of overlapping core roosting/foraging areas and areas that do not overlap. Some projects may be greater than 20 acres (8.1 ha) with approval from the Service that the effects of the actions fit within the programmatic consultation. Yet, the average acreage cleared per project between 2016 and 2022 was approximately 2 acres.

Tree removal/trimming in proximity to existing transportation corridors (i.e., within 100 ft [30.5 m] of road surfaces) will not likely result in any new habitat fragmentation. Few roosts are expected in proximity to existing corridors (see above) and new Indiana bat habitat fragmentation along existing transportation corridors is unlikely. However, a greater percentage of Indiana bat roosts (~13%) are located beyond 100ft (30.5 m) of road surfaces. Therefore, clearing of forest beyond 100 ft (30.5 m) of road surfaces, <u>even in the inactive season</u>, is likely to result in loss of roosting and foraging habitat such that additional habitat will need to be located.

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[63] Exceptions can be made on a case-by-case basis if the local Service Field Office confirms that the effects of the action do not exceed the impacts as anticipated in this PBO (e.g. the amount of tree removal still maintains sufficient roosting and foraging habitat within the home range of the covered bat species).

In the mixed wooded/agricultural landscape of Pike and Adams counties, Illinois, Menzel et al. (2005) observed Indiana bats using linear features like roadways and riparian corridors either as travel corridors or perhaps as part of their foraging ranges. In cases where there is a narrow tree corridor along a road and it is removed and there are few other forested corridors, patterns in foraging and traveling may be altered. In cases where work along the ROW decreases available forest but does not eliminate it, the remaining forest will allow for some continued use for foraging and travel. However, foraging is expected to be focused away from existing roads and away from any roadway expansions (see Stressor #2 – Noise/Vibration).

In conclusion, transportation projects involving tree removal/trimming during the inactive season within 100 ft (30.5 m) of existing roads (that do not remove documented habitat) are not anticipated to result in impacts to roosting and foraging habitat and/or commuting corridors that would then result in adverse effects to Indiana bats (i.e., effects are insignificant). However, tree removal/trimming beyond 100 ft (30.5 m) of existing roadways may result in greater fragmentation and reduction in available habitat. Thus, tree removal/trimming **any time of year beyond 100 ft** (30.5 m) is anticipated to result in adverse impacts to returning Indiana bats. In addition, tree removal/trimming of documented habitat is also anticipated to result in adverse effects to Indiana bats.

Loss/fragmentation/degradation of spring emergence/fall swarming habitat

Impacts to staging/swarming habitat are not well understood. It is assumed that impacts to staging/swarming habitat closer to a hibernaculum are likely more destructive than loss of forest miles away, but this has not been well established. From the Indiana Bat Recovery Plan (Service 2007):

> "[t]he habitat surrounding hibernacula may be one of the most important habitats in the annual cycle of the Indiana bat. This habitat must support the foraging and roosting needs of large numbers of bats during the fall swarming period. After arriving at a given hibernaculum, many bats build up fat reserves (Hall 1962), making local foraging conditions a primary concern. Migratory bats may pass through areas surrounding hibernacula, apparently to facilitate breeding and other social functions (i.e., bats that utilize the area for swarming may not hibernate at the site) (Barbour and Davis 1969, Cope and Humphrey 1977). Modifications of the surface habitat around the hibernacula can impact the integrity, and in turn the microclimate, of the hibernacula. Areas surrounding hibernacula also provide important summer habitat for those male Indiana bats that do not migrate, which is thought to be a large proportion of the male population. Loss or degradation of habitat within this area has the potential to impact a large proportion of the total population. This is particularly true for hibernacula supporting large numbers of bats, or areas that support multiple hibernacula that together support large numbers of bats. For example, four caves located in eastern Crawford County and western Harrison County in southern Indiana, within approximately 10 miles (16.1 km) of each other, harbored 128,000 Indiana bats during the 2005 hibernacula survey; this was 28% of the total range-wide population." p.80.

One site in north Missouri is known to harbor up to 123,000 Indiana bats (this is 25% of the total range-wide population) (Service unpublished data). The area of bat use around this site likely extends beyond that of other hibernacula that house a few hundred or a thousand individuals.

Similar to summer habitat impacts, in many cases, the scope of State DOT projects is unlikely to result in discernable modifications to available fall swarming/spring emergence habitat around hibernacula. No tree removal/trimming projects within 0.5 miles (0.8 km) of hibernacula are included as part of this programmatic consultation. This minimizes the likelihood of reducing important spring emergence/fall swarming habitat. However, tree removal/trimming activities are anticipated to occur outside 0.5 miles (0.8 km) of hibernacula. Across the range, projects with tree removal/trimming within 100 ft (30.5 m) of existing roadways during the inactive season are not anticipated to result in a reduction of fall swarming/spring staging habitat such that responses from Indiana bat are anticipated (i.e., discountable). Yet, tree removal/trimming beyond 100 ft (30.5 m) of existing roadways may result in greater fragmentation and reduction in available habitat. The maximum proposed acreage of clearing for any given project is approximately 20 acres (8.1 ha) per 5-mile (8 km) section of road/rail. This amount of tree removal/trimming is not expected to result in alterations of Indiana bat normal behavioral patterns in most instances and is therefore discountable. Some projects may exceed 20 acres (8.1 ha) if the action's effects do not exceed the impacts as anticipated in this programmatic and are verified by the Service.

NLEB

Loss of Documented Maternity Roosts (during the inactive season)

Similar to Indiana bats, adverse effects to NLEBs may occur even if maternity roost trees are cleared during the hibernation period (inactive season). For that reason, a determination of whether roost removal is likely to adversely affect NLEBs should be based on the amount of proposed tree removal/trimming. There are few documented NLEB roosts across the range and the likelihood of a transportation project intersecting with those roosts is low. However, should it occur, additional undocumented roosts may occur nearby and be removed during tree removal/trimming activities. Adverse effects to individual NLEB and their associated colonies are anticipated from loss of documented roosts and nearby undocumented roosts due to NLEBs needing to expend additional resources to locate new suitable roosts, and possible colony fragmentation that is anticipated to reduce colony fitness (see below for further discussion).

Loss of Unknown Maternity Roosts (during the inactive season)

Johnson et al. (2012) found that NLEBs form social groups among networks of roost trees that are often centered around 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). NLEBs form smaller social groups within a maternity colony and exhibit non-random roosting behaviors, with some female NLEBs roosting more frequently together than with others (Garroway and Broders 2007; Patriquin et al. 2010; Johnson et al. 2012).

Similar to Indiana bats, NLEBs 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). Roost trees, although ephemeral in nature, may be used by a colony for many 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 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 NLEBs must endure regularly, the loss of multiple roosts, which could comprise most or all of a home range, likely stresses individual NLEBs, 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 (see Loss/fragmentation/degradation of summer roosting/foraging habitat/travel corridors for that discussion) but addresses loss of individual roosts.

NLEBs are flexible in their tree species roost selection and roost trees are an ephemeral resource. Therefore, the species would be expected to tolerate some loss of roosts provided suitable alternative roosts are available. Silvis et al. (2014a) modeled the effects of roost-loss on NLEBs and then Silvis et al. (2015) removed known NLEB roosts during the winter to investigate the effects. Once removals exceeded 20–30% 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.

There is no GIS analysis similar to Indiana bats (see Roost Tree Locations in Proximity to Existing Roads section) to address the likelihood of NLEBs roosting in proximity to existing transportation corridors. However, since both Indiana bats and NLEBs are in the genus *Myotis* and are forest bats frequently co-occurring in the same habitats, we are using Indiana bats as a surrogate for NLEBs for the purpose of assessing the likelihood of roosts in proximity to roads. Given the low expected probability of central-node roost tree in proximity to existing roads, the likelihood that a viable central-node roost is located within 100 ft (30.5 m) of an existing road on any given project location within a given year, is discountable. Therefore, across the entire range of the species and across all projects conducted by State DOTs/ Transportation Agencies, loss of central node roosts within 100 ft (30.5 m) of the road/rail during the inactive season is similarly discountable.

There is a greater likelihood that node roosts may occur within 100 ft (30.5 m) of an existing road. However, given the location and anticipated additional node roosts further from the roadside, the loss of a node roost within 100 ft (30.5 m) of the road/rail surface during the inactive season for a given maternity colony is not anticipated to result in any discernable effects (i.e., is insignificant) to the NLEB., Extending the analysis out from 100 ft (30.5 m) increases the likelihood that a project will intersect with a central-node roost or a node roost to the point where it is no longer discountable. Thus, tree removal/trimming beyond 100 ft (30.5 m) of road surfaces any time of year is expected to result in adverse effects.

Loss/fragmentation/degradation of summer roosting/foraging habitat/travel corridors

Some portions of the NLEB range are more forested than others. In areas with less forest or more fragmented forests (e.g., western U.S. edge of the range, and some parts of central midwestern States) forest loss would be expected to reduce available habitat more than in heavily forested areas (e.g., Appalachians and northern forests). The impact of loss of roosting and/or foraging habitat within NLEB home ranges is expected to vary depending on the scope of removal. NLEBs are flexible in their tree species roost selection and roost trees are an ephemeral resource. Therefore, the species would be expected to tolerate some natural rate of loss of roosts provided suitable alternative roosts are available for roosting and foraging within the species home range.

In addition to potential disruption of colony networks (Silvis et al. 2015), removal of roosting and/or foraging habitat can result in longer flights for NLEBs to find alternative suitable habitat. NLEBs emerge from hibernation with their lowest fat reserves and return to their summer home ranges where they are familiar with roosting and foraging areas. Since NLEBs have summer home range fidelity (Foster and Kurta 1999, Patriquin et al. 2010, Broders et al. 2013), loss or alteration of forest habitat may put additional stress on females when returning to summer roost or foraging areas after hibernation if females were forced to find new roosting or foraging areas (expend additional energy).

Hibernation and reproduction are the most energy-demanding periods for temperate-zone bats like the NLEB (Broders et al. 2013). Further, flight is an energy-demanding mode of transportation (particularly for pregnant females). Bats may reduce costs of searching for food by concentrating their foraging in areas of known high profitability, a benefit that could result from local knowledge and site fidelity (Broders et al. 2013). Cool spring temperatures provide an additional energetic demand as bats need to stay sufficiently warm or enter torpor. Entering torpor comes at a cost with delayed parturition; bats born earlier have a greater chance of surviving their first winter and breeding their first year (Frick et al. 2009). Delayed parturition may be costly because young of the year and adult females would have less time to prepare for hibernation (Broders et al. 2013). NLEB females roost colonially with their largest counts in spring presumably, this is one way to reduce thermal costs for individual bats (Foster and Kurta 1999). In summary, NLEBs have multiple energetic demands (particularly in spring) and must have sufficient suitable roosting and foraging habitat available in close enough proximity to allow for successful reproduction.

In areas with WNS, there is additional energy demands for NLEBs. For example, WNS-affected bats have fewer fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Reichard and Kunz 2009, Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing. Mean NLEB home range sizes for individual females have been minimally estimated at 148.8 to 173.7 acres (60.2 to 72.3 ha) (Owen et al. 2003, Lacki et al. 2009). Carter and Feldhamer (2005) estimated roosting area size for NLEB at 460.4 acres (186.3 ha). In more forested regions, these home ranges may represent a small fraction of potentially available habitat, or there may be more NLEB in those areas with significant overlap or continuity of home ranges. In non-forested regions, this may represent a large percentage of the available habitat.

As previously explained for the Indiana bat, we do not expect a NLEB maternity colony to be centered along a roadway and therefore forest impacts are limited to some extent for each colony area. The estimated average annual tree clearing per State within 300 ft (91.4 m) of existing road/rail surface is approximately 320 acres (129.5 ha) and the maximum proposed acreage of clearing for any given project under this programmatic is approximately 20 acres (8.1 ha) per 5-mile section of road/rail)[64] [as opposed to 363.6 acres for any given project per 5 linear miles (8 km) described above in the scenario of a maternity colony home range being centered along a road,]. Given the available literature on home range sizes of individual NLEB of 148.8 to 173.7 acres (60.2 to 72.3 ha) (Owen et al. 2003, Lacki et al. 2009), 20 acres (8.1 ha) represents 11.5-13.4% of an individual home range for a NLEB. Colonies have larger home ranges than individual bats with areas of overlapping core roosting/foraging areas and areas that do not overlap. This consultation is intended to cover projects with smaller impacts to any given maternity colony. Some projects may be greater than 20 acres (8.1 ha) with approval from the Service that the effects of the actions fit within the programmatic consultation. Yet, the average acreage cleared per project between 2016 and 2022 was approximately two acres.

Tree removal/trimming close to existing transportation corridors (i.e., within 100 ft [30.5 m] of road/rail surfaces) will not result in any new habitat fragmentation. Few roosts are expected in proximity to existing corridors (see above) and so new NLEB habitat fragmentation along existing transportation corridors is unlikely. In cases where work along the ROW decreases available forest but does not eliminate it, the remaining forest will allow for continued use for foraging and travel. However, foraging is expected to be focused away from existing roads and away from any roadway expansions (see Stressor #2 – Noise/Vibration).

In conclusion, transportation projects involving tree removal/trimming during the inactive season within 100 ft (30.5 m) of existing roads (that do not remove documented habitat) are not anticipated to result in impacts to roosting and foraging habitat, and/or commuting corridors that would then result in adverse effects to NLEBs (i.e., effects are insignificant). However, tree removal/trimming beyond 100 ft (30.5 m) of existing roadways may result in greater fragmentation and reduction in available habitat.

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[64] Exceptions can be made on a case-by-case basis, if the local Service Field Office confirms that the effects of the action do not exceed the impacts as anticipated in this PBO (e.g. the amount of tree removal still maintains sufficient roosting and foraging habitat within the home range of the covered bat species).

Thus, tree removal/trimming in suitable habitat **any time of year beyond 100 ft** (30.5 m) is anticipated to result in adverse impacts to returning NLEBs. In addition, tree removal/trimming of documented habitat even within 100 ft (30.5 m) of road/rail surface) is anticipated to result in adverse effects to NLEBs.

Loss/fragmentation/degradation of spring emergence/fall swarming habitat

Impacts to staging/swarming habitat are even less understood for NLEB when compared to Indiana bats. It is assumed that the likelihood of impacts to staging/swarming habitat increases as they get closer to a hibernaculum, but this has not been well established. Given the small numbers of NLEBs wintering in most known hibernacula, less fall swarming/spring staging habitat would be expected to be required for NLEB when compared to Indiana bats. We have more to learn about whether many NLEB swarm around certain hibernacula before choosing their ultimate hibernation site. As researchers continue to learn more about NLEB spring and fall habitat needs, Transportation Agencies/the Service will revisit this analysis.

Similar to impacts to summer habitat, in many cases, the scope of State DOT projects is unlikely to result in discernable modifications to available fall swarming/spring emergence habitat around hibernacula. No tree removal/trimming projects within 0.5 miles (0.8 km) of hibernacula are included as part of this programmatic consultation. This minimizes the likelihood of reducing important spring emergence/fall swarming habitat. However, tree removal/trimming activities are anticipated to occur outside 0.5 miles (0.8 km) of hibernacula. Across the range, projects with tree removal/trimming within 100 ft (30.5 m) of existing roadways during the inactive season are **not** anticipated to result in a reduction of fall swarming/spring staging habitat such that responses from NLEBs are anticipated (i.e., discountable). Yet, tree removal/trimming beyond 100ft (30.5m) of existing roadways may result in some fragmentation and reduction in available habitat. The maximum proposed acreage of clearing for any given project is approximately 20 acres (8.1 ha) per 5-mile (8 km) section of road/rail. This amount of tree removal/trimming is not expected to result in alterations of NLEB normal behavioral patterns in most instances and is therefore discountable. Some projects may exceed 20 acres (8.1 ha) if the action's effects do not exceed the impacts as anticipated in this programmatic and are verified by the Service.

TCB

Loss of Documented Maternity Roosts (during the inactive season)

Effects to TCBs may occur even if maternity roost trees are cleared during the hibernation period (inactive season). Determination of whether roost removal in the inactive season is likely to adversely affect TCBs is a matter of its scale (amount) and type (suitable roost trees). Fidelity of TCB maternity colonies to their summer ranges is well documented (Service 2019, Service 2023). Although loss of a roost is a natural phenomenon (e.g., leaves fall off) that this species must endure regularly, the loss of multiple roost trees in the inactive season, which could comprise most or all of a home range in a forest-fragmented landscape, likely stresses individual TCBs, affects reproductive success, and impacts the social structure of a colony (Service 2007). As stated in the Service's SSA, we have "high confidence that these changes in landcover may be associated with losses of suitable roosting or foraging habitat, longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality (during active season tree removal). Despite this knowledge, we have uncertainty about how much forest removal must occur within a home range before impacts associated with winter tree removal are realized. We also have imperfect knowledge of where roosts (summer and winter) for TCB occur. Therefore, we have uncertainty about which colonies (summer and winter) are at greatest risk of impacts associated with habitat loss" (Service 2021). Throughout its range, many transportation projects will impact forest that is unoccupied by TCBs. However, for purposes of this programmatic consultation, Transportation Agencies often infer species presence rather than fund P/A surveys. Limited data suggest TCBs are unlikely to roost close to existing transportation corridors (see Section 5.2).

Depending on forest availability, pregnant females displaced from preferred summer habitat will have to expend additional energy to search for alternative habitat which may result in reduced reproductive success (failure to carry to full term or failure to raise pup to volancy). Females that do give birth may have pups with lower birth weights given the increased energy demands associated with longer flights, or their pups may experience delayed development. Overall, the effect of the loss of summer habitat on individual TCBs from the maternity colonies may range from no effect to death of juveniles. The effect on the colonies could then be reduced reproduction for that year.

Given the low expected probability of roost trees in proximity to existing roads, the likelihood that a viable roost is located within 100 ft (30.5 m) of an existing road on any given project location within a given year, is discountable. Therefore, across the entire range of the species and across all projects conducted by State DOTs/ Transportation Agencies, loss of roost trees within 100 ft (30.5 m) of the road/rail surface during the inactive season is similarly discountable (given the anticipated roost trees located further from the roadside).

Extending the analysis out from 100 ft (30.5 m) increases the likelihood that a project will intersect with roost tree to the point where it is no longer discountable. Thus, tree removal/trimming beyond 100 ft (30.5 m) from road surfaces any time of year is expected to result in adverse effects.

Loss/fragmentation/degradation of summer roosting/foraging habitat/travel corridors

TCBs rely on forested habitats for foraging and travel corridors. TCBs may be directly affected by forest habitat loss by removal of occupied roost trees (Belwood 2002; Service 2021). Removal of roosting and/or foraging habitat can result in longer flights for bats to find alternative suitable habitat. Individuals emerge from hibernation with their lowest fat reserves and return to their summer home ranges where they are familiar with roosting and foraging areas. Since these species exhibit summer home range fidelity (Foster and Kurta 1999, Patriquin et al. 2010, Broders et al. 2013), loss or alteration of forest habitat may put additional stress on females when returning to summer roost or foraging areas after hibernation if females were forced to find new roosting or foraging areas (expend additional energy). Hibernation and reproduction are the most energy-demanding periods for temperate-zone bats such as these species (Broders et al. 2013). Further, flight is an energy-demanding mode of transportation (particularly for pregnant females). Bats may reduce costs of searching for food by concentrating their foraging in areas of known high profitability, a benefit that could result from local knowledge and site fidelity (Broders et al. 2013). In a fragmented landscape, bats may have to fly across less suitable habitat. Recovery from the stress of hibernation and migration may be slower as a result of the added energy demands of searching for new roosting/foraging habitat especially in an already fragmented landscape where forested habitat is limited.

In areas with WNS, there are additional energetic demands for TCBs. For example, WNS-affected bats have fewer fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012, Warnecke et al. 2012) and have wing damage (Reichard and Kunz 2009, Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy, pup-rearing, and healing.

As previously explained in the Indiana bat and NLEB sections, we do not expect a TCB maternity colony to be centered along a roadway and therefore forest impacts are limited to some extent for each colony area. The estimated average annual tree clearing per State within 300 ft (91.4 m) of existing road/rail surface is approximately 320 acres (129.5 ha) and the maximum proposed acreage of clearing for any given project is approximately 20 acres (8.1 ha) per 5-mile section of road/rail)[65] [as opposed to 363.6 acres for any given project per 5 linear miles (8 km) described above in the scenario of a maternity colony home range being centered along a road, page 82]. With the reported home range sizes of individual TCBs of 420 acres (170 hectares) and 642 acres (260 hectares) (Wisconsin DNR 2018), 20 acres (8.1 ha) represents 4.7 – 3.1% of an individual home range for a TCB. Colonies have larger home ranges than individual bats with areas of overlapping core roosting/foraging areas and areas that do not overlap. This consultation is intended to cover projects with smaller impacts to any given maternity colony. Some projects may be greater than 20 acres (8.1 ha) with approval from the Service that the effects of the actions fit within the programmatic consultation. Yet, the average acreage cleared per project between 2016 and 2022 was approximately two acres.

Tree removal/trimming close to existing transportation corridors (i.e., within 100 ft [30.5 m] of road/rail surfaces) will not result in any new habitat fragmentation. Few roosts are expected in proximity to existing corridors (see above) and so new TCB habitat fragmentation along existing transportation corridors is unlikely. In cases where work along the ROW decreases available forest but does not

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[65] Exceptions can be made on a case-by-case basis if the local Service Field Office confirms that the effects of the action do not exceed the impacts as anticipated in this PBO (e.g. the amount of tree removal still maintains sufficient roosting and foraging habitat within the home range of the covered bat species).

eliminate it, the remaining forest will allow for continued use for foraging and travel. However, foraging is expected to be focused away from existing roads and away from any roadway expansions (see Stressor #2 – Noise/Vibration).

In conclusion, transportation projects involving tree removal/trimming during the inactive season are not anticipated to result in impacts to roosting and foraging habitat, and/or commuting corridors that would then result in adverse effects to TCBs (i.e., effects are insignificant).

Loss/fragmentation/degradation of spring emergence/fall swarming habitat

Impacts to staging/swarming habitat are not well understood. It is assumed that impacts to staging/swarming habitat closer to a hibernaculum are likely more destructive than loss of forest miles away, but this has not been well established. In many cases, the scope of projects within the programmatic consultation are unlikely to result in discernable modifications to available fall swarming/spring emergence habitat around hibernacula. Tree removal/trimming activities within 0.5 mile of a known TCB hibernaculum are not within the scope of this consultation.

Similar to impacts to summer habitat, in many cases, the scope of State DOT projects is unlikely to result in discernable modifications to available fall swarming/spring emergence habitat around hibernacula. No tree removal/trimming projects within 0.5 miles (0.8 km) of hibernacula are included as part of this programmatic consultation. This minimizes the likelihood of reducing important spring emergence/fall swarming habitat. However, tree removal/trimming activities are anticipated to occur outside 0.5 miles (0.8 km) of hibernacula. Across the range, projects with tree removal/trimming within 100 ft (30.5 m) of existing roadways during the inactive season are not anticipated to result in a reduction of fall swarming/spring staging habitat such that responses from TCBs are anticipated (i.e., discountable). Yet, tree removal/trimming beyond 100 ft (30.5m) of existing roadways may result in some fragmentation and reduction in available habitat. The maximum proposed acreage of clearing for any given project is approximately 20 acres (8.1 ha) per 5-mile (8 km) section of road/rail. This amount of tree removal/trimming is not expected to result in alterations of TCB normal behavioral patterns in most instances and is therefore discountable. Some projects may exceed 20 acres (8.1 ha) if the action's effects do not exceed the impacts as anticipated in this programmatic and are verified by the Service.

Direct Effects from Tree Removal/Trimming – Indiana bat, NLEB, and TCB

Impacts to Indiana bats, NLEBs, and TCBs from loss of forest would be expected to vary depending on the timing of removal, location (within or outside Indiana bat, NLEB, TCB home range), and extent of removal. While bats can flee during tree removal, the removal of occupied roosts (during spring through fall and year-round in some portions of the NLEB and TCB range) is likely to result in direct injury or mortality to some percentage of Indiana bats, NLEBs, and TCBs (Service 2021). The percentage would be expected to be greater if flightless pups or inexperienced flying juveniles were present (McAlpine et al. 2021).

Felling roost trees during the active season may result in adverse effects to Indiana bats, NLEBs, or TCBs. If bats are roosting in a tree that is cut down, bats may either stay in the tree and potentially be crushed or fly out (adults or volant pups) during the day and be 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 non-volant 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, impacts to 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. In particular, in the NLEB and TCB YR active range where they tend to roost in trees during cold temperatures (<4.5 °C or <40 °F), adults in winter torpor are less likely to escape.

The likelihood of potential roost trees containing a larger number of Indiana bats, NLEBs, and TCBs is greatest during pregnancy and lactation (April-July) with exit counts falling dramatically after this time. For example, two studies found NLEBs use of certain trees appears to be highest in the 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).

Direct effects to Indiana bats, NLEBs, and TCBs from tree removal/trimming associated with projects addressed in this consultation will frequently be avoided by means of inactive season tree removal, a TOY restriction during the pup season, and in the YR active range during winter torpor when temperatures drop below 4.5°C or 40°F. However, in some circumstances, tree removal/trimming during the active season cannot be avoided, particularly in portions of the NLEB and TCB range where they remain active on the landscape year-round (Figures 10 and 11). In fact, the consequences of occupied tree removal/trimming for adult NLEBs and TCBs in winter torpor (in YR active range) may be greater than for swarming/staging populations in other portions of the range because if trees are cut when bats are in torpor, they are less likely to arouse in time to safely exit their roost location. However, the likelihood of injury or death occurring is low because there are not many days in these areas with temperatures <4.5°C or 40°F (Jordan 2020).

As part of the proposed action for this programmatic consultation, the agencies have committed to avoiding the removal of documented habitat for the Indiana bat, NLEB, and TCB during the pup season and between December 15 and February 15 in suitable habitat within Zone 1 of the NLEB and/or TCB YR active ranges. The agencies have also committed to avoiding tree removal/trimming outside of documented habitat for the Indiana bat, NLEB, and TCB beyond 100 ft (30.5 m) from the road/rail surface during the pup season (Tables 11 and 12). Therefore, the months of active season tree removal/trimming will generally be limited to April, August, and September, with some tree removal/trimming occurring in October, November, and March in Zone 1 of the NLEB and/or TCB YR active ranges. This significantly reduces the likelihood of lethal impacts to the covered bat species by avoiding the period when Indiana bat, NLEB, and TCB colonies are most concentrated (largest colony counts in fewer trees) and young bats cannot fly; but these effects are not discountable when considering the number of projects that may happen throughout the range of the species as part of this programmatic. To date and moving forward, a minimum of 90% of tree removal/trimming projects using this consultation have been, and are expected to be, conducted during the inactive season. Furthermore, while tree removal/trimming within 100 ft (30.5 m) of the road/rail surface during the inactive season is not anticipated to result in any discernable effects (i.e., is insignificant) to the covered bat species, if these trees were felled during the active season, the potential for impacts while these bats are present is significant considering the number of project locations anticipated across the species' range within this programmatic consultation.

Given the generalist roosting behavior of TCBs, and the fact that they may be active on the landscape year-round in southern portions of their range, without negative P/A surveys, tree removal/trimming within suitable habitat of the TCB YR active range is considered likely to adversely affect the TCB.

AMMs–Tree Removal

Unless P/A surveys in suitable habitat document that the Indiana bat, NLEB, and TCB are not likely to be present, these AMMs are REQUIRED, as applicable.

Note: The word "trees" as used in the AMMs refers to trees that are suitable habitat for each species within their range.

Tree Removal/Trimming AMM 1. Modify all phases/aspects of the project (e.g., temporary work areas, alignments) to the extent practicable to avoid tree removal/trimming in excess of what is required to implement the project safely.

Tree Removal/Trimming AMM 2. Ensure tree removal/trimming is limited to that specified in project plans and ensure that contractors understand clearing limits and how they are marked in the field (e.g., install bright colored flagging/fencing prior to any tree removal/trimming to ensure contractors stay within clearing limits).

Tree Removal/Trimming AMM 3. Ensure tree removal/trimming is limited to the inactive season, occurs within 100 ft of the road/rail surface, and is outside of documented habitat.

Tree Removal/Trimming AMM 4. Avoid conducting tree removal/trimming outside documented habitat for the Indiana bat, NLEB, and TCB beyond 100 ft of the road/rail surface during the pup season.

Tree Removal/Trimming AMM 5. If removing/trimming trees outside documented habitat for the Indiana bat, NLEB, and TCB within 100 ft of the road/rail surface during the pup season, all trees removed/trimmed must be <9 in (22.9 cm) DBH.

Tree Removal/Trimming AMM 6. Avoid conducting tree removal/trimming within documented habitat for the Indiana bat, NLEB, and TCB during the pup season.

Tree Removal/Trimming AMM 7. Avoid conducting tree removal/trimming of suitable habitat in Zone 1 of the NLEB and/or TCB YR active ranges between December 15 – February 15[66].

Summary–Tree Removal

Forest loss may adversely affect bats if the effected forest patches include Indiana bat primary or multiple alternate roosts NLEB central-node roost trees, or TCB roosts. Rather than focusing on general forest loss, it is important to ensure that suitable roosts remain on the landscape.

For projects with inactive season tree removal/trimming outside of documented habitat for the Indiana bat, NLEB, or TCB within 100 ft (30.5 m) of the road/rail surface, the impact is expected to be insignificant and/or discountable (excluding the NLEB and TCB YR active range). Yet projects within documented habitat (anywhere) and outside documented habitat beyond 100 ft (30.5 m) from the existing road/rail surface have a greater likelihood of removing and fragmenting Indiana bat, NLEB, and TCB habitat across the range of the species. This is due to the greater likelihood that a project will intersect with an Indiana bat primary roost or secondary roost tree, NLEB central-node roost trees, or TCB roost trees to the point where the impact is no longer discountable. Indirect effects in the form of harm are possible from loss of maternity roosts; loss/fragmentation/degradation of summer roosting/foraging habitat/travel corridors; and the loss/fragmentation/degradation of spring emergence/fall swarming habitat, which is anticipated to cause returning bats to expend additional resources to find suitable alternative roosts. Therefore, tree removal/trimming beyond 100 ft (30.5 m) of the road/rail surface is expected to result in adverse effects.

In addition, there are projects with active season tree removal/trimming that may be unable to avoid direct impacts to the covered bat species, particularly within the YR active ranges for the NLEB and TCB. While bats can flee during tree removal/trimming, removal of occupied roosts in the active season is likely to result in direct injury or mortality to some percent of Indiana bats, NLEBs, and TCBs on the landscape. This percentage would be expected to be greater if flightless pups or inexperienced flying juveniles were also present. Direct effects to the covered bat species from tree removal/trimming within the active season will frequently be avoided within the species' pup season (Tree Removal/Trimming AMMs 4-6). Yet, with bats active on the landscape across such a large range, this programmatic consultation does not consider the removal of suitable habitat during the active season to be discountable. Therefore, any project that includes the clearing of suitable habitat during the active season of the covered bats species is considered likely to adversely affect the covered bat species

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[66] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.

Stressor #2–Noise/Vibration

Stressor Introduction–Noise/Vibration

Noise and vibration are stressors that may disrupt normal feeding, sheltering, and breeding activities of the Indiana bat, NLEB, and TCB. Many activities (sources) that increase noise/vibration (stressor) above existing background levels may affect the covered bat species. Anthropogenic activities, such as urban and traffic noise, constitute a major source of ambient noise on the landscape. For bats that use echolocation to detect prey, the reception of relevant echoes could potentially be impaired by high levels of background noise (Schaub et al. 2008). Yet, evidence also suggests that bats adjust echolocation call structure to avoid acoustic interference from background noise in their local environment (Schaub et al. 2008).

Activities (sources) Causing Stressor:

- Increase in capacity and/or speed from road expansion/new alignment (new lanes); or
- Percussive activities from construction or maintenance that increase noise/vibration above existing background levels, examples include, but are not limited to:
    - pile driving,
    - rock drilling,
    - hoe ramming,
    - jackhammering, and
    - blasting.

Stressor Effects–Noise/Vibration

Indiana bats, NLEBs, and TCBs may be exposed to noise/vibration from transportation activities near their roosting, foraging, or swarming areas. An individual's response to noise/vibration is dependent on the magnitude of the noise, the proximity of the individual to the source, and an individual's level of habituation to the stressor. No exposure to hibernating bats is anticipated from vibration and noise above existing background levels, as projects within 0.5 miles (0.8 km) of hibernacula are not included in this programmatic consultation. Also, percussive activities within suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that cause noise/vibration above existing background levels when conducted beyond 100 ft (30.5m) of the road/rail surface during the pup season for the covered bat species is outside the scope of this programmatic consultation. To eliminate the potential for NLEBs and TCBs in winter torpor to be exposed to this type of noise/vibration, percussive activities within suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that cause noise/vibration above existing background levels when conducted beyond 100 ft (30.5m) of the road/rail surface in Zone 1 of the NLEB and TCB YR active ranges between December 15 and February 15 are also not included in this programmatic consultation.

Significant changes in noise levels may result in temporary to permanent alteration of bat behaviors. The novelty of these noises and their relative volume levels will likely dictate the range of responses from individuals or colonies of bats. At low noise levels (or farther distances), bats initially may be startled, but they would likely habituate to the lower noise levels. At closer range and at louder noise levels (particularly if accompanied by physical vibrations from heavy machinery and the crashing of falling trees), bats may be startled to the point of fleeing from their day-time roosts and in a few cases may experience increased predation risk. Noise/vibration that continues for multiple days is likely to cause bats roosting within or close to these areas to shift their focal roosting areas further away from the noise or temporarily abandon these roosting areas.

Bunkley et al. (2015) evaluated activity levels of bats located 50 meters (164 ft) from the center of a natural gas compressor station in New Mexico. Compressor station noise ranged from about 65 dBA to 80 dBA at a frequency of 24 kilohertz (kHz). The authors found that bats using a call frequency below 35 kHz altered their activity levels, but bats using a call frequency above 35 kHz did not alter activity levels. Both Indiana bats and NLEBs have calls above 35 kHz, and TCB has calls >40 kHz, thus in this scenario we would not anticipate these bats to alter their activity levels.

There are some studies on potential effects of traffic noise on bats. For example, Schaub et al. (2008) found that captive greater mouse-eared bats (*M. myotis*) preferred (80% of the time) silent chambers versus chambers with playback of close traffic noise. In Schaub's controlled study, the bats avoided areas exposed to sources of intense noise, including that resembling noise of vehicular traffic (Schaub et al. 2008). The authors concluded that foraging areas within 50 meters of highways and presumably other sources of intense broadband noise "are degraded in their suitability as foraging areas for the greater mouse-eared bat" and that the number of vehicles would affect the intensity of the degradation. In addition, Luo et al. (2014) observed that bats reduced their foraging effort in conditions with traffic noise, even when traffic noise did not overlap with prey echoes. Bats abandoned feeding patches immediately after the start of noise playback, suggesting that they are avoiding the noise itself.

The impact of noise levels and their association with distance from road traffic has also been studied. Berthinussen and Altringham (2012) conducted acoustic studies along transects from 0-1,600 m (5,249 ft) of a major road in the United Kingdom and found that bat (*Pipistrellus pipistrellus, P. pygmaeus, Nyctalus* spp., and *Myotis* spp.) activity and species diversity increased with distance from the road along the entire 1,600 m. However, this could not be completely attributed to traffic noise. Noise levels decreased significantly with distance from the road, but 89% of the reduction in noise occurred in the first 164 ft (50 m) of the road and no reduction was detected beyond 328 ft (100 m). Other possible, but discounted reasons for decreased bat activity further than 328 ft (100 m), included light or chemical pollution (Berthinussen and Altringham 2012). Ultimately, they concluded that the most likely explanation was a barrier effect from the road itself (opening) or increased mortality because of collision.

Zurcher et al. (2010) appears to have found both a barrier effect and an effect from presence of vehicles. They observed bats (including Indiana bats) approaching roads in Indiana and found that when vehicles were present, 60% of bats reversed course without crossing the road at an average distance of 36 ft (11 m) from the road (range of 0 to 131 ft [0 to 40 m]) and the remaining 40% crossed. Estimated vehicle speed, height of bat, and noise levels had no effect. When vehicles were absent, 32% of bats reversed course and 68% crossed. In summary, even without vehicles present, a third of the bats reversed (barrier) but the presence of vehicles doubled this rate (vehicle noise/movement).

Indiana bats have also been noted to tolerate traffic noise and other effects from roads. During spring emergence studies in New York, biologists have documented roost trees within 640 and 680 ft (195 and 207 m) of I-81, 370 ft (113 m) of I-481, and 213 ft (65 m) of I-84 (Service 2008). Historically, Indiana bats were documented roosting within approximately 984 ft (300 m) of a busy State route adjacent to Fort Drum Military Installation (Fort Drum) (U.S. Army 2014). More recently, both Indiana bat and NLEB populations have declined around Fort Drum, presumably due to the effects of WNS. Yet, both species are still being detected acoustically on the installation. Also, Hendricks et al. (2004 unpublished report) documented three male Indiana bats in a roost located along a railroad track in Missouri. This roost site experiences high noise levels from trains passing on an irregular schedule. In addition to roosting in areas with noise disturbance, Indiana bats have been documented foraging in similar situations (numerous studies are summarized in Belwood 2002 and Service 2016). Additionally, while hibernating bats are presumed to be vulnerable to increased noise, a laboratory study found that bats quickly acclimated to repeated and prolonged noise, such as the noise from nearby traffic (Luo et al., 2014).

In another study near I-70 and the Indianapolis Airport, a primary maternity roost was located 1,970 ft (601 m) south of I-70 (3D/International, Inc. 1996). This primary maternity roost was not abandoned despite constant noise from the Interstate and airport runways. However, the roost’s proximity to I-70 may be related to a general lack of suitable roosting habitat in the vicinity and the noise levels from the airport were not novel to the bats (i.e., the bats had apparently habituated to the noise) (Service 2002). Therefore, it is not definitive that Indiana bats will shift or abandon their roosts because of adjacent disturbances. Given the relatively poor environment created along larger, paved roads with significant traffic volume, vegetated areas immediately adjacent to existing roads are not anticipated to provide ideal habitat for bats, although some will continue to roost there.

See GIS Analysis in Tables 5 and 6 for more information on known location information for Indiana bat roosts compared to roads.

In addition to traffic noise, the Service and Transportation Agencies assessed available literature for effects from other noise sources on Indiana bats and NLEBs. Gardner et al. (1991) had evidence that Indiana bats continued to roost and forage in an area with active timber harvest. However, the results of this study suggested that noise and exhaust emissions from machinery could possibly disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment. Callahan (1993) noted the likely cause of the bats in his study area abandoning a primary roost tree was from disturbance associated with a bulldozer clearing brush adjacent to the tree. However, his last exit count at this roost was conducted 18 days prior to the exit count of zero.

Several past construction projects on Fort Drum were carried out adjacent to multiple known Indiana bat roosts. Construction around project sites has been ongoing off and on for multiple years during the active season but has not seemingly appeared to affect known roosts or Indiana bat behavior. The last known capture and roosting locations were within approximately 800 and 400 m of construction, respectively. A military installation in general has large amounts of noise and disturbance, and these bat species continue to occupy Fort Drum.

No specific auditory data relating to disturbance of Indiana bats, NLEBs, or TCBs is available in the current literature. However, little brown bats, a closely related species, are sensitive to sound between 10 and 130 kHz, with their greatest sensitivity being between 35 and 40 kHz (Dalland, 1965; Grinnell, 1963). A previous biological assessment for Indiana bats found that construction equipment in Fort Leonard Wood, Missouri, generated sound in the 0.025-to-20-kHz range, with peak frequencies less than 0.125 kHz (Montgomery Watson and 3D/I, 1998). Thus, while bats can hear the higher frequencies of such sounds, peak frequencies of most construction equipment noise are expected to be well below the frequency range audible to bats. While it is reasonable to infer that some Indiana bats and NLEBs, as well as TCBs, may be temporarily disturbed by noise and vibration from maintenance activities, construction activities, and some road expansion within or directly adjacent to previous roosting habitat, bats are likely to become habituated to the noise/vibration.

Noise and vibrations associated with new transportation corridors is expected to result in some changes to bat behaviors, and combined with the loss of forest habitat, a shift in roosting behavior away from a newly constructed corridor would be anticipated. Given that this programmatic consultation does not include the construction of new transportation corridors (roads, rails) but only addresses the construction and maintenance of existing corridors and some road/rail expansion, this programmatic consultation will not consider the effects of noise/vibration from new transportation corridors.

AMMs–Noise/Vibration

The proposed action excludes vibration and noise above existing background levels within 0.5 miles of a hibernacula. The proposed action also excludes percussive activities within suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that cause noise/vibration above existing background levels when conducted beyond 100 ft (30.5m) of the road/rail surface <u>during the pup season</u> for the covered bat species. Further, within Zone 1 of the NLEB and TCB YR active ranges, percussive activities within suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that cause noise/vibration above existing background levels when conducted beyond 100 ft (30.5m) of the road/rail surface between December 15 and February 15 are not included in this programmatic consultation. These avoidance measures minimize impacts to the covered bats species during their most sensitive time periods. Thus, no AMMs in addition to the tree removal/trimming and bridge, culvert, and structure AMMs (that address temporary noise/vibration) are required to further reduce the likelihood of responses to stressors associated with noise and vibration.

Summary–Noise/Vibration

With the proposed action, no effects are expected to hibernating Indiana bats, NLEBs, or TCBs (inactive season), covered bats in the pup season (beyond 100 ft [30.5 m]), nor NLEBs and TCBs in winter torpor of Zone 1 within their YR active ranges (beyond 100 ft [30.5 m]) because noise/vibration near these important seasonal bat roosting areas or during this sensitive time period is outside the scope of this programmatic consultation. Therefore, we are left to assess potential impacts to the covered bat species during the active season (excluding the pup season), and NLEBs and TCBs that are active on the landscape in the YR active ranges.

Indiana bats, NLEBs, and TCBs that are currently present in proximity (within 100 ft [30.5 m]) to existing transportation corridors are expected to be habituated to the existing noise and vibration levels (or have already modified their behaviors to avoid them). Therefore, noise/vibration from the operation, construction, and maintenance of existing transportation corridors is not expected to result in any discernable response by bats that are already roosting or foraging in these areas. Further, data shows that the likelihood of bats roosting within 100 ft (30.5 m) of the road/rail surface is low (see Roost Tree Locations in Proximity to Existing Roads section). Therefore, percussive activities within suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that cause noise/vibration above existing background levels when conducted within 100 feet (30.5 m) of the road/rail surface during the active season is NLAA the covered bat species.

Temporary noise/vibration above existing background levels from percussive activities associated with construction or maintenance of existing transportation corridors, as well as an increase in noise as a result of increased capacity and/or speed from road expansion/new alignment has the potential to impact bats roosting beyond 100 ft [30.5]) of the existing road/rail surface, as bats in these areas are not as accustomed to noises/vibration. However, due to the limited scope of road expansion/new alignment under this programmatic consultation, and based on the studies above, we expect the covered bat species to only temporarily shift to adjacent roosting areas from these activities. As such, percussive activities within suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that cause noise/vibration above existing background levels when conducted beyond 100 feet (30.5 m) of the road/rail surface during the active season (excluding the pup season and Zone 1 of the NLEB and TCB YR active areas) are NLAA the covered bat species.

Stressor #3–Lighting[67]

Stressor Introduction – Lighting

Increased artificial lighting may be a stressor to the Indiana bat, NLEB, and TCB. There are two activities (sources) associated with transportation projects that may result in an increase of artificial lighting.

Activities (sources) Causing Stressor:

- Temporary Lighting (construction lighting); and
- Replacement/new permanent lighting (e.g., bridge, culvert, or structure, roads, interchanges, rest stops, trails).

Stressor Effects – Lighting

Bat behavior may be affected by the presence of artificial lights when traveling between roosting and foraging areas. Foraging in lighted areas may increase the risk of predation or it may deter bats from flying in those areas all together. Bats that significantly alter their foraging patterns may increase their energy expenditures resulting in reduced reproductive rates. This depends on the context (e.g., duration, location, extent, type) of the lighting.

Some bats seem to benefit from artificial lighting, taking advantage of high densities of insects attracted to light. For example, 18 species of bats in Panama frequently foraged around streetlights, including slow-flying edge foragers (Jung and Kalko 2010). However, seven species in the same study were not recorded foraging near streetlights. Bat activity differed among the color of lights, with higher activity at bluish-white and yellow-white lights than orange light. Bat activity at streetlights varied for some species with season and moonlight (Jung and Kalko 2010). In summary, this study suggests highly variable responses among species to artificial lighting.

Some species appear to avoid lighted areas. Downs et al. (2003) found that lighting of *P. pygmaeus* roosts reduced the number of bats that emerged. In Canada and Sweden, *Myotis s*pp*.* and *Plecotus auratus* were only recorded foraging away from streetlights (Furlonger et al. 1987, Rydell 1992). Stone et al. (2009) found that commuting activity of lesser horseshoe bats (*Rhinolophus hipposideros*) in Britain was reduced dramatically, and the onset of commuting was delayed in the presence of high-pressure sodium (HPS) lighting. Stone et al. (2012) also found that light-emitting diodes (LED) caused a reduction in *Rhinolophus hipposideros* and *Myotis s*pp. activity. In contrast, there was no effect of lighting on *P. pipistrellus*, *P. pygmaeus,* or *Nyctalus/Eptesicus* spp.

While there is limited information regarding potential neutral, positive, or negative impacts to Indiana bats from increased light levels, slow-flying bats such as *Rhinolophus* spp*., Myotis* spp*., and Plecotus* spp.

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[67] See glossary for definition.

have echolocation and wing-morphology adapted for cluttered environments (Norberg and Rayner 1987). They emerge from roosts relatively late when light levels are low, probably to avoid predation by diurnal birds of prey (Jones and Rydell 1994). Therefore, it would be expected that Indiana bats would avoid lit areas. In Indiana, Indiana bats avoided foraging in urban areas and Sparks et al. (2005) suggested that it may have been in part due to high light levels. Using captive bats, Alsheimer (2012) also found that the Indiana bat and NLEB's congeneric little brown bat was more active in the dark than light. Overall, for the covered bat species the effects of lighting seem to be neutral or negative.

AMMs–Lighting[68]

Lighting AMM 1. Direct temporary lighting away from suitable habitat during the active season.

Lighting AMM 2. When installing new/additional permanent lighting or replacing existing permanent lights, use downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting); or for those Transportation Agencies using the BUG system developed by the Illuminating Engineering Society,[69] the project should be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable.

Summary–Lighting

Given that agencies may need to use artificial lighting temporarily during construction/maintenance activities, install new/additional permanent lighting, or replace existing permanent lighting in some situations, there is a potential for Indiana bats, NLEBs, or TCBs to be affected if the light levels are above existing baseline light conditions. For projects without any construction lighting or with temporary lighting used in the inactive season, no effects to the covered bat species are anticipated. For projects that include the replacement of existing permanent lighting that is not substantially different than baseline light conditions, no effects to the covered bat species are anticipated. For projects with temporary lighting used during the active season or in YR active area where the lighting is directed away from suitable habitat, the lighting is not likely to adversely affect Indiana bats, NLEBs, or TCBs.

For projects with new/additional permanent lighting, or the replacement of existing permanent lighting that may be substantially different than baseline light conditions (e.g., introduction of lighting into an area not previously lit or an increase in the number of lights), there may be an affect to Indiana bats, NLEBs, or TCBs. If such lighting can be installed using downward-facing, full cut-off lens lights (or for those Transportation Agencies using the BUG system developed by the Illuminating Engineering Society,[70] lighting is to be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable), and directed away from forest habitat completely (e.g., only toward non-forested right of way or roadway), the lighting is not likely to adversely affect either covered bat

[68] See glossary for definition.
[69] http://www.escolighting.com/PDFfiles/BUG_rating.pdf
[70] http://www.escolighting.com/PDFfiles/BUG_rating.pdf

species. However, if new/additional permanent lighting is substantially different than baseline light conditions and cannot be installed in this manner, further consultation with the Service is required.

Stressor #4 – Alteration of Clean Drinking Water, Foraging Habitat, and Composition of Insect Prey Base

Stressor Introduction–Water/Foraging Habitat Alteration

Loss or fragmentation of forest foraging habitat is addressed above. This section addresses impacts to wetlands and other water features that also serve as clean water sources and foraging habitat for Indiana bats, NLEBs, and TCBs.

Transportation projects may alter available drinking water sources or foraging habitat from a variety of activities. For example, there may be permanent loss from wetland and/or stream fill. Construction or maintenance projects may also temporarily reduce water quality from dust and sedimentation and from the application of road salts or other de-icing materials. Bats may be exposed to chemicals from transportation activities near their roosting or foraging areas. They may drink contaminated water sources or forage in affected areas with the potential to eat insects that have been exposed to chemicals (e.g., petrochemicals, deicers). Foraging bats may be directly exposed to chemicals (e.g., herbicides) if applied while bats are flying; however, no herbicide application occurs at night by Transportation Agencies/State DOTs.

Activities that reduce the quantity or that alter the qualities of water sources and foraging habitat may impact bats, even if conducted while individuals are not present. However, the extent of project impacts, often coupled with standard BMPs, are anticipated to result in insignificant impacts. Many activities (sources) may result in an alteration of clean drinking water or foraging habitat (stressor) that could result in effects to bats.

<u>Activities (sources) Causing Stressor:</u>
The following activities (sources) may cause stressors that could result in direct or indirect effects to the covered bat species (depending on timing of activity):

- Loss/fragmentation of drinking water and/or aquatic foraging habitat:
    - Wetland fill, and
    - Stream crossing (piping).
- Alteration of drinking water and/or aquatic foraging habitat and/or degradation of aquatic invertebrate communities:
    - Hot rock exposure – causes acidification of water (see below):
        - Excavation, and
        - Blasting.
    - Activities that expose bare soil (sedimentation/dust):
        - Excavation,
        - Vegetation removal,

        - Grubbing,
        - Grading, and
        - Blasting.
    - Deicers:
        - Road maintenance, and
        - Bridge alteration.
    - Herbicides:
        - Vegetation management,
        - Invasive species management, and
        - Establishment/maintenance of wetland mitigation sites.
    - Alteration (spills):
        - Road construction,
        - New bridge construction,
        - Vehicle and equipment-use (petrochemicals),
        - Refueling (petrochemicals),
        - Bridge alteration (e.g., paint), and
        - Emergencies/accidents – address through emergency consultation.
- Direct effects to the covered bat species (ingestion of contaminated water or insects):
    - Any of the activities listed above.

Stressor Effects–Water/Foraging Habitat Alteration

Wetland Fill/Stream Crossing

During construction of new transportation corridors (outside scope of this programmatic) or expansion of existing corridors, wetlands or other water bodies may be filled. Streams may be filled, piped, or relocated. Filling of water bodies that are under the jurisdiction of the USACE or State permitting agency require separate permits and often include mitigation projects.

Hot Rock Exposure

Some geologic formations across Pennsylvania (and perhaps other portions of the Indiana bat, NLEB, or TCB range) include forms of acid-bearing rocks. During excavation, there is the potential to encounter these rocks, which could lead to the acidification of water. Pennsylvania Department of Transportation follows their Acid-Bearing Rock Policy to reduce risk of environmental impacts. Projects with any hot rock exposure will be coordinated with the local Service Field Office pursuant to ESA Emergency Consultation procedures.

Sedimentation

Temporary effects on water quality could occur during construction, which could reduce local insect populations. Insects associated with aquatic habitats make up part of the diet of Indiana bats, NLEBs, and TCBs. Therefore, impacts to water quality may result in temporary, short-term indirect effects on foraging bats during spring, summer, and autumn. BMPs will minimize erosion and subsequent sedimentation, thus reducing potential impacts on aquatic ecosystems.

Temporary measures will be incorporated into all projects to protect water quality during construction. However, it is still possible to have periods where erosion and sedimentation may cause short-term declines in aquatic insect populations in adjacent wetlands, ponds, and other water bodies. Since potential impacts from sedimentation are expected to be localized, foraging bats should have alternative drinking water and foraging locations. The surrounding landscape will continue to provide an abundant prey base of both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential direct effects to Indiana bats, NLEBs, or TCBs from a reduction in water quality are anticipated to be insignificant.

Dust

The creation of airborne dust by construction equipment is likely to occur in all earth moving projects. The magnitude of dust is dependent on many factors, including humidity, wind velocities and direction, and location of soil disturbances. Dust will be created during the spring, summer, and autumn when bats are roosting in adjacent forested habitats and possibly foraging throughout the project corridor. Any potential effects from dust would be very local within and immediately adjacent to the corridor. The implementation of dust control strategies and presence of adjacent vegetation will eliminate or greatly reduce the settling distance. It is very unlikely that dust created from construction would drift into a roost where an Indiana bat, NLEB, or TCB is roosting.

Dust is known to coat adjacent vegetation, thus possibly reducing insect production locally along a narrow band; this may result in decreased foraging opportunities adjacent to the road. Data are not available for the effect of dust on bats. However, contractors will implement dust control strategies (i.e., watering down disturbed soil) during construction activities and any potential effects to the covered bat species from dust are anticipated to be insignificant.

Deicers

Snow and ice control operations are conducted in accordance with any local guidelines. Activities associated with snow and ice control include plowing snow and ice from the road and applying both salt and liquid solutions to provide safe driving conditions. The plowing of snow and ice from the road is restricted to the pavement and adjacent shoulders. Since this activity will occur during cold, snowy weather conditions primarily during winter, it will have no direct or immediate effect on the Indiana bat, NLEB, or TCB. The bats will be hibernating during this period and will not be active.

Once the snow and ice melts, deicing agents would be carried from the roadway and shoulders by surface water. While some of this diluted salt and liquid solution will be filtered from surface water by vegetated shoulders and swales and constructed stormwater treatment facilities, some will settle out in surface water areas, especially wetlands. This could occur in any of the adjacent wetlands, ponds, or streams. State DOTs only use the required number of deicing agents to provide safe road conditions and often pre-treat roads before snowfall events occur. This proactive treatment will result in smaller amounts of deicing agents used. Deicing agents have been documented as having short-term effects on aquatic macroinvertebrates depending on dilution rates. Although direct lethal effects of salt contamination are probably restricted to near-road areas, sublethal effects are well known, particularly for sensitive organisms or sensitive life stages (Findlay and Kelly 2011). Long-term impacts to herbaceous roadside vegetation are possible. For example, increased sodium and chloride levels were associated with increased growth of *Typha angustifolia* and decreased vegetation diversity in calcareous fens in Illinois. The increased sodium and chloride levels were linked to home septic systems and roads (Panno et al. 1999). Greater impacts from deicing agents would be expected on isolated wetlands because of less dilution opportunities. Even though application of deicing agents will occur during the winter, potential indirect effects to Indiana bats, NLEBs, and TCBs, if they occur, would be during the spring and summer foraging periods. Deicing agents are not expected to reach levels to affect most aquatic insects, but it is possible that some pollution intolerant species could be temporarily eliminated from the affected surface waters. If this occurs and they are species that Indiana bats, NLEBs, or TCBs consume as prey, it could then result in a short-term indirect effect on foraging behavior. However, the covered bat species are considered selective opportunistic foragers and thus would likely be able to locate additional aquatic and/or terrestrial insects nearby. These bats are also not anticipated to frequently forage along many existing roads (see Stressor #2 – Noise/Vibration).

<u>Herbicides</u>

Herbicides may be used to control weed species including noxious or invasive plants throughout ROWs. Treatment of targeted plant species will result in a reduction in the amount and frequency of mowing activities. In addition, herbicides are used to control vegetation in site-specific areas, such as around signposts, guardrails, among others. Treatments typically occur in spring, early summer, or fall. Herbicide application is generally applied once during the year either by hand or from a truck-mounted boom sprayer having spray heads designed to minimize drift. Application occurs during the day when bats are roosting, and often in the morning to avoid and minimize wind-induced drift. Since herbicide will be applied to vegetation growing at heights much lower than typical roosts for Indiana bats, NLEBs, and TCBs, no overspray is expected to reach locations where bats may be roosting.

It is possible that some non-water safe herbicide could accidentally get into surface waters from either overspray or drift, which may affect bat's drinking water and/or cause bats to ingest chemicals through drinking or through bioaccumulation from eating affected insects. However, this is very unlikely due to the minimal amounts of herbicide (one treatment/year) generally used to remove unwanted vegetation from ROWs, especially from around all highway structures within the maintained ROW. Herbicide application is only one of several methods used to control weeds within ROWs. Alternative methods include manual and mechanical removal and biological treatments. In addition, all herbicides will be used in accordance with their label instructions and herbicides applicators will be appropriately licensed. Effects from herbicide exposure or indirect effects to insects (prey) consumed by the bats are insignificant and discountable, very unlikely to occur, or cannot be detected or measured.

<u>Spills</u>

Accidents during project operation could result in the leakage of hazardous chemicals into the environment which could affect water quality resulting in reduced densities of aquatic insects that bats consume. If an accident occurred and hazardous chemicals leaked into the environment, a rapid response from State and/or Federal agencies would limit the size of the spill area. However, if chemicals did reach surface waters (streams and wetlands), a short-term reduction in both aquatic and terrestrial insects could occur, thus reducing the spring, summer, or autumn prey base for foraging Indiana bats, NLEBs, or TCBs. If this occurred, it would be localized, thus allowing bats to move nearby and continue foraging. Because the goal of many projects is to make the road safer a reduction in overall accidents should be less, and the likelihood of an accident involving chemicals greatly reduced. The effects of a possible accident involving leaking hazardous chemicals are unlikely to occur.

AMMs–Water/Foraging Habitat Alteration

No AMMs are required to further reduce likelihood of response to stressors associated with water/foraging habitat alteration.

Summary–Water/Foraging Habitat Alteration

In summary, all State DOTs/Transportation Agencies follow State and/or Federal wetland permitting, stormwater management, and water quality standards. Implementation of the standard BMPs (e.g., minimization of wetland fill, implementation of erosion control measures) is expected to provide continued clean water and aquatic foraging habitat for the covered bat species.

Even if there are minor water quality changes that cause a temporary, localized reduction in prey base and drinking resources for the Indiana bat, NLEB, and TCB, Transportation Agencies presume that the surrounding landscape will continue to provide an abundant prey base of both terrestrial and aquatic insects during project construction, operation, and maintenance. Therefore, any potential direct effects to the covered bat species from a reduction in water quality are anticipated to be insignificant.

Stressor #5–Alteration of Clean Air (Slash Pile Burning)

Stressor Introduction– Slash Pile Burning

Slash pile burning may result in smoke (stressor), which may cause direct effects to the Indiana bat, NLEB, and TCB. Slash piles may be burned where permitted by law.

Activities (sources) Causing Stressor:

- Vegetation disposal:
    - Slash pile burning.

Stressor Effects–Burning

Impacts from heat are not expected given that slash piles are contained within open ROWs and are not placed directly under roosts. However, smoke during the active season or close to an occupied roost tree in the YR active range can affect bats. If the fire is small and far enough from roosts, no discernable effects are anticipated. However, if the fire is larger or closer to roosts and winds are in the direction of roosts, there is a greater risk of smoke inhalation. The proximity of a burn pile to an active roost is unlikely, and all fires should be very small in size so as not to reduce road visibility. Small slash piles would be expected to burn over a shorter duration and a large quantity of smoke would be necessary to disturb any roosting bats to the point they would flush.

Burns carrying over into the night are anticipated to increase luminance levels and produce smoke. Smoke and nighttime lighting have the potential to disturb foraging bats. However, effects from smoke and nighttime lighting will primarily occur inside an area devoid of vegetation (for fire precautions). We do not anticipate the covered bat species will use unvegetated areas for foraging and as a result are unlikely to be affected by the smoke and nighttime lighting. Therefore, effects of burning and nighttime lighting on Indiana bats, NLEBs, and TCBs are expected to be discountable.

AMMs–Burning

No AMMs are necessary to avoid exposure of Indiana bats, NLEBs, and TCBs to the stressor associated with burning.

Summary–Burning

Given that slash pile burning is localized, controlled, and located away from trees, no discernable effects to Indiana bats, NLEBs, or TCBs are anticipated. In addition, the likelihood of smoke resulting in fleeing or causing harm or death is low because it would have to occur close to an occupied roost tree (Jordan 2020).

Stressor #6–Collision

Stressor Introduction–Collision

Collision is a stressor that may directly kill or injure Indiana bats, NLEBs, and TCBs. State DOT/ Transportation Agency activities (sources) may increase the risk of collision (stressor) to the covered bat species.

<u>Activities (sources) Causing Stressor:</u>

- Road/rail widening - increasing capacity and/or speed.
- new alignment (new travel lanes)

Stressor Effects–Collision

Increased vehicular collision risk may occur to the Indiana bat, NLEB, and TCB from road/rail widening or new roadway/railway alignments. Widening road/rails and new alignments allow for additional vehicles, which would increase the odds of collision. Realignments are typically to improve road safety (e.g., straightening a curve), which may allow for slight increases in speed and thus a greater likelihood of collision. The covered bats may be killed or injured if they collide with vehicles when traveling between roosting and foraging areas. Further, while there may be a risk of collision between bats and vehicles on existing roads/rails, the trigger for consultation/coordination is a change in the existing baseline condition. If there are sites with documented fatalities from vehicle collision that are not covered by an existing consultation, they are outside of this programmatic consultation.

Vehicular collision has been documented for Indiana bats and other *myotids*. Indiana bats do not seem particularly susceptible to vehicle collisions, but it may threaten local populations in certain situations (Service 2007). Russell et al. (2009) assessed the level of mortality from vehicle collisions on a bat colony in Pennsylvania where a major highway separated roosting habitat from the primary foraging areas. Fatalities of 29 individual bats (3 *Myotis* species) were recorded due to vehicle collision. Actual number of fatalities was likely higher due to the difficulty in finding bat carcasses (Ramalho et al. 2021; Russell et al. 2009). Collision has been documented for other *myotids* in Europe. The most abundant bat species killed crossing roads in Europe are: *M. nattereri, M. daubentonii, Eptesicus serotinus, Plecotus auritus, Nyctalus noctula, Barbastella barbastellus, and Pipistrellus pipistrellus sensu lato* (Lesinski et al. 2011).

Collision risk to bats varies depending on time of year, location of road/rail in relation to roosting and foraging areas, the characteristics of their flight and habitat use during flight, traffic volume, traffic speed, and whether young bats are dispersing (Lesinski 2007, Lesinski 2008, Russell et al. 2009, Bennett et al. 2011). In the Czech Republic, Gaisler et al. (2009) noted most bat fatalities were associated with a road section between two artificial lakes. Lesinski (2007) evaluated road kills in Poland and determined that the number of young-of-year bats killed was significantly higher than adults. Also, low-flying gleaners (*M. daubentonii*) were killed more frequently than high-flying aerial hawkers (*N. noctula*). Foraging behavior for the NLEB is hawking and gleaning (Brack and Whitaker 2001, Fenton and Bogdanowicz 2002, Ratcliffe and Dawson 2003, Feldhamer et al. 2009). Indiana bat's foraging behavior is described as aerial hawking (Fenton and Bogdanowicz 2002). TCBs exhibit slow, erratic, fluttery flight while foraging (Fujita and Kunz 1984).

It can be difficult to determine whether roads/rails pose a greater risk for bats colliding with vehicles or a greater likelihood of deterring bat activity in the area. As discussed in Stressor #2 – Noise/Vibration, roads may serve as a barrier to bats (Bennett and Zurcher 2013, Bennett et al. 2013, Berthinussen and Altringham 2012, Wray et al. 2006). Bennett et al. (2011) indicated that three main road characteristics contribute to the barrier effects of roads: traffic volume, road width, and road surface. Roads with very few vehicles and only two lanes had little effect on Indiana bat movement (Bennett et al. 2013). Zurcher et al. (2010) concluded that bats perceive vehicles as a threat and were more than twice as likely to reverse course if a vehicle was present than if it was absent. Berthinussen and Altringham (2012) found that bat activity and diversity was lower closer to roads, but that activity and diversity increased where there was continuity in trees and hedgerows.

Kerth and Melber (2009) studied barbastelle bats (*B. barbastellus*) and Bechstein's bats (*M. bechsteinii*) and found that roads restricted habitat accessibility for bats, but the effect was related to the species' foraging ecology and wing morphology. Foraging ecology of gleaning and woodland species was more susceptible to the barrier effect than high-fliers that feed in open spaces (Kerth and Melber 2009).

Russell et al. (2009) noted that when bats crossed at open fields, they flew much lower than canopy height (<2 m), and when adjacent canopy was low, bats crossed lower and closer to traffic than where tree canopies were higher. The NLEB forages at lower heights (1 to 3 m) than Indiana bats (2 to 30 m) (Service 2014). During migration, Indiana bats may fly at or below the canopy level (Meinke et al. 2010, Turner 2006), although fatalities of Indiana bats during late summer and fall at wind turbine facilities indicates that migration heights are higher than canopy level. Data from summer mist-net surveys and wind turbine projects suggest that TCBs may fly very high during fall migration (Taucher et al. 2012). Observations of TCBs report they emerge early in the evening and forage at treetop level or above (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116), but may forage closer to ground later in the evening (Mumford and Whitaker 1982). To minimize bat collision, several studies suggested maintaining canopy connectivity across the road by restoring or establishing commuting routes (treelines, hedgerows) (Wray et al. 2006, Bennett and Zurcher 2013). While maintaining canopy connectivity may help minimize collision, we expect this approach would be most feasible for smaller roads but anticipate the risk of collision on smaller roads is lower due to less traffic.

AMMs–Collision

No AMMs are required to reduce exposure to the stressor associated with collision. Projects that raise the road/rail profile above the tree canopy in documented habitat for the Indiana bat, NLEB, and/or TCB are outside the scope of this programmatic consultation.

Summary–Collision

Although studies have shown that roads may serve as a barrier to bats and there is low likelihood that individuals of these covered bat species are roosting and foraging near roadways because noise levels are high or habitat availability is low, collision risk should still be evaluated for road/rail widening, new alignments, and newly elevated road/rail profiles near suitable habitat. Risk of collision appears to increase where canopy connectivity has been disrupted and there are no safe bat commuting routes across the road/rail corridor, or where bats use streams as travel corridors across roadways/railways. Collision risk may also be higher in areas with extensive existing road/rail networks where bats have few options but to cross roads/rails to reach their foraging areas. Thus, the Service anticipates that bats may be struck by vehicles and killed or fatally injured.

5.3 Resource #2–Bridges/Culverts (Artificial Roosts)

Occurrences of Bats in Bridges or Culverts

Twenty-four of the 45 U.S. species of bats have been documented using bridges, culverts, and other structures as artificial roosts (Keeley and Tuttle 1999), including Indiana bats, NLEBs, and TCBs. Bats roosting in bridges during the day are often found in expansion joints and other crevices; in contrast, night bat roosts are often found in open areas between support beams that are protected from the wind (Keeley and Tuttle 1999). Indiana bats have been documented roosting under bridges in at least seven states: Indiana (Kiser et al. 2002, A. King, Service, pers. comm. 2010), Ohio (A. Boyer, Service, pers. comm. 2010), Kentucky (J. MacGregor, KY Department of Fish and Wildlife Resources, pers. comm.), Iowa (Benedict and Howell 2008), Tennessee (D. Pelren, Service, pers. comm. 2014), West Virginia (B. Douglas, Service, pers. comm. 2010), and North Carolina (Lauren Wilson, Service, pers. comm. 2023). NLEBs have been documented using bridges in at least five states: Illinois (Feldhamer et al. 2003), Louisiana (Ferrara and Leberg 2005), Iowa (Benedict and Howell 2008), Tennessee (J. Griffith, Service, pers. comm. 2014), and Mississippi (McCartney et. al., 2024); culverts in at least five states: Indiana (Indiana (R. McWilliams, Service, pers. comm. 2023), Oklahoma (Martin, K. 2005), Mississippi (McCartney et. al., 2024), Missouri (Droppelman 2014), and Tennessee (J. Griffith, Service, pers. comm. 2014). TCBs have been documented using bridges in at least three states: Louisiana (Ferrara and Leberg 2005), South Carolina (Newman 2020), and Minnesota (Christopher E. Smith, MnDOT, pers. comm. 2023), and culverts in southeastern states along the Gulf of Mexico and Atlantic coastlines.

Between October 2006 and April 2011, there were 878 observations of Indiana bats roosting in a bridge over the West Fork of the White River in Indiana. Indiana bats were documented during every month except January and February. This bridge is 15 miles (24.1 km) from one of the largest hibernacula in the state and is 25 miles (40.2 km) from 12 other hibernacula (Cervone and Yeager 2016). In 2017, a maternity colony was documented using a bridge in Tippecanoe County, Indiana. This is the first documented Indiana bat maternity colony found using a bridge. The bridge is a single span concrete bridge with expansion joints that run parallel with the span. The underside of the bridge is approximately 8 ft (2.4 m) above the surface of the water. In 2021, Indiana bat maternity use was found at a bridge in southern Indiana. Monitoring in the summer of 2022 showed peaks of nearly 100 Indiana bats in July. Bats used areas of spalled concrete and vertical faces of support beams and corners where beams and diaphragms intersected (R. McWilliams, Service, pers. comm, 2023).

In September 2014, 66 Indiana bats were documented in a metal culvert approximately 180 ft (54.9 m) long by 9 ft (2.7 m) high under four lanes of I-65 in Clark County, Indiana. The culvert was re-inspected in May 2016 and there was no documentation of bats; however, in mid-August 2016, approximately 12 to 15 bats were counted. The culvert was recently inspected in mid-August and early September 2023 (after the new structure was built and additional travel lanes added) and documented 60 and 107 Indiana bats, respectively. Biologists assume bats are using the culvert as a migration stopover rather than a summer roost (R. McWilliams, Service, pers. comm. 2023). The surrounding landscape is a mix of agriculture, rural neighborhoods, forest blocks, and riparian areas.

Benedict and Howell (2008) quantified bridges used for night-roosting in Iowa in 2005 and 2006. Of the 37 bridges visited, 6 Indiana bats were documented. Five of the six Indiana bats were found under concrete bridges, the other Indiana bat was found using a steel bridge. Five of the six were males and the female was found under a concrete bridge. All the bridges passed over a creek or river with trees along the riparian edge.

In Tennessee, one Indiana bat was tracked from its hibernaculum to a bridge in west Tennessee in 2014. It apparently utilized the bridge as a temporary roosting site in transition to a likely maternity colony in Benton County, Tennessee.

West Virginia has two documented locations of Indiana bats using bridges as a roost; one Indiana bat was documented using a smaller two-lane “older” style bridge near the Monongahela National Forest with minimal traffic (B. Douglas, Service, pers. comm. 2010), and a bachelor (male) colony has been established under a four-lane highway with concrete cells underneath. The bachelor colony is located under a span between a pier and abutment. The span is “cave-like,” built into a hillside, and is enclosed on three sides. The four-lane highway bridge receives heavy traffic, including large trucks that create loud noise and strong vibrations. However, it spans a mid-sized stream and small country road with minimal noise or disturbance. Likely the key factor is the level of disturbance below the bridge/roost site. This bachelor colony has been documented from summer through December (B. Douglas, Service, pers. comm. 2013).

In western North Carolina, many *Myotis* species of bats (Indiana bat, little brown bat, eastern small-footed bat [*Myotis leibii*], gray bat [*Myotis grisescens*], and NLEB, as well as big brown bats, TCBs, and Mexican free-tailed bats (*Tadarida brasiliensis*) have been found roosting in bridges (Susan Cameron, Service, pers. comm. 2023).

NLEBs and TCBs have been found using bridges as roosts, including the following types of bridges: parallel box beam, pre-stressed girder, cast-in-place, and I-beam. Feldhamer et al. (2003) surveyed 232 bridges in southern Illinois and found four species of bats using 15 bridges. NLEBs comprised <3% of the bats found and TCBs comprised 18.4% of the bats found. In Louisiana, Ferrara and Leberg (2005) documented seven NLEBs and 79 TCBs out of 902 bridges surveyed in 2002 to 2003 (4% and 45% of total bats detected, respectively). Of 53 bridges surveyed at night, only 15% were occupied, and the only species was Rafinesque’s big-eared bat (*Corynorhinus rafinesquii)* (i.e., the seven NLEBs and 79 TCBs detected were using the bridges as day roosts). However, Kiser et al. 2002 reported NLEBs using bridges as night roosts as well. Analysis of guano in 2023 at a bridge in northern Indiana found NLEB DNA (R. McWilliams, Service, pers. comm. 2023).

Of the 37 bridges visited in Benedict and Howell’s study in 2005 and 2006 in Iowa (2008), two NLEBs were found under two different concrete bridges (one was a lactating female; the sex of the other was not clear in the report). Also, a NLEB bachelor colony using a timber bridge was found in Iowa in 2013 (K. McPeek, Service, pers. comm. 2014). At about the onset of WNS-associated declines in Minnesota, two bridges, including one being used as a maternity roost, were documented to have NLEBs in 2017 and 2018. NLEBs have not been verified using these two bridges since 2018 (Christopher E. Smith, MnDOT, pers. comm. 2023).

Katzenmeyer (2016) conducted a comprehensive assessment of culverts and box bridges in Mississippi between November and March from 2010 to 2015. Although neither Indiana bats nor NLEBs were observed, the survey recorded five other bat species and their abundance in 16 caves and 214 culverts.

Over the five-year period, 3,789 roosting bats were recorded in caves and 16,812 were detected in culverts, with TCBs and southeastern myotis (*Myotis austroriparius*) most abundant. More recently, as part of the 2023 Mississippi Bats and Bridges Initiative, 113 culverts and 33 bridges were surveyed in seven Mississippi counties from late August – October. Twenty-nine culverts and three bridges were occupied by NLEBs (representing a 26% and 9% occupancy rate respectively out of the total number of culverts/bridges surveyed) in six counties (McCartney et. al., 2024). A total of 76 NLEBs were documented in the 29 culverts and three bridges, with 18 of the culverts containing one individual each. Thirteen of the sites contained two – five individuals each and one site (a bridge) contained 17 individuals.

In Missouri, a bat survey conducted for a mine tailings impoundment associated with the Brushy Creek Mine in Reynolds County documented two NLEBs using a 250 ft (76.2 m) long corrugated metal culvert pipe for roosting. This pipe culvert carries Lick Creek under County Road 908 and is 9 ft in diameter (Droppelman 2014). Survey results in Tennessee indicated that NLEBs have no preference in roosting sites. In addition to bridges and culverts, the survey documented NLEBs in barns, porches, mobile homes, and telephone poles when potential roost trees were nearby and available (J. Griffith, Service, pers. comm. 2014). Data collected across the state of North Carolina show no evidence that NLEBs are using culverts in the state, though most surveys, until recently, were limited to culverts measuring 5 ft tall by 200 ft long. The following species were documented using culverts as roosting sites in North Carolina: gray bat, TCB, big brown bat, Mexican free-tailed bats, and Rafinesque's big-eared bat. Further, five survey efforts for NLEBs in bridges and culverts in Eastern North Carolina have failed to detect the species roosting in these structures.

Visual diurnal and nocturnal surveys of selected culverts (>36-in diameter) were conducted along Dry Creek/Daytown Road in Delaware County, Oklahoma on September 16, 2005. A solitary male NLEB was noted in one culvert (CD17) located in the northern portion of the project. No other bats were noted during the surveys (Martin, K. 2005). Additional assessments from 2010 through 2023 in 10 counties in Oklahoma have found NLEBs, TCBs, cave myotis, big brown bats, and gray bats roosting in culverts (P. Crawford, ODOT, pers. comm.)

TCBs utilize both bridges and culverts in many parts of the range, and they have been detected in both structure types at all times/seasons of the year. Bridges do not appear to be commonly used as hibernation sites throughout much of the range, although some states have detected TCBs in weepholes/plugged drains in the winter, on the edges of metal under decking, and occasionally in expansion joints. In the southern portion of the range where TCBs exhibit shorter torpor bouts and remain active and feed year-round, most states have reported that TCBs are more common in culverts than bridges overall, but especially in the winter. Several other states have reported TCBs hibernating in culverts extensively, with rare instances of culvert use in the summer. However, most surveys are biased to colder months.

On cooler days, tree cavities are consistently colder than bridges due to poor insulation, and trees may pose a greater freezing risk than bridges to bats. TCBs that used tree roosts did so on warmer days, but often switched to bridges on cooler days. The daily mean temperature of tree roosts when occupied was 11 +/- 4.6°C in accessible tree cavities, with temperature fluctuations of and 4.0 +/- 1.9°C (Newman et al. 2021). Bridges likely were warmer than cavities during cold periods as a result of solar radiation and concrete's high thermal mass. Therefore, bridges could provide predictable microclimates for TCBs to use during periods of increased freezing risk (Newman et al. 2021).

TCBs usage of nontraditional roost sites such as bridges and cavities can vary with ambient temperatures and among roost structures (Newman et al. 2021). TCBs hibernating in Texas culverts are believed to select roosts based on microclimate (Meierhofer et al. 2022) and potentially proximity to other roosts and suitable summer habitat (Sandel et al. 2001). Meierhofer et al. (2022) suggested ambient weather conditions, including humidity, determine occupancy of culverts by TCBs. In culvert hibernacula in Texas, maximum and minimum temperatures ranged from -6 to 27°C for 1995–1996 and -1 to 29°C for 1996–1997 (Sandel et al. 2001). TCBs were more likely to be present in culverts at lower elevations and lower temperatures (Meierhofer et al. 2019).

TCBs along the southeastern Gulf of Mexico and Atlantic coastlines exhibit different strategies in the winter when compared to northerly parts of their range, often roosting in roadway culverts in the states of North Carolina (Katherine Etchison, Service, pers. comm. 2023); South Carolina (J.B. Kindel, South Carolina Department of Natural Resources, pers. comm. 2023); Georgia (Ferrall 2022, Lutsch 2019); Alabama (Jessica Anderson, unpublished data 2022); Florida (Lisa Smith et. al 2022); Mississippi (Cross, 2019, Katzenmeyer 2016); Louisiana (Nikki Anderson, Louisiana Department of Wildlife and Fisheries, pers. comm. 2023); and Texas (Meierhofer et. al 2021, 2019; Sandel et. al 2001). A study in South Carolina also indicated that TCBs overwintering in bridges display skin temperatures similar to short-term torpor bouts rather than traditional hibernation.

Ferrara et al (2005) studied bridge use by bats in north-central Louisiana and reported that TCBs were rarely observed during the summer by represented approximately 5% of the bats during winter (November to March). Colony abundance in culverts can exceed 1,000 individuals, as observed in Mississippi and Texas, but other states report many, low abundance colonies at a high occupancy frequency, as observed by Ferrall (2022) in Georgia, with winter culvert occupancy rates of 32% (N=369) and as high as 52% in Mississippi (Katzenmeyer 2016). Considering the high exposure of culvert, tree, and bridge roosts during winter months, this behavior appears to be limited to areas with mild winters and few frost days. Generally, winter roosting in these exposed areas is contained within zones where mean minimum temperatures for December through February are generally warmer than 35-40°F (1.7-4.4°C) with some large culvert roosts located within 50-100 kilometers north of this zone (Figure 9).

Bridge/Culvert Characteristics

Many studies have documented the characteristics of bridges and culverts being used as artificial roosts by bats to determine roosting potential. Kiser et al. (2002) identified bridges built with concrete girders being used by Indiana bats and NLEBs ranged from 45.9 to 223 ft (14 to 68 m) in length, and 26.2 to 39.3 ft (8 to 12 m) in width. All the bridges were over streams and all, but one bridge was bordered by forested, riparian corridors connected to larger forested tracts. The riparian forest was within 9.4 to 16.4 ft (3 to 5 m) of the bridges. Traffic across the bridges ranged from less than 10 vehicles per day to almost 5,000 vehicles per day.

In Keeley and Tuttle's 1999 study, structures surveyed showed that ideal roosting characteristics for most bat species using artificial roosts include concrete structures with crevices that were sealed at the top, at least 6-12 in deep, 0.5 -1.25 in wide; 10 ft or more above the ground; and typically, not located over busy roadways. The Feldhamer et al. 2003 study reported an average height for 9 of the roosts were 16.7 ft (5.1 m) above the ground. They did not note if any species showed a preference for a bridge type, or if any maternity or bachelor colonies were discovered.

Cleveland and Jackson (2013) reported bats (species unreported) roosting in 55 of 540 bridges examined in Georgia. Bats were found in 78% (43 of 55 roost bridges) of roost bridges with transverse crevices, but only 7.2% (4 of 55 roost bridges) were found in roost bridges with parallel crevices and 7.2% (4 of 55 roost bridges) of roost bridges with a combination of transverse and parallel crevices. All roost bridges either spanned water or were within 0.62 miles (1 km) of water. Roost bridges had open flyways with at least 6.56 ft (2 m) under their roost.

Ormsbee et al. (2007) noted that the largest numbers of night-roosting bats are often located in the warmest chambers of bridges, which tend to occur at either end and are located over land. Whereas central chambers over water are less suitable (as a result of greater exposure to air currents and convective heat loss). Adam and Hayes (2000) also reported higher occupancy in end chambers than center chambers. Feldhamer et al. (2003) reported that when occupied bridges in Southern Illinois spanned flowing water, areas of the bridge that were occupied by bats were situated over land. However, the 2023 Mississippi Bats and Bridges Initiative survey documented three bridges occupied by the NLEB that were cement prestressed girder structures located over relatively wide rivers (> 100 ft) that are tributaries to the Mississippi River, with two of the bridges located over the same river four miles apart.

An evaluation of 44 culverts in the Netherlands determined lowest height and cross-sectional area amenable to bats are 0.4 m (1.3 ft) and 1.2 m^2 (3.9 ft^2), respectively (Boonman 2011). Also, 15 box culverts along Interstate Highway 45 in southeast Texas documented southeastern bat, TCB, and big brown bat in culverts varying from 1.2-2.2 m (3.9-7.2 ft) in height, 1.2-1.8 m (3.9-5.9 ft) in width, and 60-120 m (197-394 ft) in length, commonly with standing water and entranceway vegetation (Smith and Stevenson 2015). In New Mexico, 2016 unpublished data from Smith and Stevenson documented minimum culvert heights of 0.6 m (2 ft) and .93 m (3 ft) for *Myotis* spp. and *Corynorhinus townsendii*, respectively.

Katzenmeyer 2016 study of 214 culverts in Mississippi documented 111 of the culverts (smallest size being 30 ft [9.14 m] long and 2 ft [0.61 m] tall) being used for winter roosting by five different bat species: Rafinesque's big-eared bat, southeastern myotis, big brown bat, TCB, and Brazilian free-tail bat. All five species were detected in culverts as short as 109 ft (33.4 m) long, but only TCBs were found in smaller culverts (smallest being 30 ft [9.14 m] long and 2 ft [0.61 m] tall). The culverts occupied by NLEB in the 2023 Mississippi Bats and Bridges Initiative survey were all cement box culverts ranging in length from 40 – 400 ft long and 2 – 12 ft high and wide.

In September 2014, 66 Indiana bats were documented in a metal culvert measuring approximately 180 ft (54.86 m) long by 9 ft (2.74 m) tall in Clark County, Indiana. Georgia has documented the species in only one culvert state-wide. Georgia Department of Natural Resources reports that Indiana bats were found winter roosting with TCBs in a concrete pipe culvert that perpendicularly intersects a triple box culvert. The pipe culvert measured 4 ft (1.22 m) tall and 50 ft (15.24 m) long; however, all bats enter the box culvert first, which measured 8 ft (2.44 m) tall and runs 504 ft (153.62 m) long (L. Pattavina & E. Ferrall, University of Georgia, pers. comm. 2022). Culvert records are limited for the Indiana bat.

A July 2014 survey in Missouri found two NLEBs in a culvert with an entrance measuring approximately 9 ft in diameter and a Google Earth length estimate of 250 ft (76.2 m) (Droppelman, 2014; L. Droppelman, Eco Tech, pers. comm. 2022). Winter 2014 surveys in Louisiana by Richard Steven documented NLEBs in seven concrete tube and box culverts ranging in size from 4.5 ft to 10.5 ft (1.36 m to 3.2 m) tall and 131 ft to 476 ft (40 m to 145 m) long. NLEBs co-occurred in these culverts with southeastern myotis, TCBs, Rafinesque's big-eared bat, and big brown bats (Nikki Anderson, unpublished data, March 23, 2022). The Louisiana Department of Wildlife and Fisheries has surveyed more than 1,000 culverts over three winters and found TCBs in 21% of them. Summer surveys of a much smaller number of culverts found the species in about 4% of surveyed culverts. The shortest length culvert occupied by TCBs was 23.3 ft (7.1 m) long and 5 ft (1.52 m) tall (Nikki Anderson, unpublished data, March 24, 2022).

In 2020, the U.S. DOT Volpe National Transportation Systems Center (Volpe Center), on behalf of FHWA, in collaboration with the Service, conducted an analysis of bridge, culvert, and structure bat assessment forms that had been uploaded through the IPaC system between 2016-2019. Data was also provided by Georgia Department of Natural Resources from bat assessment forms across the state. The information from both sources was combined to create a "bats in structures assessment form database" that contains a total of 2,378 assessments. Evidence of bats (all species) was reported from 260 assessments (Table 8). Where evidence of bats was observed, 184 assessments (71%) included information on the species present (Table 9). While Indiana bats and NLEBs have been observed using bridges and culverts, none were reported in this analysis.[71] However, TCBs were documented using both bridges and culverts.

[71] Not all Transportation Agencies identify the bats species when bat occupancy or signs of bat use are observed.

Table 8. Evidence of Bats in Bridges and Culverts (2015-2019)

Assessment Type	Total Bat Evidence Entries	% of Assessments with Bat Evidence
Bridge (n=1,148)	84	7.3%
Culvert (n=689)	140	20.3%
Unknown (n=541)	36	6.7%
Total: (n = 2,378)	*260*	

Table 9. Bats Species Identified from Volpe's Bats in Structures Assessment Form Database

Bat Species Name	Bat Species Acronym	# of Database Entries Identifying the Species
tricolored bat	PESU	101
southeastern myotis (*Myotis austroriparius*)	MYAU	64
big brown bat (*Eptesicus fuscus*)	EPFU	45
Mexican or Brazilian free-tailed bat (*Tadarida brasiliensis*)	TABR	11
Rafinesque's big-eared bats (*Corynorhinus rafinesquii*)	CORA	7
gray bat (*Myotis grisescens*)	MYGR	5
eastern red bat (*Lasiurus borealis*)	LABO	2
little brown bat (*Myotis lucifugus*)	MYLU	1
evening bat (*Nycticeius humeralis*)	NYHU	1
	Total:	*237*[72]

An additional analysis was conducted using the bats in structures assessment form database to assess how culvert size might influence the presence of bats. Of the 689 culverts assessed, 154 (23%) were associated with culvert size data, and of those 53 indicated presence of bats (see Table 11 for more detail). Where evidence of bats was observed in culverts with a reported height, 100% also reported species information; as noted above, none of the species identified included Indiana bat or NLEB. Yet, TCBs were documented at 25 of the 53 culverts with presence of bats. Of the 53 culverts with bat use, the minimum culvert height was 2 ft (0.60 m) (one culvert), and the maximum was 9 ft (2.74 m). TCBs were found in the minimum and maximum culvert heights. Only three culverts of the 53 with evidence of bats were under ≤3 ft (0.91 m) in height (southeastern myotis and TCB); three culverts were less than 4 ft (1.22 m) in height (southeastern myotis and TCB); the remaining 47 culverts with documented use of bats were ≥ 4 ft (1.22 m) in height (southeastern myotis, TCB, Rafinesque's big-eared bat, and gray bat).

[72] Note this total exceeds 184 assessments because an assessment may have identified multiple species.

Table 10. Culvert Assessments with Size Data.

Culvert Assessment	Size Information Included?	Number of Culverts	Percent of Total
No Evidence of Bats	No	448	65%
	Yes	101	15%
Evidence of Bats	No	87	13%
	Yes	53	8%
Total:		*689*	*100%*

Table 11. Evidence of Bats in Culvert with Reported Size.

Culvert size class (reported height)	Culverts with No Evidence of Bats	Culverts with Evidence of Bats	Percent of Size Class with Evidence of Bats	Total number of Culverts	Percent of Total
Under 4ft	34	6	15%	40	26%
4ft and above	67	47	41%	114	74%
Total:	*101*	*53*		*154*	*100%*

TCB surveys conducted in January, February, April, and August 2023 along 2.6 miles of road in Caldwell County, North Carolina, in the Grandfather Ranger District, Pisgah National Forest included an assessment of 29 culverts. Nine culverts were inspected internally by two biologists crawling on hands and knees. The remainder of the culverts were inspected externally, from their inlets/outlets with high-lumen flashlight and binoculars. Not all bats in all culverts were visible from the outside so external surveys in some cases did not represent complete assessments. Several culverts were made of dry-stacked rock/stone that are estimated to be about 100 years old. Some of these had collapsed inlets creating a cave/mine like environment. The inlet in others was retrofitted with a reinforced concrete pipe (RCP) to maintain water flow and function. The rest of the culverts were corrugated metal pipes (CMPs) or CMPs retrofitted with RCP inlets.

Of the 29 culverts assessed, 7 culverts contained TCBs in winter torpor across 7 survey dates in January - April. Six of the 9 stone culverts were occupied by TCBs. Only one of the 20 CMPs/RCPs were occupied by TCBs. Within the 6 stone culverts, 1-2 TCBs were observed. In the 7th CMP/RCP culvert, 12 TCBs were observed. There were 3 instances where bats either moved within the culvert or were present only during some of the January survey dates, documenting that bats were awake and moving during some portion of the time between January 5 and January 24, 2023. The culvert that contained 12 bats in January 2023 still contained 3 TCBs on April 11th, some still apparently in winter torpor. Four of the winter occupied culverts along with four culverts not occupied in the winter were assessed in August 2023; no bats or signs of bat use were detected.

The largest entrance height in each occupied culvert ranged from 27'' to 56''. The smallest entrance heights of occupied culverts were as short as 10'' or were collapsed all together. Occupied culvert lengths varied from 36 to 83 ft The CMP/RCP combo pipe containing 12 TCBs (9 TCBS on the CMP and 3 TCBSs on the RCP) was 83 ft long; its largest entrance, though only 29'' under field conditions due to fill and water, was a 3 ft diameter CMP/RCP. This culvert had limited airflow potentially due to a smaller inlet opening measuring 10 in by 24 in.

Bektas et al. (2018) assessed 517 bridges in Iowa for evidence of bat roosting. Logistic regression models were used to identify bridges, land cover distribution, and predicted bat species distribution characteristics that increase the probability of bat roosting. The study showed that physical bridge characteristics alone could not be used to distinguish bat roost potential. Land cover and bat species distribution data combined with physical bridge characteristics help identify structures with the higher probability of bat roosting.

The data compiled from the publications above identifies culverts with day roosting bats to range from 1.3 ft (0.4 m) (Boonman, 2011) to 10 ft (0.4m – 3m) (Keeley and Tuttle, 1999) in height. However, the bat species identified varied widely and thus likely the wide range in size characteristics. Also, the Volpe Center analysis revealed only 15% of culverts (6 culverts) under 4 ft (1.2 m) had evidence of bat use (Table 11), with neither Indiana bats nor NLEBs identified. Only 3 of the 6 culverts under 4 ft (1.2 m) had evidence of TCBs, only 1 of which was <3 ft (0.9 m).

Based on the information available and working with the Service's bat survey guidance team, for the purposes of this programmatic consultation, culverts that do not meet the minimum dimensions in the current survey guidance will be considered unlikely to provide suitable roosting habitat for the Indiana bat, NLEB, and TCBs. Thus, an assessment will not be required for culverts that do not meet the minimum diameter/height and length standard (refer to the Service's current survey guidance for minimum culvert dimensions for determining Indiana bat, NLEB, and TCB suitability).

Until further data can rule out low bridges as potential roost sites, it is not possible to exclude them from requiring an assessment. Additionally, excluding broad categories of bridges based on their physical characteristics such as their composition does not seem feasible. It is possible that bridge roosting characteristics change over time as concrete may begin to spall, which would in turn provide roosting sites. Smith and Stevenson (2016) further support the idea that the physical characteristics described by Keeley and Tuttle (1999) are a set of ideal characteristics and not a list of definitive criteria required by bat for roosting.

There may be instances where a bridge, culvert, or structure bat use assessment fails to initially identify Indiana bats, NLEBs, or TCBs but later in time, prior to or during construction, these bats are observed. Also, Indiana bats, NLEBs, and TCBs may unexpectedly roost in smaller culverts than the minimum standard. In both situations, adverse effects (including harm or kill) to these bats may occur; therefore, Transportation Agencies and State/local DOTs are required to cease activity that could result in take of the covered bat species and notify the local Service Field Office within two working days of the discovery and determine how to proceed as described in Section 8.3 Monitoring and Reporting.

Stressor #1–Bridge/Culvert Removal, Replacement, Alteration – Active Season

Stressor Introduction – Bridge/Culvert Removal, Replacement, Alteration – Active Season

Bridge/culvert removal, replacement, or alteration during the active season when occupied by Indiana bats, NLEBs, or TCBs is expected to result in adverse effects. Also, in southern portions of the NLEB and TCB range, where these bat species are active year-round and enter winter torpor for short periods of time, direct effects are likely to occur.

<u>Activities (sources) that affect roosting areas underneath the bridge:</u>

- Bridge/culvert alteration,
- Bridge removal/demolition, and
- Culvert removal and slip lining.

Stressor Effects – Bridge/Culvert Removal, Replacement, Alteration – Active Season

The effects of bridge/culvert removal, replacement, or alteration may include:

1. Killing/injuring bats during activities conducted while the covered bats are present (including the NLEB and TCB YR active ranges when bats are in winter torpor in these areas).
2. Removing roosts and behaviorally impacting a bat colony that has demonstrated repeated use of bridges/culverts as their roost.

We expect Indiana bats, NLEBs, and TCBs may be injured or killed if they do not exit the bridge/culvert before it is removed or during alteration activities taking place in portions of the bridge/culvert where bats are roosting. The covered bat species may be crushed during bridge/culvert removal or during extensive deck work that may bore down to the underside of the bridge or inside the culvert. They may be killed or injured during routine maintenance (such as repairing spalling concrete) if they are roosting in the area needing repairs.

Effects to the covered bat species from bridge/culvert activities are associated with the time of year in which the activities take place. Kiser et al. (2002) observed adult, lactating, post-lactating, and newly volant juvenile Indiana bats roosting under bridges. In 2014, 2016, and 2023, biologists observed Indiana bats roosting in a metal culvert (converted to concrete in 2017) in Clark County, Indiana. If a bridge/culvert is removed or altered during the early summer, it is expected to have greater impacts than when pups have matured. However, if newly volant pups are present, the bridge/culvert is likely being used as a maternal roost site and pups would also be present during non-volant timeframes in June/July. If bridge/culvert removal, replacement, or alteration occurs when the pups are non-volant, they will be unable to exit on their own. They will either be killed or will require their mothers to expend additional energy to move them to a secure location. They will also be vulnerable to predation.

In Zone 1 of the NLEB and TCB YR active ranges, altering or removing bridges or culverts when occupied by NLEBs or TCBs in winter torpor is expected to result in adverse effects to these species. NLEBs and TCBs in winter torpor during colder periods throughout the YR active range may be killed or injured during bridge/culvert activities, as they will not be able to arouse quickly enough to exit the bridge or culvert.

AMMs – Bridge/Culvert Removal, Replacement, Alteration – Active Season

The following Bridge, Culvert, and Structure AMMs are REQUIRED for the range-wide programmatic consultation, as applicable, unless one or more of the following criteria apply*:*

- The bridge, culvert, or structure is 1,000 ft (305 m) or more from suitable bat habitat in areas **outside of the TCB range** (Indiana bat and NLEB only); or
- The culvert does not meet the minimum dimensions provided in the Service's range-wide bat survey guidance;[73] or
- A bridge, culvert,[74] or structure bat assessment[75]has occurred and documented no signs of use by the Indiana bat, NLEB, or TCB;[76] or
- Documentation from the local Service Field Office confirms that Indiana bats, NLEBs, and TCBs are not using the bridge, culvert, or structure.[77]

Note: If there are safety concerns associated with assessments of bridges, culverts, or structures please coordinate with the local Service Field Office for further assistance.

Bridge, Culvert, and Structure AMMs - Large Number of Covered Bats (>5); or Assuming Presence of Covered Bat Species

Bridge, Culvert, and Structure AMM 1a. Not applicable to Active Season

Bridge, Culvert, and Structure AMM 1b. Not applicable to Active Season

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[73] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

[74] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

[75] Refer to Appendix D – Bridge, Culvert, and Structure Bat Assessment Form Guidance from the User's Guide or new Service structure assessment guidance for acceptable assessment practices and validity length of bridge, culvert, and structure bat assessments: https://www.fws.gov/media/users-guide-range-wide-programmatic-consultation-indiana-bat-and-northern-long-eared-bat.

[76] E.g., P/A surveys, roosting potential, guano testing, etc.

[77] Documentation required.

Winter Torpor Period (in Zone 1 of the NLEB and/or TCB YR active ranges)
Bridge, Culvert, and Structure AMM 2. Avoid bridge and culvert removal, replacement, and/or alteration activities between December 15 – February 15.[78] If activities must be performed during this period, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Active Season (in the hibernating and YR active ranges)
Bridge, Culvert, and Structure AMM 3a. Ensure bridge, culvert, or structure removal, replacement, and/or alteration activities conducted during the active season will not disturb roosting Indiana bats, NLEBs, or TCBs using the bridge, culvert, or structure.

The following types of bridge or culvert work can generally be conducted with the presence of bats:

- Above bridge deck or culvert work where construction equipment or materials do not extend to the underside of deck or within the culvert where bats may be located (e.g., materials won't drip down to underside of deck or within the culvert) and does not include vibration or noise above existing background levels, including general traffic (e.g., road line painting, wing-wall work).
- Below bridge deck or culvert work that is conducted away from roosting bats and does not involve vibration or noise above existing background levels, including general traffic (e.g., wing-wall work, some abutment, beam end, scour, or pier repair).

Bridge, Culvert, and Structure AMM 3b. Ensure suitable roosting habitat is still available within the bridge, culvert, or structure once construction/replacement is complete (when assessment documents use by a large number of covered bat species, >5). Suitable roosting sites may be incorporated into the design of a new bridge, culvert, or structure.

Bridge, Culvert, and Structure AMMs - Small Number of Covered Bats (≤5)

Bridge, Culvert, and Structure AMM 4. Not applicable to Active Season

Winter Torpor Period (in Zone 1 of the NLEB and TCB YR active ranges)
Bridge, Culvert, and Structures AMM 5. Avoid bridge and culvert removal, replacement, and/or alteration activities between December 15 – February 15.[79] If activities must be performed during this

[78] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.
[79] Date-based time of year restrictions are used instead of temperature-based time of year restrictions, because activities are more difficult to stop and start based on changing site conditions. A temperature-based time of year restriction requires a high level of communication and control over individual practitioners that is not likely to be effectively implemented.

period, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Active Season (in the hibernating and YR active ranges)
Bridge, Culvert, and Structure AMM 6. Ensure bridge, culvert, or structure removal, replacement, and/or alteration activities conducted during the active season will not disturb roosting Indiana bats, NLEBs, or TCBs using the bridge, culvert, or structure.

The following types of bridge or culvert work can generally be conducted with the presence of bats:

- Above bridge deck or culvert work where construction equipment or materials do not extend to the underside of deck or within the culvert where bats may be located (e.g., materials that may drip down to underside of deck or within the culvert) and does not include vibration or noise above existing background levels, including general traffic (e.g., road line painting, wing-wall work).
- Below bridge deck or culvert work that is conducted away from roosting bats and does not involve vibration or noise above existing background levels, including general traffic (e.g., wing-wall work, some abutment, beam end, scour, or pier repair).

Summary – Bridge/Culvert Removal, Replacement, Alteration – Active Season

In conclusion, Indiana bats, NLEBs, and TCBs are known to roost in multiple types of bridges and culverts. If a bridge/culvert bat use assessment is conducted and there are no signs of roosting bats, activities associated with the removal, replacement, or alteration of the bridge/culvert are not likely to adversely affect these bat species.

During the active season (outside of the TOY restriction of December 15 – February 15 for Zone 1 of the NLEB and TCB YR active ranges), if an assessment shows signs of bat use by the Indiana bat, NLEB, or TCB, and the bridge work is restricted to the deck of the bridge and does not bore down to the superstructure, the project is NLAA the covered bat species. If the culvert work is restricted to the fill above the culvert and does not bore down to the culvert structure itself, the project is NLAA the covered bat species. If this type of bridge and/or culvert work is not restricted, adverse effects to the covered bats are anticipated. In addition, any project that removes, replaces, or alters a bridge/culvert that has documented use by a large number of covered bat species (≥5), in which suitable roosting habitat is no longer available within the bridge, culvert, or structure once construction/replacement is complete is outside the scope of this programmatic consultation and will require site specific analysis.

There may be instances where a bridge/culvert bat use assessment fails to initially identify Indiana bats, NLEBs, or TCBs but later in time, prior to or during construction, these covered bats are observed. In these situations, adverse effects (including harm or kill) to the covered bat species may occur; therefore, Transportation Agencies and State/local DOTs are required to cease activity that could result in take of these bats and notify the local Service Field Office within two working days of the discovery and determine how to proceed as described in Section 8.3 Monitoring and Reporting.

Stressor #2 – Bridge/Culvert Removal, Replacement, Alteration – Inactive Season

Stressor Introduction – Bridge/Culvert Removal, Replacement, Alteration – Inactive Season

Removing or altering bridges or culverts when unoccupied by bats may have an indirect adverse effect, depending on the type of alteration.

Activities (sources) that affect roosting areas underneath the bridge:

- Bridge/culvert alteration,
- Bridge removal/demolition, and
- Culvert removal and slip lining.

Stressor Effects – Bridge/Culvert Removal, Replacement, Alteration – Inactive Season

The effects of bridge/culvert removal, replacement, or alteration may include:

1. Removing suitable roosting habitat and behaviorally impacting the bat colony that has demonstrated repeated use of bridges or culverts as their roost.
2. Additional energetic burden on the females while they search for a new roost site.
3. Colony collapse depending on the importance of that roost site.

Similar to removing roost trees during the winter in the hibernating range of the Indiana bat, NLEB, and TCB, bridge/culvert removal or alteration is expected to add stress to the bat colonies returning to the site after hibernation. Additional energy will be required during their search for a new roost site. We expect that removal or altering (during the inactive season) of a more permanent roost site such as a bridge or culvert with a large number of covered bats (>5) would be more detrimental than if the colony were roosting in a tree given the higher fidelity and less frequent roost switching associated with bridges and culverts.

As discussed in the tree roosting section above, Indiana bat, NLEB, and TCB maternity colonies exhibit fission-fusion behavior and switch day roosts within their summer home range. Roost-switching may be done for a variety of reasons, including allowing bats to locate alternate roosts and be prepared for the natural loss of this ephemeral resource. While roost trees are ephemeral, bridges and culverts may serve as a more permanent resource. This may result in reduced “switching” behavior by Indiana bats, NLEBs, and TCBs.

Lewis (1995) reviewed the literature on roosting behavior of 43 species in 12 of 19 chiropteran families. They proposed that the amount of roost-switching corresponds to the roost permanency. These limited data suggest higher fidelity for artificial structures than natural roosts among NLEBs, Indiana bats, and little brown bats. Brigham (1991) suggested site fidelity in big brown bats differs depending on the available roosts. He reported big brown bats were site faithful when roosting in a building in Ontario but those roosting in trees in British Columbia exhibited roost switching. Timpone et al. (2010) reported less roost switching when NLEBs used a man-made structure versus a tree. NLEBs spent up to three consecutive nights roosting in a tree and up to 11 consecutive nights roosting in a man-made structure. While this shift in behavior has not been reported for Indiana bats, the bachelor colony of Indiana bats under the West Virginia turnpike is worth noting. They were first discovered in 2011. The site is monitored monthly and as of 2023, Indiana bats continue to use the site yearly and have been observed using the bridge during the hibernating season. However, their use has dropped due to the lower number of Indiana bat overall in West Virginia (E. Stout, Service, 2023). Britzke et al. (2003) offered a potential explanation that the low rate of roost switching observed in Indiana bats using tree roosts in North Carolina/Tennessee may be due to roost availability versus permanency of a roost site. Thus, the loss of a permanent site such as a bridge might be more stressful to a colony than the loss of a roost tree because they are not actively switching roosts.

AMMs – Bridge/Culvert Removal, Replacement, Alteration – Inactive Season

The following Bridge, Culvert, and Structure AMMs are REQUIRED for the range-wide programmatic consultation, as applicable, unless one or more of the following criteria apply*:*

- The bridge, culvert, or structure is 1,000 ft (305 m) or more from suitable bat habitat in areas **outside of the TCB range** (Indiana bat and NLEB only); or
- The culvert does not meet the minimum dimensions provided in the Service's range-wide bat survey guidance;[80] or
- A bridge, culvert,[81] or structure bat assessment[82] has occurred and documented no signs use by the Indiana bat, NLEB, or TCB;[83] or
- Documentation from the local Service Field Office confirms that Indiana bats, NLEBs, and TCBs are not using the bridge, culvert, or structure.[84]

Note: If there are safety concerns associated with assessments of bridges, culverts, or structures please coordinate with the local Service Field Office for further assistance.

[80] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.
[81] Refer to Range-wide Indiana and northern long-eared bat survey guidelines for assessment practices and validity length of bridge, culvert bat use assessments: https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.
[82] Refer to Appendix D – Bridge, Culvert, and Structure Bat Assessment Form Guidance from the User's Guide or new Service structure assessment guidance for acceptable assessment practices and validity length of bridge, culvert, and structure bat assessments: https://www.fws.gov/media/users-guide-range-wide-programmatic-consultation-indiana-bat-and-northern-long-eared-bat.
[83] E.g., P/A surveys, roosting potential, guano testing, etc.
[84] Documentation required.

Bridge, Culvert, and Structure AMMs - Large Number of Covered Bats (>5); or Assuming Presence of Covered Bat Species

Inactive Season (in the hibernating range)

Bridge, Culvert, and Structure AMM 1a. Perform bridge, culvert, or structure removal, replacement, and/or alteration activities during the winter hibernation period (inactive season) unless a hibernating colony of bats is present.[85] If hibernating bats are observed using the bridge, culvert, or structure, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Bridge, Culvert, and Structure AMM 1b. Ensure suitable roosting habitat is still available within the bridge, culvert, or structure once construction/replacement is complete (when assessment documents use by a large number of covered bat species, >5). Suitable roosting sites may be incorporated into the design of a new bridge, culvert, or structure.

Bridge, Culvert, and Structure AMM 2 - Not applicable to Inactive Season

Bridge, Culvert, and Structure AMM 3a - Not applicable to Inactive Season

Bridge, Culvert, and Structure AMM 3b - Not applicable to Inactive Season

Bridge, Culvert, and Structure AMMs - Small Number of Covered Bats (≤5)

Inactive Season (in the hibernating range)

Bridge, Culvert, and Structure AMM 4. Perform bridge, culvert, or structure removal, replacement, and/or alteration activities during the winter hibernation period (inactive season) unless a hibernating colony of bats is present.[86] If hibernating bats are observed using the bridge, culvert, or structure, Transportation Agencies and State DOTs will coordinate with the local Service Field Office for project-specific consultation guidance.

Bridge, Culvert, and Structure AMM 5 - Not applicable to Inactive Season

Bridge, Culvert, and Structure AMM 6 - Not applicable to Inactive Season

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[85] If a hibernating colony of bats other than Indiana bat, NLEB, or TCB is observed, please coordinate with the local Service Field Office and appropriate State agency.

[86] If a hibernating colony of bats other than Indiana bat, NLEB, or TCB is observed, please coordinate with the local Service Field Office and appropriate State agency.

Summary – Bridge/Culvert Removal, Replacement, Alteration – Inactive Season

In conclusion, Indiana bat, NLEBs, and TCBs are known to roost in multiple types of bridges and culverts. Bridge/culvert removal, replacement, or alteration without any signs of use by the Indiana bat, NLEB, or TCB are not likely to adversely affect these covered bat species. If a bridge/culvert project with signs of use by the covered bat species can be completed in the winter (inactive season), has no signs of hibernating bats, and once completed, will still provide suitable roosting habitat, the project is NLAA the covered bat species. If bridge or culvert removal, replacement, and/or alteration will be performed during the winter hibernation period and bats use the bridge or culvert for hibernation, coordination with the local Service Field Office for project-specific consultation guidance is required. Bridge/culvert removal, replacement, or alteration activities conducted while NLEBs and TCBs are in winter torpor between December 15 – February 15 in Zone 1 of their YR active ranges are outside the scope of this programmatic consultation.

5.4 Resource #3 – Structures (Artificial Roost)

Occurrences of Bats in Structures

Indiana bats infrequently roost in houses or other similar structures. For example, Butchkoski and Hassinger (2002) documented the only known Indiana bat maternity colony roosting in a structure, an abandoned church, in Pennsylvania. Indiana bats have also been reported in two houses in New York (NYSDEC unpublished data, ESI 2006) and a barn in Iowa (Chenger 2003). Benedict and Howell (2008) captured 13 Indiana bats from barns in 2005 and 2006. Two showed evidence of using the structures as day roosts and the other 11 appeared to use the barns as night roosts. However, they noted their study was designed to examine day roosts. Kunz and Reynolds (2003) synopsis of roosting habitats of bats in North America indicate Indiana bats use buildings as roosts sites.

NLEBs have also been found roosting in structures such as barns, houses, and sheds (particularly when suitable roost trees are unavailable) (Service 2014). For example, Broders and Forbes (2004) noted that some use of bat boxes and human-made structures, like shutters, has been documented. Benedict and Howell (2008) captured 11 NLEBs in barns. Captures included adult males, lactating and non-reproductive females, and one volant young. One bat was observed using the barn as a day roost, but six were captured entering the barns within 45 minutes after bat activity began. They speculated the bats were entering the barn to glean insects or spiders from inside the structure. As mentioned earlier, Bohrman and Fecske (2013) tracked two female NLEBs to a barn near Great Swamp National Wildlife Refuge in New Jersey, where suitable natural roosts were abundant. One of these bats, a non-reproductive female, remained in the barn for 11 days of tracking, while the other, a lactating female, was tracked to the barn on all but two of 11 days of tracking. Another lactating female NLEB switched tree roosts almost daily. Three little brown bats also tracked during this study were located in the barn on 15 out of 20 total days of tracking. Two NLEB maternity colonies have been documented in man-made structures. Henderson and Broders (2008) documented NLEBs using a barn as a maternity roost site on Prince Edward Island, Canada. The females used the barn from late June through mid-August and switched to roosting in trees in early June and late August, presumably during late pregnancy and lactation. Timpone et al. (2010) reported NLEBs used an abandoned barn as a maternity roost in conjunction with the little brown bat. They also documented the use of an equipment shed as a NLEB roost site. As mentioned above, NLEBs in Tennessee are generalists in their roosting preference. They have been found in barns, porches, mobile homes, and telephone poles when potential roost trees were nearby and available (J. Griffith, Service, pers. comm. 2014). They have also been found overwintering in man-made structures with conditions similar to hibernacula (Service 2022a).

TCBs also roost in human-made structures (in addition to bridges and culverts) such as the eaves of barns or the underside of open-sided shelters (e.g., porches, pavilions). TCBs rarely roost in buildings, and when they do, they are often in well-lit or full daylight areas (Barbour and Davis 1969). Some buildings are only used by maternity colonies during early spring and then abandoned for tree roosts prior to giving birth to young (Whitaker et al. 2014); however, in other cases, maternity colonies remain in buildings until young are born and become volant (Allen 1921, Lane 1946, Cope et al 1960, Whitaker 1998, Wisconsin DNR 2017b).

Similar to our discussion above regarding the use of bridges and culverts as roosts, altering or removing structures used as Indiana bat, NLEB, or TCB roosts is a stressor. We are concerned about two primary types of impacts: (1) killing/injuring bats during activities conducted while bats are present; and (2) removing roosts and impacting bats that have demonstrated repeated use of structures as their roost.

Stressor #1 – Structure Removal, Replacement, Alteration – Active Season

Stressor Introduction – Structure Removal, Replacement, Alteration – Active Season

For Transportation Agencies/State DOTs, manmade structure (non-crossing) activities may include but are not limited to, work at: rest areas, welcome centers, picnic shelters, barns, offices, residential buildings, parking garages, kiosks, ticket stations and platforms at rail stations, vehicle inspection pits, storage facilities, and structures at weigh stations. Structures may also need to be removed to provide safe work environments or space for ROW expansion or upgrades to the rest area, weigh station, or rail station. As with the bridge and culvert discussion above, if Indiana bats, NLEBs, or TCBs are present during these activities, they may be disturbed, injured, or killed.

<u>Activities (sources) Causing Stressors:</u>

- Structure (non-bridge/culvert) removal or replacement, and
- Structure alteration (sealing entry/exit points for bats).

Stressor Effects–Structure Removal, Replacement, Alteration – Active Season

The effects of structure removal, replacement, or alteration while Indiana bats, NLEBs, or TCBs are present may include:

1. Killing/injuring bats during activities conducted while the covered bat species are present (including the NLEB and TCB YR active ranges when bats are in winter torpor in these areas).

2. Removing roosts and behaviorally impacting the bat colony have demonstrated repeated use of structures as their roost.

We expect Indiana bats, NLEBs, or TCBs may be injured or killed if they do not exit the structure before it is either removed or there are activities taking place in portions of the structure where the covered bat species are roosting. Butchkoski and Hassinger (2002) documented an Indiana bat maternity colony using an abandoned structure. If a structure is altered during the summer maternity season, a range of impacts would be expected depending on when in the maternity season the impacts occur. If impacts occur early in the maternity season, then the females may abort their pups. If bats are forced to flee from roosts during the daytime, they may experience greater risk of predation. Also, bats (primarily non-volant pups or adults using winter torpor during cool temperatures) may be injured or killed by being crushed.

If work is conducted while the covered bat species are present, they may be disturbed during activities causing stressors, such as noise and vibration at the roost location. As bats would generally be expected to roost in locations away from commonly used areas (e.g., attics, under shingles, behind shutters), normal cleaning and routine maintenance of structures are not anticipated to result in any adverse impacts to bats. Yet, working in attics with documented roosting bats or work directly around roosting bats (e.g., window replacement, shingle replacement) is more likely to have adverse effects to the covered bat species.

In the YR active range of the NLEB and TCB, these bats may use structures during period of winter torpor when temperatures drop significantly cooler. We expect NLEBs or TCBs bats may be injured or killed during this time if the structure is either removed or there are activities taking place in portions of the structure where these bats are in winter torpor.

AMMs – Structure Removal, Replacement, Alteration – Active Season

[refer to AMMs under Bridge/Culvert Stressor #1 above]

Stressor Summary – Structure Removal, Replacement, Alteration – Active Season

Indiana bats, NLEBs, and TCBs using structures during the active season may be disturbed, injured, or killed from structure alteration or removal. In Zone 1 of the NLEB and/or TCB YR active ranges, these bats while in winter torpor may be killed or injured during structure activities and thus projects between December 15 – February 15 in these arears are outside the scope of this programmatic consultation. In addition, any project that removes, replaces, or alters a structure that has documented use by a large number of covered bats (>5), in which suitable roosting habitat is no longer available within the structure once construction/replacement is complete is outside the scope of this programmatic consultation and will require site specific analysis.

In conclusion, Indiana bats, NLEBs, and TCBs are known to roost in manmade structures. If a structure bat assessment is conducted and there are no signs of roosting bats, activities associated with the removal, replacement, or alteration of the structure are not likely to adversely affect the covered bat species.

During the active season (outside the TOY restriction of December 15 – February 15 for Zone 1 of the NLEB and TCB YR active ranges), if an assessment shows signs of bat use by the Indiana bat, NLEB, or TCB and impacts to bats can be avoided and they are not disturbed, then the structure activities are NLAA the covered bat species. If impacts to the covered bat species cannot be avoided, adverse effects are anticipated.

There may be instances where a structure bat assessment fails to initially identify Indiana bats, NLEB, or TCBs but later in time, prior to or during construction, these covered bats are observed. In these situations, adverse effects (including harm or kill) to the covered bats species may occur; therefore, Transportation Agencies and State/local DOTs are required to cease activity that could result in take of these species and notify the local Service Field Office within two working days of the discovery and determine how to proceed as described in Section 8.3 Monitoring and Reporting.

Stressor #2 – Structure Removal, Replacement, Alteration – Inactive Season

Stressor Introduction – Structure Removal, Replacement, Alteration – Inactive Season

The removal, replacement, or alteration of manmade structures (non-crossing) may injure or kill Indiana bats, NLEBs, or TCBs that may be using these structures for hibernation (inactive season). Also, in the YR active range of the NLEB and TCB, where these bats may be using structures during winter torpor for short periods of time, direct effects to NLEBs and TCBs may occur. Structures may also need to be removed to provide safe work environments or space for ROW expansion or upgrades to the existing structure (e.g., rest area, weigh station, or rail station).

Activities (sources) Causing Stressors:

- Structure (non-bridge/culvert) removal or replacement, and
- Structure alteration (sealing entry/exit points for bats).

Stressor Effects – Structure Removal, Replacement, Alteration – Inactive Season

The effects of structure removal, replacement, or alteration during the inactive season may include:

1. Removing roosts and behaviorally impacting the bat colony that may have demonstrated repeated use of the structure as their roost.
2. Additional energetic burden on the females while they search for a new roost site.
3. Result in colony collapse depending on the importance of that roost site.

Permanent man-made structures (non-crossing) provide a long-term suitable roost and may reduce normal roost switching behavior. It is feasible that colonies established in a man-made structure are less likely to have investigated alternative roosts compared to colonies established in trees. Bohrman and Fecske (2013) tracked two female NLEBs to a barn in the Great Swamp National Wildlife Refuge in New

Jersey used for roosting when trees were available for roosting nearby. One of the bats, a non-reproductive female, remained in the barn for 11 days of tracking, while the other, a lactating female, was tracked to the barn on all but two of 11 days of tracking. Another lactating female NLEB switched tree roosts almost daily. Bohrman and Fecske (2013) tracked a female Indiana bat to the same barn in New Jersey three years earlier (L. Wight, Unpublished data), and she remained there for five consecutive days of tracking (longer than the 1.9 day average for all bats in the study/what is generally reported for the species). Three little brown bats also tracked during this study were located in the barn on 15 out of 20 total days of tracking. It appears that a colony may modify their behavior to decrease the amount of roost switching if roosting in a more permanent structure or if there is limited availability of suitable roosts in the area.

Whitaker (1998) noted TCBs roosting in buildings in Indiana commonly switched roosts. However, he reported that they still switched less frequently than has been reported for bats using tree roosts. Lausen and Barclay (2006) found that big brown bats roosting in buildings had lower predation risk, earlier births, faster juvenile growth rates, and increased energy savings compared to those roosting in natural rock crevices.

As with removing roost trees or bridges or culverts in the inactive season, structure removal/demolition is expected to add stress to the bat colonies returning to the site after hibernation. Additional energy will be required during their search for a new roost site. We expect that removal or altering of a more permanent roost site such as a structure with a large number of covered bats (>5) would add stress, perhaps more than if the colony were roosting in a tree.

AMMs – Structure Removal, Replacement, Alteration – Inactive Season

[refer to AMMs under Bridge/Culvert Stressor #2 above]

Stressor Summary – Structure Removal, Replacement, Alteration – Inactive Season

In conclusion, the removal, replacement, or alteration of structures without any signs of use by the covered bat species are not likely to adversely affect Indiana bats, NLEBs, and TCBs. If a structure bat assessment documents signs of use by the covered bat species, these structure activities, when carried out during the inactive season with no signs of hibernating bats, are NLAA Indiana bats, NLEBs, or TCBs, so long as suitable roosting habitat within the structure is still available. If structure removal, replacement, or alteration will be performed during the winter hibernation period with signs of hibernating bats, coordination with the local Service Field Office for project-specific consultation guidance is required. Structure removal, replacement, and alteration activities conducted while NLEBs and TCBs are in winter torpor between December 15 – February 15 in Zone 1 of their YR active ranges is outside the scope of this programmatic consultation.

5.5 Resource #4 – Hibernaculum and Winter Torpor Roosts

Indiana bats, NLEBs, and TCBs hibernate in caves and mines, but may also use other types of habitats that resemble caves and mines such as railroad tunnels, storm sewers, dams, among others. They have specific requirements of their winter habitat. Temperature, humidity, air flow, surrounding habitat, stability, and other factors must be suitable for a structure or part of a structure to be used as a hibernaculum.

Indiana bats, NLEBs, and TCBs are particularly vulnerable during hibernation because they are in a torpid state and extremely sensitive to the effects of disturbance. Further, Indiana bats often congregate by the hundreds or thousands in tight clusters, so disturbance to a small area can affect the entire population of a hibernaculum. Disturbances during hibernation causes bats to lose valuable fat stores making them vulnerable to starvation. Additionally, arousal from torpor can be extremely energy consumptive for solitary roosting TCBs in these hibernacula because they do not benefit from passive warming that occurs when a warm bat clusters next to a torpid bat (Jackson et. al 2022, Thomas et. al 1990).

As stated in the Indiana bat status of the species, 13 hibernacula are designated as critical habitat. Activities that may impact Indiana bat critical habitat are outside the scope of this programmatic consultation. Based on previous consultation history, this scenario is anticipated to occur only rarely, and additional analyses will be needed. The Service determined that it is not prudent to designate critical habitat for the NLEB nor the TCB.

NLEBs and TCBs in the YR active range are actively roosting in trees year-round and only entering winter torpor (i.e., a state of lowered body temperature and metabolic activity) during extreme cold spells. At sites in coastal South Carolina, where TCBs roost in trees, culverts, and bridges, Newman (2020) found highly variable but similar mean winter torpor bout length of 2.7 days, with bats often utilizing passive warming on mild winter days to conserve energy during arousal events where they actively left the day roost and were observed foraging during 33% of the tracked days (November through March). Similarly, Grider et al. (2016) acoustically detected TCBs throughout the Piedmont and Coastal Plain of North Carolina, two regions that differ in winter temperature. Although activity was lower during the winter in both areas, TCBs in the Piedmont had a lower level of winter activity compared to summer activity than TCBs in the Coastal Plain, which had more similar levels of activity in the winter and summer.

Accurately defining these areas above (as well as the additional one discussed below) are important as it helps define where potential AMMs should be applied. For example, a winter tree clearing restriction of December 15 – February 15 is included in this PBO to avoid direct take of NLEBs and TCBs roosting in trees during winter cold spells (i.e., < 40° F) when these bats are likely to be in winter torpor within the YR active ranges for both species (Figures 10 and 11).

There are portions of the YR active range where southern latitude temperatures are not cold enough/long enough for TCBs to use winter torpor in trees. To identify these portions where the mean minimum temperature stayed above 40° F throughout the winter months, a team of Service biologists used the NOAA U.S. Climate Normals data.[87] By using the mean, the team of Service biologists acknowledge there will be brief cold snaps where temperatures dip below 40° F, and potentially other situations (e.g., dry spells or food scarcity) that could lead to short term torpor use, but those would be infrequent and short in duration. Based on this data, a winter tree clearing restriction in this southern portion (depicted as Zone 2 in Figure 9) of the TCB YR active range is not applied to TCBs in this PBO.

The Service's draft recovery plan for the Indiana bat identifies the following threats to hibernacula: modifications to caves, mines, and surrounding areas that change airflow and alter microclimate in the hibernacula; human disturbance and vandalism; and natural catastrophes (Service 2007). Similar threats to NLEBs are identified in the final listing rule (87 FR 73488). Activities (Table 12) associated with the construction, operations, or maintenance of transportation systems that may disturb hibernating bats; NLEBs and TCBs in winter torpor in their YR active ranges; or alter hibernacula include blasting, excavation, changing the course or volume of drainage, increasing or decreasing air flow (e.g., filling a sink hole), or affecting the surrounding habitat (see also fall swarming/spring emergence habitat below). These could affect bats directly if conducted during hibernation or when NLEBs and TCBs are in winter torpor in the YR active ranges; or indirectly if occurring in the spring, summer, or fall. Even when bats are not present, altering hibernacula to render them less suitable may result in death or decreased fitness of returning bats if they cannot find suitable alternative sites or if they expend their fat reserves while searching for these sites.

As discussed in the Status of the Species (Section 4), another threat to the Indiana bat, NLEB, and TCB in their hibernacula has emerged, WNS, which has devastated some populations of hibernating bats. Activities that disturb bats affected by WNS may result in more severe impacts to the hibernating population.

[87] https://www.ncei.noaa.gov/products/land-based-station/us-climate-normals

Table 12. Summary of Activities That May Directly Affect Covered Bats in Hibernation or NLEB and TCBs in Winter Torpor (YR Active Ranges) and Activities That May Alter Their Hibernaculum(a).

Activities (Sources)	Potential effects to covered bats when present	Potential effects to hibernaculum(a)
blasting	crushing, entombment, disturbance (noise, vibrations)	physical structure, microclimate variables
pile driving and pile extraction	crushing, disturbance (noise, vibrations)	physical structure, microclimate variables
heavy equipment uses (such as hoe ram, vibratory roller, tracked vehicles, static compaction, among others)	crushing, disturbance (noise, vibrations)	physical structure, microclimate variables
excavation	crushing, disturbance (noise, vibrations)	physical structure, microclimate variables
cave and mine entrance or sinkhole alteration	crushing, freezing	physical structure, microclimate variables, hydrology
wetland or stream fill	drowning (alter hydrology)	microclimate variables, hydrology,
grade or drainage alteration	drowning (alter hydrology)	microclimate variables, hydrology,
surface vegetation removal	drowning (alter hydrology)	microclimate variables, hydrology
surface vegetation disposal (slash pile burning)	smoke inhalation	microclimate variables
new /trail construction/or facilities	disturbance (noise)	microclimate variables
new sinkhole repair	crushing, disturbance (noise)	microclimate variables, hydrology

Stressor #1 – Activities that Directly Affect Bats

Stressor Introduction – Activities that Directly Affect Bats

The covered bat species can be directly affected if present when activities take place in or around hibernacula or in the YR active range when NLEBs and TCBs are in winter torpor. Bats may experience crushing, drowning, smoke inhalation, or disruption from noise, vibration, and human disturbance. There are multiple activities (sources) associated with transportation projects that may result in direct effects to the covered bat species in hibernation and/or winter torpor.

<u>Activities (sources) Causing Stressor:</u> (See Table 12)

Stressor Effects

The majority of projects within 0.5-mile of known cave or cave-like hibernacula for Indiana bat, NLEB, and TCB are not within the scope of this PBO. The covered bat species may be injured or killed if present during structural changes to hibernaculum(a). Blasting, pile driving, or other heavy equipment use may cause cave and mine ceilings to collapse, which could directly kill hibernating bats or trap them inside. Bats may be crushed if they are present during activities that fill sinkholes, caves, or mine portals. Also, activities that involve digging into hibernacula or cause vibrations that cause collapse of hibernacula may crush bats. Activities that alter hydrology such as impacts to streams or wetlands, surface vegetation changes, grading, alteration of the cave entrances or sinkholes could cause the cave to flood and drown any bats that are present (Brack et al. 2005).

<u>Crushing</u> – Indiana bats, NLEBs, and TCBs may be injured or killed if present during structural changes to hibernaculum(a). Blasting, pile driving, hoe ram use, and excavation may cause cave and mine ceilings to collapse, which could directly kill hibernating bats or trap them inside. Bats may be crushed if they are present during activities that fill sinkholes, caves, or mine portals. The fill material may be deposited directly onto hibernating animals. Also, activities that involve digging into hibernacula or cause vibrations that cause collapse of hibernacula may crush bats.

<u>Drowning</u> – Activities that alter the hydrology such as impacts to streams or wetlands, surface vegetation changes, grading, alteration of the cave entrances or sinkholes could cause the cave to flood and drown any bats that are present (Brack et al. 2005).

<u>Smoke Inhalation</u> – Indiana bats, NLEBs, and TCBs may also be exposed to smoke. Smoke and noxious gases from slash pile burning can enter hibernacula depending on wind and weather conditions (Perry 2011). If smoke is drawn into a hibernaculum while bats are present or in close proximity to an occupied roost tree in the YR active range, mortality from smoke inhalation and reduced fitness from premature arousal could occur (Carter et al. 2002).

<u>Disturbance, Noise, and Vibration</u> – Indiana bats, NLEBs, and TCBs may be disturbed during activities that cause noise/vibration which may increase bat arousal during hibernation and/or winter torpor resulting in death or reduced fitness at spring emergence. Hardin and Hassel (1970) exposed small clusters of Indiana bats to noise, light, streams of air, and being handled and found that only altering the airstream and being handled aroused the bats. Activities that cause arousal during hibernation and/or winter torpor can be detrimental and may affect body condition and survival in the spring (Menzel et al. 2001). Thomas (1995) found that sound and light do initiate arousal in portions of the hibernating population for little brown bats and NLEBs. Speakman et al. (1991) exposed 25 individual hibernating bats in Europe to non-tactile (head lamp, photographic flash, sound, speech, temperature increase) and tactile stimuli. He found that tactile stimulation resulted in much greater energy expenditure. Activities where the noise level rises to a point that causes the bat to alter its normal behavior or results in bat arousal during hibernation are a concern. The duration of the noise may also be a factor.

Blasting and the use of construction equipment such as vibratory rollers near caves or close to NLEBs or TCBs in a winter torpor state in the southern portion of the range, can be a concern depending on vibration levels caused by the activity (Table 13). Reported ground vibration levels from construction activities are variable; however, the data provides a reasonable estimate for a wide range of soil conditions (FTA 2006). Besha (1984) indicated the peak particle velocity (PPV) is the best way to measure the level of disturbance to humans, animals, and structures. PPV is the level of ground vibration and is measured with a seismometer.

Table 13. Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft (7.6 m) (in/sec) [cm/sec]
Pile Driver (impact)	upper range	1.518 in/sec [3.856 cm/sec]
	typical	0.644 in/sec [1.636 cm/sec]
Pile Driver (sonic)	upper range	0.734 in/sec [1.864 cm/sec]
	typical	0.170 in/sec [0.432 cm/sec]
Clam Shovel Drop (slurry wall)		0.202 in/sec [0.513 cm/sec]
Hydromill (slurry wall)	in soil	0.008 in/sec [0.020 cm/sec]
	in rock	0.017 in/sec [0.043 cm/sec]
Vibratory Roller		0.210 in/sec [0.533 cm/sec]
Hoe Ram		0.089 in/sec [0.226 cm/sec]
Large Bulldozer		0.089 in/sec [0.226 cm/sec]
Caisson Drilling		0.089 in/sec [0.226 cm/sec]
Loaded Trucks		0.076 in/sec [0.193 cm/sec]
Jackhammer		0.035 in/sec [0.089 cm/sec]
Small Bulldozer		0.003 in/sec [0.008 cm/sec]

Source: FTA 2006

For a particular site in West Virginia, a study concluded that hibernating bats in a mine portal could withstand vibration levels of 0.06 to 0.20 inches per second (in/sec) (0.15 to 0.51 cm/sec) without adverse effects (West Virginia Department of Environmental Protection 2006). In that same study, surface seismographs recorded ground vibrations at a level 2.0 to 7.8 times higher than underground vibrations. The West Virginia Department of Environmental Protection (2006) study generated a predicted linear equation for calculating underground PPVs [0.19* (surface vibration) + 0.0039] for surface vibrations less than 0.50 in/sec (1.27 cm/sec).

Myers (1975) concluded that at 393 ft (120 m) there was no evidence of impact to hibernating bats with a PPV of 0.02 in/sec (0.05 cm/sec). In the blasting plan for Glen Park Hydroelectric Project, Besha (1984) recommended a PPV of 0.1 in/sec (0.25 cm/sec) to protect Indiana bats at a nearby cave. At a quarry operation with ongoing blasting near Jamesville, New York, it is estimated the caves within 1,000 ft (305 m) containing bats experience a PPV no less than 0.25 in/sec (0.64 cm/sec) with no apparent impact to the bat population numbers since observations began in 1968 (Besha 1984).

Human Disturbance Transportation projects that increase human activity (e.g., new alignments/trails) or improve access at hibernacula entrances may result in ongoing disturbance to Indiana bats, NLEBs, and TCBs. Human disturbance of hibernating bats led to a decline in Indiana bat populations from the 1960s to the 1980s. Disturbance can cause bats to expend crucial fat reserves. If disturbance occurs too often, fat reserves can be depleted before the species can begin foraging in the spring (Thomas et al. 1990). Boyles and Brack (2009) modeled survival rates of hibernating bats and found that when human disturbances reached a certain frequency level, they became detrimental to survival. Access points further than 0.5 miles (0.8 km) from hibernacula openings are expected to be far enough to reduce any new access risk to most hibernacula.

AMMs – Activities that Directly Affect Bats

Hibernacula AMM 1. For projects located within karst areas, on-site personnel will use best management practices,[88] secondary containment measures, or other standard spill prevention and countermeasures to avoid impacts to possible hibernacula. Where practicable, a 300 ft (91.4 m) buffer will be employed to separate fueling areas and other major contaminant risk activities from caves, sinkholes, losing streams, and springs in karst topography.

Summary – Activities that Directly Affect Bats

The majority of activities within 0.5 miles (0.8 km) of hibernacula are outside the scope of this programmatic consultation. While exposure risk is greatest at the hibernaculum(a) openings, there may be impacts that occur further away depending on the cave or mine system, geology, and landscape setting (topography). Activities that alter hibernacula are outside the scope of this programmatic consultation.

The only activities that may occur within 0.5 miles (0.8 km) of hibernacula and be considered in this programmatic consultation include those that do not cause any stressors to the covered bat species, as described in the BA/BO (i.e., do not involve slash pile burning, ground disturbance, vibrations, noise above existing background levels, temporary or new/additional permanent lighting, nor tree removal/trimming). Site-specific reviews of projects within 0.5 miles (0.8 km) of hibernacula that do cause stressors will ensure that all potential exposure pathways are adequately addressed.

Activities greater than 0.5 miles (0.8 km) from hibernaculum(a) openings are not expected to result in any direct effects to hibernating Indiana bats, NLEBs, TCBs, or their habitat. However, activities taking

[88] Coordinate with the local Service Field Office on recommended best management practices for karst in your state.

place in the YR active range for the NLEB and TCB may have direct effects to these bats in winter torpor (as mentioned above) and those NLEB and TCB active on the landscape, not in hibernation (refer to Resource #1–Forested Habitat).

Stressor #2 – Changes to Microclimate

Stressor Introduction – Changes to Microclimate

The microclimate variables important to the covered bat species are temperature, humidity, and airflow (Raesly and Gates 1987). Therefore, any activities that affect these characteristics may impact the suitability of caves as hibernacula. Bats in hibernation are susceptible to dehydration due to high evaporative loss from their naked wings and large lungs (Perry 2013). Temperature, humidity, airflow, and air pressure affect evaporation loss rates (Perry 2013). Dehydration has been identified as one of the causes of arousal during hibernation (Boyles et al. 2006). Mortality may occur directly due to dehydration or through increased arousals and energy depletion.

Richter et al. (1993) documented temperature changes as a result of modifications made to cave entrances which ultimately affected the suitability of the hibernacula.

There are multiple activities (sources) associated with transportation projects that may result in changes to hibernacula microclimate.

Activities (sources) Causing Stressor: (See Table 12)

Stressor Effects – Changes to Microclimate

Surface-disturbing activities around caves can impact bat populations if those activities result in changes to the microclimate (temperature, humidity, and air flow) of the karst/cave system (Ellison et al. 2003). Karst ecosystems are predominately carbonate rocks in landscapes containing underground streams, sinkholes, caves, dry valleys, springs, and seeps (van Beynen et al. 2012, Kastning and Kastning 1999). In these unique systems, water flows rapidly through the carbonate rocks from the surface to the aquifer. This characteristic increases the vulnerability of karst systems to surface disturbing activities (van Beynen et al. 2012).

Water may affect the humidity and temperature of the cave (Perry 2013) and any alteration in humidity may make the hibernacula less suitable for bats. Surface runoff flow and streams entering caves can increase or decrease the temperature in the cave (Perry 2013). Changes in cave hydrology can result from surface grading changes or increases in impervious surfaces. Increases in the amount of water entering the hibernacula can cause flooding to all or parts of the structure resulting in potential loss of suitable habitat (see Physical Changes to Hibernacula). Flooding in stream caves often occurs after tree removal/trimming in the upstream watershed (Clarke 1997). Surface vegetation and the uptake of water by plants regulate the flow and amount of water available to the karst system (Bilecki 2003). Tree removal/trimming in karst areas can alter soil characteristics, water quality, and local hydrology (Bilecki

2003, Hamilton-Smith 2001). The impacts to soil result in changes to the water regime and microclimate (Hamilton-Smith 2001). Changes to the soil through compaction from heavy equipment can also alter the water regime by increasing runoff and decreasing infiltration, thus increasing erosion rates (Brown and Kirk 1999). Fires located near the cave entrance may cause erosion (Ellison et al. 2003) and affect airflow due to loss of vegetation (Perry 2011). Humidity within the cave can be altered by mechanical groundbreaking and vegetation modification on the surface of the cave (Clarke 1997).

Stormwater runoff can increase the risk of sinkhole creation (Chesapeake Stormwater Network 2009). New openings are likely to affect the temperature, humidity, and airflow of the cave. Blockage or alteration of entry points can alter airflow in a cave or mine and cause changes to the microclimate (Tuttle and Kennedy 2002). This may force bats to use suboptimal hibernation sites. Microclimate changes could result in individuals having to use less optimal locations in the hibernaculum and leave them vulnerable to predation, freezing, or exhaustion of fat reserves.

AMMs – Changes to Microclimate

Hibernacula AMM 1. For projects located within karst areas, on-site personnel will use best management practices,[89] secondary containment measures, or other standard spill prevention and countermeasures to avoid impacts to the possible hibernacula. Where practicable, a 300 ft (91.4 m) buffer will be employed to separate fueling areas and other major contaminant risk activities from caves, sinkholes, losing streams, and springs in karst topography.

Summary – Changes to Microclimate

The majority of activities within 0.5 miles (0.8 km) of hibernacula are outside the scope of this programmatic consultation. Activities greater than 0.5 miles (0.8 km) from hibernaculum(a) openings are not expected to result in any alteration of the microclimate of the cave. While exposure risk is greatest at the hibernaculum(a) openings, there may be impacts that occur further away depending on the cave or mine system, geology, and landscape setting (topography). Activities that alter hibernacula are outside the scope of this programmatic consultation.

The only activities that may occur within 0.5 miles (0.8 km) of hibernacula and are included in this programmatic consultation are:

- Activities that do not cause any stressors to the covered bat species, as described in the BA/BO (i.e., do not involve slash pile burning, ground disturbance, vibrations, noise above existing background levels, temporary or new/additional permanent lighting, nor tree removal/trimming.

[89] Coordinate with the local Service Field Office on recommended best management practices for karst in your state.

Site-specific reviews of projects within 0.5 miles (0.8 km) of hibernacula that do cause stressors will ensure that all potential exposure pathways are adequately addressed.

Stressor #3 – Physical Changes to Hibernacula

Stressor Introduction – Physical Changes to Hibernacula

Any changes to hibernacula may cause sites to no longer be available or preferable roosting locations. In the most extreme situations, sites can be excavated or filled in entirely. Sites can also be altered by less extreme work and result in filled or blocked entrances, partially or entirely flooded passageways, or new entrances/openings.

There are multiple activities (sources) associated with transportation projects that may result in physical changes to hibernacula.

Activities (sources) Causing Stressor: (Table 12)

Stressor Effects – Physical Changes to Hibernacula

Excavation–New openings may be created during excavation or other geophysical exploration. New openings may alter airflow thus impacting the microclimate of the cave (see Microclimate).

Vibration–Vibration impacts could affect the structure of the hibernacula, resulting in closures to existing openings, closures to parts of the hibernacula, and a complete collapse of the structure itself. There is limited information on vibration effects to the structural integrity of caves. Vulnerability of hibernacula to vibration is likely site-specific. There is extensive research on the effects of vibration on structures that may be useful. FTA, NPS, and the American Association of State Highway and Transportation Officials (AASHTO) have established safe threshold levels for ground-borne vibration impacts to protect structures. FTA's threshold to prevent architectural damage for conventional sensitive structures is 0.2 in/sec (0.508 cm/sec) PPV. To protect historic sites, NPS established safe levels of vibration at 0.2 in/sec (0.508 cm/sec) PPV for structures that exhibit significant levels of historic or architectural importance or that are in a poor or deteriorated state of maintenance and 0.5 in/sec (1.27 cm/sec) PPV for all other historic sites (NPS 1984).

Criteria to prevent damage to structures from construction and maintenance activities were developed by AASHTO in 1990. The maximum vibration levels (PPV) for preventing damage to structures from intermittent construction or maintenance activities are as follows: historic sites or other critical locations 0.1 in/sec (0.254 cm/sec); residential buildings, plastered walls 0.2 to 0.3 in/sec (0.508 to 0.762 cm/sec); residential buildings in good repair with gypsum board walls 0.4 to 0.5 in/sec (1.016 to 1.27 cm/sec); and engineered structures, without plaster 1.0 to 1.5 in/sec (2.54 to 3.81 cm/sec)(Jones and Stokes 2004).

There is limited information on adequate buffer distances to protect hibernaculum(a) from the effects of vibration. We evaluated distances of concern for blasting projects associated with mining. Many States have regulations that specify at what location adjacent landowners are notified for blasting projects. For example, Pennsylvania (25 Pa. Code § 87.127), West Virginia (West Virginia Department of Environmental Protection 1999), Indiana (IC 14-36 et seq.), and Ohio (OAC 1501:13-9-10) all notify residents within 0.5 miles (0.8 km) of a blasting site. This distance of 0.5 miles (0.8 km) from a hibernaculum provides a clear boundary of the area of concern where to begin our analysis of effects to the hibernaculum from the proposed activities.

Activities, such as blasting, that result in partial cave or mine collapse can also alter the microclimate of the cave (see Microclimate). Blockage or alteration of entry points can result in loss of habitat if bats can no longer enter the hibernaculum.

AMMs – Physical Changes to Hibernacula

Hibernacula AMM 1. For projects located within karst areas, on-site personnel will use best management practices,[90] secondary containment measures, or other standard spill prevention and countermeasures to avoid impacts to the possible hibernacula. Where practicable, a 300 ft (91.4 m) buffer will be employed to separate fueling areas and other major contaminant risk activities from caves, sinkholes, losing streams, and springs in karst topography.

Summary – Physical Changes to Hibernacula

The majority of activities within 0.5 miles (0.8 km) of hibernacula are outside the scope of this programmatic consultation. Activities greater than 0.5 miles (0.8 km) from hibernacula openings are not expected to result in any alterations to hibernacula. Activities that alter hibernacula are outside the scope of this programmatic consultation. While exposure risk is greatest at the hibernaculum(a) openings, there may be impacts that occur further away depending on the cave or mine system, geology, and landscape setting (topography).

The only activities that may occur within 0.5 miles (0.8 km) of hibernacula and be included in this programmatic consultation are:

- Activities that do not cause any stressors to the covered bat species, as described in the BA/BO (i.e., do not involve slash pile burning, ground disturbance, vibrations, noise above existing background levels, temporary or new/additional permanent lighting, nor tree removal/trimming

Site-specific reviews of projects within 0.5 miles (0.8 km) of hibernacula that do cause stressors will ensure that all potential exposure pathways are adequately addressed.

[90] Coordinate with the local Service Field Office on recommended best management practices for karst in your state.

5.6 Summary of Effects

This section summarizes activities that are included within the scope of this programmatic consultation.

Actions That Will Have No Effect on Bats

Some projects may occur near or within Indiana bat, NLEB, or TCB suitable habitat, but the project will result in **no effects or discountable likelihood of effects** without the implementation of any avoidance or minimization measures. Transportation projects that will have *no effect* on the Indiana bat, NLEB, or TCB include the following:

- Activities outside the species' range;
- Activities inside the species range (outside 0.5 miles [0.8 km] of hibernacula), but no suitable habitat within the project action area;
- Activities (anywhere, including within 0.5 miles [0.8 km] of hibernacula) that do not cause any stressors to the covered bat species, such as those that do not involve ground disturbance, vibrations, noise above existing background levels [including general traffic], temporary or new/additional permanent lighting, tree removal/trimming, and bridge, culvert, and structure);
- Percussive activities in suitable habitat (not related to tree removal/trimming and/or bridge, culvert, structure work) that involve noise/vibration above existing background levels when conducted greater than 0.5 miles (0.8 km) of a hibernaculum during the inactive season; and
- Removal, replacement, or alteration of bridges, culverts, or structures that do not meet the minimum culvert dimensions (see the Service's current survey guidance).

Actions That May Affect Bats

If no bat P/A surveys have been conducted and the project is within suitable habitat for the Indiana bat, NLEB, or TCB, State DOTs and/or Transportation Agencies will infer presence of the appropriate bat species. If P/A surveys document that the covered species are not likely to be present in suitable habitat, the project is not likely to adversely affect the Indiana bat, NLEB, or TCB. Percussive activities in suitable habitat (not related to tree removal/trimming and/or bridge, culvert, or structure work) that involve noise/vibration above existing background levels are not likely to adversely affect the Indiana bat, NLEB, or TCB so long as the activities are otherwise within the scope of the PBO (greater than 0.5 miles (0.8 km) of a hibernaculum; no further than 100 ft (30.5 m) of the road/rail surface during the pup season; and not carried out between December 15 and February 15 in Zone 1 of the NLEB and TCB YR active ranges). Activities involving the removal, replacement, or alteration of bridges, culverts, or structures with no signs of bat use [e.g., bats, guano], and do not impact suitable habitat within the project action area are also not likely to adversely affect the covered bat species.

Transportation projects within the scope of this programmatic consultation may occur near or within Indiana bat, NLEB, or TCB suitable habitat, in which it will be necessary to implement AMMs to avoid or minimize impacts to be insignificant/discountable. Temporary or new/additional permanent lighting activities that implement the lighting AMMs are NLAA the Indiana bat, NLEB, and TCB. Yet, even with the implementation of AMMs, some transportation projects may still result in adverse effects to the Indiana bat, NLEB, and TCB. Refer to Tables 13 and 14 below to identify projects that are NLAA or LAA Indiana bats, NLEBs, or TCBs due to tree removal/trimming and Tables 15 to identify projects that are NLAA or LAA Indiana bats, NLEBs, and TCBs due to bridge, culvert, and structure activities.

Table 14. Tree Removal/Trimming Activities in the Hibernating Range of the Indiana bat, NLEB, and TCB.

Distance to existing road/rail surface	Bat Information	Timing of Action/Project	Conclusion
≤0.5 miles (0.8 km) of hibernacula	Suitable Habitat	Anytime	Outside Scope
Any Distance	Negative P/A surveys	Anytime[91]	NLAA
≤100 ft (30.5 m)	Outside documented habitat for the Indiana bat or NLEB or TCB	Inactive Season	NLAA
≤100 ft (30.5 m)	Outside documented habitat for the Indiana bat or NLEB or TCB and all cleared/trimmed trees must be <9 in DBH	Pup Season	LAA
≤100 ft (30.5 m)	Outside documented habitat for the Indiana bat or NLEB or TCB and cleared/trimmed trees are >9 in DBH	Pup Season	Outside scope
Any Distance	Outside documented habitat for the Indiana bat or NLEB or TCB	Active Season *(excluding Pup Season)*	LAA
>100 ft (30.5 m)	Outside documented habitat for the Indiana bat or NLEB or TCB	Inactive Season	LAA
>100 ft (30.5 m)	Outside documented habitat for the Indiana bat or NLEB or TCB	Pup Season	Outside Scope
Any Distance	Documented habitat for the Indiana bat or NLEB or TCB	Inactive Season	LAA
Any Distance	Documented habitat for the Indiana bat or NLEB or TCB	Pup Season	Outside Scope
Any Distance	Documented habitat for the Indiana bat or NLEB or TCB	Active Season *(excluding Pup Season)*	LAA

[91] P/A surveys conducted within the fall swarming/spring emergence home range of a documented Indiana bat, NLEB, or TCB hibernacula (contact the local Service Field Office for appropriate distance from hibernacula) that result in a negative finding requires additional consultation with the local Service Field Office to determine if clearing of forested habitat is appropriate and/or if seasonal clearing restrictions are needed to avoid and minimize potential adverse effects on fall swarming and spring emerging Indiana bats, NLEBs, or TCBs.

Table 15. Tree Removal/Trimming Activities in the YR Active Ranges of the NLEB and TCB.

Distance to existing road/rail surface	Bat Information	Timing of Action/Project	Conclusion
≤0.5 miles (0.8 km) of hibernacula*	Suitable Habitat	Anytime	Outside Scope
Any Distance	Negative P/A surveys	Anytime	NLAA
≤100 ft (30.5 m)	Outside documented habitat for the NLEB or TCB and all cleared/trimmed trees must be <9 in DBH	Pup Season	LAA
≤100 ft (30.5 m)	Outside documented habitat for the NLEB or TCB and cleared/trimmed trees are >9 in DBH	Pup Season	Outside scope
Any Distance	Outside documented habitat for the NLEB or TCB	Dec 15 – Feb 15**	Outside Scope
Any Distance	Outside documented habitat for the Indiana bat, NLEB, or TCB	Anytime *excluding Pup Season* and *Dec 15 – Feb 15***	LAA
>100 ft (30.5 m)	Outside documented habitat for the NLEB or TCB	Pup Season	Outside scope
Any Distance	Documented habitat for the NLEB or TCB	Pup Season	Outside Scope
Any Distance	Documented habitat for the NLEB or TCB	Dec 15 – Feb 15**	Outside Scope
Any Distance	Documented habitat for the NLEB or TCB	Anytime *excluding Pup Season* and Dec 15 – Feb 15**	LAA

***** In the NLEB and TCB YR active ranges, this distance applies to hibernating in "traditional hibernacula" such as caves and mines, and not bats exhibiting short bouts of torpor in trees, culverts, etc.

** For the YR active ranges of the NLEB and TCB, winter tree clearing restrictions from Dec. 15 – Feb. 15 do not apply in areas where the mean minimum temperature is above 40° F throughout the winter months (depicted as Zone 2 in Figure 9).

Table 16. Bridge, Culvert, and Structure Projects >0.5 miles (0.8 km) of Indiana bat, NLEB, or TCB Hibernacula.

Bat Use Information	Timing of Action/Project	Suitable for roosting after the project is complete?	Conclusion
Bats present during inactive season (bridge, culvert, or structure is serving as hibernacula)	***Inactive Season*** – bats likely to be disturbed/killed	NA	outside scope
Bats in winter torpor in Zone 1 of the NLEB and TCB YR active ranges	***Dec 15-Feb 15*** – bats likely to be disturbed/killed	NA	outside scope
Known bat use in the active season or assumed bat use (large number of bats - >5 bats)	***Inactive Season*** – (so long as no hibernating bats)	Yes	NLAA
Known bat use in the active season or assumed bat use (large number of bats - >5 bats)	***Inactive Season*** – (so long as no hibernating bats)	No	outside scope
Known bat use in the active season or assumed bat use (large number of bats - >5 bats)	***Active Season*** – bats unlikely to be disturbed/killed	Yes	NLAA
Known bat use in the active season or assumed bat use (large number of bats - >5 bats)	***Active Season*** – bats unlikely to be disturbed/killed	No	outside scope
Known bat use in the active season or assumed bat use (large number of bats - >5 bats)	***Active Season*** – bats likely to be disturbed/killed	NA	outside scope
Known bat use in the active season (small number of bats - $\leq$ 5 bats)	***Inactive Season*** – (so long as no hibernating bats)	NA	NLAA
Known bat use in the active season (small number of bats - $\leq$ 5 bats)	***Active Season*** – bats unlikely to be disturbed/killed	NA	NLAA
Known bat use in the active season (small number of bats - $\leq$ 5 bats)	***Active Season*** – bats likely to be disturbed/killed	NA	LAA

5.7 Beneficial Effects

As mentioned above, the Transportation Agencies worked with the Service to develop the measures included in the proposed action as part of a section 7(a)(1) conservation strategy, and the Transportation Agencies' goals of streamlining section 7(a)(2) consultations and contributing to the recovery of the Indiana bat, NLEB, and TCB. Therefore, as a whole, we expect implementation of the programmatic consultation to be beneficial to all three species.

Beneficial effects to Indiana bat, NLEB, and TCB are anticipated from projects that are conducted in ways that avoid and minimize impacts. In addition, for projects that result in adverse impacts to Indiana bats, compensatory mitigation is included as part of the proposed action (see Section 3). There are a variety of options for mitigation with a focus on protecting occupied habitat (summer or winter).

This range-wide programmatic consultation will provide the option to combine the compensation for impacts to the Indiana bat from multiple projects within a state and will facilitate a more coordinated and strategic conservation effort than project-by-project mitigation. The incorporation of an ILF program provides an immediate option, among others, to streamline compensatory mitigation projects for Transportation Agencies. The prioritization of compensatory mitigation projects is intended to focus projects in areas that will achieve the greatest conservation benefit.

6.0 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 PBO. 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 ESA.

Reasonably foreseeable non-Federal activities that are anticipated to occur in the action area include land conversion associated with activities such as development for residential/commercial/agricultural growth and timber harvesting. The Service does not have any information on the amount or types of residential, industrial, or agricultural development that have or will occur within the action area. It is difficult to predict how much land conversion will occur since these land conversion activities are typically driven by the economy/location of the activity. This programmatic consultation only addresses activities adjacent to existing road/rail surfaces, not new transportation corridors. Therefore, the covered bats are already exposed to several stressors such as noise, vibration, lighting, and fragmentation caused by the existing road corridor. For most activities, noise/vibration from non-Federal activities adjacent to existing transportation corridors is not expected to result in any additional response to these bats. Transportation activities that increase the noise above the current baseline during the active season (including NLEB and TCB year-round active range in Zone 2) and for long periods of time are likely to disturb the covered bat species. Increased lighting associated with residential and commercial development and directed toward bat habitat during the active season may also disturb Indiana bat, NLEB, and TCB. However, the type, amount, and location of lighting that may be installed are difficult to predict. Tree removal/trimming from non-Federal activities in proximity to existing transportation corridors (i.e., 100 ft [30.5 m] from road surfaces) is not anticipated to result in any new habitat fragmentation. However, tree removal/trimming beyond 100 ft (30.5 m) of existing roadways may result in greater fragmentation and reduction in available habitat. Winter tree removal/trimming of documented roosts/roosting habitat or foraging habitat is anticipated to result in adverse impacts to returning bats. In addition, in the YR active ranges of the NLEB and TCB, winter tree removal/trimming of suitable habitat is anticipated to adversely impact these bats in temporary bouts of winter torpor and those in suitable roosting or foraging habitat.

7.0 JEOPARDY AND ADVERSE MODIFICATION ANALYSIS

Section 7(a)(2) of the ESA requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

7.1 Jeopardy Analysis Framework

"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). In accordance with policy and regulation, the jeopardy analysis in this PBO relies on 4 components: (1) Status of the Species, which evaluates the species range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) Environmental Baseline, which evaluates the status of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) Effects of the Action, which determines impacts of the proposed action; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the species. The jeopardy analysis in this PBO emphasizes the range-wide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination (see 50 CFR 402.14(g)).

In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat and to the environmental baseline to formulate our Opinion as to whether the proposed action is likely to appreciably: (1) reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the RND of that species; or (2) appreciably diminish the value of critical habitat for both the survival and recovery of a listed species.

Per the Service's consultation handbook (Service and NMFS 1998), survival is defined as "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Per the Service's consultation handbook (Service and NMFS 1998), recovery is defined as "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA." The "criteria set out in Section 4(a)(1)" means determining when a species no longer meets the definition of an "endangered species" or a "threatened species" because of any of the following factors:

(A) present or threatened destruction, modification, or curtailment of habitat or range;
(B) overutilization for commercial, recreational, scientific, or educational purposes;
(C) disease or predation;
(D) inadequate existing regulatory mechanisms; and
(E) other natural or manmade factors affecting the species continued existence.

An endangered species is "in danger of extinction throughout all or a significant portion of its range" (ESA Section 3(6)). A threatened species is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (ESA Section 3(20)).

To conduct this analysis, we begin by assessing whether there are effects to any individuals of the species of interest (as discussed in the Effects of the Action section above). If all effects are insignificant, discountable, or wholly beneficial, no further consultation is required. In other words, if we conclude that individuals are *not* likely to experience reductions in reproductive success or survival likelihood, fitness consequences for the species range-wide would not be expected as well. In this case, the agency has ensured that their action is not likely to jeopardize the continued existence of the species and our analysis is completed. Conversely, if we are unable to show that individuals are unlikely to experience reductions in their reproductive success or survival likelihood, we are required to assess how those effects are or are not anticipated to result in an appreciable reduction in the likelihood of both the survival and recovery <u>of the species</u>. We do not assess appreciable reduction of RND at an individual level because we do not assess appreciable reduction of survival and recovery at an individual level.

Because many species are composed of multiple populations and there may be meaningful differences in those populations (e.g., genetics, morphology, size) to the overall species survival and recovery, it is a logical intermediate step to evaluate the effects of impacts to individuals on the population(s) they are associated with. If our analyses indicate that reductions in the fitness of the population(s) are not likely to occur then there can be no appreciable reductions in reproduction, numbers, or distribution at a species level and we conclude that the agency has ensured that their action is not likely to jeopardize the continued existence of the species. If there are reductions in the fitness of the population(s) impacted, we then assess whether those changes affect the overall species survival and recovery range-wide based on the importance of the population(s) for species level representation, resiliency and redundancy, the level of impact, and the status of the species.

7.2 Indiana Bat

In Section 5 of this PBO, we identified the stressors associated with the various types of transportation activities included in the proposed action and analyzed how Indiana bat individuals would respond if exposed to these stressors. From this analysis, we determined that:

1. Projects that are proposed within 0.5 miles (0.8 km) of hibernacula are limited to activities with stressors that should not result in any response from Indiana bats and are not likely to modify the environment of the hibernacula.
2. Projects that are proposed beyond 0.5 miles (0.8 km) of hibernacula will cause various stressors for which exposure will cause adverse Indiana bat responses.
3. The proposed AMMs will frequently avoid exposure or reduce adverse responses.
4. The proposed AMMs protect Indiana bat maternity roosts during the pup season.
5. The proposed compensatory mitigation measures are expected to benefit Indiana bats.

When Indiana bats use a project action area for active-season habitat, tree removal/trimming is the most likely stressor to cause adverse responses.

Summary of Effects of Tree Removal/Trimming and Collision

For the original 2016 PBO, State DOTs and FHWA Division Offices estimated the average annual acreage of tree removal from the edge of the road/rail surface out to 300 ft (91.4 m) to be 320 acres [129.5 ha] per State (see Table 1). To calculate anticipated incidental take using this surrogate measure (for the 2016 PBO), we used this average annual acreage of tree removal/trimming (320 acres [129.5 ha]) multiplied by the numbers of states within the range of the Indiana bat (22 states). Thus, we estimated 7,040 acres (2,849 ha) of suitable Indiana bat habitat per year could be removed during the implementation of the programmatic consultation. Based upon projects that used this consultation from 2017-2021, we reported clearing of approximately 4,645 acres of suitable Indiana bat (and NLEB) habitat during this 5-year period; 242 acres of which resulted in incidental take of Indiana bats. This is total acreage (not acres/year).

This current PBO expands the scope to projects beyond 300 ft (30.5 m) of the road/rail surface, of which the amount of estimated average annual tree removal/trimming per State in this expanded area is unknown. However, acreage of tree removal/trimming is limited to 20 acres (8.1 ha) of forest per project (per 5-mile [8 km] segment). This limits the extent of tree removal/trimming included under this PBO. Also, most projects that previously used the PBO involve less than 2 acres (0.8 ha) of tree removal/trimming per project. The original estimate of 7,040 acres (2,849 ha) of suitable Indiana bat habitat per year that could be removed, proved to be significantly higher than what occurred (average of 929 acres per year). Therefore, we expect the increase in annual acreage of tree removal/trimming as a result of expanding the scope of the PBO beyond 300 ft (30.5 m) of the road/rail surface will not increase the original estimate of 7,040 acres (2,849 ha). In addition, the acreage of incidental take for each bat species is not cumulative, as the range of the three covered bat species overlap. Thus, we expect 7,040 acres (2,849 ha) of suitable Indiana bat habitat per year remains a reasonable estimate of the quantity of tree removal/trimming that may occur with the implementation of the proposed action. We do, however, expect the acres of tree removal/trimming that results in incidental take of the Indiana bat to increase above 242 acres over a 5-year period.

When considering the current estimated number of maternity colonies across the ranges of the species and low incidence of known roosts, it is clear that not all suitable forested habitat is occupied by the Indiana bat. Therefore, not all projects will impact forests that are occupied by the species. However, FHWA, FRA, and FTA infers presence of the species within suitable habitat (as defined in the Service's Range-wide Bat Survey Guidelines) when P/A surveys are not conducted. Therefore, not all tree removal/trimming within suitable habitat for the Indiana bat will cause take of individuals for the following reasons:

- The acreage estimates are based on trees removed/trimmed, but not all the trees removed/trimmed are suitable habitat.
- FHWA estimates that 90%[92] of the projects will implement inactive season tree removal/trimming, which reduces the impacts to Indiana bats by avoiding direct effects to the species.
- Transportation Agencies infer species presence in suitable habitat and apply conservation measures in such areas, when in fact the habitat may not be occupied by the species at the time of project construction. As such, not all habitat removal will cause adverse effects to the Indiana bat.
- Transportation Agencies may conduct bat surveys that indicate Indiana bats are not likely present.
- It is reasonably likely that many projects will involve less than 2 acres (0.8 ha)[93] of tree removal/trimming in a widely dispersed arrangement across the range of the Indiana bat.
- There is no tree removal/trimming outside of documented Indiana bat habitat beyond 100 ft (30.5 m) of the road/rail surface during the pup season.
- There is no removal of documented Indiana bat habitat during the pup season.

The Service anticipates incidental take of a small number of Indiana bats per LAA project resulting from tree removal/trimming under this programmatic consultation. Incidental take from tree removal/trimming during the active season (excluding the pup season) within suitable Indiana bat habitat is expected to be in the form of harm or kill. Tree removal/trimming during the inactive season outside of documented Indiana bat habitat beyond 100 ft (30.5 m) from the road/rail surface or in documented habitat (any distance) during the inactive season may result in harm to returning individuals that will be required to find each other and sufficient suitable roosts. We anticipate harm

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[92] FHWA originally estimated 25% in the 2018 PBO, but data reports for projects that used this consultation between 2017 and 2021 show that 90% of the projects implemented inactive season tree clearing.

[93] The 2018 PBO originally estimated tree clearing of less than 5 acres per project, but data reports for projects that used this consultation between 2017 and 2021 show most projects involved less than 2 acres of tree removal/trimming.

from inactive season tree removal/trimming to a small percentage of Indiana bats associated with a maternity colony whose members travel, roost, and forage within the project action area during the active season. Such harm is limited to the acres removed/trimmed identified for each project and the associated degradation of remaining forest in close proximity to expanded road/rail surfaces.

Tree removal/trimming is generally limited to approximately 20 acres (8.1 ha) of forest per project (per 5-mile [8 km] segment) and there may be associated degradation of remaining forest in close proximity to expanded road/rail surfaces. Projects with more than 20 acres (8.1 ha) of tree removal/trimming, but that are distributed across more than 5 miles (8 km), may have similar impacts to multiple maternity colonies rather than one colony. Tree removal/trimming in the inactive season may result in harm to Indiana bats during the first spring/summer after tree removal/trimming has occurred by causing a shift in roost trees, foraging patterns, and home range. We expect that given the linear nature and small amount of tree removal/trimming along existing road/rail surfaces, that in most cases, alternative roosting and foraging areas are generally available for each maternity colony to use near the action area; therefore, the impact of inactive season tree removal/trimming will likely diminish in subsequent years.

Some Indiana bats are anticipated to be taken by vehicle collisions associated with projects under this programmatic consultation. Yet, it is difficult to distinguish between bat/vehicle collisions that are a result of the operation of existing transportation infrastructure (baseline condition) or a result of road/rail widening, realignments, and new alignments covered under this programmatic consultation. Furthermore, in most cases, it is difficult to detect when bats collide with vehicles, as carcasses may be thrown outside the search area, carried away on the vehicles with which they collide, or scavenged by other wildlife. Also, any such strikes would likely go either unnoticed or unreported. Thus, the number of Indiana bats likely to be struck and killed from vehicles traveling on the roadways/railways associated with this programmatic consultation is difficult to quantify.

A subset of projects covered by this programmatic consultation include the removal of suitable habitat for road/rail widening, realignments, and new alignments. These project types increase the likelihood of vehicular collisions when the covered bat species are traveling between roosting and foraging areas due to road/rail widening, increased traffic volume and speed, and when canopy connectivity has been disrupted. As such, a subset of the 7,040 acres (2,849 ha) of suitable Indiana bat habitat that may be removed under this programmatic consultation is anticipated to cause incidental take of Indiana bats from vehicle collisions.

Summary of Effects of Bridge, Culvert, and Structure Activities

Bridge, culvert, or structures activities conducted during the active season, with a small number of Indiana bats observed (five or fewer), in which bats are likely to be disturbed or killed may result in incidental take in the form of harm or kill. In addition, bridge, culvert, and structure bat assessments may fail to initially detect bats, but during construction, a small number of Indiana bats may be encountered, such that take may occur in the form of harm or kill.

Indiana bats have been documented using bridges, culverts, and structures as day and/or nighttime summer roosts (see Section 5.3 of the PBO), but few assessments conducted in relation to this consultation between 2015 and 2019 have documented bat use, and none have detected presence of Indiana bats. As mentioned earlier (Table 8), the "bats in structures assessment form database" contained 2,378 assessments for between 2015 – 2019. This database revealed that 7.3% of bridges, 20.3% of culverts, and 6.7% of "other structures" assessed showed evidence of bat use (260 projects). Of the 260 assessments that revealed signs of bat use, 184 assessments included information on the species present, and no Indiana bats were observed. Indiana bat presence was inferred when assessments did not identify the bat species or when the transportation agency chose not to conduct an assessment.

We have applied the percentages of bridges, culverts, and structures that showed evidence of bat use (above),[94] to the estimated number of bridge, culvert, and structure projects to be implemented range-wide per year (374 bridges, 224 culverts, and 176 structures).[95] As a result, the Service anticipates that incidental take of a small number (fewer than five individuals) of Indiana bats per project may occur at up to 30 bridges, 47 culverts, and 13 structures range-wide per annual reporting year as a result of activities on existing bridges, culverts, and structures.

Based upon projects that used the PBO between 2015-2019, incidental take was exempted for up to 9 bridges/culverts (45 Indiana bats) and up to 4 bridges/culverts (20 Indiana bats) in 2021. Despite the low percentage of bridges, culverts, and structures that has signs of bat use in relation to this programmatic consultation (between 2015 -2019), we cannot rule out the possibility that Indiana bats will be adversely affected during the implementation of this program. Occasional use of bridges, culverts, and structures by the Indiana bats for roosting (Section 5.3), the potential for assessments to have missed Indiana bat use, and the potential for Indiana bats to begin using a bridge, culvert, or structure after the assessment and before work begins indicates that harm to individual Indiana bats from at least one site is likely to occur. However, we do not anticipate that maternity colonies as a whole will be harmed, as the implementation of the Bridge, Culvert, and Structure AMMs further reduce the likelihood of adverse effects, particularly to maternity colonies on bridges, culverts, and/or structures. Although individual bats or small numbers ($\leq$5) of covered bats may have been missed during an assessment, we expect an assessment would not miss a maternity colony of Indiana bats. Therefore, incidental take of Indiana bats in the form of harm or kill may occur from limited bridge, culvert, or structure activities conducted in the active season and five or fewer Indiana bats would be adversely affected in each incident.

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[94] The percentages of bridge, culvert, and structure projects that showed evidence of bat use were rounded up to the next whole number; 8%, 21%, and 7% respectively.

[95] The average number of bridge, culvert, and structure projects to be implemented range-wide per year were increased 30% due to the inclusion of the TCB increasing the scope of the programmatic consultation 30% above the Indiana bat and NLEB range.

Conclusion

After reviewing the current overall declining range-wide status of the Indiana bat and the similar condition of the species within the action area (environmental baseline), we then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. The Indiana bat is distributed widely across all or parts of 22 states. The impacts resulting from these projects will be dispersed; will affect only a small proportion of the area where the species may be present; and will be significantly minimized in areas where it is known to occur. The Service finds that such impacts are not likely to harm, or kill at a level that would reduce appreciably the RND of the Indiana bat, and therefore, we do not anticipate a reduction in the likelihood of both survival and recovery of the species. It is the Service's Opinion that this range-wide program of transportation activities, as proposed, is not likely to jeopardize the continued existence of the Indiana bat.

7.3 Northern Long-eared Bat

In Section 5 of this PBO, we identified the stressors associated with the various types of transportation activities included in the proposed action and analyzed how NLEB individuals would respond if exposed to these stressors. From this analysis, we determined that:

1. Projects that are proposed within 0.5 miles (0.8 km) of hibernacula are limited to activities with stressors that should not result in any response from NLEB and are not likely to modify the environment of the hibernacula.
2. Projects that are proposed beyond 0.5 miles (0.8 km) of hibernacula will cause various stressors for which exposure will cause adverse NLEB responses.
3. The proposed AMMs will frequently avoid exposure or reduce adverse responses.
4. The proposed AMMs protect NLEB maternity roosts during the pup season.
5. The proposed compensation measures in the range of the Indiana bat will likely also benefit the NLEB.

When NLEBs use a project action area for active-season habitat (including year-round use habitat), tree removal/trimming is the most likely stressor to cause adverse responses.

Summary of Effects of Tree Removal/Trimming and Collision

For the original 2016 PBO, State DOTs and FHWA Division Offices estimated the average annual acreage of tree removal/trimming from the edge of the road/rail surface out to 300 ft (91.4 m) to be 320 acres [129.5 ha] per State (see Table 1). To calculate anticipated incidental take using this surrogate measure (for the 2016 PBO), we used this average annual acreage of tree removal/trimming (320 acres [129.5 ha]) multiplied by the numbers of states within the range of the NLEB (37 states + D.C.). Thus, we estimated 12,160 acres (4,921 ha) of suitable NLEB habitat per year could be removed/trimmed during the implementation of the programmatic consultation. Based upon projects that used this consultation from 2017-2021, we reported clearing of approximately 4,645 acres of suitable NLEB habitat during this

5-year period; 743 acres of which resulted in incidental take of NLEBs. This is total acreage (not acres/year).

This current PBO expands the scope to projects beyond 300 ft (30.5 m) of the road/rail surface, of which the amount of estimated average annual tree removal/trimming per State in this expanded area is unknown. However, acreage of tree removal/trimming is limited to 20 acres (8.1 ha) of forest per project (per 5-mile [8 km] segment). Also, most projects that previously used the PBO involve less than 2 acres (0.8 ha) of tree removal/trimming. This limits the extent of tree removal/trimming included under this PBO. The original estimate of 12,160 acres (4,921 ha) of suitable NLEB habitat per year that could be removed, proved to be significantly higher than what occurred (average of 929 acres per year). Therefore, we expect the increase in annual acreage of tree removal/trimming as a result of expanding the scope of the PBO beyond 300 ft (30.5 m) of the road/rail surface will not increase the original estimate of 12,160 acres (4,921 ha). In addition, the acreage of incidental take for each bat species is not cumulative, as the range of the three bat species overlap. Thus, we expect 12,160 acres (4,921 ha) of suitable NLEB habitat per year remains a reasonable estimate of the quantity of tree removal/trimming that may occur with the implementation of the proposed action. We do, however, expect acres of tree removal/trimming that results in incidental take of the NLEBs to increase above 743 acres over a 5-year period.

When considering the current estimated number of maternity colonies across the ranges of the species and low incidence of known roosts, it is clear that not all suitable forested habitat is occupied by the NLEB. Therefore, not all projects will impact forests that are occupied by the species. However, FHWA, FRA, and FTA infers presence of the species within suitable habitat (as defined in the Service's Range-wide Bat Survey Guidelines) when P/A surveys are not conducted. Therefore, not all tree removal/trimming within suitable habitat for the NLEB will cause take of individuals for the following reasons:

- The acreage estimates are based on trees removed/trimmed, but not all the trees removed/trimmed are suitable habitat.
- FHWA estimates that 90%[96] of the projects will implement inactive season tree removal/trimming, which reduces the impacts to NLEBs by avoiding direct effects to the species.
- Transportation Agencies will infer species presence in suitable habitat and apply conservation measures in such areas, when in fact the habitat may not be occupied by the species at the time of project construction. As such, not all habitat removal will cause adverse effects to the NLEB.
- Transportation Agencies may conduct bat surveys that indicate NLEBs are not likely present.

[96] FHWA originally estimated 25% in the 2018 PBO, but data reports for projects that used this consultation between 2017 and 2021 show that 90% of the projects implemented inactive season tree clearing.

- It is reasonably likely that many projects will involve less than 2 acres (0.8 ha)[97] of tree removal/trimming in a widely dispersed arrangement across the range of the NLEB, which consists of 282,351,352 acres of suitable habitat[98] range-wide.
- There is no tree removal/trimming outside of documented NLEB habitat beyond 100 ft (30.5 m) of the road/rail surface during the pup season.
- There is no removal of documented NLEB habitat during the pup season.
- There is no removal of suitable NLEB habitat in Zone 1 of the NLEB YR active range between December 15 – February 15.

The Service anticipates incidental take of a small number of NLEBs per LAA project resulting from tree removal/trimming under this programmatic consultation. Incidental take from tree removal/trimming during the active season (excluding the pup season) in NLEB suitable habitat is expected to be in the form of harm or kill. Also, removing occupied roost trees in areas where NLEBs are active year-round (excluding the pup season and December 15 to February 15) is also expected to cause incidental take of NLEBs in the form of harm or kill.

Tree removal/trimming during the inactive season outside of documented NLEB habitat beyond 100 ft (30.5 m) from the road/rail surface or in documented habitat (any distance) during the inactive season may result in harm to returning individuals that will be required to find each other and sufficient suitable roosts. We anticipate harm from inactive season tree removal/trimming to a small percentage of NLEBs associated with a maternity colony whose members travel, roost, and forage within the project action area during the active season. Such harm is limited to the cleared acreage identified for each project and the associated degradation of remaining forest in close proximity to expanded road/rail surfaces.

Tree removal/trimming is generally limited to approximately 20 acres (8.1 ha) of forest per project (per 5-mile [8 km] segment) and there may be associated degradation of remaining forest in close proximity to expanded road/rail surfaces. Projects with more than 20 acres (8.1 ha) of tree removal/trimming, but that are distributed across more than 5 miles (8 km), may have similar impacts to multiple maternity colonies rather than one colony. Tree removal/trimming in the inactive season may result in harm to NLEBs during the first spring/summer after tree removal/trimming has occurred by causing a shift in roost trees, foraging patterns, and home range. We expect that given the linear nature and small amount of tree removal/trimming along existing road/rail surfaces, that in most cases, alternative roosting and foraging areas are generally available for each maternity colony to use near the action

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[97] The 2018 PBO originally estimated tree clearing of less than 5 acres per project, but data reports for projects that used this consultation between 2017 and 2021 show most projects involved less than 2 acres of tree removal/trimming.

[98] The extent of suitable habitat for the NLEB is estimated per state using a rule-based model rather than simply acres of forested habitat. The model merges National Land Cover Dataset data (including all forest layers and canopy coverage of greater than 45% to identify areas with larger contiguous forest stands) with suitable habitat for the species. Only areas with greater than 10 acres of forested area were included in the acreage of suitable habitat, as smaller fragments of habitat were considered unlikely to support the species.

area; therefore, the impact of inactive season tree removal/trimming will likely diminish in subsequent years.

A small number of NLEBs are anticipated to be taken by vehicle collisions associated with projects under this programmatic consultation. Yet, it is difficult to distinguish between bat/vehicle collisions that are a result of the operation of existing transportation infrastructure (baseline condition) or a result of road/rail widening, realignments, and new alignments covered under this programmatic consultation. Furthermore, in most cases, it is difficult to detect when bats collide with vehicles, as carcasses may be thrown outside the search area, carried away on the vehicles with which they collide, or scavenged by other wildlife. Also, any such strikes would likely go either unnoticed or unreported. Thus, the actual number of individual NLEBs that may be struck and killed from vehicles traveling on the roadways/railways associated with this programmatic consultation is difficult to meaningfully quantify.

A subset of projects covered by this programmatic consultation include the removal of suitable habitat for road/rail widening, realignments, and new alignments. These project types increase the likelihood of vehicular collisions when the covered bat species are traveling between roosting and foraging areas due to road/rail widening, increased traffic volume and speed, and when canopy connectivity has been disrupted. As such, as subset of the 12,160 acres (4,921 ha) of suitable NLEB habitat that may be removed under this programmatic consultation is anticipated to cause incidental take of NLEBs from vehicle collisions.

Summary of Effects of Bridge, Culvert, and Structure Activities

Bridge, culvert, or structure activities conducted during the active season, with a small number of NLEBs observed (five or fewer bats), in which bats are likely to be disturbed or killed may result in incidental take in the form of harm or kill. Also, take in the form of harm or kill is likely to occur from these activities taking place in the NLEB YR active range. In addition, bridge, culvert, and structure bat assessments may fail to initially detect bats, but during construction, a small number of NLEBs may be encountered, such that take may occur in the form of harm or kill.

NLEBs have been documented using bridges, culverts, and structures as day and/or nighttime summer roosts (see Section 5.3 of the PBO), but few assessments conducted in relation to this consultation between 2015 and 2019 have documented bat use, and none have detected presence of NLEBs. As mentioned earlier (Table 8), the “bats in structures assessment form database” contained 2,378 assessments for between 2015 – 2019. This database revealed that 7.3% of bridges, 20.3% of culverts, and 6.7% of “other structures” assessed showed evidence of bat use (260 projects). Of the 260 assessments that revealed signs of bat use, 184 assessments included information on the species present, and no NLEBs were observed. NLEB presence was inferred when assessments did not identify the bat species or when the transportation agency chose not to conduct an assessment.

We have applied the percentages of bridges, culverts, and structures that showed evidence of bat use (above),[99] to the estimated number of bridge, culvert, and structure projects to be implemented range-wide per year (374 bridges, 224 culverts, and 176 structures).[100] As a result, the Service anticipates that incidental take of a small number (five or fewer individuals) of NLEBs per project may occur at up to 30 bridges, 47 culverts, and 13 structures range-wide per annual reporting year as a result of activities on existing bridges, culverts, and structures.

Based upon projects that used the PBO between 2015-2019, incidental take was exempted for up to 9 bridges/culverts (45 NLEBs) and up to 4 bridges/culverts (20 NLEBs) in 2021. Despite the low percentage of bridges, culverts, and structures that had signs of bat use in relation to this programmatic consultation (between 2015 -2019), we cannot rule out the possibility it is likely that NLEBs will be adversely affected during the implementation of this program. Occasional use of bridges, culverts, and structures by the NLEB for roosting (see Section 5.3 of the PBO), the potential for assessments to have missed NLEB use, and the potential for NLEBs to begin using a bridge, culvert, or structure after the assessment and before work begins indicates that harm to individual NLEBs from at least one site is likely to occur. However, we do not anticipate that maternity colonies as a whole will be harmed, as the implementation of the Bridge, Culvert, and Structure AMMs further reduce the likelihood of adverse effects, particularly to maternity colonies on bridges, culverts, and/or structures. Although individual bats or small numbers ($\leq$5) of covered bats may have been missed during an assessment, we expect an assessment would not miss a maternity colony of NLEBs. Therefore, incidental take of NLEBs in the form of harm or kill may occur from limited bridge, culvert, or structure activities conducted in the active season and five or fewer NLEBs would be adversely affected in each incident.

Conclusion

After reviewing the current overall declining range-wide status of the NLEB and the similar condition of the species within the action area (environmental baseline), we then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. The NLEB is distributed widely across all or parts of 37 states. The impacts resulting from these projects will be dispersed; will affect only a small proportion of the area where the species may be present; and will be significantly minimized in areas where it is known to occur. The Service finds that such impacts are not likely to result in harm, or mortality at a level that would reduce appreciably the reproduction, numbers, or distribution of the NLEB, and therefore, we do not anticipate a reduction in the likelihood of both survival and recovery of the species. It is the Service's Opinion that this range-wide program of transportation activities, as proposed, is not likely to jeopardize the continued existence of the NLEB. No critical habitat has been designated for the NLEB.

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[99] The percentages of bridge, culvert, and structure projects that showed evidence of bat use were rounded up to the next whole number; 8%, 21%, and 7% respectively.

[100] The average number of bridge, culvert, and structure projects to be implemented range-wide per year were increased 30% due to the inclusion of the TCB increasing the scope of the programmatic consultation 30% above the Indiana bat and NLEB range.

7.4 Tricolored Bat

In Section 5 of this PBO, we identified the stressors associated with the various types of transportation activities included in the proposed action, and analyzed how TCB individuals would respond if exposed to these stressors. From this analysis, we determined that:

1. Projects that are proposed within 0.5 miles (0.8 km) of hibernacula are limited to activities with stressors that should not result in any response from the TCB and are not likely to modify the environment of the hibernacula.
2. Projects that are proposed beyond 0.5 miles (0.8 km) of hibernacula will cause various stressors for which exposure will cause adverse TCB responses.
3. The proposed AMMs will frequently avoid exposure or reduce adverse responses.
4. The proposed AMMs protect TCB maternity roosts during the pup season.
5. The proposed compensation measures in the range of the Indiana bat will likely also benefit the TCB.

When TCBs use a project action area for active-season habitat (including year-round use habitat), tree removal/trimming is the most likely stressor to cause adverse responses.

Summary of Effects of Tree Removal/Trimming and Collision

For the original 2016 PBO, State DOTs and FHWA Division Offices estimated the average annual acreage of tree removal/trimming from the edge of the road/rail surface out to 300 ft (91.4 m) to be 320 acres (129.5 ha) per State (see Table 1). To calculate anticipated incidental take of TCBs using this surrogate measure, we would take a similar approach for TCB, and use the average annual acreage of tree removal/trimming (320 acres [129.5 ha]) and multiply by the numbers of states within the range of the TCB (39 states + D.C.). This would give us an estimate of 12,800 acres (5,180 ha) of suitable TCB habitat per year could be removed during the implementation of the programmatic consultation. Yet, the scope of this PBO extends beyond 300 ft (91.4 m) from the road/surface, of which the average annual acreage of tree removal/trimming per State in this expanded area is unknown. However, acreage of tree removal/trimming is limited to 20 acres (8.1 ha) of forest per project (per 5-mile [8 km] segment). Also, most projects that previously used the PBO involve less than 2 acres (0.8 ha) of tree removal/trimming. This limits the extent of tree removal/trimming included under this PBO.

Since the original acreage estimates of suitable Indiana bat and NLEB habitat per year to be removed proved to be significantly higher than what occurred, we expect the increase in annual acreage of tree removal/trimming as a result of expanding the scope of the PBO beyond 300 ft (30.5 m) of the road/rail surface will not increase the estimate of 12,800 acres (5,180 ha) per year for suitable TCB habitat as well. In addition, the acreage of incidental take for each bat species is not cumulative, as the range of the three bat species overlap. Thus, we expect 12,800 acres (5,180 ha) of suitable TCB habitat per year remains a reasonable estimate of the quantity of tree removal/trimming that may occur with the implementation of the proposed action.

When considering the current estimated number of maternity colonies across the ranges of the species and low incidence of known roosts, it is clear that not all suitable forested habitat is occupied by the TCB. Therefore, not all projects will impact forests that are occupied by the species. However, FHWA, FRA, and FTA infers presence of the species within suitable habitat (as defined in the Service's Range-wide Bat Survey Guidelines) when P/A surveys are not conducted. Therefore, not all tree removal/trimming within suitable habitat for the TCB will cause take of individuals for the following reasons:

- The acreage estimates were based on trees removed/trimmed, but not all the trees removed/trimmed are suitable habitat.
- FHWA estimates that 90%[101] of the projects will implement inactive season tree removal/trimming, which reduces the impacts to TCBs by avoiding direct effects to the species in the hibernating range.
- Transportation Agencies will infer species presence in suitable habitat and apply conservation measures in such areas, when in fact the habitat may not be occupied by the species at the time of project construction. As such, not all habitat removal will cause adverse effects to the TCB.
- Transportation Agencies may conduct bat surveys that indicate TCBs are not likely present.
- It is reasonably likely that many projects will involve less than 2 acres (0.8 ha)[102] of tree removal/trimming in a widely dispersed arrangement across the range of the TCB.
- There is no tree removal/trimming outside of documented TCB habitat during the pup season beyond 100 ft (30.5 m) of the road/rail surface.
- There is no removal/trimming of documented TCB habitat during the pup season.
- There is no removal/trimming of suitable TCB habitat between December 15 – February 15 in Zone 1 of the TCB YR active range (see Figure 9).[103]

The Service anticipates incidental take of a small number of TCBs per LAA project resulting from tree removal/trimming under this programmatic consultation. Incidental take from tree removal/trimming during the active season (excluding the pup season) in TCB suitable habitat is expected to be in the form of harm or kill. Also, removing occupied roost trees in areas where TCBs are active year-round (excluding the pup season and December 15 to February 15) is also expected to cause incidental take of TCBs in the form of harm or kill.

Tree removal/trimming during the inactive season outside of documented TCB habitat beyond 100 ft (30.5 m) from the road/rail surface or in documented habitat (any distance) during the inactive season

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[101] FHWA originally estimated 25% in the 2018 PBO, but data reports for projects that used this consultation between 2017 and 2021 show that 90% of the projects implemented inactive season tree clearing.

[102] The 2018 PBO originally estimated tree clearing of less than 5 acres per project, but data reports for projects that used this consultation between 2017 and 2021 show most projects involved less than 2 acres of tree removal/trimming.

[103] Winter tree clearing restrictions from December 15 – February 15 do not apply in the NLEB and TCB YR active areas where the mean minimum temperature is above 40° F throughout the winter months (depicted as Zone 2 in Figure 9).

may result in harm to returning individuals that will be required to find each other and sufficient suitable roosts. We anticipate harm from inactive season tree removal/trimming to a small percentage of TCBs associated with a maternity colony whose members travel, roost, and forage within the project action area during the active season. Such harm is limited to the cleared acreage identified for each project and the associated degradation of remaining forest in close proximity to expanded road/rail surfaces.

Tree removal/trimming is generally limited to approximately 20 acres (8.1 ha) of forest per project (per 5-mile [8 km] segment) and there may be associated degradation of remaining forest in close proximity to expanded road/rail surfaces. Projects with more than 20 acres (8.1 ha) of tree removal/trimming, but that are distributed across more than 5 miles (8 km), may have similar impacts to multiple maternity colonies rather than one colony. Tree removal/trimming in the inactive season may result in harm to TCBs during the first spring/summer after tree removal/trimming has occurred by causing a shift in roost trees, foraging patterns, and home range. We expect that given the linear nature and small amount of tree removal along existing road/rail surfaces, that in most cases, alternative roosting and foraging areas are generally available for each maternity colony to use near the action area; therefore, the impact of inactive season tree removal/trimming will likely diminish in subsequent years.

A small number of TCBs are anticipated to be taken by vehicle collisions associated with projects under this programmatic consultation. Yet, it is difficult to distinguish between bat/vehicle collisions that are a result of the operation of existing transportation infrastructure (baseline condition) or a result of road/rail widening, realignments, and new alignments covered under this programmatic consultation. Furthermore, in most cases, it is difficult to detect when bats collide with vehicles, as carcasses may be thrown outside the search area, carried away on the vehicles with which they collide, or scavenged by other wildlife. Also, any such strikes would likely go either unnoticed or unreported. Thus, the actual number of individual TCBs that may be struck and killed from vehicles traveling on the roadways/railways associated with this programmatic consultation is difficult to meaningfully quantify.

A subset of projects covered by this programmatic consultation include the removal of suitable habitat for road/rail widening, realignments, and new alignments. These project types increase the likelihood of vehicular collisions when the covered bat species are traveling between roosting and foraging areas due to road/rail widening, increased traffic volume and speed, and when canopy connectivity has been disrupted. As such, a subset of the 12,800 acres (5,180 ha) of suitable TCB habitat that may be removed under this programmatic consultation is anticipated to cause incidental take of TCBs from vehicle collisions.

Summary of Effects of Bridge, Culvert, and Structure Activities

Bridge, culvert, or structure activities conducted during the active season, with a small number of TCBs observed (five or fewer bats), in which bats are likely to be disturbed or killed may result in take in the form of harm or kill. Also, take in the form of harm or kill is likely to occur from these activities taking place in the TCB YR active range. In addition, bridge, culvert, and structure bat assessments may fail to initially detect bats, but during construction, a small number of TCBs may be encountered, such that take may occur in the form of harm or kill.

TCBs have been documented using bridges, culverts, and structures as day and/or nighttime summer roosts (see Section 5.3 of the PBO), but few assessments conducted in relation to this consultation between 2015 and 2019 have documented bat use, and none have detected presence of TCBs. As mentioned earlier (Table 8), the "bats in structures assessment form database" contained 2,378 assessments for between 2015 – 2019. This database revealed that 7.3% of bridges, 20.3% of culverts, and 6.7% of "other structures" assessed showed evidence of bat use (260 projects). Of the 260 assessments that revealed signs of bat use, 184 assessments included information on the species present, and no TCBs were observed. TCB presence was inferred when assessments did not identify the bat species or when the transportation agency choose not to conduct an assessment.

We have applied the percentages of bridges, culverts, and structures that showed evidence of bat use (above),[104] to the estimated number of bridge, culvert, and structure projects to be implemented range-wide per year (374 bridges, 224 culverts, and 176 structures).[105] As a result, the Service anticipates that incidental take of a small number (five or fewer individuals) of TCBs per project may occur at up to 30 bridges, 47 culverts, and 13 structures range-wide per annual reporting year as a result of activities on existing bridges, culverts, and structures.

Despite the low percentage of bat use of bridges, culverts, and structures assessed in relation to this programmatic consultation, TCBs were one of the most frequently observed bats using bridges, culverts, and other structures. Therefore, we anticipate that TCBs will be adversely affected during the implementation of this program. Use of bridges, culverts, and structures by the TCB for roosting (see Section 5.3 of the PBO), the potential for assessments to have missed TCB use, and the potential for TCBs to begin using a bridge, culvert, or the structures after the assessment and before work begins, indicates that harm to individual TCBs is likely to occur. However, we do not think it is likely that maternity colonies as a whole will be harmed, as the implementation of the Bridge, Culvert, and Structure AMMs further reduces the likelihood of adverse effects, particularly to maternity colonies on bridges, culverts, and/or structures. Although individual bats or small numbers ($\leq$5) of covered bats may be missed during an assessment, we think it is unlikely that any assessment will miss observance of a maternity colony of TCBs. Therefore, incidental take of TCBs in the form of harm or kill may occur from limited bridge, culvert, or structure activities conducted in the active season and five or fewer TCBs would be adversely affected in each incident.

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[104] The percentages of bridge, culvert, and structure projects that showed evidence of bat use were rounded up to the next whole number; 8%, 21%, and 7% respectively.

[105] The average number of bridge, culvert, and structure projects to be implemented range-wide per year were increased 30% due to the inclusion of the TCB increasing the scope of the programmatic consultation 30% above the Indiana bat and NLEB range.

Conclusion

After reviewing the current overall declining range-wide status of the TCB and the similar condition of the species within the action area (environmental baseline), we have assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. The TCB is distributed widely across all or parts of 39 states. The impacts resulting from these projects will be dispersed, will affect only a small proportion of the area where the species may be present, and will be significantly minimized in areas where it is known to occur. The Service finds that such impacts are not likely to result in harm, or mortality at a level that would reduce appreciably the reproduction, numbers, or distribution of the TCB, and therefore, we do not anticipate a reduction in the likelihood of both survival and recovery of the species. It is the Service's Conference Opinion that this range-wide program of transportation activities, as proposed, is not likely to jeopardize the continued existence of the TCB. No critical habitat has been designated for the TCB.

8.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA (16 USC 1538) 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 as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in injury or death to 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 (50 CFR § 17.3). Under the terms of ESA section 7(b)(4) [16 USC 1536(b)(4)] and section 7(o)(2) [16 USC 1536(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 (ITS).

The measures described below are nondiscretionary and must be undertaken by the Transportation Agencies so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The Transportation Agencies have a continuing duty to regulate the activity covered by this ITS. If the Transportation Agencies: (1) fail to implement the terms and conditions; or (2) fail to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse.

To monitor the impact of incidental take, the Transportation Agencies and/or State DOT's must report the progress of the action and its impact on the species to the Service as specified in the ITS, which we describe below in Section 8.3 Monitoring and Reporting.

8.1 Amount or Extent of Take Anticipated

In this section, we describe the incidental take of Indiana bats, NLEBs, and TCBs that is reasonably certain to occur from the implementation of the proposed program of transportation activities. Based on the stressor-exposure-response analyses of Section 5 of the PBO we anticipate that take is reasonably certain to occur resulting from tree removal/trimming and some activities to existing bridges, culverts, and structures. The Service also anticipates that the Indiana bat, NLEB, and TCB may collide with vehicles from the operation of road/rail widening, realignments, and new alignment projects covered under this programmatic consultation. The covered bats may be directly killed or fatally wounded as they fly across the roadway/railway to access roosting and/or foraging areas. However, we do expect some offset of collision risk from existing roadways/railways to new roadway/railways as vehicles from one road/rail shift to using the new road/rail.

We express the anticipated incidental take with surrogate measures. 50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided that the biological opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take or to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

Tree Removal/Trimming and Collision

For impacts from tree removal/trimming and vehicle collisions, the following ITS uses acres of habitat from which trees are removed/trimmed as a surrogate (Table 17). In this situation, acres of habitat impacted by tree removal/trimming and those acres associated with road/rail widening, realignments, and new alignments are a reasonable and appropriate surrogate for incidental take of the Indiana bat, NLEB, and TCB as required at 50 CFR 402.14(i)(1)(i) for the following reasons:

- There is a causal link between the surrogate and the incidental take – tree removal/trimming within suitable habitat is what will directly and indirectly cause the anticipated incidental take. Also, suitable habitat removed/trimmed for road/rail widening, realignments, and new alignments are likely to indirectly cause incidental take of the covered bats species from vehicle collisions associated with these types of projects that increase road/rail miles or widths, traffic volume or traffic speed.
- For the Indiana bat, NLEB, and TCB, it is not practical to express the amount of anticipated take in terms of individuals because there is no density or abundance estimate for the portion of the action area where take is anticipated. As a result, predicting the precise number of individuals that will be taken is not possible. Additionally, it is not practical to monitor take-related impacts in terms of individual Indiana bats, NLEBs, and TCBs for the following reasons: (1) all 3 species have a small body size and are drab in color, which makes encountering dead or wounded individuals unlikely; (2) the 3 species occupy summer habitats (heavily forested) where they are difficult to locate (multiple roosts located within and outside of the action area); (3) all 3 species spend a substantial portion of their lifespan underground; (4) take may occur offsite (e.g., the

bat dies outside of the action area, particularly take by vehicle collisions as carcasses may be thrown outside the search area, carried away on the vehicles with which they collide, or scavenged by other wildlife); (5) starvation or failure to reproduce cannot be detected; and (6) losses may be masked by fluctuations in numbers associated with WNS. Because the location, timing, and acreage of habitat impacts can be readily identified, measured, and monitored, this surrogate is the most reasonable means for detecting when take may be exceeded.

- The extent in acres of tree removal/trimming in suitable habitat provides a clear standard because each project that includes tree removal/trimming in suitable habitat for the 3 bat species will be tracked and reported as described in Section 8.3 of the PBO.

As explained in the Jeopardy Analysis section for each of the covered bat species, we estimate 7,040 acres (2,849 ha) of suitable Indiana bat habitat per year; 12,160 acres (4,921 ha) of suitable NLEB habitat per year; and 12,800 acres (5,180 ha) of suitable TCB habitat per year could be removed during the implementation of the Program. The number of Indiana bats, NLEBs, and TCBs taken within this acreage is greatly influenced by the implementation of the proposed AMMs (Section 2.3). Our analysis in Section 5 of the PBO, which supports the Conclusion of section 7, assumes full compliance with these measures.

Work on Bridges, Culverts, or Structures

As with tree removal/trimming, the number of bridges, culverts, and structures that will be impacted where signs of use by the covered bat species are observed will serve as the surrogate measure for the anticipated incidental take of Indiana bats, NLEBs, and TCBs. This is an appropriate surrogate for the following reasons, as required at 50 CFR 402.14(i)(1)(i):

- The anticipated take of Indiana bat, NLEBs, and TCBs will occur because of the bridge, culvert, or structure work associated with these specific projects. Therefore, there is a causal link between the work associated with these projects and the anticipated take.
- It is not practical to monitor take-related impacts in terms of individuals of the listed species. The small size and cryptic behavior of Indiana bats, NLEBs, and TCBs roosting at these bridges, culverts, or structures will prevent accurate enumeration of the number taken.
- The number of bridges, culverts, or structures where work occurs and that have signs of use by the covered bat species is a number that is readily tracked, and it will be clear if the number of such projects is exceeded.

As explained in the Jeopardy Analysis section for each bat species, we estimate incidental take of Indiana bats, NLEBs, and TCBs at 30 bridges, 47 culverts, and 13 structures range-wide per year during the implementation of the Program. The likelihood and number of Indiana bats, NLEBs, and TCBs taken at this number of bridges, culverts, and structures is greatly influenced by the implementation of the proposed AMMs (Section 2.3). Our analysis in Section 5 of the PBO, which supports the Conclusion of section 7, assumes full compliance with these measures.

Table 17. Amount and Type of Anticipated Incidental Take.

Species	Amount of Take Anticipated (Surrogate) Per Year Range-wide	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
NLEB	12,160 acres (4,921 ha)	Adults or juveniles	Harm or kill	Temporary reduced reproduction (reduced pregnancy success) of individuals associated with loss of (and relocating) roosting and foraging habitat. Infrequent death of individual NLEBs that unsuccessfully flee during tree removal/trimming during the active season (outside pup season and Dec. 15 – Feb. 15 in the YR active range).[106] Killed or harmed from vehicular collisions associated with road/rail widening, realignment, and new alignment projects.
NLEB	30 affected bridges, 47 affected culverts, and 13 affected structures	Adults or juveniles	Harm or kill	Temporary displacement from bridge, culvert, or structure roosts. Potential for a few individuals to be killed or harmed (fewer than five individuals per bridge, culvert, or structure).
Indiana bat	7,040 acres (2,849 ha)	Adults or juveniles	Harm or kill	Temporary reduced reproduction (reduced pregnancy success) of individuals associated with loss of (and relocating) roosting and foraging habitat. Infrequent death of individual Indiana bats that unsuccessfully flee during tree removal/trimming during the active season (outside pup season). Killed or harmed from vehicular collisions associated with road/rail widening, realignment, and new alignment projects.
Indiana bat	30 affected bridges, 47 affected culverts, and 13 affected structures	Adults or juveniles	Harm or kill	Temporary displacement from bridge, culvert, or structure roosts. Potential for a few individuals to be killed or harmed (fewer than five individuals per bridge, culvert, or structure).

[106] Winter tree clearing restrictions from December 15 – February 15 do not apply in the NLEB and TCB YR active areas where the mean minimum temperature is above 40˚ F throughout the winter months (depicted as Zone 2 in Figure 9).

TCB	12,800 acres (5,180 ha)	Adults or juveniles	Harm or kill	Temporary reduced reproduction (reduced pregnancy success) of individuals associated with loss of (and relocating) roosting and foraging habitat. Infrequent death of individual TCBs that unsuccessfully flee during tree removal/trimming during the active season (outside pup season and Dec. 15 – Feb. 15 in the YR active range).[107] Killed or harmed from vehicular collisions associated with road/rail widening, realignment, and new alignment projects.
TCB	30 affected bridges, 47 affected culverts, and 13 affected structures	Adults or juveniles	Harm or kill	Temporary displacement from bridge, culvert, or structure roosts. Potential for a few individuals to be killed or harmed (fewer than five individuals per bridge, culvert, or structure).

This PCO for the TCB follows the same format and content as the PBO; however, the incidental take statement provided with the PCO for the TCB does not take effect until the TCB is listed, and the Service and Transportation Agencies adopt the PCO as a PBO on the proposed action. At that time, the proposed action will be reviewed to determine whether any take of the TCB has occurred. Modifications of the PCO/PBO and incidental take statement may be appropriate to reflect that take. No take of the TCB may occur between the listing of the species and the adoption of the PCO as a PBO, or the completion of a subsequent formal consultation on the individual project.

8.2 Effect of the Take

In Section 7 of this PBO, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the Indiana bat, NLEB, or TCB.

8.3 Reasonable and Prudent Measures

The proposed action includes several measures (Section 2.2 of the PBO) that avoid and minimize the incidental take of Indiana bats, NLEBs, and/or TCBs resulting from projects that the Transportation Agencies fund or approve. Further, the compensatory mitigation measures of the proposed action (Section 2.10 of the PBO) contribute to our finding in Section 7.2 that the proposed action is not likely to jeopardize the continued existence of the Indiana bat. These compensation measures also benefit the NLEB and TCB where suitable habitat overlaps with the Indiana bat, thus contributing to the

[107] Winter tree clearing restrictions from December 15 – February 15 do not apply in the NLEB and TCB YR active areas where the mean minimum temperature is above 40° F throughout the winter months (depicted as Zone 2 in Figure 9).

conservation of NLEB and TCB as well. Because the Transportation Agencies will not typically carry out the projects they fund or approve under the proposed action, we find that that the following reasonable and prudent measure is necessary and appropriate to minimize the incidental taking resulting from such projects:

- The Transportation Agencies will ensure that State/local Transportation Agencies, which choose to include eligible projects under this programmatic action, incorporate all applicable conservation measures (avoidance, minimization, and compensation) in the project proposals submitted to the Service for ESA section 7 compliance using this PBO.

The prohibitions against taking the TCB found in section 9 of the Act do not apply until the species is listed. However, the Service advises the Transportation Agencies to consider implementing the reasonable and prudent measure listed above. If this PCO is adopted as a PBO following a listing, these measures, with their implementing terms and conditions, will be nondiscretionary.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Transportation Agencies must comply with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The Transportation Agencies or their representatives will offer annual instruction to appropriate personnel who are involved in developing and implementing projects for inclusion in this programmatic action. This instruction shall inform personnel about:
    a. The criteria for determining that a project is eligible for such inclusion;
    b. Identifying the information required for using the Project Submittal Form and describing the process for using the IPaC Assisted Determination Key;
    c. The required conservation measures; and
    d. The administrative process for using this PBO as the mechanism for project-level ESA section 7 compliance (including the process for using the IPaC Assisted Determination Key.

2. The Transportation Agencies, State/local DOTs will make all reasonable efforts to educate personnel to report any sick, harmed, and/or dead bats (regardless of species) located in the project action area during construction, operations, maintenance, or monitoring activities immediately to the local Service Field Office. Due to the number of staff/contractors, it is not expected or required to educate all personnel working in the project action area, but only those who are most likely to observe bats during the course of normal working conditions.

Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the ITS [50 CFR §402.14(i)(3)].

1. The Transportation Agencies will provide an annual report to the POC's (as described in the adaptive management section [section 1.2] of this PBO), no later than July 31, for the preceding calendar year, of all project-level activity under their programmatic consultation. The report will provide the information listed below, or alternative information that the Transportation Agencies and the Service agree is appropriate.
    a. Number of projects using the programmatic consultation (in total and per state); and
    b. Total acreage removed/trimmed (acres NLAA and LAA); and
    c. Timeliness of consultation; and
    d. The incidental take (acreage of tree removal/trimming and number of bridges, culvert, and structures) per project and a total for all projects. This acreage and number of bridges, culverts, and structures serves as a surrogate measure of incidental take per project and for the program as a whole.
    e. The annual report from TCF. A description of project compensatory mitigation for the Indiana bat that the Transportation Agencies or their representatives implemented through ILF funds, conservation banks, project-proponent-sponsored mitigation, or through other means. For compensatory mitigation implemented through means besides ILF and conservation banks, the applicable Transportation Agency will provide a summary description of where, when, and how the mitigation was accomplished.

2. The Transportation Agencies, their cooperators, and any contractors must take care when handling dead or wounded Indiana bats, NLEB, TCBs, or any other federally listed species that are found at project sites to preserve biological material in the best possible state and to protect the handler from exposure to diseases, such as rabies. Project personnel are responsible for ensuring that evidence for determining the cause of injury or death is not unnecessarily disturbed. Reporting the discovery of dead or wounded listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this PBO is exceeded and to ensure that the terms and conditions are appropriate and effective. Parties finding a dead, wounded, or sick specimen of any endangered or threatened species must promptly notify the local Service Field Office of applicable jurisdiction.

3. If an initial bridge, culvert, or structure bat assessment failed to detect Indiana bat, NLEB, or TCB use or occupancy, yet bats are later detected prior to or during construction, Transportation Agencies and State/local DOTs are required to cease activity that could result in take of covered bats and promptly notify the local Service Field Office within two working days of the discovery. Through coordination with the local Service Field Office, if it is determined that roosting bats have not or will not be disturbed, or $\leq$5 covered bats have been or may be adversely affected,

the activity may be included in this programmatic consultation. In such instances, if incidental take occurred, please document the type (i.e. injure or kill) and amount (i.e. number of individuals) and submit documentation to the local Service Field Office within 5 working days from completion of the bridge/culvert or structure construction (use Appendix E - Post Assessment Discovery of Bats at Bridge, Culvert, or Structure Form from the User's Guide). Incidental take of Indiana bats, NLEBs, and TCBs at up to 30 bridges, 47 culverts, and 13 structures range-wide per annual reporting year is covered under the ITS in the PBO provided that the take is reported to the Service.

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA [16 USC 1536(a)(1)] directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has identified the following actions that, if undertaken by the Transportation Agencies and/or State/local transportation agencies, would further the conservation of the Indiana bat, NLEB, and/or TCB:

1. If authorized by the landowner, block (e.g., gate) access roads and right-of-ways leading to known or presumed occupied hibernacula from unauthorized access.
2. Monitor post-construction mortality from vehicular collisions for 2 years and report to the Service.
3. Fund proactive surveys to learn more about Indiana bats, NLEB, and TCB distribution and occurrences across the landscape. Types of surveys include spring emergence radio tracking, fall radio tracking, summer netting, and summer acoustics.
4. Fund targeted research for the Indiana bat, NLEB, and TCB to:
    a. Address information gaps related to life history, summer and winter habitat needs, migration patterns, and survey techniques;
    b. Identify high bat collision areas and ways to minimize the risk of vehicular collisions with bats;
    c. Refine conservation measures to achieve meaningful conservation while minimizing regulatory burden; and
    d. Address impacts from WNS.
5. Provide funding towards developing a range-wide database of bat survey efforts to build, retain, and disseminate knowledge about the status and distribution of listed and candidate bat species.
6. Pursue acquisition of parcels or easements to protect Indiana bat, NLEB, and TCB roosting, foraging, and commuting habitat.

To inform us of actions taken to avoid or minimize impacts, or to benefit listed species and/or their habitats, the Service requests notification of the implementation of any of these conservation recommendations.

10. REINITIATION NOTICE

Consultation with the Transportation Agencies on their limited range-wide program for transportation projects that may affect the Indiana bat, NLEB, and TCB is concluded. Reinitiation of 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 of Indiana bat, NLEB, or TCB is exceeded; or
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 PBO;
3. The agency action is subsequently modified in a manner that causes an effect to listed species or designated critical habitat not considered in this PBO; or
4. A new species is listed, or critical habitat designated that may be affected by the action.

For clarification, per condition #1 above, the anticipated incidental take is exceeded when, for a site-specific project:

- Work on existing bridges/culverts or structures implemented under this programmatic consultation includes take of Indiana bats, NLEBs, and/or TCBs of five or more individuals per bridge, culvert, or structure.

Or in one calendar year:

- Transportation projects implemented under this programmatic consultation remove trees from more than 7,040 acres (2,849 ha) of habitat suitable for the Indiana bat; or
- Transportation projects implemented under this programmatic consultation remove trees from more than 12,160 acres (2,849 ha) of habitat suitable for the NLEB; or
- Transportation projects implemented under this programmatic consultation remove trees from more than 12,800 acres (5,180 ha) of habitat that is suitable for the TCB; or
- Work on existing bridges, culverts, and structures implemented under this programmatic consultation includes take of Indiana bats, NLEBs, and/or TCBs at more than 30 bridges, 47 culverts, or 13 structures range-wide.

This concludes the PBO and PCO for the proposed action's effects to the Indiana bat, NLEB, and proposed TCB. A formal conference follows the same procedures as formal consultation and ends with the issuance of a CO. You may ask the Service to confirm this PCO as a PBO issued through formal consultation if the TCB is listed. Based on the timing of this PCO and the expected final rule to list the TCB in the near future, the Service has concluded that this PCO shall immediately be adopted as a PBO for upon the effective listing date of the TCB. The Transportation Agencies shall send a request to the

Service to convert this PCO for TCB to a PBO, and request individual projects completed as COs under the PCO be converted to BOs under the PBO for TCB. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during this programmatic conference, the Service will confirm the PCO as a PBO and no further section 7 consultation will be necessary. Following an adoption of this PCO as a PBO, the Transportation Agencies shall request reinitiation of consultation as defined in the reinitiation notice above.

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